WALLOPS FLIGHT FACILITY SHORELINE RESTORATION AND INFRASTRUCTURE PROTECTION PROGRAM: PROPOSED GROIN, BREAKWATER AND SHORELINE CULTURAL RESOURCE SURVEYS, ACCOMACK COUNTY, VIRGINIA

Prepared for:

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ABSTRACT

This report presents results of four cultural resource tasks at Wallops Flight Facility (WFF), in Accomack County Virginia as part of the National Aeronautics and Space Administration (NASA) Shoreline Restoration and Infrastructure Protection Program (SRIPP). These tasks include a remote sensing survey of a proposed breakwater location, a scientific diving survey of a proposed groin location, a pedestrian survey of the Wallops Island shoreline, and the archaeological monitoring of geotextile tube installation on the same shoreline. A total of 37.3 hectares (92.1 acres) was evaluated during the four survey efforts. It was undertaken to assist NASA with compliance with Section 106 of the National Historic Preservation Act of 1966, as amended; with the Abandoned Shipwreck Act of 1987; and with the National Environmental Policy Act (42 U.S.C. 4321 et seq.) of 1970. These investigations and report were completed in accordance with Virginia Department of Historic Resources (VDHR) guidelines outlined in *Guidelines for Archaeological Investigations in Virginia* (1996), and with the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (Federal Register 48, No 190, 1983). NASA has consulted with VDHR staff regarding these project efforts between 2006 and 2009.

The primary objective of this study was to identify maritime related cultural resources, particularly submerged watercraft, and buried archaeological sites within the survey areas. The archaeological predictive model presented in *Cultural Resource Assessment of Wallops Flight Facility* (Myers 2003) identified the potential to encounter prehistoric and historic sites on WFF (which was approved by VDHR in a letter dated December 3, 2003), including the Atlantic coast shoreline and near shore waters. That report indicated that there was a moderate potential to encounter significant historic resources on this portion of WFF. Cultural resources surveys were required as a result of this determination before construction actions could begin. These actions include the construction of a new beach groin and breakwater, the installation of geotextile tube to arrest beach erosion, and the replenishment of beach sands lost to erosion.

No significant cultural resources were identified during the Phase I pedestrian survey of the Wallops Island coastline, the archaeological monitoring of geotextile tube placement, and the scientific diving survey of the proposed beach groin location. A total of five target groups were identified during the remote sensing survey of the proposed breakwater. None of these target clusters have the potential to represent significant submerged cultural resources. They instead represent debris associated with the previous wooden piling and steel cable breakwater demolished at this location. As previously stated, the four archaeological tasks undertaken for SRIPP did not identify any significant cultural resources. No further work is recommended.

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1.0 INTRODUCTION

This report presents results of four cultural resource tasks at Wallops Flight Facility (WFF), in Accomack County Virginia, as part of the proposed National Aeronautics and Space Administration (NASA) Shoreline Restoration and Infrastructure Protection Program (SRIPP) (Figure 1-1). URS Group, Inc. (URS) conducted this work to assist WFF with compliance with Section 106 of the National Historic Preservation Act of 1966, as amended; with the Abandoned Shipwreck Act of 1987; and with the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et seq.) of 1970. NASA is the lead agency preparing an Environmental Impact Statement under NEPA for their SRIPP at WFF; the U.S. Army Corps of Engineers and the Minerals Management Service are cooperating agencies on the EIS and other SRIPP-related compliance including Section 106 of the National Historic Preservation Act of 1966, as amended and the Abandoned Shipwreck Act of 1987. The four cultural resources tasks include a remote sensing survey of a proposed breakwater location, a scientific diving survey of a proposed groin location, a pedestrian survey of the Wallops Island shoreline, and the archaeological monitoring of geotextile tube installation on the same shoreline. A total of 37.3 hectares (92.1 acres) was evaluated during the three survey efforts. These investigations were undertaken in consultation with the Virginia Department of Historic Resources (VDHR) between 2006 and 2009, and in accordance with guidelines established in *Guidelines for Archaeological Investigations in Virginia* (1996), and the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (Federal Register 48, No 190, 1983).

The project area is composed of three separate survey parcels, which includes the proposed beach groin location, the proposed breakwater location, and the entire Wallops Island coastline contained within the bounds of WFF (Figure 1-2). The area of potential effect (APE) for the Wallops Island shoreline is 6.2 kilometers (3.85 miles), or approximately 28 hectares (69 acres), of coastal beach in Accomack County, on Virginia's Eastern Shore. The pedestrian survey was undertaken from the waterline to the beach edge within this portion of WFF. Archaeological monitoring of the 1,402 meters (4,600 feet) of shoreline that received geotextile tubes occurred within this study area, beginning at the southern terminus of the seawall and extended to the camera station at the southern end of NASA Property. The APE for the proposed groin is located in the Atlantic Ocean, directly opposite of the camera station at the southern end of NASA property. It measures approximately 152.4 meters (500 feet) by 30.5 meters (100 feet), or 0.45 hectares (1.1 acres). The APE of the proposed breakwater is located on the seaward edge of the proposed beach groin, and extends 121.9 meters (400 feet) to either side of the groin. It measures approximately 365.9 meters (1,200 feet) by 243.9 meters (800 feet), or 8.9 hectares (22 acres).

The primary objective of this study was to identify maritime related cultural resources, particularly submerged watercraft, and buried archaeological sites within the survey areas. The archaeological predictive model presented in *Cultural Resource Assessment of Wallops Flight Facility* (Myers 2003) identified the potential to encounter prehistoric and historic sites on WFF (which was approved by VDHR in a letter dated December 3, 2003), including the Atlantic coast shoreline and inland waters. This report indicated that there was a moderate potential to encounter significant historic resources on this portion of WFF. A series of cultural resources

surveys was required as a result of this determination before construction actions could begin. Construction actions include the construction of a new beach groin and breakwater, the placement of geotextile tube to arrest beach erosion, and the replenishment of beach sands lost to erosion.

The investigations were undertaken between September 21, 2006, and August 28, 2009. Christopher Polglase, R.P.A., served as project manager for this project. Jean B. Pelletier R.P.A., served as principal investigator, scientific diver, senior remote sensing specialist and analyst. Anthony Randolph, R.P.A., served as scientific diver, remote sensing specialist and analyst. Bridget Johnson, R.P.A., conducted archival research. Amanda Hale, R.P.A., served as scientific diver, and Vince Shirbach contributed as archaeological support staff.

This report is divided into seven sections, including this introduction. Section Two is a review of previous archaeological and architectural sites, and contains surveys within 1.6 kilometers (1 mile) of the project area, followed by a discussion of known shipwrecks within 20.9 kilometers (13 miles) of the project area. Section Three contains the prehistoric and historic cultural contexts, which are used to evaluate the potential for encountering submerged prehistoric and historic cultural resources within the project area. Section Four reviews the environmental setting of the region. Section Five presents the research methods and repositories used during background investigations, survey methods, and the expected results of the survey. Section Six contains results of the remote sensing survey. Section Seven presents a summary and recommendations for the overall project. Section Eight contains references cited. Appendix A contains a list of side scan sonar anomalies, Appendix B contains the qualifications of investigators, and Appendix C contains a VDHR response letter to recommendations offered for the archaeological monitoring of geotextile tube installation.

2.0 PREVIOUS INVESTIGATIONS

2.1 ARCHAEOLOGICAL INVESTIGATIONS

A review of previously investigated sites provides a context used to assess the potential to encounter archaeological materials within the project area. A total of seven archaeological surveys were conducted within 1.6 kilometers (1 mile) of the project area (Table 2-1). These surveys identified a total of 10 archaeological sites within this radius (Table 2-2). Site 44AC558 was identified by the Eastern Shore Archaeological Society, but no formal report has been filed.

Table 2-1. Archaeological Surveys within 1.6 kilometers (1 mile) of the Project Area

Sites Identified	Company Name	Report Date
None	Mark Wittkofski (Wittkofski 1980)	1980
None	Greenhorn & O'Mara, Inc (Dinnell and Collier 1990)	1990
None	Telemarc, Inc (Otter 1991)	1991
None	3D/Environmental Services Inc. (Miller 1991)	1991
None	Louis Berger Group, Inc (Ahlman and LaBudde 2001)	2001
44AC9, 44AC89	Darrin Lowery (Lowery 2000, 2003)	2000, 2003
44AC159, 44AC459	URS Corporation (Myers 2003)	2003

Mark Wittkofski conducted a Phase I reconnaissance for a proposed parking lot on Wallops Island for the US Navy in 1980. He determined that the area had a low potential to contain archaeological resources as it had been disturbed and graded with modern fill (Wittkofski 1980). Wittkofski conducted a comprehensive survey of Accomack and Northampton Counties throughout the 1980s. This survey identified 281 previously unrecorded archaeological sites, none of which are within the project area.

Greenhorne & O'Mara, Inc. (Dinnell and Collier 1990) conducted a study of the southwestern portion of the Main Base for the Wallops Naval Facilities Engineering Command. They identified one site, but it was outside the 1.6 kilometer (1 mile) radius of the current project area.

Telmarc, Inc (Otter 1991) conducted a Phase I archaeological survey adjacent to the WFF in 1991. This study was conducted as part of a property acquisition west of a runway. No cultural resources were identified.

3D/Environmental Services, Inc. (Miller 1991) completed a cultural resources inventory which included an evaluation of archaeological and architectural resources of the WFF in 1991. The study was designed to produce a predictive model and sensitivity assessment for archaeological resources, as well as acting as a planning document for future evaluations at WFF.

Louis Berger Group, Inc. (Ahlman and LaBudde 2001) conducted an archaeological survey for the proposed Route 709 bridge replacement located northwest of the island. They identified three archaeological sites. These sites are all located beyond the 1.6 kilometer (1 mile) radius of the project area.

Darrin Lowery (2000, 2003) conducted an archaeological survey of the Chesapeake and Atlantic shorelines associated with Accomack and Northampton Counties of Virginia. His findings were presented in two volumes designed to assess the impact of natural and human activities to archaeological sites along the shore. He documented numerous previously identified sites, both historic and prehistoric in nature, as well as documenting several new sites. His report identified seven sites (44AC9, 44AC77, 44AC78, 44AC79, 44AC80, 44AC81, 44AC89) within a 1.6 kilometer (1 mile) radius of the project area. Site 44AC9 represents an archaic shell midden that is limited to the plow zone and includes a few prehistoric ceramics sherds. Sites 44AC78, 44AC79, 44AC80, and 44AC81 all represent shell middens from an undetermined prehistoric period. Site 44AC77 was a historic artifact scatter consisting primarily of ceramics which date to the second and third quarters of the 19th century. Site 44AC89 consists of a possible Revolutionary War earthwork located on Wallops Island.

URS conducted a cultural resources assessment of WFF in 2003 (Meyers 2003). The goal of this study was to further assess archaeological and architectural potential. Two archaeological sites, 44AC159 and 44AC459 were encountered within the 1.6 kilometer (1 mile) radius of the current project area. Site 44AC159 is located on Wallops Island and consists of a clam and oyster shell midden approximately 3 feet in height. Site 44AC459 was a late 19th to early 20th century structure associated with the US Coast Guard. A total of 291 artifacts were recovered from this site including nails, brick, glass, ceramic, and shell.

Table 2-2. Archaeological Sites within 1.6 Kilometers (1 Mile) of the Project Area

Site Number	Site Type	Cultural Period
44AC9	Shell Midden	Archaic
44AC77	Historic Artifact Scatter	Late 19th century
44AC78	Shell Midden	Undetermined Prehistoric
44AC79	Shell Midden	Undetermined Prehistoric
44AC80	Shell Midden	Undetermined Prehistoric
44AC81	Shell Midden	Undetermined Prehistoric
44AC89	Military Earthworks	Revolutionary War
44AC159	Shell Midden	Unknown
44AC459	Historic Coast Guard Site	Late 19th-20th century
44AC558	Artifact Scatter	Undetermined Prehistoric

2.2 ARCHITECTURAL INVESTIGATIONS

Two previously identified historic properties are located within a 1.6 kilometer (1 mile) radius of the project area (Table 2-3). Within the WFF itself are two historic properties that were found to be eligible for listing in the NRHP in the 2004 *Historic Resources Survey and Eligibility Report for Wallops Flight Facility, Accomack County, Virginia* (URS/EG&G 2004): the Wallops Exchange and Morale Association (WEMA) Recreational Facility/U.S. Coast Guard (USCG) Lifesaving Station (V-065, VDHR# 001-0027-0100), and the Observation Tower (V-070, VDHR#001-0027-0101). In a letter dated November 4, 2004, VDHR concurred with NASA's determination of eligibility for these two properties.

Table 2-3. Architectural Sites within a 1.6 kilometer (1 mile) of the Project Area

DHR ID #	Name	National Register Eligible
001-0027-0100	U.S. Coast Guard Lifesaving Station	Yes
001-0027-0101	Observation Tower	Yes

2.3 KNOWN SHIPWRECKS IN THE WALLOPS ISLAND AREA

Twelve shipwrecks have been recorded in the vicinity of Wallops Island, extending 20.9 kilometers (13 miles) off shore (Table 2-4). These wrecks were identified primarily using NOAA's Automated Wreck and Obstruction Information System (AWOIS), and Bruce Berman's *Encyclopedia of American Shipwrecks* (1972).

The proximity of Wallops Island to the Chincoteague Inlet, which serves as the entrance to Chincoteague Bay, resulted in extensive commercial and recreational vessel traffic along the Wallops Island coastline en route to Chincoteague and other barrier islands. Reported craft losses in the vicinity of Wallops Island are consistent with vessel classes commonly operated within the Chesapeake region. All craft were lost during the 20th century. A total of four wrecks were sailing schooners and three were barges. A single tug boat and fishing trawler were also lost, along with three unidentified vessels.

Table 2-4. Vessels Sunk within 20.9 kilometers (13 miles) of Wallops Island

Vessel Name	Vessel Type	Date of Loss	Date Built	Tonnage	Cause of Loss	Location
E.R. Smith	Unknown	1/25/1943	Unknown	Unknown	Sunk	Lat: 37.8167 Long: 75.3663
Florence and Lillian	Schooner	9/19/1921	1874	252	Foundered	SW of Chincoteague Lighthouse
Jennie N Huddell	Schooner	2/4/1910	1870	279	Stranded	Carter's Shoal, Chincoteague
Lizzie Godfrey	Schooner	7/12/1914	1890	77	Stranded	Chincoteague Inlet
Nancy Jane	Fishing Trawler	3/2/1968	Unknown	Unknown	Sunk, broken up	Lat: 37.8667 Long: 75.4163
P. J Hooper	Tug	3/26/1971	Unknown	Unknown	Unknown	Lat: 37.8367 Long: 75.3399
Ruhama Shaw	Barge	12/8/1917	1915	473	Foundered	Blackfish Bank, Va.
Ruth	Barge	12/9/1917	1908	435	Foundered	Blackfish Bank, Va.
Steel Barge No. 2	Barge	1/23/1935	1889	2217	Foundered	Blackfish Bank Buoy, Va
Unknown	Sailing	Unknown	Unknown	Unknown	Unknown	Lat: 37.8646 Long: 75.4005
Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Lat: 37.8001 Long: 75.2463
Wm. Meekins	Schooner	12/22/1918	1874	79	Stranded	Chincoteague, Va.

Source: AWOIS, Berman 1972

3.0 CULTURAL CONTEXT

The Virginia Department of Historic Resources (VDHR) has developed a chronological framework for the prehistory and history of the Commonwealth. This framework provides the basis for understanding prehistoric and historic cultural development in the area, as well as providing a context for predicting the types and kinds of archaeological sites expected in the project area. Included in this background section are Prehistoric Context and Historic Contexts.

3.1 PREHISTORIC CONTEXT

VDHR has defined three major periods of prehistory. These are the Paleoindian Period (10,000 – 8000 BC), the Archaic Period (8000 – 1000 BC), and the Woodland Period (1000 BC – AD 1600). Table 3-1 summarizes the chronology of these periods. The Archaic and Woodland Periods are further subdivided into Early, Middle, and Late Periods, which are characterized by changes in material culture (e.g., projectile point styles), environmental adaptation, subsistence strategies (e.g., hunting and gathering, fishing, and horticulture), settlement patterns, technology, and socio-political configurations. Each major time period is discussed below, along with relevant data concerning settlement and subsistence patterns established by excavations and study of archaeological sites in the Coastal Plain.

Table 3-1. Prehistoric Culture Chronology

Culture Period	Sub-Period	Date Ranges
Paleoindian	n/a	10,000 – 8000 BC
Archaic	Early	8000 – 6500 BC
	Middle	6500 – 3000 BC
	Late	3000 – 1000 BC
Woodland	Early	1000 BC – AD 300
	Middle	AD 300 – AD 1000
	Late	AD 1000 – AD 1600
Contact	n/a	ca. AD 1600

3.1.1 Paleoindian Period (10,000 – 8000 BC)

The region was first inhabited approximately 12,000 years ago with an influx of people who practiced a hunting and foraging lifestyle. Although there is evidence of human occupation in western North America and South America before 10,000 – 12,000 BC, there is no conclusive evidence in the Middle Atlantic region for human occupation before the Paleoindian Period. There is a great deal of debate over the issue of a “pre-Clovis” culture in the Americas that predates the traditional “Clovis” culture of the Paleoindian Period. Archaeological sites such as Cactus Hill in Virginia (e.g., McAvoy and McAvoy 1997), Meadowcroft Rockshelter in

southwestern Pennsylvania (e.g., Adovasio et al. 1978), and the Topper Site in South Carolina (e.g., Parfit 2000; Rose 1999) have provided tantalizing but inconclusive evidence for human occupations predating the Paleoindian Period. There is currently no evidence for pre-Paleoindian occupations on the Delmarva Peninsula although shifts in survey strategies in recent decades (e.g. Lowery 2001, 2003) have resulted in new discoveries that may change the focus of research in this area. There are also extensive aeolian soils on the coastal plain that may cover more ancient fluvial sediments (Foss et al. 1978). Some of the depositional contexts may eventually reveal buried Paleoindian or pre-Paleo occupations. The discussion below focuses on the widely accepted definition of the Paleoindian culture in the Middle Atlantic region.

The end of the Pleistocene epoch (ca. 12,000 – 10,000 years ago) represents the terminus of the Ice Age or at least the beginning of a long interglacial episode. The environment during this time was quite different from modern conditions. Moisture locked in glacial ice sheets resulted in lower sea levels and greater exposure of coastal lands. Areas exposed during this time were subsequently inundated by the global sea level rise that began at the end of Pleistocene, when climatic amelioration resulted in melting continental ice sheets. During this period of post-glacial warming, the climate was probably three to eight degrees Celsius colder than at present, and the vegetation consisted of an open spruce parkland forest composed of spruce, pine, fir and alder (Brush 1986:149; Owens et al. 1974; Sirkin et al. 1977).

The Paleoindian toolkit included fluted projectile points, which were typically manufactured from high-quality lithic materials chosen for their predictable and consistent flaking properties. Projectile point types include Clovis, Cumberland/Barnes, Crowfield, Hardaway-Dalton, and Hardaway Side-Notched (Dent 1995; Lowery 2001, 2003). Other tools in the Paleoindian toolkit include endscrapers, sidescrapers, gravers, burins, denticulates, knives, *pieces esquillées*, wedges, perforators, and generalized unifaces and bifaces (Dent 1995).

Preferred lithic materials for these projectile points were high-quality cryptocrystalline rock such as jasper and chert (Brown 1979; McCary 1984), though tools made from locally available quartz and quartzite cobbles have been documented at sites in the Middle Atlantic region (e.g., Ebright 1992; McAvoy and McAvoy 1997). Archaeologists have postulated that Paleoindian hunter-gatherers traveled long distances to obtain raw materials for tool production (e.g., Custer 1984a; Gardner 1977). Recent research, however, has documented the availability of high-quality cherts and jasper cobbles in the Coastal Plain (e.g., Lowery 2001, 2003), suggesting that Paleoindians did not necessarily travel long distances to obtain lithic raw materials.

Paleoindian Period settlements consisted of seasonally-occupied camps, from which forays were made to obtain specialized resources, such as stone for tool manufacture (Custer 1984a; Dent 1995; Gardner 1977). Site types postulated for the Paleoindian Period include base camps, quarry sites, quarry reduction stations, quarry-related base camps, base camp maintenance stations, outlying hunting stations, and isolated projectile point finds (Custer 1989; Gardner 1989). These site types are considered part of the "seasonal round" of Paleoindian settlement patterning.

The isolated point find is the most common of these manifestations and the distribution of such finds on the Delmarva Peninsula shows a concentration on the Mid-peninsular drainage divide where bay-basin features represent Pleistocene surface water sources (Custer 1989:29). This is not to say that other areas were not frequented; perhaps it simply reflects the availability of more exposed acreage for occupation in the Middle of the peninsula. These sites are in headwater

areas where streams flow to the bay and the ocean. Davidson (1981) also notes the use of interior drainages during this period; a trend that continues though the Middle Archaic. A single fluted point site is recorded in Virginia on the lower Delmarva Peninsula, (Custer 1989:93), but this find is not noted in McCary's (1984) fluted point survey.

Custer (1984a, 1989) classifies upper Delmarva Paleoindian sites within the Delaware Chalcedony Complex, which focuses on outcrops of high quality cryptocrystalline lithic raw materials, specifically Delaware chalcedony. Settlement patterns focused on these high quality lithic resources and on environmental resource gathering zones such as upland or interior swamps, headwater zones and similar early Holocene environmental settings.

Paleoindian subsistence patterns are difficult to discuss for the Middle Atlantic region due to the paucity of recovered faunal and floral remains. Paleoindians in the western United States are considered to be "big game" hunters of extinct Pleistocene megafauna such as the mammoth, caribou, musk ox, and giant beaver. There is no concrete evidence for a similar subsistence pattern in the Middle Atlantic region, though megafaunal remains have been recorded in the area (Custer 1989; Dent 1995; Edwards and Merrill 1977; Lowery 2001, 2003). Paleoindians in this area likely subsisted on mammals such as white-tailed deer, caribou and moose, along with smaller mammals. While Paleoindian subsistence probably focused on hunted game, there is evidence to suggest that plant foods and fish were also important food resources (Dent 1995; McNett l985). It should also be noted that a rich array of megafauna (e.g., mammoth, mastodon, walrus, and ground sloth) recovered from the continental shelf of the east coast may represent some of the key species that were hunted at the end of the Pleistocene (Edwards and Merrill 1977). One of the mammoth finds, for example, comes from the outer edge of the coastal plain in the lower Delmarva Peninsula area of Virginia (Edwards and Merrill 1977:11).

Paleoindian sites are not widely known in the Virginia Coastal Plain. Much of what archaeologists know about Paleoindians comes from isolated finds of fluted projectile points. Few intact Paleoindian sites have been identified in the region (Dent 1995; Lowery 2001, 2003); however, dozens of isolated fluted point finds have been documented on the Delmarva Peninsula (e.g., Custer 1989; Dent 1995). The Paw Paw Cove site, located in the northern Chesapeake Bay area in Maryland, is currently the only excavated Paleoindian site on the Delmarva Peninsula (Dent 1995; Lowery 2001, 2003). One theory explaining the lack of documented Paleoindian sites is that they are located on the Continental Shelf of the Atlantic Ocean in areas that would have been dry land during the Paleoindian Period (e.g., Dent 1995; Lowery 2001, 2003).

3.1.2 Archaic Period (8000 – 1000 BC)

The Archaic Period dates to ca. 10,000 to 3,000 years ago, and is conventionally sub-divided into the Early (8000 – 6500 BC), Middle (6500 – 3000 BC), and Late (3000 – 1000 BC) Sub-Periods. In the Middle Atlantic area, Archaic sites are much more numerous, larger, and richer in artifacts than earlier Paleoindian sites. They represent a series of adaptations that engendered an increasingly sedentary existence, and focused on resources available along large rivers and major tributaries. Other, often smaller sites of this period located away from the main streams probably represent seasonal or other specialized activities. Increasing territoriality and regional diversity are reflected in numerous artifact varieties, especially projectile points, throughout the Archaic Period. Evidence from Paleoindian and Early Archaic sites suggests that the transition from the Paleoindian way of life was a gradual transition (Custer 1990).

This transition was associated with a major climatic change that marks the end of the Pleistocene and beginning of the Holocene. The cool and moist climate of the late Ice Age shifted to a warmer and drier climate that approximates that of today. Rising sea levels inundated the lower Susquehanna River Valley and began forming the Chesapeake Bay estuary and its large salt and brackish water marshes, habitats that provided a rich and diverse subsistence base (Kraft 1976). As temperatures increased during the early Holocene, vegetation in the region shifted from coniferous forests of spruce to mixed deciduous/coniferous forests of hemlock, birch, hickory, and oak (Brush 1986:149; Custer 1990:10; Owens et al. 1974; Sirkin et al. 1977). The spread of deciduous woodlands into upland areas after 7000 BC opened up new habitats to be exploited by animals and humans (Custer 1990).

3.1.3 Early Archaic Period (8000 – 6500 BC)

Environmental conditions during the Early Archaic Period were not drastically different from the Paleoindian Period. Glacial recession continued and deciduous forests expanded, possibly leading to a proliferation of temperate fauna. The most distinctive cultural characteristic of the Early Archaic was the appearance of notched projectile points, most notably the Palmer and Kirk varieties. There was a continuation of the Paleoindian tradition of using high quality cryptocrystalline lithic materials until the end of the Early Archaic Period, when lower quality quartz and quartzite materials were more frequently used. Archaeological investigations in the Patuxent River drainage showed that the majority of Kirk points found were made of rhyolite. This indicates that by the Kirk phase, people traveled long distances in order to obtain preferred lithic raw materials, or that by this time long-range trade networks had been established (Steponaitis 1980:68). Although rhyolite is certainly exploited as a lithic raw material by this time, it still does not represent the intensive use evident during the Late Archaic.

There was significant innovation in stone tool kits during the Early Archaic Period. Stemmed and side-notched serrated projectile points replaced fluted projectile point varieties. The variety of projectile points associated with these periods indicates possible changes in subsistence strategies and exchange networks, and a possible regionalization of cultural traditions. Projectile point styles characteristic of the period include: corner-notched, serrated point styles such as Kirk, Palmer, Charleston, Lost Lake, Decatur, Amos, Kessel, and Fort Nottoway/Thebes; and stemmed points such as the Kirk stemmed and Pequea types (Custer 1984a, 1989, 1996; Dent 1995; Lowery 2001, 2003). Other tool types characteristic of Early Archaic Period assemblages include grinding slabs, milling stones, nutting stones, chipped stone adzes, wedges, perforators, knives, and scrapers, as well as unifacial and bifacial tools (Dent 1995; Lowery 2001, 2003).

Early Archaic Period inhabitants continued to show a preference for high-quality lithic materials, either transported into the area through trade or travel, or obtained from cobble sources in river and stream beds. Some researchers (e.g., Lowery 2001, 2003) have noted that Early Archaic people appear to have a preference for non-local cherts, chalcedonies, and jaspers, and have also noted the increased use of rhyolite for tools during this period (e.g., Custer 1984a; Dent 1995; Lowery 2001, 2003).

Both Gardner (1974) and Custer (1980) have hypothesized that Early Archaic Period peoples banded together into macro-base camps, or groups of families, in the spring and summer, and dispersed into smaller micro-base camps in the fall and winter months. Larger base camps were located in the valley floodplains while the smaller autumn and winter encampments were located in upland regions.

There is little faunal evidence from archaeological sites dating to the Early Archaic period, though "it is assumed that this environment supported bear, deer, elk, and a variety of small game adapted to a northern climate" (Kavanagh 1982:9). One exception is the Cactus Hill site (44SX202) which contains the remains of species that are still common in the region today (Whyte 1995). Floral evidence from sites such as the Crane Point site, in Talbot County, Maryland, includes hickory nut, butternut, acorn, amaranth, and chenopodium (Lowery 2001, 2003). Other sites in the Chesapeake Bay region have produced similar results (Dent 1995). The floral remains recovered from Early Archaic contexts indicate that a variety of plants were used for food. Stone artifacts such as grinding slabs, milling stones, and nutting stones are also indicative of increased reliance on plant foods, while adzes indicate increased manufacture of items from wood (e.g., shelter). The changes in tool types have been interpreted as a shift in subsistence strategies towards a broad-spectrum adaptation, utilizing a variety of species of animals and plants, rather than focusing primarily on large animals.

Numerous Early Archaic Period sites are located throughout the Delmarva Peninsula (Custer 1989; Dent 1995), mostly from surface finds in estuarine and shore locations. Early Archaic Period base camps on the Eastern Shore may have been located on floodplains or river terraces that have since become submerged by sea level rise. Smaller procurement or temporary camps may be located on the high terrace areas (elevations above 25 feet amsl), though none have been recorded in Accomack County. The same terraces that produced fluted points have also produced numerous finds of Early Archaic points, recovered by artifact collectors who search shoreline surfaces at low tide. These submerged manifestations represent significant clusters of Early Holocene sites. Nearby upland areas may also contain a variety of procurement sites and lithic scatters.

3.1.4 Middle Archaic Period (6500 – 3000 BC)

The beginning of the Middle Archaic Period coincides with the on-set of the Atlantic climatic episode, which was a warm, humid period with a gradual rise in sea level that led to the development of inland swamps. It was a period marked by an increase in summer drought, sea level rise, grassland expansion into the Eastern Woodlands, and the appearance of new plant species (Carbone 1976:106; Hantman 1990:138). Human settlements consisted of small base camps located in or near inland swamps that were convenient to access seasonally available subsistence resources as well as small, temporary upland hunting sites. This adaptation, along with the use of a greater variety of plant resources, allowed for an increase in general foraging (Kavanagh 1982:50).

The Middle Archaic Period is characterized by a variety of projectile point styles, including bifurcated styles (e.g., St. Albans, LeCroy, and Kanawha) that were introduced at the end of the Early Archaic Period (Dent 1995). Other projectile point styles used during the Middle Archaic Period include Stanly Stemmed, Neville, Morrow Mountain I and II, Halifax, and Guilford types (Dent 1995; Lowery 2001, 2003). Morrow Mountain and Neville points are more rarely found in Virginia. The former are found principally in the Southeast whereas Neville points are a typical Northeast type. Brewerton and Otter Creek styles were introduced during the latter part of the Middle Archaic Period, and persist into the early Late Archaic Period. Other artifact types characteristic of the Middle Archaic Period include groundstone tools (e.g., adzes and gouges), as well as scrapers, perforators, spokeshaves, and expediently-made flake tools for a variety of functions (Dent 1995; Lowery 2001, 2003). Rhyolite became more commonly used for making tools, though other local resources such as quartz and quartzite were utilized as well. The

tendency towards greater reliance on local lithic sources led to a marked increase in numbers of informal flake tools for short-term use.

Middle Archaic Period sites have been documented on the Delmarva Peninsula, and include isolated point finds as well as sites with buried components (Dent 1995; Lowery 2001, 2003). Community pattern and settlement data are somewhat limited due to the scarcity of Middle Archaic Period sites with good, interpretable depositional contexts. Surface sites are, however, located in a variety of settings including uplands, river terraces, and wetland areas. Middle Archaic Period sites on the Delmarva Peninsula have been documented along Carolina Bay features, spring-fed interior wetlands, upland terraces, and confluences of freshwater streams (Lowery 2001, 2003). Subsistence patterns appear to be very similar to the preceding Early Archaic Period, based on the limited data that are available (Dent 1995; Lowery 2001, 2003). Middle Archaic points in nearby areas of Maryland have been found on sites (e.g., 18SO75 and 18SO105) along Kings Creek and the Manokin River. Like earlier Holocene manifestations, most of sites are known through isolated point finds on river terraces and along eroding shorelines.

3.1.5 Late Archaic Period (3,000 – 1000 BC)

Modern vegetation had become established in the region by approximately 3,000 BC, and the climate was punctuated by alternating periods of dry and moist conditions (Brush 1986:150). The Late Archaic Period is characterized by a warmer and drier climate than today, with the development of xeric forests (e.g., oak and hickory) and open grasslands (Carbone 1976; Custer 1984b). Sea level continued to rise, but was relatively stable by the end of the Late Archaic Period (Dent 1995; Lowery 2001, 2003). The warmer and drier climate appears to have stabilized stream valleys and estuaries in the region, making such localities more attractive for settlement. These settings developed into rich habitats with a great diversity of exploitable resources, particularly shellfish and anadromous fish (Davidson 1981; Hughes 1980). This is reflected in the changes manifested in Late Archaic tool kits as well as in the number of site types and site locations utilized. For example, settlement data from the lower Eastern Shore show increased use of riverine and estuarine settings, and there is a concomitant use of ephemeral settings as well, including headwaters, and low and high order stream areas (Davidson 1981, Hughes 1980).

The Late Archaic Period is characterized by a large variety of projectile point styles, including Otter Creek, Vosburg, and Brewerton, Lackawaxen, Bare Island, Halifax Side-Notched, Vernon, Clagett, Piscataway (a type that persists into the Woodland Period), and Holmes (Dent 1995). The initial sequence for the Late Archaic was developed by Stephenson and Ferguson (1963) and referred to Piscataway, Otter Creek, Vernon, and Brewerton projectile point styles. Otter Creek points have been recovered from Middle and Late Archaic contexts including an Otter Creek component identified at the Higgins site (Ebright 1989). Other Otter Creek sites in the Middle Atlantic region and the Northeast in general are described by Steponaitis (1980) and Funk (1965).

Projectile point styles characteristic of the end of the Late Archaic (sometimes referred to as the Terminal Archaic Period) include “broadspears” such as the Savannah River, Susquehanna Broadspear, Koens-Crispin, Lehigh, and Perkiomen types (Dent 1995). Other projectile point types found during the Terminal Archaic that persist into the Early Woodland Period include the

Orient Fishtail and Dry Brook types. The Fishtail phase marks the end of the Archaic period and the beginning of the Early Woodland.

Besides the established formal projectile point styles, there appears to have been an increase in the production of informal tools made out of flakes (Klein and Klatka 1991:98). Other artifacts characteristic of the period include steatite (soapstone) bowls, groundstone tools (axes, adzes, celts, gouges), perforators and drills fashioned from broken projectile points, and scrapers (Dent 1995). Rhyolite was established during this period as a preferred lithic raw material for tool manufacturing. It was during the Terminal Archaic as well as the succeeding Early Woodland Period that large amounts of rhyolite were transported from sources in the Blue Ridge to the Coastal Plain. The network that facilitated trade in rhyolite is not well understood (Kavanagh 1982:99).

Surface collections in the Delmarva region show greater use of locally available lithic raw materials (e.g., quartz and quartzite) during the Late Archaic. Broadspears recovered from eastern shore sites, especially the Susquehanna broadspears, are almost exclusively made from South Mountain (Blue Ridge) rhyolite. In the lower eastern shore of Maryland, these have been recovered, along with bannerstones and gorgets, from sites (e.g., site 18WO32) along the Pocomoke River.

The Late Archaic was characterized in the eastern United States by evidence of population growth, patterns of regional differentiation, and increased technological specialization. Trade networks appear to have been established for the exchange of raw materials and finished goods. The first large, semi-sedentary (i.e., occupied for several months or seasons) base camps were established along rivers and streams, and along estuaries on the Delmarva Peninsula. Surface site data show increases in site size, which may simply represent multiple, repeated occupations rather than single, large group manifestations. Site types postulated for the area include base camps, temporary camps, and resource procurement stations (Dent 1995).

Subsistence was still largely based upon gathering and hunting, although there was an increased reliance on riverine resources toward the end of the period (Steponaitis 1980). Seasonal hunting and foraging continued, but exploitation of riverine resources rapidly became an important part of the subsistence base. This continues the earlier trend toward a broad spectrum adaptation in which a variety of resources were exploited in many different environmental settings. The result has been the identification of Late Archaic sites in just about every habitable setting in the region. This broad spectrum adaptation is another way of characterizing what Caldwell (1958) originally called *primary forest efficiency* in the Archaic of the Eastern Woodlands.

A number of indicators point to an intensification of certain subsistence strategies ca. 2000 BC, which represents a major change in lifeways. This intensification has been explained as a consequence of gradual change (Caldwell 1958) and as episodic change relating to a shift in the composition of the environment (Carbone 1976). Structures such as fish weirs, used to exploit anadromous fish runs, were constructed during this period, and reflect the intensive riverine focus of the latter part of this period. While riverine resources were certainly important, interior and upland areas continued to be utilized by Late Archaic peoples. Late Archaic subsistence economies may be described as diffuse, considering the use of upland areas for a broad range of resource procurement activities gathering foods such as acorns, hickory nuts, and butternuts as well as large and small game (Cleland 1976). Subterranean storage pits and steatite containers appear in the archaeological record by 1500 BC. These technological developments led to food

surpluses and the subsequent preservation of these surpluses over an extended period. The appearance of large numbers of implements, useful in processing seed and fiber products, is further evidence of this emerging economic pattern.

3.1.6 Woodland Period (1000 BC – AD 1600)

The Woodland Period dates from 1000 BC – AD 1600, and is conventionally divided into the Early (1000 BC – AD 300), Middle (AD 300 – 1000), and Late (AD 1000 – 1600) sub-periods based on changes in ceramic types, lithic technologies, subsistence patterns, and social development. The climate during the Woodland Period is characterized by a return to cool, moist conditions and establishment of vegetation that is characteristic of the region today. The Woodland Period is marked by the introduction of ceramics, significant population growth, and an increasingly sedentary way of life. Hunting and gathering of wild floral and faunal resources remained important, but incipient horticulture, based on maize cultivation, eventually formed an important part of the subsistence base.

3.1.6.1 Early Woodland Period (1,000 BC – AD 300)

It was previously thought that the transition between the Late Archaic and Early Woodland Period represented the introduction of horticulture (e.g., Fritz 1993; Smith 1992, 1995). Although Early Woodland groups in the South and Midwest used cultivated plants, there is presently no evidence that cultivated foods played a role in the diet of Early Woodland people in the Chesapeake Bay area. Efficient hunting and gathering systems stemming from several millennia of development (e.g., Caldwell 1958), including the exploitation of riverine and marine species, apparently slowed the acceptance of viable cultigens. Cultivated foods begin to assume an important role after 800 to 900 AD, when varieties of tropical cultigens arrived in the Middle Atlantic area (Smith 1995). These complemented cultigens of the eastern agricultural complex (e.g. sunflower, goosefoot, sumpweed, and little barley) that had been developing for centuries.

The introduction of pottery around 1,000 BC marks the beginning of the Woodland Period. Potters' innovations, as reflected in ceramic types, have become a significant basis for dating Woodland Period archaeological site components. The earliest ceramic types from the Eastern Shore are the steatite-tempered Marcey Creek ware and the crushed rock-tempered Dames Quarter ware. Both of these wares were later replaced by the sand or crushed quartz-tempered Accokeek wares, Wolfe Neck wares, and the grog-tempered (crushed clay) Coulbourn wares (Custer 1983, 1989; Dent 1995; Egloff and Potter 1982; Mouer 1991; Stephenson et al. 1963).

Stone artifacts characteristic of the Early Woodland Period include Calvert, Rossville, Potts, and Piscataway types, some of which are also found in Late Archaic contexts (Dent 1995; Lowery 2001, 2003; Hranicky 1991, 1993, 1994; Hranicky and Painter 1989). Other artifact types include drills, perforators, flake tools, scrapers, bifaces, anvil stones, net sinkers, mortars, pestles, manos, metates, groundstone tools (axes, adzes, celts), ground slate, gorgets, and tools made from animal bone and teeth (Dent 1995).

The Early Woodland Period is marked by an intensification of burial ceremonialism. Influences from the Ohio River Valley include the Adena culture, which is represented on a few key sites in the Middle Atlantic region during the Early Woodland Period. Artifacts associated with the Adena culture include Cresap stemmed points, large bifaces, blocked-end tubular pipes, effigy pipes, copper beads and other copper artifacts, gorgets, pendants, bird stones, bar stones, ground slate objects, and red ochre (Dent 1995; Lowery 2001, 2003). Although these artifacts are most

typically found associated with cremation burials, Adena artifacts have been recovered from habitation sites in the region (Dent 1995; Lowery 2001, 2003). Evidence for Adena influence in the region has also been documented as surface finds of trade items (e.g., Adena blocked-end tubular pipes) along major streams and occasional finds of Adena projectile points (e.g., site 18WO144). The Nassawango site near Salisbury (Wise 1974) contained more substantial evidence of an Adena presence on the Coastal Plain in Maryland. Mortuary data have also come from Adena sites in nearby Delaware, such as Killens Pond (7K-E-3), Saint Jones (7K-D-1), and the Frederica site (7K-F-2) (Custer 1984a:121-2). On the western shore of Chesapeake Bay, a cremation site (West River Site) from which Adena artifacts were recovered is one of the few buried features dating to this time period in the region (Ford 1976).

Early Woodland settlement patterns were still predominantly riverine, with sites most often identified at the junction of freshwater and brackish water streams. Early Woodland sites are generally larger than those of previous times, and there seems to have been an increasing reliance on riverine and estuarine resource areas. The smaller camps were established seasonally in areas where ripening resources or concentrations of game could be found. Gardner (1982:60) notes that the settlement-subsistence system of this period was focused primarily on a series of base camps where people gathered together to exploit seasonally available resources. These base camps were used to harvest anadromous fish in the spring and early summer, and to exploit estuarine resources in the fall and early winter. Barber (1991) contends that an increase in sedentism was in part a result of a stabilized sea level that facilitated the establishment of resource-rich environments. Other than a trend toward sedentism and more focused hunting and gathering, subsistence patterns were similar to the preceding Late Archaic period with increasing reliance on marine resources (e.g., shellfish) and cultivated plants (Dent 1995; Lowery 2001, 2003).

3.1.6.2 Middle Woodland Period (AD 300 – 1000)

The Middle Woodland Period (AD 300 – 1000) generally is not well-defined, and researchers disagree about the exact boundaries of the period. Dent (1995:235) has referred to this period of "technological homogenization" where "ceramic and projectile point variability becomes limited to fewer types." Despite the presence of fewer ceramic and projectile point styles, the Middle Woodland Period represents a continuation and further development of cultural complexity that culminates in the Late Woodland Period. The intensification in trade networks over a large region is one of the notable trends evident by the onset of the Middle Woodland Period. It is thought that warmer and drier conditions may have prevailed during this period (Kellogg and Custer 1994; Lowery 2001, 2003).

The major ceramic types for the period are Popes Creek and Mockley wares (Dent 1995). Popes Creek ceramics were first manufactured in the Early Woodland Period, and the style persisted through the early Middle Woodland Period in the region (Maryland Archaeological Conservation Laboratory 2002). Mockley shell-tempered ceramics are common in the latter half of the Middle Woodland Period.

Stone tool kits utilized by Middle Woodland peoples are basically the same as those used during the succeeding Late Woodland, but more exotic lithic materials are evident in Middle Woodland assemblages. The technology evident in many Middle Woodland sites seems to favor bifacial tool production rather than the prepared core and blade flake technology that typifies Ohio Valley cultures. Projectile points characteristic of the Middle Woodland Period include Selby

Bay/Fox Creek and the Jack's Reef types (Custer 1989; Dent 1995; Potter 1993; Stewart 1992). Other tool types found during the Middle Woodland Period are similar to those found during the Early Woodland Period, and include drills, perforators, flake tools, scrapers, bifaces, anvil stones, net sinkers, mortars, pestles, manos, metates, groundstone tools (e.g., axes, adzes, celts), ground slate, gorgets, and tools made from animal bone and teeth (Dent 1995). Dent (1995) notes that bone tools, such as awls and needles, appear to be more ubiquitous during the Middle Woodland than the Early Woodland Period. The presence of non-local rhyolite, argillite, and jasper at a few sites suggests that exchange networks may have been established between the Costal Plain and areas near western Maryland and the New Jersey Fall Line.

There are a few sites in the Chesapeake Bay region that evidence an elaboration of mortuary ceremonialism, with projectile points, ceramics, bone artifacts, shell beads, large pentagonal bifaces, platform pipes, bannerstones, and pendants (Lowery 2001, 2003). These sites appear later in Middle Woodland period, suggesting a reemergence of mortuary ceremonialism and continued selective influences from the Ohio River Valley/Great Lakes region (Lowery 2001, 2003).

Settlement patterns were largely similar to those of the Early Woodland Period, although base-camp settlements located at freshwater/brackish water junctions appear to have been abandoned in favor of broader floodplain sites where maximum resource exploitation of both non-tidal and tidal aquatic resources was possible. The large number of sites for this time period and the extensive size of some of the sites support the argument for possible seasonal aggregation and dispersal. There is some evidence for a significant shift toward settlement of coastal and estuarine areas (Davidson 1981) though Hughes (1980) notes that inland areas along swamps and small streams are still being utilized at that time. Hunting and gathering continued as the primary food sources, with increased reliance on riverine and domesticated plant resources. The presence of large, shell Midden sites during the Middle Woodland Period indicates the increased reliance on shellfish. There is also an intensification of horticultural practices, although hunting, fishing, and plant collecting are still important subsistence pursuits. The subsistence economy is also marked by the initiation of maize horticulture.

3.1.7 Late Woodland Period (AD 1000 – 1600)

Cultivated crops came to play an important role in subsistence for much of the region during the Late Woodland Period (AD 1000 – 1600 (Dent 1995). Some researchers (e.g., Lowery 2001, 2003) suggest, however, that agriculture did not play a big role on the Delmarva Peninsula, and that hunting, gathering, and fishing were the basis of the subsistence economy. The climate had stabilized by this period, and "environmental conditions were essentially modern in character" (Lowery 2001:87).

Chesapeake Bay region artifacts characteristic of the Late Woodland Period include a variety of ceramic types, including Cashie Currioman, Gaston, Killens, Minguannan, Moyaone, Potomac Creek, Rappahannock, Roanoke, Sullivan Cove, Townsend, and Yeocomico wares (Dent 1995; Maryland Archaeological Conservation Laboratory 2002). Only the Killens, Minguannan, Rappahannock, and Townsend wares appear on Delmarva Peninsula archaeological sites (Custer 1989; Dent 1995).

Projectile points characteristic of the Late Woodland Period include small triangular styles, such as the Madison and Levanna types and their variants (Custer 1989; Dent 1995; Lowery 2001, 2003). There is an apparent preference for locally available stone material for making points.

Other stone artifacts recovered from Late Woodland Period sites include scrapers, perforators, bifaces, hoes, choppers, net sinkers, groundstone axes, celts, adzes, mauls, grinding slabs, metates, manos, mortars, pestles, pendants, boatstones, bannerstones, and abraders (Dent 1995; Stephenson et al. 1963). Artifacts made from shell and bone are recovered from Late Woodland Period sites, including fish hooks, scraping implements, pendants, beads, awls, bodkins, beamers, needles, pins, and beads (Dent 1995). Clay tobacco pipes were manufactured during this period. Copper beads and pendants are also, but rarely, found (Dent 1995).

Unlike the rich mortuary traditions of the Early and Middle Woodland Periods, Late Woodland mortuary sites consist of large ossuaries containing human remains and few grave goods. Exotic items found in Early and Middle Woodland Period mortuary contexts are absent from Late Woodland ossuaries (Dent 1995; Lowery 2001, 2003). Smaller, single interments are found throughout the Chesapeake region. Late Woodland Period dog burials have also been recorded in Virginia (Dent 1995).

The establishment of stable agriculture during the Late Woodland Period led to the development of sedentary floodplain village communities. Villages were often located within palisades near agricultural fields. The reliance on agriculture, and the presence of village palisades, hearths, storage pits, Middens, and burials, is indicative of the greatest degree of sedentism seen until this time. Settlements were generally located on broad floodplains, often near the junction of a tributary stream and river. Small transient camps have been found in upland settings (Gardner et al. 1984:18-20). Hunting and gathering was conducted from larger estuarine camps surrounded by micro-band camps. Other trends include shifts in lithic raw material preferences, perhaps related to the development of more sedentary lifestyles. Smaller foraging and hunting ranges would have resulted in more limited exploration for lithic raw materials and greater dependence on resources found near the camps, as well as those regularly obtained through exchange with other groups.

Increased population density and competition for choice land and resources led to the rise of chiefdoms and a hierarchical type of political organization. Hunting, gathering, and fishing were still practiced, but to a lesser extent than earlier. Agriculture does not appear to have played a major role in the Late Woodland Period subsistence economy on the Delmarva Peninsula, though populations do seem to have adopted a more sedentary lifestyle. There was an increase in social and political interaction among native tribes in the region after AD 1500, and Potter (1993:151) has suggested that an alliance of coastal plain Algonquian groups was formed prior to European contact.

3.1.8 Potential to Encounter Prehistoric Sites within the Project Area

The most likely sites to be encountered in the project area are Paleoindian in nature, because the offshore landforms being evaluated may have been exposed during the Late Pleistocene. Paleoindian sites are rare on the Delmarva Peninsula, and usually consist of isolated projectile point finds. Large habitation sites that may be detectable with remote sensing technologies are not associated with early prehistory.

A sub bottom profiler array can, in theory, detect buried relict channels that may have been exposed during the Late Pleistocene. The margins and confluences of these buried channels represent locations where Paleoindian Period peoples may have frequented. The preservation potential within the survey areas, which will be discussed in the next section, is very low, and it is highly unlikely that any buried relict channels have survived intact to the present time. By

extension, there is a very low possibility to find an intact prehistoric site where there are no intact buried relict channels.

3.2 MARITIME HISTORIC CONTEXT

Wallops Island is a barrier land mass located on the eastern shore of the Delmarva Peninsula in Accomack County, Virginia. The maritime history of this sparsely inhabited island is intimately related to the political, economic, and cultural background of Virginia's Eastern Shore, particularly Accomack County. This maritime context will focus on the history of this portion of Virginia for this reason. Details regarding the history of Wallops Island are included throughout.

3.2.9 Contact Period (1524-1606)

The Contact Period begins as European explorer's first venture into North America in search of a northwestern passage to Asia and Cathay. Early voyages to the Eastern Shore of Virginia began in the early 16th. The first documented landing took place in 1524, when French adventurer Giovanni da Verrazano landed approximately 16.1 kilometers (10 miles) north of Cape Charles. Contracted to explore the new world by Francis I of France, Verrazano hastily mapped the eastern shore of the Chesapeake Bay and daringly penetrated the headwaters of the Pocomoke River in his carrick, *La Dauphine*. He also documented lifeways of the indigenous Accomac peoples, including the construction and use of seaworthy dugout canoes. Verrazano dubbed the region Arcadia in a subsequent report to the French crown (Wise 1911, Lowery 2000). A second landing took place in 1525. Explorer Lucas Vasquez d' Ayllon cruised the interior of the Eastern Shore of Virginia in an effort to identify a northern passage out of the Chesapeake Bay. He surveyed numerous waterways during this venture and landed several times to provision his vessel (Wise 1911).

Other explorers who sailed Virginia's Eastern Shore between 1571 and 1606 were Englishman Bartholomew Gilbert and Dutch captain Richard Hakluyt (Wise 1911, Lowery 2000). Bartholomew Gilbert explored the southern coasts of Virginia, beginning in 1602, in search of the lost residents of Roanoke Island. Sailing a fifty ton bark with a small crew, Gilbert was caught in a storm off the Capes of Virginia during the summer of 1603. To escape the storm he sailed into the Chesapeake and anchored one mi (1.6 km) off the eastern shore. In need of provisions and water, Gilbert and a small well armed party went ashore. After travelling only a short distance on the beach they were attacked by the local Accawmack tribe, and Gilbert and a crew member were killed (Wise 1911).

Vessels employed by European explorers between 1525 and 1600 shared similar characteristics. The 16th century was the first period during which ship design was based on predetermined mathematical projections. Vessels developed from these projections maintained rounded hulls with a length to breadth ratio between 2.8 and 3.1 to 1. These characteristics resulted in slow, seaworthy ships with a massive tonnage or carrying capacity. Waterline length varied between 20 and 45 meters (65.6 and 147.6 feet) (Steffy 1994). Ships of this time were called carrick, galleon, nao, caravel, pinnace, bergaitin, and fluit (Unger 1994).

3.2.9.1 Settlement to Society (1607-1750)

Much like the rest of the Chesapeake Bay region, Virginia's eastern shore was primarily settled by English immigrant farmers. Explorer John Smith attracted his countrymen to the area in 1607

when he exclaimed that the area was a fertile, wooded land with many creeks, bays and inlets that permitted navigation into the interior. The first settlement in the area was a satellite community hailing from Jamestown. Governor Thomas Dale sent Lieutenant William Craddock and a score of men to Smith Island in 1614 to provide salt and fish for the struggling Virginia colony (Wise 1911, Ames 1940). The success of this small town, called Dale's Gift, generated interest among colonists, thus initiating the permanent settlement of the region. Salt production became the first industry of Virginia's Eastern Shore, and it remained a profitable one until the early 18th century (Ames 1940).

The southern portion of the Delmarva Peninsula was formally recognized by the English crown in 1634 when the House of Burgesses established Accomac Shire under the direction of England and King Charles I. It stood as one of the original eight shires of Virginia and was named for the local Accawmack tribe. This shire was divided into Accomack and Northampton Counties in 1671 (Wise 1911). The earliest permanent settlement on Virginia's eastern shore was located on the southwestern side of the peninsula along the Chesapeake Bay where it was more protected from the elements. This settlement, known as Accomack Plantation, was composed of three distinct settlements along Kings Creek, Old Plantation Creek, and Magothy Bay at Cape Charles (Turman 1964). The town of Accomac became the location of a county courthouse on the seaward side of the peninsula.

English and Dutch settlement on the eastern shore gradually increased throughout the 17th century, and land grants were routinely issued throughout Accomack County for parcels ranging from 200 to 2,000 acres. The grant for Wallops Island was awarded during this land rush. Englishman John Wallop was given 1,450 acres on then Kickotank Island in 1672 to reward his effort to seed Accomack with British colonists. This grant was later revised to 1,800 acres in 1682 and then 1,500 acres in 1692. The island, which was later dubbed Wallops Island, is shown on the 1693 map of the region done by Daniel of St. Thomas Jenifer (Figure 3-1) It was intended that all lands granted by the English crown be farmed speculatively by the owner for the benefit of mother England and the still isolated peninsula (Whitelaw 1968). After being granted to Wallop, the island became known as Wallops Island and was passed down to his children and grandchildren.

The colonial economy of the Delmarva Peninsula was more diverse than that of the tobacco dominated western shore. Salt making began on Smith Island in 1619, and became a luxury commodity throughout the colonies until the first quarter of the 18th century. Fertile fields throughout Accomack and Northampton Counties yielded excellent grain, corn, and tobacco. Industries associated with these crops, such as grain mills and tobacco cask manufacturing houses, dotted the landscape as additional plantations were established. Hemp and flax were also grown for the manufacture of cloth, and bricks were made for the construction of permanent structures on plantations and at Accomac Town. Fishing and boat manufacture were also growing industries at coastal settlements (Ames 1940). Vessel production was so vital to the success of the region that the Accomack assembly offered an incentive in 1661 of 50 pounds of tobacco for every vessel ton produced (Wise 1911). The diverse eastern shore economy established in the early 17th century continued with little change over the next 300 years.

Prospective buyers in Amsterdam, Boston, Baltimore, London, and the Greater Antilles clamored for eastern shore products, and maritime trade became key to the prosperity of this isolated community between 1630 and 1750. Dutch and English trading houses located throughout Accomack County owned seaworthy vessels that traveled between Boston, England,

Baltimore, and the Greater Antilles with cargoes of grain, tobacco, flax, and salt. These moderately sized 20 to 40 ton ships returned laden with molasses, sugar, rum, and refined goods slated for re-distribution among prospering colonists (Ames 1940). These trading craft, called *Africa*, *Blessing of Virginia*, *Deliverance*, *Anne Clear*, *May Flower*, and *Artillery*, became the face of eastern shore commerce for 120 years, and generated fortunes for merchants such as Richard Scarburgh and William Claybourne (Wise 1911).

The success of merchant fleets throughout colonial America did not go unrecognized by the English Crown, and Parliament passed a series of acts that restricted the local trade of competing nations. The first of these navigation acts was passed in 1651, and it stated that goods shipped to England had to be carried by English vessels. This declaration infuriated foreign merchants, particularly the large Dutch population on the eastern shore. The resultant regional conflict between Dutch and English traders became known as the Dutch War, which raged between 1651 and 1653. The war was contested politically on land and between Dutch and English privateers at sea, and many merchant vessels were sunk or taken as prizes as a result (Wise 1911, Ames 1940). Dutch interests suffered terribly during the conflict, and they ceased to be a major economic factor in the region after the war.

Maritime prosperity on the eastern shore also enticed those motivated by quick profit, and piracy was a looming threat along the eastern seaboard throughout the seventeenth and early eighteenth centuries. The isolated barrier islands of the southern Delmarva Peninsula served as excellent havens for captured prizes and pirate vessels alike (Shomette 1985). John James of *Providence Frigate*, William Kidd of *Adventure Galley*, Edward Davis, and John Cook all harried merchant shipping in the region (Middleton 1953). Fear of piracy along the eastern shore prompted local officials to establish lookouts along the coast; Captain Gilbert Moore was commissioned to patrol the coast in search of possible culprits. Accomack assembly member John Custis also petitioned the Virginia governor for a royal frigate to discourage further predation. Captain Edward Teach, commonly known as Blackbeard of *Queen Anne's Revenge*, was born and raised in Accomack County (Wise 1911, Shomette 1985).

As the Eastern Shore is relatively isolated from the mainland of Virginia, the most expedient way to travel between the two locations was by boat. In order to facilitate travel, a ferry system was established. A ferry had been making two round trips per week from the port of Northampton to York and Hampton since 1705. John Masters was given rights to operate a ferry from the Eastern Shore to the ports of York and Hampton in 1724. During his operation of the ferry the main port was soon moved to Mattawoman Creek, the main branch of Hungars. He provided one transport for the passage of foot passengers and one for men and horses (Turman 1964).

The importance of shipping on Virginia's Eastern Shore in this period became evident in the increased restrictions placed on shipping. Towns that could become ports and attract shipping grew exponentially both in population and wealth. Virginia passed "An Act for Cohabitation and Encouragement of Trade and Manufacture" in 1680 (Henning 1819b). This act was designed to establish towns for storehouses in order to better control the moment of tobacco and other exports. All produce was to be carried to the designated towns before export and all goods brought into the colony including "servants, Negros, and other slaves" were to be landed only in these towns (Henning 1819b: 477). Only one such town was established for Accomack County, called Onancock, on the bay side of the peninsula. This town was the site of brisk trade with the western shore of Virginia and was one of the major ports of the colony. In an attempt to limit the number of ports to concentrate prosperity, customs began being collected. Each port from which

boats entered and departed had a customs collector, and each ship captain was responsible for ensuring that goods loaded aboard his ship had been properly inspected and a certificate from the customs collector (Turman 1964).

In 1691, Virginia passed an act concerning the establishment, location, and operation of ports throughout Virginia (Henning 1819a). This designated where vessels could load and unload goods and where goods could be sold (Henning 1819a). It also decried the home of the Naval Officer who kept track of the vessels coming and going for each district. This port was located in Accomack County at Onancock, where by 1691 "the court house, several dwelling houses and warehouses are already built" (Henning 1819a). The court remained at Onancock until 1786 when it was moved to the sea ward side of Accomack, as this location was considered more convenient for the local population (Wise 1967:233). Ports at Accomack in Folly Creek (seaside) and Onancock (bayside) were designated official ports in the same year (Henning 1819c:321). The two towns are only 4.5 mi apart by land.

As ports became larger and supported greater volume of incoming and outgoing traffic, it became necessary to protect the channels leading to these ports. Sailing vessels brought in significant amounts of sand, gravel and ballast stone, which were often dumped in the channels and wharves surrounding these ports. The General Assembly passed a law requiring every county adjacent to a navigable stream to provide a place to deposit ballast on shore where it would not wash back into the waterway and obstruct navigation (Turman 1964). They were also required to provide an overseer to regulate this process. Ship captains were required to pay the overseer a fee for unloading ballast on shore, which prompted many vessel operators to load their vessels with paying ballast such as limestone, chalk, bricks, and stones to avoid paying the ballast fee while earning freight charges.

Virginia, as a colony of Great Britain, was discouraged from manufacturing finished goods, and the crown mandated importation of nearly all housekeeping materials. Colonial officials reported to the Lords of Trade in 1741 that "The colonial Virginias has all the necessities they wished for the adornment of their persons or for the furnishing of the homes just as if they lived in Great Britain" (Coulter 1945:296). The majority of manufactured goods came from Great Britain, but other goods arrived from all over the known world. Five British ports dominated trade with Virginia during the 18th century; these were (in order of importance) London, Bristol, Glasgow, Liverpool and Whitehaven. England's center of shipping was London, and "Drawing into its markets the manufactures of Britain, continental Europe, and Asia, and having its own special products, 18th century London was the world emporium of trade" (Coulter 1945:297). Vessels destined for Virginia may have originated in Britain, but the cargo came from all over the world.

There was considerable trade between Virginia and the British West Indies during the colonial period. The islands of Barbados, Antigua, St. Kitts and Jamaica were producers of sugar and rum, and imported food and wood from the colonies in return. Vessels traveling to Virginia from the West Indies usually carried a cargo of sugar and a few slaves. The vessels were smaller sloops, not the larger African ships devoted to slaving (Kline 1975). Moreover, slaves that had spent time in the West Indies were considered "seasoned" or acclimated to the climate and culture of colonial America. These were preferred to slaves that came directly from Africa for reasons associated with disease, language, and conduct (Coulter 1945).

Accomack County and its district port of Accomack were a common destination for the smaller coastal vessels from northern American colonies and the West Indies (Kline 1975). Larger

vessels, such as the slavers coming directly from Africa, would call on the larger ports of the South Potomac, Rappahannock, and York River districts (Klien 1975). Accomack, being small and removed from the rest of the colony, was not a favored destination of slave traders. Only 125 slaves were brought to the county (via the port at Accomack) during the 42 year period of 1727 to 1769. None of the voyages to Accomack came directly from Africa, but from the West Indies and other colonies. In contrast, the district of York River received 15,607 slaves during the same period, with 60 percent of the voyages coming directly from Africa (Kline 1975). There was a direct correlation between the size of the vessels and the size of the port it was able to enter.

Craft common to the southern eastern shore between 1607 and 1750 were varied. During both the 17th and 18th century, vessels operating in the Wallops Island area would have been small craft used to move small amounts of goods and produce up and down the seaside of the peninsula. Their capacity would have been that of livery, or transport, to the larger transatlantic vessels that would carry hundreds of large hogsheads of tobacco to London and beyond. One colonist described the Chesapeake Bay and the surrounding waterways in 1724 as "navigable for sloops, shallops, long-boats, flats, canoes and *Periaguas*" (Brewington 1953). Vessels used in the American colonies were very similar to their European counterparts, as locally constructed vessels were not typically built for a specific purpose, but could be used for anything befitting their size (Chapelle 1951). There were few distinctly colonial vessel types recorded during this period. Modifications of previously used vessels were made, but there are seldom detailed descriptions or terms for these regionally modified vessels. The major vessel types used during this period include the dugout/log canoe, the punt or flat boat, bateau, the sloop, and the shallop.

The dugout represents the earliest vessel type employed in the Chesapeake region. It originated from the local Native American population that inhabited Virginia's Eastern Shore. These vessels were typically carved from a single log to form a trough-like vessel (Brewington 1963). This vessel type, which was embraced and modified by the colonists, ultimately resulted in a craft ranging from 12 to 40 feet in length that could be constructed of several logs shaped and mortised together. Adaptations of this general form included the addition of multiple logs, which allowed the vessels to be larger, more stable, and have a deeper draft. They were typically undecked, and sometimes had framed and planked topsides with sharp ends. These canoes were likely originally rowed and punted, but were adapted to be rigged with one or two spritsails and could have a jib set on raking, unstayed pole masts (Brewington 1966). Large dugout canoes fitted with sails were often referred to as *periaguas* (Chapelle 1951).

The punt and flat represent very similar vessel types; the distinction between the two was the presence or absence of sails. The flat was frequently employed as a ferryboat, and possessed curved ends with platforms at the bow and stern with the rest of the hull left open (Chapelle 1951). This vessel was typically flat bottomed, and double ended. The flat was commonly rowed or punted, and generally did not have a sail. The punt was constructed very similarly to the flat but it possessed a single forward mast and a boomless spritsail (Chapelle 1951). Both the flat and the punt were simple to construct and very efficient in the shallow, shoal waters of the Chesapeake. They were used as ferry boats and for transporting goods.

The *bateau*, which translates to boat in French, became a specialized vessel type in the Chesapeake during the 18th century. Regionally, the term bateau was applied to a chine built hull that averaged 40 to 45 feet long (Chapelle 1951). These vessels could be rowed or poled. They were occasionally fitted with sails and external keels to facilitate sailing close-hauled.

The sloop was the most popular vessel type used in the British colonial period. Sloops varied in capacity from 25 to 70 tons during the 18th century, and were typically rigged fore and aft (Chapelle 1951). These vessels would have a single mast with a gaff mainsail, two to three headsails, a square topsail and a square lower sail (Chapelle 1935). Sloops were designed with an external rudder, a flat transom, a slightly curved bow, and a single mast with no bowsprit (Chapelle 1935). They tended to be at least partially decked. Sloops were small in the beginning of this period, but were constructed larger as the 18th century progressed.

The shallop represents one of the many vessel types used during the colonial period for which the name can represent many vessel configurations. The authors of the 17th and 18th century were not overly familiar with nautical terminology, and used various terms to describe them. The shallop was often referred to as a ship's boat, longboat, or launch. These vessels were initially used to lighter crew from ship to shore, and were very popular in the Chesapeake due to a shallow draft and ease of handling. It was a versatile vessel that was easy and inexpensive to construct. Shallops could be used for fishing and transportation of goods and people in a region that favored water transport over road travel (Baker 1966). The shallop often acted as a farm and household boat to be used for everyday purposes. These vessels were typically two masted, open boats without a boom on the main mast which could range from 18 to 28 feet along the keel (Chapelle 1951). A less common variation included decking with a boomed mainsail.

3.2.10 Colony to Nation (1750-1789)

The second half of the 18th century along Virginia's Eastern Shore was fraught with conflict. The Seven Year's War, which began in 1755 and lasted nine years in Virginia, was a dispute between England and France. It had a notable influence upon Virginia. Fighting occurred throughout North America, including the Eastern Shore. The Virginia General Assembly met in 1755 to establish a quota of men to be recruited from each county (Turman 1964). The conflict was to establish British supremacy on the North American continent, but Eastern Shore residents were more concerned with preventing British occupation of their homes. Many local men were placed on guard duty or sent to occupy the frontier to such an extent that tobacco production diminished and overall trade declined. Militiamen were placed on guard in all navigable creeks and rivers. Several forts were also established (Turman 1964).

The war had a detrimental effect on tobacco production and trade on the Eastern Shore, but it also began to make the local population more self sufficient. With a limited ability to receive goods from British ships, Eastern Shore residents began making many of their own goods. Travelling weavers, tailors, and shoemakers also went from town to town making necessary items. Virginia-made linen sheets and pillow cases became more prevalent, and weaving equipment became a necessity on every plantation (Turman 1964).

King George III succeeded his grandfather as ruler of England after the Seven Year's War, and began exerting his authority over the colonies in ways that had never before been experienced. Parliament passed the Townshend duties in 1767, which taxed lead, paint, paper, tea, and glass (Turman 1964). This act had a dramatic impact on residents of the Eastern Shore, as the paper tax affected all legal documents as well as newspapers and almanacs. The paint tax represented a hardship to ship builders who were now unable to paint ship bottoms. It also challenged the residents who painted their homes in order to preserve the wood in the damp seaside climate. This act was repealed in 1770 following intense protest and the boycott of goods, with the exception of the tax on tea.

The boycotts of British made goods, as well as the difficulty in receiving imported goods during the Seven Years War, made Virginia's Eastern Shore largely self sufficient. They were capable of producing many necessities themselves, saving money typically used for imported products from England and other European nations. Tobacco remained the principal cash crop, but pork, beef, hides, shoes, corn, wheat, salt and sea food also became major exports. Records show that castor oil, which could be used for medicine, soap, axle grease, and paint, was also produced in quantities large enough for export (Turman 1964). Flax was also produced for domestic use and export. It could be used to produce linen, and its seeds were used in the production of house and boat paint.

When the war for independence broke out with England, the general sentiment on the Eastern Shore was in favor of colonial independence. The two Eastern Shore counties supplied seven companies of soldiers, one captain, two lieutenants, one ensign, four sergeants and a drummer to the Ninth Virginia Regiment (Turman 1964).

War soon touched the lives of residents of Accomack and Northampton Counties, as British warships took control of the mouth of the Chesapeake Bay. The ports of these two counties soon became a major part of the Colonial supply line. The 1751 Fry and Jefferson map illustrates many of the important creeks and islands which became vital cogs in supplying the Continental Army (Figure 3-2). Ports along the ocean side of the peninsula, including Metompkin and Chincoteague Creeks, were able to receive supplies from France and other neutral countries and transport them to the interior. Medicine, munitions, and other necessary supplies were received along the seaside, transported over land, and reloaded onto small vessels in the creeks and rivers of the Chesapeake, where they were transported to the head of the Bay and down the western side of Virginia and Maryland (Turman 1964). This round-about route was necessary to avoid blockading British vessels and raiding barges operating throughout the Chesapeake region.

A fort was established on Parramores Beach in order to prevent British raiding barges from entering the vital port of Metompkin Creek, and to protect incoming ships (Turman 1964). The fort and other defensive measures along the Eastern Shore peninsula did not prevent the British from seizing a portion of the shore in 1779. This action, and the establishment of a base on Hog Island under the command of Captain John Kidd, infuriated Virginians. This base allowed the British to send out small ships, tenders, and barges to raid surrounding farms and plantations to supply nearby warships. Raids typically took place at night when livestock were corralled and poultry were in their roosts. It was not uncommon for British raiding parties to burn the property of, and steal silver and valuables from, resistors (Turman 1964).

Ferry service between the Eastern Shore and the mainland was discontinued during the British occupation. Vessels that had been involved in the ferry service were leased to the fledgling American government and used to transport troops and goods along the Bay (Turman 1964). These ferries and similar privately owned transport vessels were used to transport Washington and his troops from the Head of the Chesapeake to just north of Yorktown in 1781 where the decisive battle of the war was fought.

Yorktown, which is commonly touted as the last battle of the American Revolution, was fought in 1781, but the last naval engagement of the war involving the Eastern Shore took place in November 1782. The Battle of the Barges occurred when Commodore Whaley of Maryland, who was charged with barges ordered to protect Maryland from British Commodore Kidd's marauding vessels, traveled into Onancock Creek to select volunteers for a skirmish with six

enemy barges (Turman 1964). Buoyed by 25 new volunteers and a vessel to be commanded by Colonel John Dropper, Whaley and his fleet successfully discerned the size of the British fleet and their location at Cadger's Strait (Shomette 1985). After a quick, forceful attack by Whaley, the British vessels nearly fled. The battle would have been a victory for the Americans, but the powder magazine exploded on one of the colonial vessels, causing death, destruction, and general pandemonium. The ensuing chaos allowed the British to board and capture Whaley's fleet, rending the conflict an embarrassing loss (Shomette 1985).

A significant trade conflict arose on the Eastern Shore between the adoption of the Virginia Constitution in 1776 and the adoption of the United States Constitution. Virginia's right to charge a toll on ships travelling between the Virginia Capes and Maryland was disputed along with the right to build piers and fish on the south bank of the Potomac. The agreement that was reached allowed Maryland ships to travel through the entrance to the Chesapeake without being charged in exchange for use of the Potomac River by Virginia citizens for commerce and fishing (Turman 1964). This agreement remains in effect to the present and illustrates the importance of maritime commerce and navigation to the residents of Virginia and Maryland.

Vessels used during this era were the same as those of the previous period with few additions. General craft continue to be small to accommodate travel in the often shallow, shoal prone waters of the Chesapeake and the barrier islands. This period and the one prior continue to exhibit ambiguity in vessel and rig types. A vessel could be described by its hull form or its rigging. The major addition of this period was the schooner.

The schooner is mentioned at various times during the first quarter of the 18th century in reference to a rigging style that was largely un-standardized (Chapelle 1935). The term "schooner" supposedly arose in 1713 when upon the launch of a new vessel, a spectator commented "Oh, how she scoons!" The owner of the vessel was enamored with this comment, and declared that it should be called a schooner (MacGregor 1997). While this may or may not be the origin of the term, these vessels became standardized by the second half of the 18th century (Chapelle 1935). Howard Chapelle (1935) suggests that the schooner is one of the first distinctive American vessels. These vessels were the most common type found in colonial waters by the time of the American Revolution because they were fast and relatively simple to construct and sail. The schooner was quickly adopted for legal and illegal trade throughout the colonies.

Most schooners were sloop hulls with two fore and aft rigged masts, with the occasional topsail added (Chapelle 1935 and Brewington 1966). They were designed to be very sharp and fast with a large sail plan. Schooners tended to be relatively small, ocean going vessels that were often used by the Royal Navy as transports (Chapelle 1935). The schooner that became the workhorse of the Chesapeake Bay had a shorter sail plan, more upright spars, and a topmast on the main mast only. This adaptation contrasted with the schooners involved in the ocean trade (Brewington 1966). Schooners would increase in length over time and ultimately transformed into clipper ships.

3.2.11 Early National and Antebellum (1789-1860)

The end of the American Revolution and the establishment of the fledgling United States ushered in a period of peace and growth on the Eastern Shore. The Eastern Shore accounted for three percent of the Virginia population with a total of 20,848 people during the first United States census in 1790 (Turman 1964). The population of the two Virginia Eastern Shore counties had

increased slightly by 1800 to 22,456 with 8,479 in Accomack County (Turman 1964). Wallops Island had 30 residents, 14 of them above the age of 16.

Industry on the Eastern Shore continued unchanged. Tobacco was still a major cash crop, with warehouses constructed near ferry landings to store the crop before transportation to market. Tobacco was placed in a "rolling house" before being transported via a "rolling road" constructed from the bayside to a warehouse along the seaside. The large hogsheads of tobacco could be attached to a frame which allowed it to roll and be pulled by a horse or ox (Turman 1964). Madison's 1807 map of Virginia illustrates the major islands and creeks of the Eastern Shore that were vital for the tobacco trade (Figure 3-3).

The production of flax was also important, and was used in the production of linen cloth, boat sails, thread, fishing lines, nets, and rope. Flax seed was also a lucrative byproduct of flax production, for the seeds could be used for making medicine and linseed oil for paints. Wool had also become an important home industry on the Eastern Shore (Turman 1964).

Ferry service between the Eastern and Western shores resumed, with two trips per week made from the port of Hungars. The major change to the ferry service was the addition of a mail contract. The operators of the Hungars ferry were to pick up the mail from the Western Shore on each trip across the Bay to deliver it to the post office on the Eastern Shore (Turman 1964).

War was again declared between the United States and Great Britain in June 1812, and the Eastern Shore was vulnerable to attack and possible occupation. The militia continued to drill regularly, and men from both Accomack and Northampton counties were called to defend their homes. The militia rotated watches along the mouths of bayside creeks. The British did not bother landing on the seaward side of the peninsula, but instead concentrated on taking control of the Chesapeake Bay. The appearance of enemy ships at the mouth of the Chesapeake once again brought an end to ferry service between the Eastern and Western shores (Turman 1964).

The British soon turned their attention to preparing to attack the American capital, Washington, D.C. The British navy selected Accomack County as its base of operation. The attack was to be a naval campaign and the Navy needed a base out of reach of the Eastern Shore militia. They selected Tangier Island located on the Chesapeake Bay to this end. Tangier Island was occupied on April 5, 1814, under command of British Rear Admiral George Cockburn. They constructed a fort there and used it until the end of the war.

The first record of attack on Virginia from this base occurred near Pungoteague on May 30, 1814. Known as the Battle of Pungoteague, British barges and tenders fired cannon at the mouth of Onancock Creek in order to draw the American militia there. The British soon crossed the bar of Pungoteague Creek in 11 tenders and barges before landing on the north side of the creek and advancing more than one mile (1.6 km). The militia engaged them briefly with no notable results. The British soon retreated back to Tangier Island. This battle, however, marked the only battle on the Eastern Shore against a European nation (Turman 1964).

Trade during the war was impaired but not paralyzed. Eastern Shore residents found themselves experiencing great difficulty transporting and receiving goods from northern cities, but local industry had developed to such an extent that they were largely self sufficient. This self sufficiency produced most of the necessities and allowed them to purchase goods from New England, France, and other friendly European countries as vessels were able to evade the British and land at seaward ports.

The war ended with little damage to the Eastern Shore, and ferry service resumed in 1815 at Hungars Ferry. This ferry, which had operated since 1724, soon faced competition from the Port of Pungoteague. The new ferry also ran two trips per week from one shore to the other (Turman 1964). A steamboat ferry service was established by the early 1840s, and it ran between the Eastern Shore and Norfolk, Hampton, and Yorktown on the Western Shore. A steamboat company was able to obtain a franchise to operate in both Northampton and Accomack Counties, and the terminal was moved to Cherrystone Creek where two trips per week were made to the mainland (Turman 1964). Once per week a steamer was sent to Pungoteague. The vessels used on this route included steamboats *Star* and *Joseph E. Coffee.*

The end of the war ushered another period of growth on the Eastern Shore. The principal crops were wheat, rye, oats, beans, peas, Indian corn, cotton, and potatoes. Castor beans were also frequently produced to manufacture castor oil. Tobacco, while still produced, was slowly being replaced by other crops. The first agricultural figures were officially recorded in the 1840 census, and the transition from staple crops to production of commercial vegetables had begun (Turman 1964). The census reports that 10,254 pounds of cotton, 107 tons of flax, and 112 pounds of tobacco were produced along with 173 pounds of beeswax, 4,598 bushels of salt, and 3,372 cords of firewood (Turman 1964). Farm products produced here were in demand in Washington, D.C., Baltimore, Philadelphia, and New York. Completion of the Chesapeake and Delaware Canal across the 14 mi neck of the Delmarva Peninsula in 1829 aided the transport of goods to the northern markets. The eventual development of steam also allowed Eastern Shore produce to be transported to market with greater speed than sailing vessels.

The increase in commercial agricultural production, especially wheat and corn, prompted the construction of mills for grinding these crops. There were a total of 75 mills between both counties by 1840. There were also five lumber mills and one brick making plant (Turman 1964). The seafood industry was also becoming increasingly important. It had become such a booming industry that the legislature was required to prohibit the sale of oysters between the first of May and the first of September in order to conserve the supply.

The location of Virginia's Eastern Shore on a peninsula with numerous small creeks, shoals, and tributaries made vessel travel necessary and hazardous. The need for lighthouses had been clear since colonial times, but the first lighthouse was not started until the late 1820s. The Cape Charles Light on Smith Island was completed in 1832 at a cost of $7,398.82. Lighthouses were completed on Assateague Island and Watts Island in 1833. A study was conducted at this time regarding the placement of a lighthouse on Hog Island, but it was not until 1852 that Congress appropriated money for its construction. Dwellings for the light keeper and assistant keeper were also constructed. Smaller lighthouses also marked the entrances to Occohannock and Pungoteague Creeks. The lights were fueled by oil with reflectors, which required regular cleaning and daily care by the lighthouse keeper. The lighthouse keeper was a vital part of Eastern Shore life until the lights were electrified nearly a century later.

19th century vessel types were designed to meet demand. The main economic stimulus in the Chesapeake was the oyster harvest, and this encouraged vessel development. Vessels became larger but retained the sails, shallow drafts, and flat bottoms necessary for navigation in the marshes, cuts, and islands of both the seaward side and bay of the Eastern Shore. Centerboard, or drop keel vessels became popular in the Eastern Shore region after 1850 (Chapelle 1951). Vessel names varied by region, but were largely dependent on the type of rigging employed.

Craft used during this period included the earlier forms like the sloop and schooner, but also boasted the clipper, various regionalized watercraft, and steam powered vessels.

The heyday of the fast clipper ships, regionally known as Baltimore Clippers, was 1845 to 1860 (Crothers 1997). This vessel type is a result of the rising demand for fast ships. Their construction design often sacrificed cargo space and low operating costs in favor of speed (Chapelle 1935). It was this disregard for practical aspects of sailing and ship construction that led to a relatively short period of use. The clippers which have been greatly popularized and romanticized are not constructed with a single characteristic hull form but rather used three basic models. These consisted of the Baltimore Clipper, which was characterized by a very sharp deadrise and fine ends, the sharp ended clipper with a very full midrise and very small deadrise, and a compromise between the two extremes, which was characterized by a noticeable, but not extreme amount of deadrise (Chapelle 1967). None of these models became dominant, as all had advantages and disadvantages and were used for different purposes. The common clipper varied in length along the waterline from 105 feet to 228 feet (Crothers 1997). The bow and stern were extremely V-shaped and very sharp at the waterline. They were typically wide at midship to accommodate cargo. Most clipper ships were three masted, but four masted vessels were also common. Four masted variants were rigged with a spanker gaff and boom on a smaller mast set near the stern (Crothers 1997). Typical rigging plans had as many as 15 yards to support sails (Crothers 1997).

A number of more regional watercraft were also being used during this period. These include the scow and the pungy. The scow first appeared in the 1750s, but was most popular in the early 19th century. It was characterized by square raked ends, hard chines, and a flat bottomed hull (Brewington 1966). They were typically rigged as a sloop or a schooner, and were fitted with a leeboard rather than a keel or centerboard. Ranging from 30 to 50 feet in length, these watercraft were considered workhorses used to haul goods and crops (Brewington 1966).

The pungy was another regional craft operating along the Eastern Shore, and has been considered the best of all native Chesapeake watercraft. While very similar in configuration to the schooner, this vessel type was characterized by a much deeper stern than bow, with a greater deadrise. The beam was greatest further forward, the ends were more raking, and a log rail was employed rather than the bulwarks of the schooner (Brewington 1966). The transom was also hewn from a solid timber rather than built plank over frame. It employed a very similar sail plan to that of the schooner but tended to be taller with lighter spars and more sharply raked rigging (Brewington 1966). While lamenting its demise, one waterman noted “no pungy was ever lost except by bad management. A pungy is all keel and no hold. She can’t carry much more than a common freight car” (*Peninsula Enterprise,* July 20, 1907). A few variations on the pungy existed, including one fitted with a centerboard for navigating shoal waters. That same waterman also commented on the speed and maneuverability of the pungy saying “a deep model, what I call long-legged, with only one topsail, no jibboom and nothin’ but a standin’ jib is surely goin’ to be a little lazy in a calm. But the more it blows the faster a pungy is. In oyster weather, fall and winter, she’s a goer. She’s got the stern to be fast” (*Peninsula Enterprise,* July 20, 1907). One of the most obvious traits of the pungy was its distinctive paint scheme. They would be painted with “the bottom, copper; the boot-top, “flesh” pink the bends, bottle green; and the bead, scarlet” (Brewington 1966).

Schooner hulls were converted into steam vessels in the Chesapeake region by making room below decks for engines and equipment and installing exhaust piping on deck. When purpose

built steam vessels were constructed, they had long, narrow hulls with a vertical single cylinder engine and side paddle wheels (Labaree et al. 1998). The boilers, like those on locomotives, were first wood burning, then coal and later diesel. Bay and river vessels employed a superstructure to prevent hogging and to stiffen the vessel (Labaree et al. 1998). They typically had two decks with the greater part of the vessel above the waterline. These vessels were ideal for carrying bulk cargo.

Steamboats in the Chesapeake region retained a shallow draft and stern paddle wheels that suited the calmer waters of the region. Ocean going steam vessels employed propellers and were constructed with a sharper hull (Labaree et al. 1998). There was great variation in hull form in steam powered vessels, but a majority of builders eventually moved both storage and cabins from below to above deck. One example of an early steamboat is the *Alabama.* This wooden hull, side wheeler was built in 1838 and was "210 feet in length, by 24.6 beam and 13.5 depth of hold" (Brown 1938:392). This vessel was owned by the Maryland and Virginia Steamboat Company and did the Baltimore to Norfolk run (Brown 1938). Vessels of this period boasted speeds of up to 10 to 14 miles-per-hour (Brown 1938).

The Chesapeake Bay was home to some of the earliest steam powered vessels, and by 1813 steam service began between Baltimore, Frenchtown and Philadelphia (Labaree et al. 1998:256). The first steamboat operating on the Eastern Shore was owned by the Floyd family and ran from Townfields to the Hampton Roads area (Whitelaw 1968). Steam vessels were employed as transport ships that offered regular service from cities such as New York and Baltimore to Norfolk and New Orleans; "In the year 1838 Maryland had nineteen registered steamboats and Virginia, sixteen" (Brown 1938:391). The railroads and steamships worked in tandem to move produce, goods and people up and down the bay by the 1850s.

Different types of work vessels evolved with the advent of steam. The steam tug boat was used to move sailing vessels through canals and rivers out to sea (Labaree et al. 1998). These hulls were both wood and metal. They set low in the water and were designed with a low, rounded stern to accommodate lines off the aft deck.

Civil War (1861-1865)

Virginia's Eastern Shore had become a vital farming and maritime region on the eve of the Civil War. Water transportation was far more expedient than road travel during this period. Steamboats were making scheduled stops on both the bayside and seaside ports to take on cargoes of produce, seafood, and other goods. While steam had gained a significant foothold in shipping commercial goods, the local people still relied upon sail transport (Turman 1964). Sailing vessels and rigging had improved to the point that more speed could be gained with smaller crews. Sail propelled vessels could also be locally produced while steam was more costly and complicated. Fleets of sailing vessels under the ownership and direction of local people were trading as far as Cuba and northern cities.

Delegates from Accomack and Northampton Counties traveled to Richmond in February of 1861 for a convention considering a referendum that allowed people to determine whether to join the Confederacy or remain in the Union. The convention chose to allow the referendum and it was scheduled for May 23, 1861 (Turman 1964). Union ships blockaded the lower Chesapeake before the referendum could take place. Lighthouses were darkened by Confederate forces and ferry service was once again halted between the Shore and the mainland. The only lighthouse

that continued operation was the Assateague Light. Both counties, with the exception of the Chincoteague precinct, voted to join the Confederacy when the referendum took place.

The courts of both Accomack and Northampton Counties authorized funds for recruiting, arms, and ammunition after deciding to join the Confederate cause. This resulted in 800 men being organized into eight companies of infantry, two cavalry, and one light artillery. These men were later divided into three regiments, two from Accomack County and one from Northampton. This arrangement was a holdover from the War of 1812 (Turman 1964). Every capable man on the peninsula was already in the militia and was required to drill three times per year.

The Eastern Shore of Virginia was a prime location for smugglers due to the many miles of coastline and small inlets that made hiding a vessel from Union patrols a relatively simple task. Fake licenses to operate were being issued to Virginia boat owners that identified them as Maryland residents. These documents allowed them to fill up their small schooners and rowboats and take them down to the Eastern Shore to supply the Confederacy (Mills 1996). Supplies could also be smuggled from the North to Chincoteague on the ocean side, and then transported overland to waiting boats along the Bay (Mills 1996). The prevalence of smuggling led to a boat burning expedition led by the Union army. They ran from Fort Monroe up Back Creek and successfully captured or destroyed several vessels engaged in smuggling (Mills 1996).

Major General John Dix was put in command of the defense of Maryland to prevent goods and men from flowing through Maryland to the Confederacy and to intimidate rebel troops (Mills 1996). His major responsibilities including ensuring supplies did not flow into Accomack and Northampton Counties. To achieve this end he devised a plan to occupy the two Eastern Shore Counties.

Brigadier General Henry H. Lockwood was to head the occupying army. He received a report on Confederate activities in the region and requested an army large enough to convince them that resistance was unwise (Turman 1964). Dix sent a letter to the people of Virginia's Eastern Shore offering protection of private property if the people would not resist occupation. He also promised to restore trade with those counties and to restore the lights in the lighthouses (Mills 1996).

Confederate General Smith ordered his men and the militia to the northern part of Accomack County to mount a defense, but he had no choice but to retreat when he received the proclamation from Dix (Turman 1964). A total of 44 officers and 64 enlisted men were able to escape to the Western Shore by boat before the Union army completely occupied the Shore. Young men who were away in college also enlisted, and others ran the blockade to join the Confederate army (Turman 1964). A total of 197 men from Accomack County and 255 from Northampton County served in the Confederacy.

Several attempts were made to run the blockade during the Union occupation, so guards were placed at the mounts of 16 streams and landings including Cape Charles, Cherrystone Inlet, Hungars Creek, and Pungoteague Inlet. Strict orders were issued that no trade was to be permitted between locals and soldiers except under very strict regulations (Turman 1964). Penalty for violation of these orders was one month hard labor or one month's imprisonment with bread and water. Once occupied, the Eastern Shore was cut off both geographically and politically from the rest of Virginia. Smuggling and blockade running continued throughout the war, but it was not as flagrant or frequent as it was originally (Mills 1996).

Despite the fact that Virginia had seceded from the Union, there were those who lived on the Eastern Shore with no interest in the war. They were simply interested in selling their daily catch of oysters. Many on Chincoteague Island remained loyal to the Union and signed an oath of allegiance on October 15, 1862, which gained them Union protection and permission to sell their oysters as far north as New York and Philadelphia (Mills 1996).

The Eastern Shore had become an important link in communication between Washington D.C. and Fort Monroe in the Hampton Roads area. A telegraph line was quickly constructed through the Eastern Shore to Cherrystone Inlet and a cable was laid to Old Point. Troops could also be moved down the shore to reinforce Fort Monroe. Steamboat service was established by the army to more easily transport goods and soldiers (Turman 1964).

There were no new vessel types introduced on the Chesapeake during the Civil War, but local craft continued to be used, as well as steam powered vessels. Vessels employed during the period leading up to the Civil War continued in use. It was not uncommon for residents of the Eastern Shore to construct work vessels for their own use in blockade running or for everyday work. The oyster industry was disrupted during the war to such an extent that watermen found the freight and ferry business to be far more profitable than oystering (Wennersten 1978)

3.2.12 Reconstruction and Growth (1865-1914)

Virginia was designated a territory following the surrender at Appomattox in 1865, and was part of Military District Number 1 (Turman 1964). This included Accomack and Northampton Counties. A constitutional convention was held in 1867, and produced a constitution that was ratified by voters in 1869. Virginia was readmitted to the Union in 1870 (Turman 1964). After being under military rule for more than eight years, residents of the Eastern Shore were excited to have self government restored.

The Federal Government realized the need to establish lifesaving stations along the Shore in 1874. Congress created the Life Saving Service in 1871 but it took three years for stations to be authorized and funds appropriated for construction in Accomack and Northampton Counties (Turman 1964). Stations authorized in 1874 included Assateague Beach Station, Wachapreague Beach Station, Hog Island Station, Cobbs Island Station, and Smith Island Station. Four more stations were authorized in 1878 and 1882, including one on Wallops Island, which is visible in the 1892 Coast and Geodetic Survey Map (Figure 3-4, Turman 1964).

Prior to the authorization of life saving stations, volunteers stepped in whenever they found a ship in distress. The addition of formal life saving stations meant that trained men with the proper equipment were always on duty and ready to assist a vessel or sailor in distress. The stations were composed of two story frame houses constructed with rooms for lifeboats which were always ready for deployment, as well as living quarters for the men. Those serving at a station were on duty for one week with at least that much time off before the next shift (Turman 1964). The keeper of the station had the same status as a commissioned officer and was tasked with training and drilling the men and directing a rescue. The coastline from Delaware Bay to the Mouth of the Chesapeake Bay made up Life Saving District 6 (Turman 1964). This district was under command of Captain Benjamin Rich from 1875 until his death in 1901. While under his command more than 800 disasters involving 6300 people were addressed as well as $12 million in property of which more than $8 million was saved. During this 26 year period, only 45 lives were lost (Turman 1964).

The Eastern Shore and much of Virginia was forced to shift from a tobacco and slave based economy to one more diversified. This eastern coastal region of Virginia began to export produce, peanuts, fish, and oysters to the western part of the state and beyond (Surface 1907). Chincoteague Island and the Bay islands of the Chesapeake became known for oyster harvesting, tonging, dredging, and dragging. Chesapeake oysters were exported all over the world. Oysters were harvested in vessels including sloops, schooners, bugeyes and skipjacks, first via wind power, then steam.

In the late 19th century, truck farming—the cultivation of a few crops for shipment to localities in which such crops cannot be grown, became very important to the Eastern Shore of Virginia and Maryland (Gemmill 1926). Large farms producing a few main crops for sale to the open market, often at some distance from the farm, became the norm on the peninsula. This required seasonal labor and reliable transportation. The need for transportation was met by wagon, boat, and rail. Farmers brought their produce to local wholesale markets by wagon and boat, where it was then transported by rail to Baltimore, Philadelphia, and New York. Skipjacks and buyboats brought the produce from remote areas. Steam vessels would transport large loads of produce from areas without ready access to the railway. Remote areas were able to receive a wider range of goods due to new transportation routes.

A railroad line was initially proposed for the Eastern Shore of Virginia and Maryland as early as 1835 (US Senate 1937). It was considered again in 1855 when plans and maps were drawn but the project abandoned (Turman 1964). The oyster trade prompted the establishment of the first rail line on the Eastern Shore. "The railroad first touched the Eastern Shore seaside in 1876 when a line… laid southwestward of Snow Hill, Maryland reached its terminus just below the Maryland-Virginia boundary and next to the Chincoteague Bay oyster grounds at what became Franklin City" (Thomas, Barnes, and Szuba 2007). This area was not only famous for oysters but also for the outdoor sports of duck hunting and fishing. Advertisements highlighted the easy transportation to the Virginia Eastern Shore: "The upper portion of the peninsula can be reached daily by rail from Philadelphia, the terminus being Greenbackville, on the sea side opposite to Chincoteague Island, and distant from it about five miles. A steam ferryboat conveys passengers from the depot to the island" (Hallock 1877).

Ready access to the railroad, and the advent of refrigerated boxcars encouraged the growth of the seafood industry. It opened many new markets and increased the demand for Chesapeake Bay seafood. A rail line was established in 1884, serving the length of the peninsula (Turman 1964). The New York, Philadelphia and Norfolk Railroad, which also owned steamships, undertook the construction of the line, running north to connect with the existing rail line near the state boarder (General Assembly of Virginia 1884). This coincided with the construction of a harbor and wharf at Cape Charles that was deep and large enough to accommodate steamships (Turman 1964). "By 1889 more than one hundred vessels from 5 to 65 tons and about two hundred decked vessels of under five tons participated in the upper seaside oyster trade" (Thomas, Barnes, and Szuba 2007). These transportation advancements promoted both truck farming and the oyster trade as tomatoes, potatoes and oysters could be put on the train in the morning and served in a restaurant in Baltimore or New York that same evening.

There was a pleasure club on Wallops Island by 1891, complete with a steam powered pleasure boat for excursions (*Peninsula Enterprise*, May 16, 1891). Other sporting clubs soon opened as the news of the fine hunting and fishing spread; "There are three clubs located on the ocean side of Accomack, one on Wallops Beach, composed principally of Pennsylvanians; one on Revels

Island and one of Wachapreague" (Johnson 1899). This was all made possible by trains and motor powered boats operating in the region.

Many of the vessels used during this period were similar to those of the previous period, with developments and innovations most often focused on the oyster business. The Chesapeake Bay was known for producing regionalized vessels designed for the oyster harvest and to meet local needs. Many of these vessel types and the miniscule distinctions between them have been lost with the shipwrights who constructed them. The vessels which became prominent during this period included the flattie, the skipjack, the bugeye, and the buyboat.

The flattie was originally used to transport produce on the Virginia and Maryland tidewater streams, as well as for use in oystering, crabbing, and duck hunting (Chapelle 1951). These vessels likely first appeared prior to the Civil War, but were most prominent during the last portion of the 19th century and represent the smaller predecessor to the skipjack. They are characterized by a V-bottom with some deadrise aft. They ranged from 16 to 30 feet in length, and tended to be partially decked (Chapelle 1951). This vessel type was supposedly out of use by the 1890s, but Chapelle notes seeing a number on the Eastern Shore in 1940 (Chapelle 1951). This vessel is said to have been created to "produce a wide sharpie that would sail well" (Chapelle 1951:312). They were said to sail very well when properly canvassed and were commonly constructed by Eastern Shore mariners for their own use. Accomack County is said to have produced the greatest number of these vessels (Chapelle 1951).

The skipjack, which was a dead-rise skiff with a V-bottom, first appeared after 1860 but did not become popular until the 1880s (Chapelle 1951). The term skipjack is frequently associated with the rigging of the Chesapeake oyster boats rather than a specific hull form. The name is said to be after the bluefish that is known to "skip" across the surface of the Bay (Wennersten 1978). The characteristic rigging is a sprit sail and a jib, without the topsail which was characteristic of older, similar vessels (Chapelle 1951). Construction was done in a very plain, craftsman-like fashion. Skipjacks usually had one raking pole mast on the foredeck and an external rudder on a square transom. One author in 1880 comments that skipjacks are "very wide, with sharp rise of floor the full length of the bottom, jib-and-mainsail rigged, heavily canvassed, and with a reputation for being very fast and Weatherly (Chapelle 1951:306)." A very specialized type originated at Chincoteague Island with masts located fore and aft that could be operated single-handedly (Chapelle 1951:330).

The bugeye originated in the Chesapeake region in the second half of the 19th century when the demand for simple, inexpensive to construct oyster dredging vessels peaked. The bugeye persisted as a popular type until nearly 1920, and is noted as the preferred vessel for oyster dredging due to its simple operation and the ability to be operated by one man (Wennersten 1978). The bugeye was originally little more than an enlarged, decked log canoe with a fixed rig, but it gradually grew and was refined. Employed primarily in oyster dredging, this vessel has been described as a "flat-bottomed centerboard schooner of small size (3 to 15 tons) decked over and with a cabin aft" (Brewington 1964:35). These watercraft typically have two masts, one situated on the foredeck and one located aft of amidships with a leg-of-mutton foresail, a mainsail and jib with a single halyard and sheet (Brewington 1964:59). They tend to have a sharp bow with a stubby bowsprit. This vessel type ranged in size between three to fifteen tons, 30 to 80 feet in length, 10 to 23 feet in beam and 2.5 to 5.5 in draft. The average vessel measured 50 feet in length, 15 feet in beam with a 4 foot draft (Brewington 1966). Hull variations began appearing in the 1880s as a means of gaining deck space. These variations included round and

square sterned vessels as well as the "patent stern" which developed in 1908 as an outboard projection of the deck. They are characterized by flat bottoms and hard bilges (Chapelle 1935).

One of the more notable vessels used in oystering, specifically tonging, was a round bottomed boat that was formed from three dug out logs that were joined together. This vessel type was used through the end of the 19th century and was rigged with a jib and one or two sails, and had no deck. They tended to be approximately eight to 25 feet in length and are noted to be especially seaworthy (Wennersten 1978).

The buyboat is synonymous in the modern Chesapeake Bay. The term "buy-boat" originated from their utility. These vessels met oyster boats, purchased their catch and transferred it on the water from boat to boat. The buyboat, though engine powered, continued to possess a main mast and limited rigging needed for a boom crane. It was developed at the dawn of the 20th century with the advent of the gas motor (Chowning 2003). It represents the end of sail power and the beginning of motor vessel ascendancy. Even though steam powered vessels were in use before gas or diesel engines, early bay vessels were too small for the boiler assembly (Chowning 2003).

The traditional schooner, skipjack or bugeye hulls would be fitted with an engine during the early years of motor adaptation, but appearance of the vessel was largely unchanged (Chowning 2003:34). Some early buyboats were bugeyes or skipjacks with cut masts, the bow sprit removed, and a small cabin on deck for shelter. The buyboat hull was designed and built to utilize both sail and motor propulsion. Buyboats were versatile and purpose designed for watermen as they could use sail power to harvest oysters (in Maryland waters power harvesting was restricted for preservation purposes) and could be used under power for hauling and other types of fishing (Chowning 2003). They ranged in length from 40 to 100 feet, with a stub mast and boom forward of the hold, a pilothouse aft, and a decked hull (Chowning 2003:3). They have three main hull configurations: frame-built, log built, and deadrise or box-built (Chowning 2003:3). The buyboat was used to haul grain, coal, log wood, produce, people, and sometimes vehicles in a time before bridges and extensive roadways (Chowning 2003). They continue to be used to the present.

Two shipwrecks from this time period are known to have been lost within 13 mi (21 km) of the Wallops Island area. Both vessels were schooners. The first, the *Jennie N. Huddel*, was a 279 ton vessel built in 1870 that was stranded at Carters Shoal in Chincoteague in 1910. The second vessel was the *Lizzie Godfrey*, a 77 ton schooner stranded at Chincoteague Inlet in 1914. These two vessels represent the first craft identified to have been lost in the vicinity. While there were likely many vessels lost here in the preceding periods, these are the first for which documentation exists.

3.2.13 World War I to the Present (1915-Present)

World War I was officially declared in 1917, and the US Coast Guard was the only armed protection available on the Eastern Shore (Turman 1964). Beaches were closely patrolled to prevent landing of enemy spies and submarines. Watch was also kept at the Cape Charles Station for enemy ships and submarine periscopes. The Life Saving Service had been combined with the Revenue Cutter Service to form the US Coast Guard in 1915. It remained under the Treasury Department, but the men serving in the Coast Guard became naval reserve units for use in time of war. The Eastern Shore became part of the Fifth Coast Guard District. Stations were linked by telephone so that in the event of a large disaster men and resources could be drawn upon from multiple stations (Turman 1964).

World War I did not have a dramatic influence upon life on the Eastern Shore of Virginia, but the end of the war and the return of troops brought remarkable changes and prosperity. Automobile use had grown so much that it had to be regulated, jobs were plentiful, and a college education was attainable (Turman 1964). Every steamboat returning to the Eastern Shore brought new cars from Baltimore. Trains also brought them on flat cars (Turman 1964). Filling stations and garages had to be erected to accommodate the flood of new automobiles. Land prices were also spiraling upward as people invested in stocks, bonds, or loans to others to grow more Irish potatoes, a major cash crop. Approximately 53,267 acres of Irish potatoes were grown in 1920 with amounts increasing yearly.

Prompted by rapid growth, the Chincoteague Toll Road and Bridge Company was organized in 1919 (Turman 1964). The road and bridge was a lifelong dream of John B. Whealton. He surveyed the land from the south of Chincoteague Island to Wallops Neck before convincing Company directors that the bridge should run into the business section of town (Turman 1964). The land was resurveyed and permission was granted by the Federal Government for a drawbridge spanning the Chincoteague Channel. The Virginia General Assembly then granted permission to build

> "A road from A.F. Jester's dock, next to the Atlantic Hotel Dock, leading across Chincoteague Channel to the marsh and then across Black Narrows Channel and marsh, then in a southwestern direction across Wide Narrows to Queen Sound at the mouth of Shell Bay, then in a westerly direction to W.H. Hickman's Farm in Wallops Neck" (Turman 1964:226).

The road was opened on November 15, 1922 with nearly 4,000 visitors arriving on the island to witness the ribbon cutting and hear the Governor speak. The newly constructed earthen causeway was eroded by rain during the speech, and many travelers became stranded on the causeway to be rescued by small boats (Turman 1964). The following day the stranded cars were rescued by ferry and renovations of the road began. The causeway reopened by Christmas of the same year.

The 1920s continued to bring changes to Accomack and Northampton Counties, including new buildings, changes to the school system, troopers appointed for highway safety, and increased public involvement by women who had been granted the right to vote. Farmers, watermen, and professionals associated with these two industries also experienced renewed success during this period (Turman 1964).

The prosperity of the 1920s was evident in the local recreational facilities. Hotels were built and visited by sportsmen during both hunting and fishing seasons. Local people also enjoyed these facilities which included three country clubs, each with a nine hole golf course (Turman 1964). Many residents also owned pleasure boats that were often raced.

The railroad was also prospering, and the railroad companies invested in several new ferries, including *Virginia Lee*, which was touted as the finest steamboat running between Norfolk, Old Point, and Cape Charles (Turman 1964). This steamer was 300 feet long with an auto deck capacity of 80 cars. *Virginia Lee* and *Maryland* made three round trips per day between Cape Charles, Norfolk, and Old Point. While *Maryland* was capable of ferrying cars on an improvised automobile deck, fares were high enough on all steamers to encourage travel by train rather than private automobile (Turman 1964).

A ferry franchise was granted to the Peninsula Ferry Company in 1930. They began operating between the north side of Cape Charles and Pine Beach (Turman 1964). They ran a large open steamer with a 100 car capacity. The Peninsula Ferry Company was able to charge fares lower than the Pennsylvania Railroad Steamers, which contributed to their success. The Virginia Ferry Company, partially owned by the Pennsylvania Railroad, superseded the Peninsula Ferry Company in 1933 with *Delmarva*, a streamlined steamer designed to carry cars and trucks (Turman 1964). The ferry terminal was moved that same year to the Pennsylvania Railroad Terminal, while the southern terminal was at Little Creek, where the railroad had built tracks for box car barges (Turman 1964).

The stock market crashed in October 1929, but the real impact of the Depression did not peak until 1934 (Turman 1964). The price of Irish potatoes fell dramatically, which brought hardship to farmers, merchants, and professionals due to the prevalence of the potato as a cash crop. When the price of potatoes fell below the cost to produce them, Virginia's Eastern Shore felt the effects of the Great Depression in earnest.

Canning and gardening began to increase in an attempt to recover from the effects of the potato failure, and thrift and industry again returned. The WPA stepped in to assist in the recovery by developing roads, mosquito control, and water systems, and opening sewing rooms for women to produce linen curtains (Turman 1964). Flax was once again produced for linen.

Farmers were harvesting crops that did not include potatoes when World War II broke out in 1939. Soybeans and vegetables that could be canned were being grown, and many of them were shipped by truck to canneries and a newly opened quick-frozen food plant (Turman 1964). Farmers were growing tomatoes, potatoes, sweet potatoes, corn, peas, string beans, lima beans, turnip greens, broccoli, spinach, and strawberries both for personal use and for sale to the military (Turman 1964). The war also expanded the poultry industry that had begun in the 1930s, and 5,745,420 chickens were fattened in Accomack County in 1945 (Turman 1964). Many other veterans were seeking employment in shipyards and war material plants by 1940.

The war brought recovery to the region, but it also brought uncertainty. The return of the draft and quotas made the war more of a reality. The Federal Government acquired land at the mouth of the Chesapeake Bay in 1940 to construct Fort John Custis (Turman 1964). This represented the first visible sign of war on the Eastern Shore.

Coastlines were being very closely monitored by 1942, especially the Atlantic side of the peninsula. Small army posts had been established at the towns of Chincoteague and Accomack, and were responsible for patrolling the shores with trained dogs from dusk to dawn (Turman 1964). These patrols were designed to locate submarines and to prevent enemy landings. While the number of submarines sunk in the Atlantic by the Civil Air Patrol operating out of Accomack and Northampton counties is unknown, there were at least 10 American ships recorded as torpedoed by enemy submarines (Turman 1964). It was not unusual for those living near the coast to hear explosions or feel their homes shake when the Civil Air Patrol was working (Turman 1964).

The government purchased land on Wallops Neck for a naval air station in 1942 and subsequently constructed a landing strip and buildings for officers and members of the unit. The Chincoteague Naval Air Station was commissioned in March of 1943 (Turman 1964). This was soon followed by the opening of a base on Wallops Island under the command of Langley Field Research Center of the National Advisory Committee for Aeronautics. They surveyed the island

in 1945, which was then owned by a group of sportsmen using it for fishing and hunting, and a portion was owned by the U.S. Lifesaving Service (Figure 3-5, Turman 1964). A total of 80 acres at the south end of the island were purchased and 1000 acres leased. Construction of facilities for firing rockets started in May 1945 and the first test rocket was fired in June. The remaining portions of Wallops Island were purchased by the Federal Government in 1949 (Turman 1964).

The end of World War II brought another period of growth to Accomack and Northampton Counties. Crops were bringing in good prices and canneries were operating to full capacity (Turman 1964). Televisions, refrigerators, and new cars were popular post-war purchases.

The Virginia Ferry Company was taken over by the Chesapeake Bay Ferry Commission in 1954 by authorization of the General Assembly (Turman 1964). The fleet boasted five vessels, three of which would be enlarged, with two more joining the fleet. They began exploring the possibility of constructing a combination bridge and tunnel across the Bay not long after the Commission was formed. This would be completed in the 1960s.

The Chincoteague Naval Air Station closed in June 1959 and preliminary negotiations were underway to allow NASA to acquire the 1,000 acres of land west of Wallops Island (Turman 1964). It was ultimately decided that the NASA expansion would take place on the former Naval Air Station site. The administrative and technical support facilities on Wallops Island were moved to the mainland on July 1, 1959, which allowed NASA to occupy the location formerly used by the Langley Field Research Center (Turman 1964). NASA was now in control of Wallops Island, which was connected to the mainland by bridge in 1960.

The close of the 20th century and the beginning of the 21st century was marked by a period of declining numbers of farms, but the rise of large farms made it possible for fewer permanent workers (Turman 1964). The major crops included potatoes, both Irish and sweet, tomatoes, snap beans, strawberries, soybeans, and other assorted vegetables. The food packing and processing industry as well as the frozen food industry also became very profitable. The seafood industry remained important but was in decline. Clams, oysters, and crabs continued to be sold in large quantities, and a number of deep sea fishing fleets operate from Virginia's Eastern Shore (Turman 1964).

Lifeboat stations operate on the ocean islands including Smith, Cobb, Hog, Little Machipongo, Parramore, Metompkin, Assateague, and Popes Islands to provide protection for mariners. These stations are under the purview of the Fifth Coast Guard District. Each station continues to provide living quarters for men on duty as well as rescue equipment and boats. While employees live on the mainland and work in shifts, all personnel will be subject to duty around the clock in the event of a disaster (Turman 1964).

The 20th century is not characterized by any distinctive regional vessel types. The primary forms operating in the region were ferries, barges, fishing vessels, tugs, and pleasure craft. These vessel types were all associated with the various maritime activities of the region.

Numerous barges and ferries were operating in the Wallops Island region during the early 20th century. Barges were used as a means of transporting large objects along the coast. There are several reports of tug towed barges transporting cars or boxcars being lost in storms (Turman 1964). One 1906 newspaper remarked that, "there are some 100 barges, with 15 tugs to attend exclusively to bay towing" (Turman 1964: 237). Fishing boats were extremely prominent in this

area and remain so to the present. The Chesapeake Bay produced nearly nine times more tons of fish per square mile (2.6 square km) than did the fishing grounds of New England in the late 1920s (Labaree et al. 1998).

A 1912 report from the United States Army to Congress to assess the necessity of dredging the Chincoteague Inlet produced the following list of vessels registered in the area during this period (United States Secretary of War 1912).

600 small boats, not registered, value each $250	$150,000
300 gasoline boats, value each $700	$210,000
100 boats between 5 and 20 tons, value each $800	$80,000
18 vessels over 20 tons, value each $2,000	$36,000
500 barges, scows, etc., value each $40	$20,000
1 steamer (ferryboat)	$10,000
1 steamer (tugboat)	$3,000

These vessels provide a snapshot of the types and importance of the vessels operating in the Wallops Island vicinity during the early 20th century. The emphasis is on practical, working vessels.

The majority of the documented wrecks in within 21 kilometers (13 miles) of the Wallops Island area occurred during this period. The eight vessels lost include two schooners, one fishing trawler, one tug, three barges, and one of unknown type. This likely does not represent the full range of vessels lost in the vicinity, but does provide a cross section of the types of vessels operating in the area during the post World War I era.

3.2.14 Shipwreck Potential within the Project Area

There was a moderate potential to encounter shipwrecks in the project area. This determination was based upon evaluation of known shipwrecks in the area and upon archival research. The likelihood of encountering vessels from the Contact Period through the late 18th century is slight because relatively few vessels traversed the Wallops Island coastline during this time period. Vessels common to this period, which include sloops, bateau, punts, flats, and shallops, were also small coastal vessels that rarely ranged that far from shore. They were also lightly constructed and less likely to have survived to the present.

Potential for encountering vessels from the 1840s to the present increases over the previous periods because the relative prosperity of Virginia's Eastern Shore generated a sharp rise in seagoing merchant vessel traffic and a general increase in seaworthy vessel forms. The most common seagoing craft operating near the project area were schooners, steamboats, barges, and assorted regional watercraft such as larger skipjacks and bugeyes.

A total of 12 known ships were reported wrecked in the project area vicinity (Table 2-4), and all were lost during the 20th century. The loss of four schooners constructed during the last quarter of the 19th century, along with three turn of the century barges, are illustrative of the vessel classes expected offshore of Wallops Island. The preponderance of these two forms on the list suggests that schooner type vessels and barges were common sights along the Wallops coastline, and that they were susceptible to loss in sea conditions endemic to that stretch of the sea. The overall potential to encounter shipwrecks in the project area is moderate, and those that may have

been encountered would most likely date from 1840 to the present, and would represent schooners, barges, or other working vessels.

4.0 PROJECT LOCATION AND DESCRIPTION

The WFF is located on the Delmarva Peninsula in the northeastern portion of Accomack County, Virginia. The Delmarva Peninsula is bordered by the Atlantic Ocean to the east and the Chesapeake Bay to the west. The WFF is located approximately 8 kilometers (5 miles) west of Chincoteague Island. The WFF project area consists of three areas totaling approximately 2,428 hectares (6,000 acres): the Wallops Main Base (902.4 hectares [2,230 acres]); the Wallops Mainland (40.5 hectares [100 acres]); and Wallops Island (1699.7 hectares [4,200 acres]), which includes approximately 404.7 hectares (1,000 acres) of tidal marsh. The Main Base is located off Virginia Route 175 and approximately 3.2 kilometers (2 miles) east of U.S. Route 13 (NASA 2005). The entrance gate for the Wallops Mainland and Wallops Island is located approximately 11 kilometers (7 miles) south of the Main Base (NASA 2005). This section summarizes the topography, natural setting, and present land use of the project area. This summary will serve as an environmental context from which regional occupations can be interpreted.

4.1 PHYSICAL ENVIRONMENT

The project area lies "in the Tidewater region of the Embayed section of the Atlantic Coastal Plain" Physiographic Province (United States Department of Agriculture, Soil Conservation Service [USDA:SCS] 1994). Three major landforms are found in Accomack County: mainland, tidal marsh, and barrier island. All three are found in the WFF project area. The mainland includes low and high terraces separated by a discontinuous escarpment at 7.62 meters (25 feet) above mean sea level (amsl). Low terraces are found west of Route 13 (outside the project area) and on the extreme eastern edge of the mainland. The low terrace "consists of broad to narrow flats bordered by tidal marshes on the east and a discontinuous escarpment on the west" (USDA, SCS 1994). The high terrace ranges in elevation from 7.62 to 15.2 meters (25 to 50 ft) amsl. The high terrace topography is more complex than the low terrace, and "is generally characterized by broad, nearly level terraces that are broken by narrow elliptical ridges [Carolina Bay features], gentle escarpments, tidal creeks, and drainageways" (USDA, SCS 1994). Extensive tidal marshes are located between the mainland and barrier islands. The marshes flood regularly with the tides, are drained by an extensive system of meandering creeks, and have immature soils. Barrier islands are roughly parallel to the mainland and are generally less than 3 meters (10 feet) amsl. Topography varies from nearly level to steep, and soils are immature and vary widely from very poorly to excessively drained (USDA, SCS 1994).

The majority of the WFF Main Base is located on a high terrace landform (7.6 to 12.2 meters [25 to 40 feet] amsl) with the northern and eastern portions located on low terrace (0 to 7.6 meters [25 feet] amsl) and tidal marsh. The Wallops Mainland is primarily located on low terrace (0 to 7.6 meters [25 feet] amsl) and tidal marsh, and Wallops Island is a barrier island with extensive tidal marshes between the island and the Wallops Mainland.

The area is underlain by Quaternary Period (ca. two million years ago to present) sands, gravels, silts, and clays (United States Geological Survey [USGS] 1973). The surface geology of the project area varies somewhat according to landform. The Accomack Member of the Omar Formation is found on the mainland, and consists of sand, gravel, silt, clay, and peat deposits (USGS 1973). Tidal marsh areas are underlain by Joynes Neck Sand, a fine to coarse-grained

sand that coarsens downward to gravel and sand. Tidal marsh areas also include organic-rich silts and clays. The barrier islands contain beaches and dunes that are composed of fine to coarse-grained quartz sands that are poorly to well-sorted (USGS 1973).

Soils in Accomack County were formed from parent material consisting of transported sediments moved and deposited by marine and stream action (USDA, SCS 1994). Within the project area, soils mapped for the terraces include Bojac, Nimmo, Molena, and Polowana series. These soils are sands and sandy loams that vary from fine to coarse in texture. Soils mapped for the tidal marshes within the project area include Chincoteague and Magotha series. Chincoteague soils are gleyed silt loams. Magotha soils are also gleyed silt loams, but are located in higher elevations within the marshes and have a mature soil profile. These areas were former uplands before they were transformed to tidal marsh by rising sea levels. Soils mapped for the barrier island in the project area (i.e., Wallops Island) include beaches, the Camocca series, and the Fisherman-Assateague complex. Beaches are unconsolidated sands with no soil development. The Camocca series and Fisherman-Assateague complex soils formed from sandy sediments and are immature soils as indicated by the absence of surface pedogenic horizons (i.e., there is no A Horizon overlying parent materials).

The lack of soil development on Wallops Island reflects the dynamic environment typical of barrier islands. On the Delmarva Peninsula, barrier island shorelines are constantly migrating inland. As the Atlantic Ocean-side is eroding, sand is deposited behind the active dunes on the landward-side of the island. This process leads to erosion of the former land surface on the Atlantic Ocean side of the island and burial of the former land surface by dune migration on the landward side of the island (Fehr et al. 1988). On Wallops Island, these soil disturbing processes have been slowed through recent human intervention (e.g., emplacement of seawall and facility construction on the island). In addition to the dynamics of barrier island formation, sea level rise during the Holocene has led to inundation of formerly dry land surfaces and extensive development of tidal marshes between the barrier islands and the mainland. The northern end of the island has been building towards Chincoteague Island over the past one hundred years. In addition, at the southern end of the island, Assawoman Inlet, which separates Assawoman Island from Wallops Island, was filled in 1986 due to a storm (NASA 2005). The inlet was temporarily reopened in 1987, but has since filled in again. These changes reflect the dynamic nature of barrier island environments. The Wallops Main Base and Mainland have been protected from tidal erosion due to the presence of the barrier islands and tidal marshes, and are not subject to the same dynamic forces that affect barrier islands.

4.2 NATURAL ENVIRONMENT

Vegetation for the area varies with landform association. On the Wallops Main Base and Wallops Mainland (mainland landform) areas include loblolly pine, black cherry, red maple, black willow, sassafras, and wax myrtle (NASA 2005). Wallops Island (barrier island landform) vegetation includes seabeach orach, common saltwort, sea rocket, American beachgrass, seaside goldenrod, northern bayberry, wax myrtle, groundsel-tree, phragmites, poison ivy, greenbriar, loblolly pine, cherry, and duckweed (NASA 2005). The tidal marsh areas between Wallops Island and the mainland are dominated by saltmarsh cordgrass and salt meadow cordgrass

(NASA 2005). Areas of marsh are also located along Mosquito Creek on the northern fringe of the Main Base area (NASA 2005). Areas of lawn are maintained in all three areas of the WFF.

Both terrestrial and aquatic faunal species are found throughout the WFF (NASA 2005). Invertebrate species include a variety of insects, snails, and crabs. In addition, sand shrimp, moon jelly, and squid are found. Fish species include sandshark, smooth dogfish, smooth butterfly ray, bluefish, pipefish, spot, croaker, sea trout, and flounder. Amphibian and reptile species include Fowler's toad, green tree frog, black rat snake, hognose snake, box turtle, and northern fence lizard. Several species of sea turtle and whales are also found in the waters of the area. Bird species include several species of sparrows and gulls, red-winged blackbird, boat-tailed grackle, fish crow, gray catbird, mourning dove, swallows, mockingbirds, robins, and starlings. Migratory birds include numerous species of ducks, geese, shorebirds, and songbirds. Predatory birds (raptors) include the osprey, bald eagle, and peregrine falcon. Mammalian species include white-tailed deer, raccoon, red fox, white-footed mouse, meadow vole, opossum, gray squirrels, and cottontail rabbit (NASA 2005).

4.3 PRESENT LAND USE

The Wallops Main Base was developed as a flight training center by the U.S. Navy in the 1940s (NASA 2002). NASA acquired the property in 1959, as well as the Mainland property, and continues to operate the runways. The Main Base also houses research facilities, operations centers, and permanent orbital and suborbital tracking centers. The Mainland provides access to Wallops Island (via a causeway across the tidal marshes), and contains Doppler radar and tracking facilities. The National Advisory Committee for Aeronautics (NACA) authorized the Langley Research Center in 1945 to proceed with development of Wallops Island as a site for rocket propelled models. This was an essential step in the nation's efforts to conduct aerodynamic research at high speeds, leading to advances in aeronautics and space science. NASA acquired the property in 1958 and continues to operate its runways. Launch sites are still located on the island, and are actively used today (NASA 2002). In addition to current use by NASA, through cooperative agreements the WFF is also used by the U.S. Navy, Virginia Commercial Space Flight Center, National Oceanic and Atmospheric Administration (NOAA), and the U.S. Coast Guard.

The majority of the WFF has been subject to continuous change and development since its founding in the 1940s. Changes to the property include frequent construction, upgrade, and removal of structures and facilities caused by technological developments and advances in rocket science and related fields. Few undeveloped areas remain on the WFF, and those areas are located along the fringes of the property, and for the most part, in the tidal marshes (though dredging activities have occurred in some areas adjacent to the Main Base and Mainland). Wooded areas are located in the southern and northern portions of the Main Base, as well as the northern portions of Wallops Island.

5.0 RESEARCH DESIGN

5.1 OBJECTIVES

The objectives of the four archaeological tasks conducted at WFF were to locate and identify potentially significant cultural resources, as shell middens or other prehistoric sites, shipwrecks, or historic maritime sites or structures. These objectives will be met by a series of archaeological tasks, including a remote sensing of the proposed breakwater location, a scientific diving survey of the proposed beach groin location, a pedestrian survey of the Wallops Island shoreline, and the archaeological monitoring of geotextile tube installation on the same shoreline.

The project area is composed of three separate survey parcels, which includes the proposed beach groin location, the proposed breakwater location, and the entire Wallops Island coastline contained within the bounds of WFF (Figure 1-2). The APE for the Wallops Island shoreline is 3.85 mi (6.2 km), or approximately 69 acres, of coastal beach in Accomack County, on Virginia's Eastern Shore. The pedestrian survey was undertaken from the waterline to the beach edge within this portion of WFF. Archaeological monitoring of the 4,600 ft (1,402 m) of shoreline that received geotextile tubes occurred within this study area, beginning at the southern terminus of the seawall and extending to the camera station at the southern end of NASA Property. The APE of the proposed beach groin is located in the Atlantic Ocean, directly opposite of the camera station at the southern end of NASA property. It measures approximately 500-ft long (152.4-m) by 100-ft wide (30.5-m), or 1.1 acres. The APE of the proposed breakwater is intended to address any ancillary impacts such as anchoring, or jack-up barges, and is located on the seaward edge of the proposed beach groin, and extends 400 ft (121.9 m) to either side of the groin. It measures approximately 1,200 ft long (365.9 m) by 800 ft wide (243.9 m), or 22 acres.

5.2 METHODS

5.2.1 Background Research

The purpose of background research is to develop cultural contexts for identifying and evaluating archaeological sites that may be encountered within the project area. Research was conducted at the National Archives in Washington, D.C. and at various online repositories. Reports of previous cultural resources investigations and previously recorded architectural and archaeological sites as well as known shipwrecks were obtained from the Virginia Department of Historic Resources. Historic maps and accounts of the development of Wallops Island were obtained from the National Archives and through books and periodicals.

5.2.2 Pedestrian Survey Methods

The area covered during the shoreline pedestrian survey spans 6.2 kilometers (3.85 miles) of Wallops Island shoreline, or approximately 27.9 hectares (69 acres Figure 5-1). The topography of the parcel was that of a flat barrier island beach and dune face that varied in width from approximately 91 meters (250 feet) to nothing at areas along the bare rock seawall. The beach in the central portion of the surveyed coastline (approximately 56.1 percent of the project area) was

completely eroded to rock seawall (Plate 5-1) during recent storm events, and no systematic survey was possible in this area. Beaches to the northeast and southwest of this rock seawall (Plates 5-2 and 5-3) were the focus of the pedestrian survey.

Due to the flat topography and constantly shifting sediments of the Wallops Island beach, the northeast and southwest extremities of the survey area were subjected to a systematic pedestrian survey, in which three archaeologists traversed transects that extended along the existing beach from the surf line to the fringe of the marsh or seawall at 20 meter (65 feet) intervals. The position of any significant cultural resource discovered during the survey was to be plotted via a Global Positioning System (GPS) unit and photographed.

Previous research conducted on Wallops Island during the *Cultural Resource Assessment of Wallops Flight Facility*, which was completed by URS in 2003, indicated that three potentially significant cultural resources may exist on the northern half of the island, including the remnants of a U.S. Coast Guard Station established in 1883, a small civilian occupation that dated to the first half of the 20th century along the southern beach remnant, and prehistoric shell middens. Archaeologists targeted these areas, along with recent flotsam that may have been washed to the beach from previously buried shipwrecks located near the shoreline of Wallops Island.

5.2.3 Archaeological Monitoring Methods

Monitoring took place on a 1,402 meter (4,600 foot) stretch of shoreline where Geotextile tubes are to be installed, beginning at the southern terminus of the seawall, and extending to the camera station at the southern end of NASA property (Figure 5-2). Geotextile tubes are durable textile cylinders that are 4.3 meters (14 feet) wide, 1.7 meters (5.5 feet) high, and have a 10.4 meter (34 foot) circumference. These are filled with sand and serve as a temporary bulwark to further impede beach erosion. Ground disturbances associated with this action included the preparation of the project corridor and the excavation of two sand slurry pits to facilitate tube filling. Approximately 304.8 meters (1,000 feet) of the northern portion of the Geotextile tube corridor were graded. The monitor was responsible for the review and photo-documentation of these actions, and also ensured that historic properties were not damaged or destroyed.

5.2.4 Scientific Diver Survey Methods

Field examination of the proposed groin site was undertaken as a controlled scientific diver survey. The proposed beach groin survey area was located in the Atlantic Ocean, directly opposite of the camera station at the southern end of NASA property (Figure 5-3, Plate 5-4). It measured approximately 152.4 meters (500 feet) by 30.5 meters (100 feet), or 0.4 hectares (1.1 acres). This parcel was divided into 11 transects spaced at 3.1 meter (10 foot) intervals, which yielded 1676.8 linear meters (5,500 linear ft) or 1.676 linear kilometers (0.96 linear survey mi). Water depth ranged between 0.3 and 3 meters (1 and 10 feet) in this survey area. Divers established underwater transects spaced at 3 meters (10 feet) and running the length of the proposed groin, and will used an underwater metal detector to identify potentially significant cultural resources. The exact position and nature of the encountered metallic materials were noted based on the diver's position along a fixed baseline. Divers also visually inspected the sediments to insure that no prehistoric materials are in the proposed project area. The dive team consisted of three scientific divers working

in tandem, a communications operator, and a dive supervisor. The safety divers and dive supervisor used a small inflatable boat (Zodiac) when dive operations were more than 76.2 meters (250 feet) away from the beach, or when water depths required a support vessel. The expected water depths within the survey area ranged between 0.3 and 3.7 meters (1 and 12 feet) in depth.

5.2.4.1 Dive Team Role Definitions

The URS scientific dive team consisted of five archaeologists, all of whom are certified divers trained in nautical archeology. There were three defined roles within the URS scientific dive team for the field examination of proposed groin site at Wallops Island; these roles were Dive Supervisor, Communications Operator, and Scientific Diver. These roles are described below. No safety divers were employed during this survey because three trained scientific divers were working in close proximity to one another at the same time.

Scientific Diver

The role of the scientific diver on this project was designed around three main tasks. The first task was to set up the survey area using marker buoys, anchors, and measuring tapes. The second task was to swim established survey transects while visually inspecting sediments for cultural resources, sweep the transect area with a survey grade underwater metal detector, and identify any potential targets. The third task was to establish new transects after the previous transect had been surveyed. There were three scientific divers operating in tandem to accomplish these tasks.

Communications Operator

The role of Communications Operator (CO) was designed to serve as the nerve center for each planned dive. The DSC was responsible for communicating with the Scientific Diver, for relaying and recording archaeological data, and for logging all dive related information on the Dive Log Form (DLF). Data recorded on the DLF by the CO includes diver name, dive time, the date, general dive objectives, and the current weather and water conditions. The dive records created by the DSC were curated as project data. The communications operator was stationed on a small inflatable survey boat (zodiac) positioned on the seaward edge of the survey area.

Dive Supervisor/Primary Archaeologist

The Dive Supervisor/Primary Archaeologist (DSA) was responsible for orchestrating the field survey in a safe, systematic manner. The supervisor continually monitored sea and general weather conditions, and will decided if operations can proceed based on these factors. The DSA was also responsible for ensuring that the survey was conducted in a systematic manner, ensuring that the entire survey area has been adequately surveyed for cultural resources. The final role of the DSA was to guarantee that the dive efforts conducted at Wallops Island conform to the Health and Safety Plan (HASP) designed for this project. The HASP was be reviewed and approved by certified Industrial Hygienists and the URS Dive Safety Control Board. The DSA

was stationed on a small inflatable survey boat (Zodiac) positioned on the seaward edge of the survey area. He also served as the vessel operator.

5.2.4.2 Survey Area Setup

The survey area for the proposed beach groin extension extended perpendicular to the Wallops Island shoreline at the location of the current groin remnant. The rectangular parcel measured 30.5 meters (100 feet) wide and extended 152.4 meters (500 feet) into the Atlantic Ocean. The survey area was delineated on shore with a 30.5 meter (100 foot) measuring tape, the extremities of which (corners of the survey area) were clearly marked with red flags. The seaward extreme of the survey area was delineated by two large red buoys firmly fixed with anchors. The positioning of these buoys was established with a survey grade ranging device set up on the shoreline. Special care was taken to ensure that there was not excessive scope in the buoy line, thus ensuring that the buoys accurately represented the limits on the survey area. Two additional lines of five red buoys were placed at 30.5 meter (100 foot) increments between the shoreline flags and the seaward most buoys. These floats served as control points that effectively divided the survey area into five smaller 30.5 meter (100 foot) by 30.5 meter (100 foot) survey blocks. The positioning of these floats was also established with a survey grade ranging device set up on the shoreline. Survey tapes that measure 30.5 meter (100 foot) in length were aligned on the bottom between each 30.5 meter (100 foot) buoy pair to serve as a set of underwater control points. They were fixed to the sea bottom using carabineers and 0.6 meter (two foot) lengths of iron rebar.

5.2.4.3 Survey Design

The scientific diver survey of the proposed beach groin extension was designed to employ three scientific divers working in concert. Each diver was equipped with underwater communications that allow contact with the communications operator at the surface and with each other. The overall survey area was evaluated in smaller 30.5 meter (100 foot) by 30.5 meter (100 foot) survey blocks that were delineated with surface buoy markers and underwater measuring tapes. Each block was denoted as Block A through Block E. Transects within the blocks were spaced every 3 meters (10 feet) and were assigned the letter designation of the corresponding block along with a number designation beginning at 1 and continuing to 11.

There were two tasks required of the three scientific divers assigned to this survey. Two divers aligned and fixed a 30.5 meter (100 foot) transect tape between underwater control tapes at 3 meter (10 foot) increments, beginning at 0 ft and extending to 30.5 meters (100 feet). The third diver swam along this transect tape investigating the bottom for cultural resources and fanning five feet to either side of the transect tape with an underwater metal detector to identify any metal objects located beneath the sediments. The location of any finds were derived from its position along the transect tape and the perpendicular distance to the left or right of the transect tapes as measured by a 1.8 meter (6 foot) folding rule. These coordinates were reported to the communications operator, along with an identification of the anomaly or surface find. These data also were recorded by the diver on an underwater dive slate. A map of underwater debris and cultural resources was created with these data. Potentially significant cultural resources were assigned a Resource Number and were identified with secondary floats marked with the corresponding number. The control divers moved the transect tape 3 meters (10 feet) further down the control tapes after the transect procedure had been completed.

There were eleven 30.5 meter (100 foot) long transects surveyed in this manner per survey block, and a total of fifty- five (55) 30.5 meter (100 foot) transects for the entire survey area.

5.2.4.4 Dive Equipment Summary

Each diver was equipped with an OTC full face mask with an integrated underwater acoustic communications system. The primary stage array contained a buoyancy compensator (BC) whip, mask whip, drysuit whip, and an integrated depth/compass and air gauge console. The diver was also outfitted in a standard BC, wetsuit or drysuit, fins, dive knife and weight belt. Portions of the survey were snorkeled with standard snorkeling gear as depth and visibility permit.

5.2.5 Remote Sensing Methods

The proposed breakwater location was subject to an extensive cultural resources remote sensing survey. The survey area was located on the seaward edge of the proposed beach groin site, and extends 121.9 meters (400 feet) to either side of the groin (Figure 5-4). It measured approximately 365.9 meters (1,200 feet) long by 243.9 meters (800 feet) wide, or 22 acres. This parcel was divided into 17 transects spaced at 15.2 meters (50 foot) intervals, which yielded 4,390.2 linear meters (14,400 linear feet) or 4.39 linear survey kilometers (2.72 linear survey miles). Water depth ranges between 0.3 and 6.1 meters (10 and 20 feet). This survey was designed to identify magnetic and acoustic anomalies that may represent significant submerged cultural resources, including submerged watercraft and buried archaeological sites. A well designed survey conducted with sensitive, high resolution sensors can detect submerged habitation sites and shipwreck debris, and can reliably differentiate these finds from the earth's ambient magnetic field and natural bottom topography.

A carefully defined set of criteria were used to distinguish naturally occurring magnetic and acoustic anomalies from significant cultural resources. Magnetic anomalies were evaluated based on data points that include anomaly duration (both time and distance), magnetic amplitude in nanoTesla (nT), and magnetic signature. Magnetic signatures were denoted as dipoles (D), monopoles (±M) or multi-components (MC) (Figure 5-5). Positive and negative monopoles refer to one half of a dipolar perturbation, and usually indicate an isolated magnetic source located some distance from the sensor. Monopoles produce either a positive or negative deflection from the ambient magnetic field. The polar signature depends on whether the positive or negative pole of the object is oriented toward the magnetometer sensor. Dipolar signatures display both a rise and a fall from the ambient field, and they are generally associated with single source anomalies located directly under the magnetic sensor. Multi-component magnetic perturbations represent several, randomly scattered ferrous objects with different magnetic orientations. Anomalies with these signatures are likely associated with man-made objects, possibly shipwrecks. The last two criteria are the location of the anomaly center, and the distribution and patterning of anomalies within the survey area.

Side scan sonar data were used to image the sea floor, to locate and identify culturally significant materials, and to map the geomorphic and bathymetric anomalies within each survey area. A sub

bottom profiler was used to detect buried structures or geomorphic features, such as buried relict channels, shell middens, shipwrecks, or buried cables and pipelines.

Data acquired from these instruments were first evaluated separately, and then as an integrated data set. Potential cultural targets are often comprised of related magnetic and acoustic anomaly groups. Targets are identified as significant if the various anomaly groups reflect parameters established for shipwrecks and other significant cultural features.

The survey array used for the WFF Beach Replenishment survey consisted of the following: a Differential Global Positioning System (DGPS), a cesium vapor marine magnetometer, side scan sonar, a continuous transmission FM chirp sub bottom profiler and an echo sounder (Plates 5-5 and 5-6). Hydrographic and navigational controls were achieved by the use of Hypack's survey software.

5.2.5.1 Positioning

A Hemisphere Crescent R130 DGPS with inertial navigation corrections (for up to 45 minutes after loss of signal) was used for this survey. The Hemisphere system transmits information in NMEA 0183 code to a computer navigation system using the *Hypack 2009a* survey software. The *Hypack* software incorporates the NMEA 0183 data string and displays vessel position on a computer screen relative to pre-programmed track lines and each instrument sensor. It also performs instantaneous data translations between various geodetic projections, which combine all incoming data with accurate positions for seamless data integration and post acquisition processing. Navigation files within *Hypack 2009a* can be utilized to produce track line maps and derive X, Y, and Z data sets for analysis and contour plotting. Positioning control points were obtained every 100 ft (30.5 m) along survey transects. The Hemisphere Crescent 130 DGPS is considered to be accurate to within 8 inches Root Mean Square (RMS) values under optimal conditions.

5.2.5.2 Magnetometer

A Geometrics G882 marine magnetometer was used for the magnetic survey. The G882 magnetometer is a 0.01 nT (RMS) sensitivity cesium magnetometer that is linked to *Hypack 2009a,* which enables precise, real-time positions for recorded magnetic data. Survey was terminated if induced magnetic background noise exceeded +/-3 nanoTesla (nT). The magnetometer sensor was towed a sufficient distance from the transom of the survey vessel to avoid magnetic interference from the propulsion and electrical systems.

5.2.5.3 Side Scan Sonar

A MarineSonic 600 kHz side scan sonar system was used to collect acoustic data for this survey. The 600 kHz system produces high resolution images with moderate ranges of a few hundred feet. Navigation fixes are imbedded with the acoustic data in real time, which allows images to be geo-referenced and side scan mosaics created for analysis.

5.2.5.4 Sub Bottom Profiler

A Benthos Chirp III sub bottom profiler was used to record sediment structure and any cultural material deposited beneath sediments. The Benthos system uses a continuously transmitted acoustic pulse that begins at 2 kHz and continues to a maximum of 20 kHz. This swept frequency can image sediment structure with up to 2 cm (0.78 in) resolution. The DGPS system feeds positioning data to the sub bottom profiler receiver and is used to control recording speed and data point position.

5.2.5.5 Echo Sounder

An ODEM Hydrotrac digital echo sounder was used to record bathymetric data for each survey transects. *Hypack 2009a* recorded the position and bottom depth every tenth of a second and corrected for transducer layback and offset values. The bathymetric data is used to better understand the geomorphology of the survey area and how that affects the distribution of magnetic and acoustic anomalies, as well as to delineate any features sitting above the sediment surface.

5.2.5.6 Data Collection and Position Control

Hypack 2009a survey software was used for survey planning and data collection. Once the survey was designed and track lines planned, *Hypack* survey module was used to establish survey control and data collection and correction. While surveying, the planned transects were projected onto the navigation screen and the data being collected, which permits “real time” quality control and field data logging of anomalous data.

All remote sensing data were correlated with DGPS positioning data and time through *Hypack 2009a*. Positions for all data were then adjusted for sensor layback and offsets. Positioning was recorded using Virginia State Plane South, US Survey foot, referencing the North American Datum of 1983 (NAD-83), and U.S. survey feet were the units of measure.

5.2.6 Marine Data Analysis

Magnetic and acoustic data were reviewed for anomalies during data collection, and that data were reviewed again during post-processing using *Hypack* data review module, Chesapeake Technology’s *SonarWiz.Map* 4.04, and Golden Software’s *Surfer* (Version 8). These computer programs were used to assess the duration, amplitude, and complexity of individual magnetic disturbances, and to review side scan sonar (SSS) and sub bottom profiler (SBP) data for anomalies. The software was also used to plot anomaly positions within the project area to better understand their spatial distribution and association with other anomalies.

Nautical archeologists maintained field notes on the locations of modern sources of ferrous material, such as pipeline and cables corridors as well as fishing grounds and charted shipwrecks that would have altered regional magnetic field readings. Magnetic perturbation of 3 nT or greater with durations greater than 10 ft (3 m), were cataloged for further analysis. Acoustic imaging was reviewed for anomalous returns that could be associated with significant submerged

cultural resources. SBP data were reviewed for buried shipwrecks, submerged prehistoric features and relict landforms that have potential to contain intact prehistoric deposits. All data sets were cross-checked for relevant correlations. Anomalies in clear association were identified as targets and underwent further analysis. The presence of known shipwrecks in the vicinity of Blackfish Bank suggests that the area has a moderate potential for containing shipwrecks and other maritime cultural resources.

5.3 EXPECTED RESULTS

Research and analysis presented in Sections Two and Three suggest that there was a moderate probability to encounter significant cultural resources within the survey areas. Evidence of historic and prehistoric activity along the Wallops Island shoreline might be encountered during the pedestrian survey of the coastline and the monitoring of geotextile tube installation. It was anticipated that archaeologists might encounter remains associated with the early Coast Guard Station of 1883, the civilian hunting activities of the early 20th century, or shell middens associated with prehistoric occupations. It was also anticipated that the results of the diving survey of the proposed beach groin and remote sensing survey of the proposed breakwater location would represent recent construction and dumping activities from the 1950-1960's associated with WFF shoreline protection projects.

6.0 RESULTS OF CULTURAL RESOURCES INVESTIGATIONS

Cultural resources tasks associated with SRIPP were undertaken to assist WFF with compliance under Section 106 of the National Historic Preservation Act of 1966, as amended; the Abandoned Shipwreck Act of 1987; and the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et seq.) of 1970. These efforts included the pedestrian survey of the Wallops shoreline, and scientific diving survey of a proposed groin location, the remote sensing survey of a proposed breakwater location, and the archaeological monitoring of Geotextile tube installation. A detailed review of the results of each effort in provided below.

6.1 RESULTS OF THE PEDESTRIAN SURVEY OF THE WALLOPS SHORELINE

A total of 6.2 km (3.85 mi) of beach line was traversed during the Wallops Island shoreline cultural resources survey on September 18, 2006. No significant cultural resources were identified during this evaluation. The north and south beaches were littered with modern materials thrown to shore during recent storm events. These materials included wooden pallets, portions of wooden decks, and fishing nets (Plate 6-1).

There was no evidence of the three potentially significant cultural resources that may have existed on the northern half of the island. These resources include remnants of a U.S. Coast Guard Station established in 1883, a small civilian occupation that dated to the first half of the 20th century along the southern beach remnant, and prehistoric shell middens. The southern portion of the beach contained evidence of structures at the surf line and in the sea itself, including caisson foundation posts (Plate 6-2) and pier remnants (Plate 6-3). Although these structural features relate to the previously discussed civilian occupation of Wallops Island, they were previously noted in the *Cultural Resource Assessment of Wallops Flight Facility* completed by URS in 2003 and will not be discussed further (Meyers 2003). None of the identified features appears to be eligible for listing in the National Register of Historic Places.

6.2 RESULTS OF CULTURAL RESOURCES MONITORING OF GEOTEXTILE TUBE INSTALLATION

A URS Senior Archaeologist inspected the Geotextile tube installation work on behalf of WFF on January 22, 2007. The APE for the cultural resource monitoring effort consisted of 4,600 ft (1,402 m) of shoreline that received geotextile tubes which began at the southern terminus of the seawall and extended to the camera station at the southern end of NASA property.

Ground disturbances during this action include the preparation of the 4,600 ft (1,402 m) corridor for the placement of Geotextile tube and the excavation of two sand slurry pits to facilitate filling. Approximately 1,000 ft (304.8 m) of the northern portion of the Geotextile tube corridor was also machine graded during monitoring. Machine grading was less than one ft in depth and did not extend below sand deposited by recent storm events (Plates 6-4). No artifacts or cultural features were observed during the grading effort.

Excavation of the northern sand slurry pit was not monitored because Geotextile tube filling was in progress, but fill material from this pit was inspected. No cultural materials were noted during the inspection of the backdirt surrounding the pit. Soils from this excavation were comprised of a dark yellowish brown loamy sand A-horizon, mixed with an equal amount of pale brown sands with seashell fragment inclusions (Plate 6-5). This sand deposit was consistent with natural, unconsolidated beach sediments. No cultural materials were noted in this area.

Review of the soil profile from the 1.8 meters (6 feet) deep southern sand slurry pit, which measured approximately 12.2 meters (40 feet) by 3.9 meters (13 feet), revealed extensive soil disturbance. A soil anomaly and associated lumber and trash deposit were visible in the southwestern pit wall (Plate 6-6). Several fragments of machine milled lumber were also seen in the nearby backdirt pile. Closer examination of the pit profile and backdirt revealed that the majority of trash consisted of modern aluminum and plastic soft drink containers, plastic electrical fittings and rubber cable sheathing. Personnel on site mentioned that the general area was recently used as a construction site for an asphalt pad used to support an electrical panel. The pad and electrical panel are still present to the south of the southern sand slurry pit. Reconnaissance of the general area revealed a wide scatter of similar material on the surface. None of the materials encountered in or near the southern slurry pit constitute a significant cultural resource.

Ground disturbances from Geotextile tube installation did not impact any significant cultural resources. WFF therefore concluded that no historic or prehistoric resources were affected by the emergency installation of these cylinders on the beachfront. VDHR concurred with this finding in a response letter dated January 27, 2007 (Appendix C).

6.3 RESULTS OF ARCHAEOLOGICAL DIVER SURVEY ON THE PROPOSED BEACH GROIN LOCATION

The proposed beach groin survey area is located in the Atlantic Ocean, directly opposite of the camera station at the southern end of NASA property. It measures approximately 152.4 meters (500 feet) long by 30.5 meters (100 feet) wide, or 1.1 acres. This parcel was divided into 11 transects spaced at 3.1 meters (10 foot) intervals, which yields 1,676.8 linear meters (5,500 feet) or 1.7 linear survey kilometers (0.96 miles). Water depth ranges between 0.3 and 3 meters (1 and 10 feet).

The archaeological survey of the proposed groin location was designed as a systematic scientific diving investigation. This investigation survey was intended to cover the footprint of the original groin structure and the proposed location of a rock jetty. Cursory visual inspection of the study area revealed that the proposed groin site was filled with concrete rubble and other construction waste (Plate 6-7). This waste may have been dumped and along the shoreline as a temporary repair to the old wooden groin. This rubble is intermixed with concrete pipe fragments and brick, all of which contain exposed iron rebar and re-wire (Plate 6-8). The corroded extremities of this rebar and re-wire represent a serious impalement and laceration hazard to divers operating in the near zero visibility water of the turbulent swash zone.

The survey plan for the proposed groin location was altered from a scientific diver survey to a systematic wading survey due to safety hazards inherent to that locale. Archeologists began carefully traversing transects at the proposed groin location at low tide, and inspected the sea bottom in the troughs of waves. Each transect was traversed to a depth of 1.4 to 1.5 meters (4.5 to 5 feet), which was the depth that could be safely reached in very low visibility water and a high surge. No significant cultural materials were identified during this portion of the proposed beach groin survey.

The final 60.9 meters (200 feet) of the 152.4 meters (500 foot) long survey area was not traversed due to the afore- mentioned safety concerns, and because this 60.9 meter (200 foot) by 30.5 meter (100 foot) section has the very low potential to contain significant historic resources. This assessment is based on the general ground disturbance that has occurred at this site. These disturbances include the construction of the original groin, and the disposal of concrete construction waste throughout the area, and the substantial erosion and sediment transport that has removed a large portion of the Wallops shoreline.

6.4 RESULTS OF CULTURAL RESOURCES REMOTE SENSING SURVEY OF A PROPOSED BREAKWATER LOCATION

Magnetic and acoustic (side scan sonar, sub bottom profiler and echo sounder) data detected during the survey were reviewed during data collection for anomalies, and reviewed a second time during post-processing efforts using the *Hypack* (version 2009a) data review module and Golden Software's *Surfer*® (Version 8). These software programs were used to assess the duration, amplitude, and complexity of individual magnetic disturbances, and to plot the positions of these anomalies within the survey areas to better understand spatial patterning and their association with acoustic and bathymetric anomalies.

Archeologists maintained field notes on the locations of modern sources of ferrous material such as underwater cables, pipelines, or beach engineering structures such as pilings, piers groins, or breakwaters as well as other jettisoned debris. Magnetic perturbations with an intensity of 3 nT or greater and a duration longer than 20 ft (6.1 m), were cataloged for further analysis. Acoustic imaging data were reviewed for anomalous returns that could be associated with significant submerged cultural resources. Acoustic images and magnetic contouring were checked against bathymetric data for potential correlation.

The proposed breakwater is situated on the seaward edge of the proposed beach groin site. It measures approximately 365.9 meters long (1,200 feet) by 243.9 meters wide (800 feet), or 22 acres. The survey area was divided into 17 transects spaced at 15.2 meter (50 foot) intervals, which yields 4390.2 linear meters (14,400 feet) or 4.39 linear survey kilometers (2.72 miles). A total of 12 transects were surveyed during this effort; the remaining five were not completed due to shoal water. Water depths decreased to 1.8 meters (6 feet) beneath the keel at Transect 12, and the sea height at that time was between 0.6 and 1.2 meters (2 and 4 feet). The potential to ground the survey vessel and magnetic sensor in wave troughs was very high, and the remaining transects were abandoned for the safety of the crew and survey sensors.

There are four side scan sonar anomalies (Figure 6-1, Table 6-1), twenty one magnetic anomalies (Figure 6-1, Table 6-2), and several bathymetric anomalies recorded in the proposed breakwater

area. Each anomaly was assigned a number preceded by A (acoustic anomaly) or M (magnetic anomaly).

A Benthos Chirp III sub bottom profiler was selected for this survey to image buried cultural resources. These resources include historic properties, such as shipwrecks, and ancient landforms, such as relict river channel margins that may have been frequented by Paleolithic Period peoples. The Benthos Chirp III sensor requires a minimum of 1.8 meters (6 feet) of water above and 2.7 meters (9 feet) of water beneath the sensor to collect data at frequencies needed for high resolution images. It was apparent that water depths in the survey area were not deep enough to safely collect reliable data. To account for the loss of sub-bottom profiler data, magnetic data, which was collected from a sensor height of between two and four feet above the sea floor, were examined for very short duration, low amplitude anomalies. These small perturbations serve as reliable indicators of cultural artifacts and features such as ancient hearths or deeply buried shipwrecks.

6.4.1 Target Descriptions

A total of five targets were derived from these data for further analysis (Figure 6-1, Table 6-3). Each target cluster is comprised of associated acoustic or magnetic anomalies, or combinations of both. These data were grouped based on proximity, spatial patterning, and magnetic signature, amplitude, or duration. Targets were assigned the prefix T to aid in plotting and differentiation. A detailed description and analysis of each target is described in below.

6.4.2 Target 1

Target 1 is comprised of magnetic perturbations M5, M8, and A1 (Figure 6-1, Tables 6-1 and 6-2). Anomaly M5 is a positive monopolar anomaly with a low amplitude of 6.6 nT, a long duration of 68.3 meters (224 feet), and a calculated ferrous mass of approximately 0.31 kilograms (0.68 pounds) with the height of sensor at 3.3 meters (10 feet) off the bottom (Tables 6-2 and 6-3, Figure 6-1). Anomaly M8 is a dipolar anomaly with a low amplitude of 11.9nT, a medium duration of 78.65 meters (258 feet), and an estimated ferrous mass calculated to be 15.45 kilograms (2 pounds) with the height of sensor at 3.3 meters (10 feet) off the bottom. The data was reviewed for magnetic pattern analysis and magnetic contouring (Figure 6-1). A single side scan sonar anomaly (A1) was recorded in the vicinity of Target 1 (Table 6-1). Anomaly A1 is a 6.7 meters (22 foot) section of pipe or cable that protrudes just above the sea floor. Analysis indicates that this anomaly consists of a single small ferrous mass that extends onto an adjoining survey line. It likely represents a section of discarded wire rope, cable or pipe. Target 1 does not represent a significant submerged cultural resource and no further work is recommended.

6.4.3 Target 2

Target 2 is composed of magnetic perturbations M19 and M21 (Tables 6-2 and 6-3, Figure 6-1). Anomaly M19 is a dipole with a long duration of 113.4 meters (372 feet), a low amplitude of 16 nT, and a calculated ferrous mass of 7.6 kilograms (16.7 pounds). Anomaly M21 is a dipolar anomaly with a low amplitude of 15.5 nT, a long duration of 114.3 meters (375 feet), and a calculated ferrous mass of 7.3 kilograms (16.1 pounds). The data was reviewed for magnetic

pattern analysis and magnetic contouring (Figure 6-1). The dipolar signature of all perturbations indicates that the magnetic sensor passed directly over or just next to the detected ferrous mass. Magnetic analysis indicates that Target 2 is a simple isolated ferrous object, such as a section of discarded wire rope or cable. There were no acoustic anomalies associated with Target 2. Target 2 does not represent a significant submerged cultural resource and no further work is recommended.

6.4.4 Target 3

Target 3 is comprised of magnetic anomalies M3 and M4 (Tables 6-2 and 6-3, Figure 6-1). Anomaly M3 is a dipolar anomaly with a low amplitude deflection of 13 nT, a medium duration of 51.2 meters (168 feet), and a calculated ferrous mass of 6.27 kilograms (13.8 pounds). Anomaly M4 is a dipole with a low amplitude deflection of 13.2 nT, a medium duration of 63.1 meters (207 feet), and a calculated ferrous mass of 6.24 kilograms (13.7 pounds). The data was reviewed for magnetic pattern analysis and magnetic contouring (Figure 6-1). The magnetic analysis of Target 3 indicates that it is a simple dipolar anomaly that lacks the complexities associated with submerged cultural resources. This target, much like Target 2, likely represents a section of wire rope or ferrous construction debris. Acoustic data recorded in this vicinity does not show any anomalous surface features. Target 3 is clearly not associated with any significant cultural resource; no further work is recommended.

6.4.5 Target 4

Target 4 consists of magnetic anomalies M16, M18, and M20 (Tables 6-2 and 6-3, Figure 6-1). Anomaly M16 is a dipolar perturbation with a low amplitude deflection of 10.6 nT, a long duration of 117 meters (383.8 feet), and a calculated ferrous mass of 5 kilograms (11 pounds). Anomaly M18 is a dipolar anomaly that has a low magnetic deflection of 11.3 nT, a long duration of 109.2 meters (358.3 feet), and a calculated ferrous mass of 5.36 kilograms (11.8 pounds). The data was reviewed for magnetic pattern analysis and magnetic contouring (Figure 6-1). Acoustic data recorded in this area did not record any anomalous objects on the seafloor. Analysis of this target indicates that it has a simple magnetic pattern indicative of construction debris likely associated with the material deposited on the old groin location. No further work is recommended for Target 4.

6.4.6 Target 5

Target 5 consists of magnetic anomaly M15 (Tables 6-2 and 6-3, Figure 6-1). Anomaly M15 is a multi-component perturbation with a low magnetic deflection of 8.5 nT, a medium duration of 63.4 meters (208 feet), and a calculated ferrous mass of 4.1 kilograms (9 pound). Multi-component anomalies are more frequently associated with submerged cultural resources and generally represent several ferrous objects oriented in different planes. Magnetic pattern analysis and magnetic contouring on adjacent survey lines indicate that there is no linkage with other anomalous data (Figure 6-1). The side scan sonar system did not record any anomalous surface features in this area other than low amplitude sand waves. Analysis of Target 5 indicates that anomaly M15 likely represents an isolated scatter of ferrous materials. Target 5 lacks the

characteristics of a shipwreck or other significant submerged cultural resource. No further work is recommended for Target 5.

6.4.7 Discussion

Analysis of the five of the target clusters indicates that the inshore area in the vicinity of the demolished beach groin was scattered with concrete construction debris that contained rebar and re-wire. This material originated from the groins and piers that dotted the southern WFF shoreline. Other ferrous debris likely originated from erosion control structures that have been built across the WFF beach. The small calculated ferrous mass of the magnetic perturbations, and the random spatial patterning of all anomalies suggest that the seafloor of the proposed breakwater location is littered with construction debris that has been re-distributed by storm events and general wave action. None of the anomalies recorded during the survey display characteristics typical of significant cultural resources.

The final 61 meters (200 feet) of the survey area not covered during the survey (for safety reasons) have a very low potential to contain significant cultural resources. This determination is based on data recorded in the first 183 meters (600 feet) of the survey, on the construction, demolition, and dumping activities that have taken place in that area, and on the high energy surge endemic to the Wallops Island coastline.

Table 6-1. Acoustic Anomalies

Anomaly Number	Block/ Line	Magnetic Association	Dimensions L x W x H (Ft)	Shape	X NAD 83 VA South State Plane, US Srv Ft	Y NAD 83 VA South State Plane, US Srv Ft	Identification
A1	Breakwater L4_1	M5 and M8	22 ftx.6ft	Pipe	12351195.09	3836604.111	Pipe Segment
A2	Breakwater L9_1		70 ftx20ftx1.5	linear	12350818.8	3836153.72	Cable or Wire Rope
A3	Breakwater L9_2		5ftx1ftx1.2ft	Rectangle	12350826.28	3836448.456	Concrete Debris
A4	Breakwater L10_1		24ftx7ftx.75 ft 19ftx10ftx1.5ft	Scatter	12351047.37	3836811.322	Scatter of Two Buried Objects

Table 6-2. Magnetic Anomalies

Block	Line #	Anom #	X NAD 83 VA South State Plane, US Srv Ft	Y NAD 83 VA South State Plane, US Srv Ft	Amplitude (nT)	Sign	Duration (ft)	Height of Sensor (ft)
Breakwater	12	M1	12350673.13	3836287.962	10.2	D	323.221	10
Breakwater	10	M2	12350583.83	3836098.596	5.79	-M	139.759	10
Breakwater	9	M3	12350564.34	3835969.092	13.36	D	168.725	10
Breakwater	9	M4	12350525.09	3835928.96	13.26	D	207.76	10
Breakwater	8	M5	12351127.25	3836647.999	6.61	+M	224.268	10
Breakwater	8	M6	12351025.01	3836504.871	9.37	D	211.341	10
Breakwater	8	M7	12350623.54	3835959.099	10.03	D	313.419	10
Breakwater	7	M8	12351171.03	3836616.551	11.97	D	258.19	10
Breakwater	6	M9	12351159.77	3836516.738	13.45	D	411.063	10
Breakwater	6	M10	12350805.52	3836052.279	4.14	D	98.3974	10
Breakwater	6	M11	12350695.8	3835902.688	9.21	D	225.102	10
Breakwater	5	M12	12350778.14	3835929.702	8.94	D	193.59	10
Breakwater	5	M13	12351319.12	3836643.236	13.38	D	353.68	10
Breakwater	4	M14	12351327.49	3836556.754	9.17	+M	106.476	10
Breakwater	4	M15	12350734.25	3835785.791	8.75	MC	208.151	10
Breakwater	3	M16	12350919.96	3835946.283	10.65	D	382.866	10
Breakwater	3	M17	12351217.39	3836356.627	9.43	+M	319.62	10
Breakwater	2	M18	12350954.42	3835915.874	11.39	D	358.333	10
Breakwater	2	M19	12351316.35	3836400.545	16.12	D	372.08	10
Breakwater	1	M20	12350950.43	3835910.478	11	D	360.387	10
Breakwater	1	M21	12351311.5	3836395.509	15.51	D	375.209	10

Table 6-3. Targets Identified during the WFF Proposed Beach Groin Survey Project

Target No.	Magnetic Anomalies Associated with Each Target	Associated SSS/ SB
T1	M5, M8	A1
T2	M19, M21	
T3	M3, M4	
T4	M16, M18 and M20	
T5	M15	

7.0 SUMMARY AND RECOMMENDATIONS

This chapter presents recommendations for four archaeological efforts undertaken as part of the NASA WFF SRIPP, Wallops Island, Virginia. These efforts include a cultural resource remote sensing of the proposed breakwater location, a scientific diving survey of the proposed beach groin location, a cultural resources pedestrian survey of the Wallops Island shoreline, and the cultural resources monitoring of Geotextile tube installation on the same shoreline. Management recommendations and a summary of the results of each effort are provided below.

7.1 PEDESTRIAN SURVEY OF THE WALLOPS SHORELINE

A total of 6.2 kilometers (3.85 miles) of coast was traversed during the Wallops Island shoreline cultural resources pedestrian survey on September 18, 2006. The beach was littered with modern debris deposited by recent storm events, and no significant cultural resources were identified during this survey. No further work on this shoreline is merited or recommended.

7.2 CULTURAL RESOURCES MONITORING OF GEOTEXTILE TUBE INSTALLATION

A URS Senior Archaeologist inspected the installation of Geotextile tube on behalf of WFF on January 22, 2007. The APE for the cultural resource monitoring effort consisted of 1,402 meters (4,600 feet) of shoreline that received Geotextile tubes, which began at the southern terminus of the seawall and extended to the camera station at the southern end of NASA property.

No archaeological resources were identified within the APE during the cultural resources monitoring effort. Ground disturbances generated by this action revealed modern landform modifications and buried construction debris. Therefore, NASA concluded that no historic or prehistoric resources were affected by Geotextile tube installation on the beachfront. VDHR concurred with this finding in a response letter dated January 27, 2007 (Appendix C).

7.3 WADING SURVEY OF A PROPOSED BEACH GROIN LOCATION

The first 250 ft of the proposed beach groin location was undertaken as a wading survey area. Scientific diving was not possible at this location because the corroded rebar that littered the area represented a serious impalement and laceration hazard to divers operating in the near zero visibility water of the turbulent swash zone. The wading survey did not identify any significant cultural resources. The final 200 ft (60.9 m) of the survey area was not surveyed due to the afore mentioned safety concerns, and because this 200 ft (60.9 m) by 100 ft (30.5 m) section has the a very low potential to contain significant historic resources. This assessment is based on the general ground disturbance that has occurred at this site, which includes the construction of the original groin, and the disposal of concrete construction waste throughout the area, and the general erosion and sediment transport that routinely takes place in the first 500 to 600 ft (125.4 to 182.8 m) of the Wallops shoreline. No further work is recommended for the proposed beach groin location.

7.4 CULTURAL RESOURCES REMOTE SENSING SURVEY OF A PROPOSED BREAKWATER LOCATION

Comprehensive analysis of survey data was conducted using criteria that included magnetic complexity, amplitude, duration, and contouring, along with the spatial patterning of all anomalies. Analysis included review of all side scan sonar data to identify any structures or geomorphic features associated with submerged historic cultural materials.

The breakwater survey area measured approximately 365.7 meters by 243.8 meters (1200 feet by 800 feet; Figure 1-1) and consists of 17 transects spaced at 15.2 meters (50 foot) intervals. A total of 5 target clusters (Table 6-3) were identified from the four acoustic anomalies (Table 6-1) and 21 magnetic anomalies (Table 6-2) recorded during the breakwater survey.

Acoustic and magnetic signatures from the five targets and isolated anomalies are consistent with modern debris that has originated from two sources. The first source was the rubble and construction debris deposited on the eastern edge of beach groin. Other debris has likely emanated from early beach engineering efforts along the WFF shoreline. This may include refuse derived from piers, pilings, and other materials deposited by wave energy reflection. None of the detected anomalies have the potential to represent significant submerged cultural resources. The final 61 meters (200 feet) of the survey area were not surveyed because it has a very low potential to contain significant cultural resources and there was a serious safety risk to the crew and survey array. No further work is recommended within the proposed breakwater survey area.

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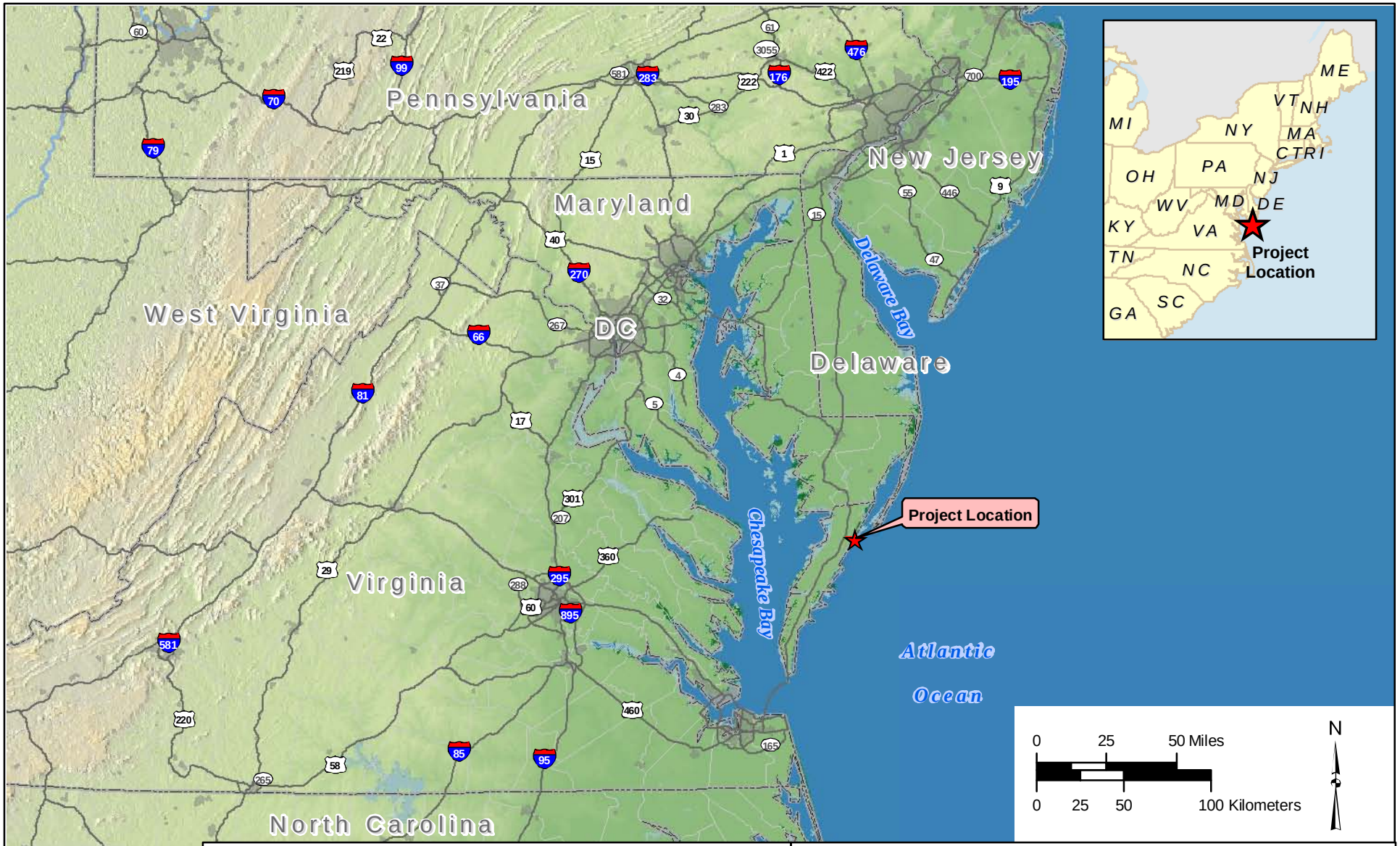
Addendum:

Report Figures and Plates



PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater, and Shoreline Cultural Resources Surveys and Geotextile Tube Monitoring	**Project Location**
SCALE	1 inch = 50 miles	
SOURCE	ESRI, USGS	**PROJECT NO.** 15299035
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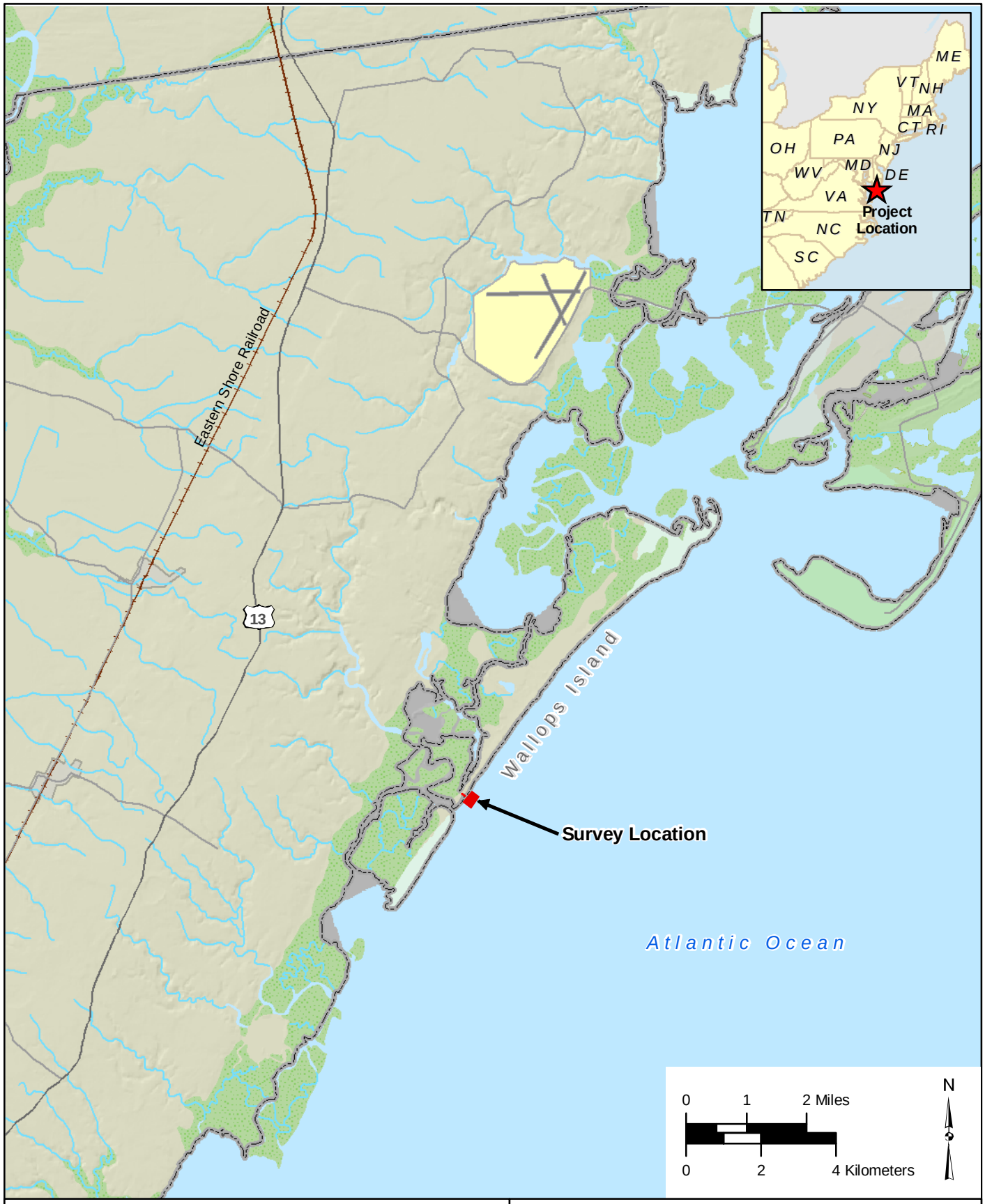

PROJECT	NASA WF**F** Shoreline Restoration and Protection **Program:** Proposed Groin, Breakwater, and Shoreline Cultural Resources Surveys and Geote**xtile Tube** Monitoring	Groin and Breakwater Survey Locations on Wallops Island	
SCALE	1 inch = 2.3 miles		
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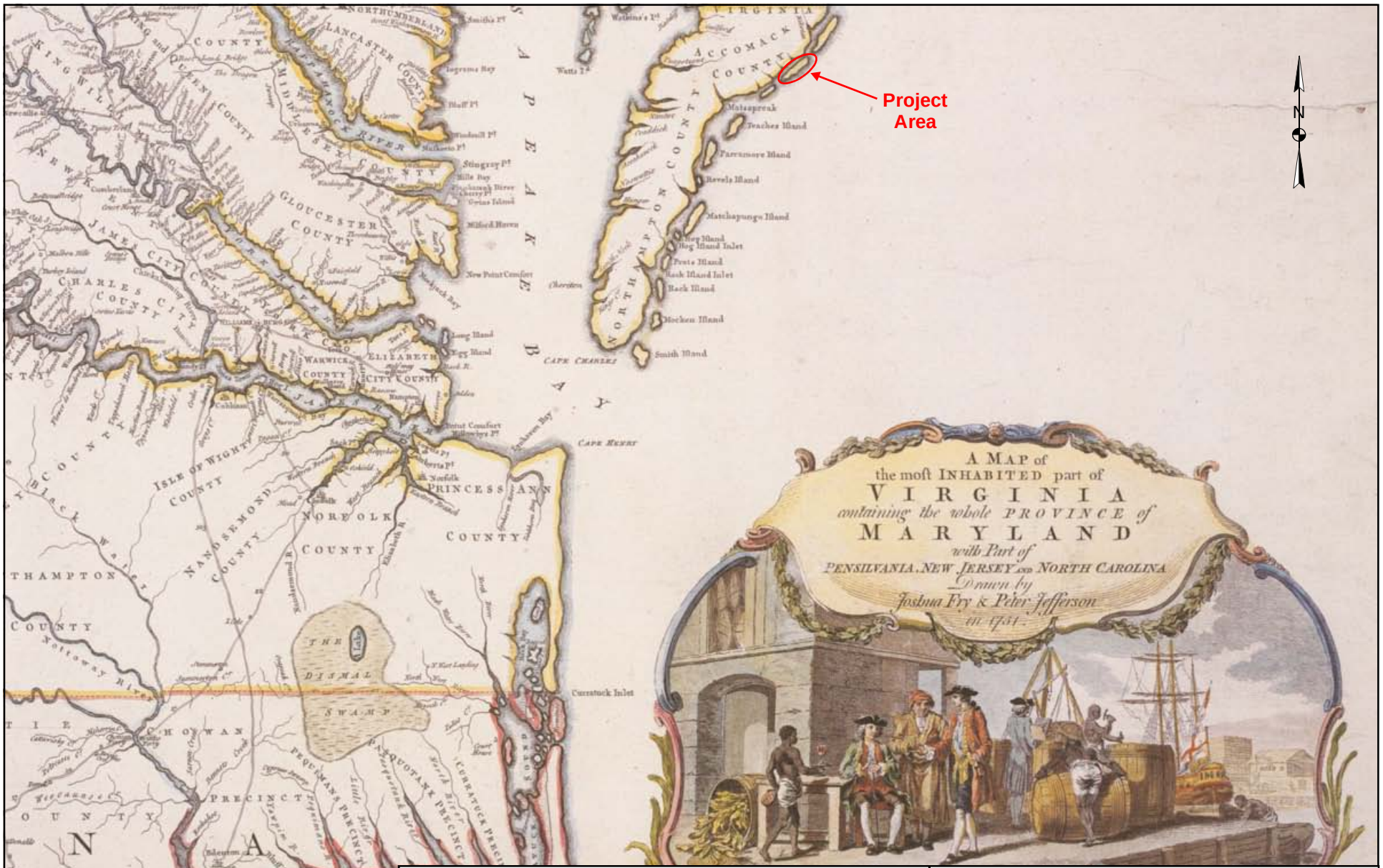
PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resources Surveys and Geotextile Tube Monitoring	**Daniel of St. Thomas Jenifer's 1693 Map**	
SCALE	1 inch = 7.8 nautical miles	**PROJECT NO.**	15299035
SOURCE	Jenifer 1693	**FIGURE NO.**	3-1



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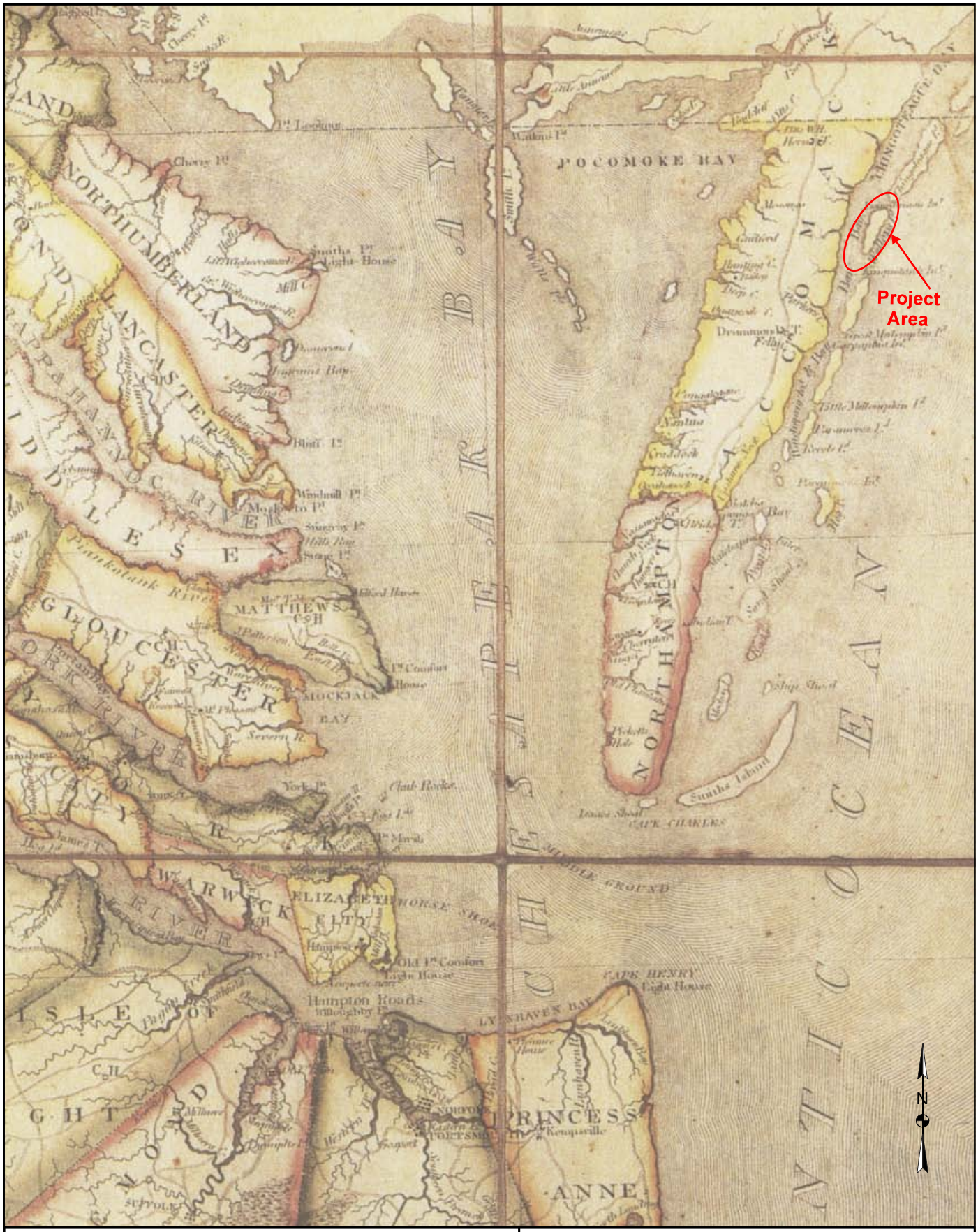

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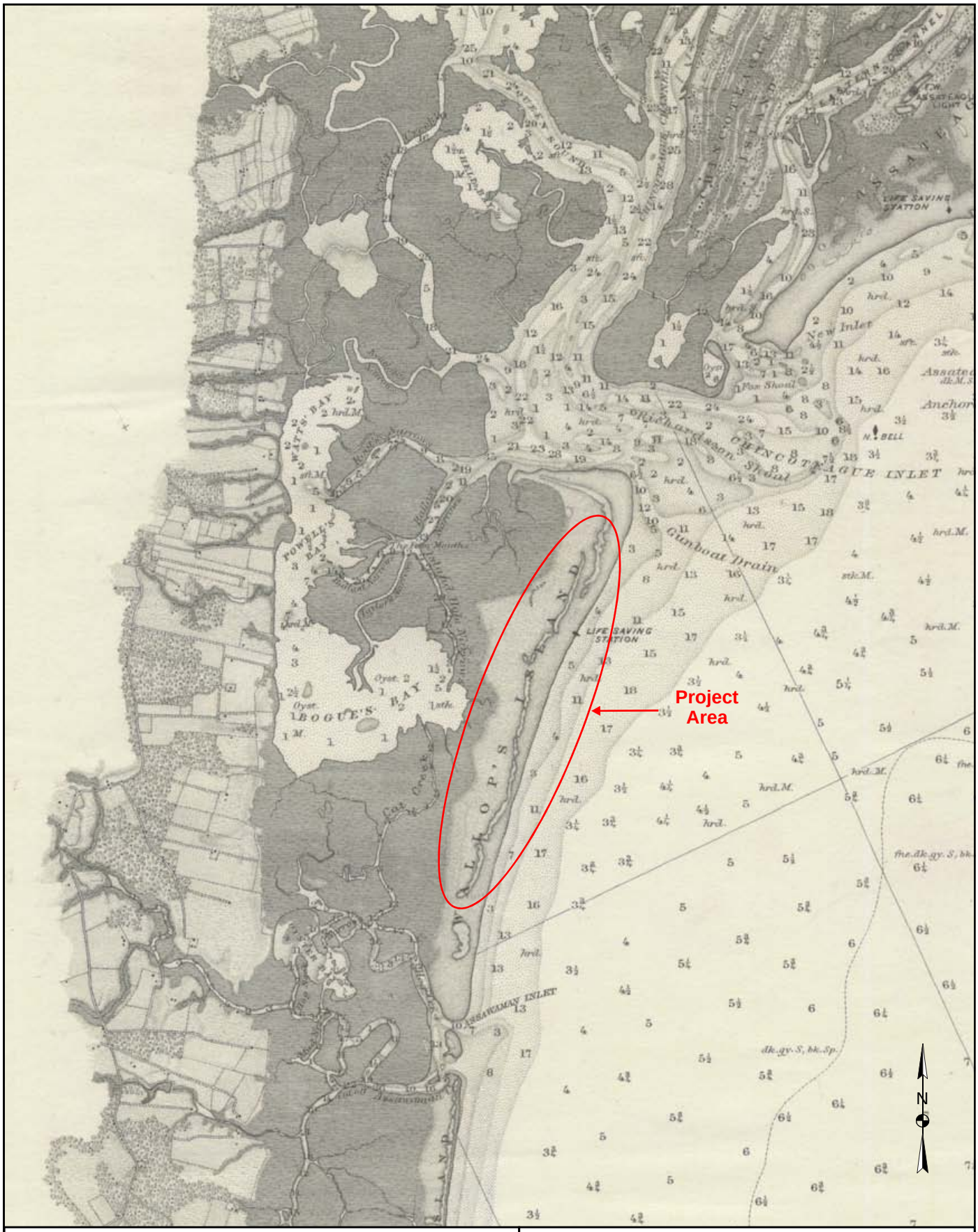
SOURCE	Madison 1807	**FIGURE NO.**	3-3



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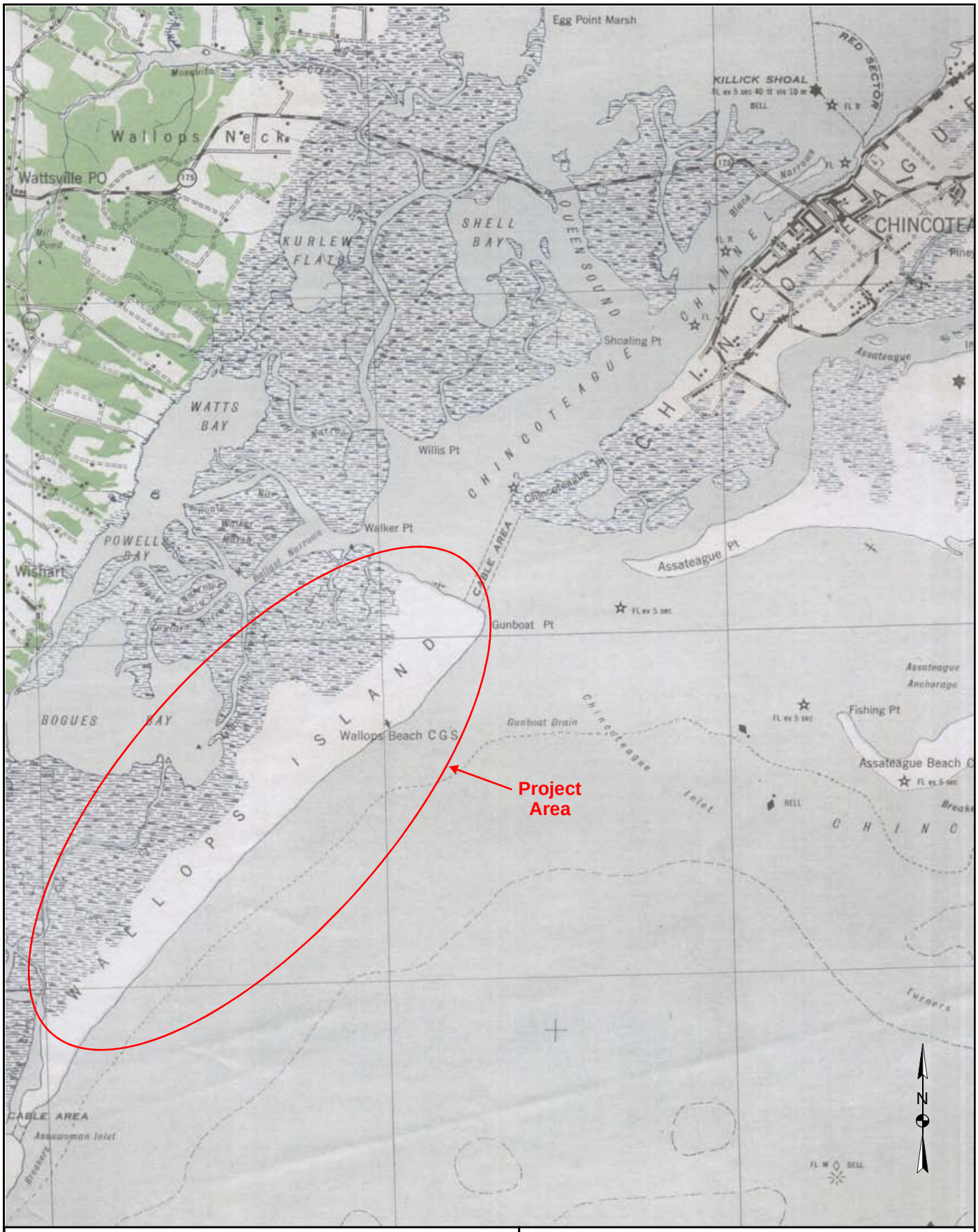
SOURCE	USC&GS Coast Chart No.129, 1892	**FIGURE NO.**	3-4



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SCALE	1 inch = 1 mile	**PROJECT NO.**	15299035
SOURCE	USGS 15 Minute Series, 1937	**FIGURE NO.**	3-5

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater, and Shoreline Cultural Resources Surveys and Geotextile Tube Monitoring	**Wallops Island Shoreline Designated for Pedestrian Survey**	
SCALE	1 inch = 1 mile		
SOURCE	USDA, NRCS	**PROJECT NO.**	15299035
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PROJECT	NASA WF**F** Shoreline Restoration and Protection Program: Proposed Groin, Breakwater, and Shoreline Cultural Resources Surveys and Geotextile Tube Monitoring	**Wallops Island Shoreline Designated for Geotubes Installation**	
SCALE	1 inch = 1 mile		
SOURCE	USDA, NRCS	**PROJECT NO.**	15299035
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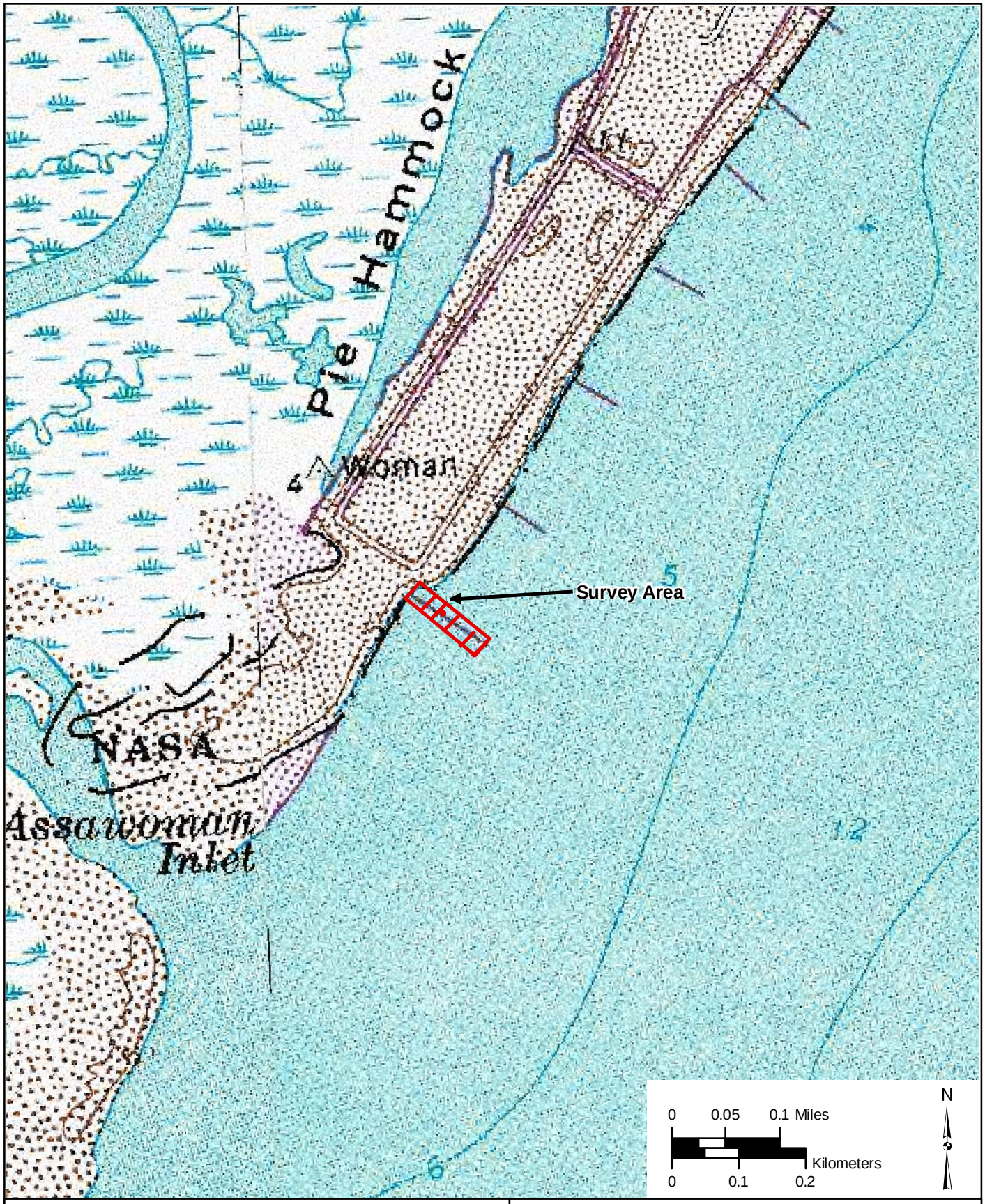

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater, and Shoreline Cultural Resources Surveys and Geotextile Tube Monitoring	**Location of the Proposed Beach Groin Survey Area**	
SCALE	1 inch = 0.11 mile		
SOURCE	USDA, NRCS	**PROJECT NO.**	15299035
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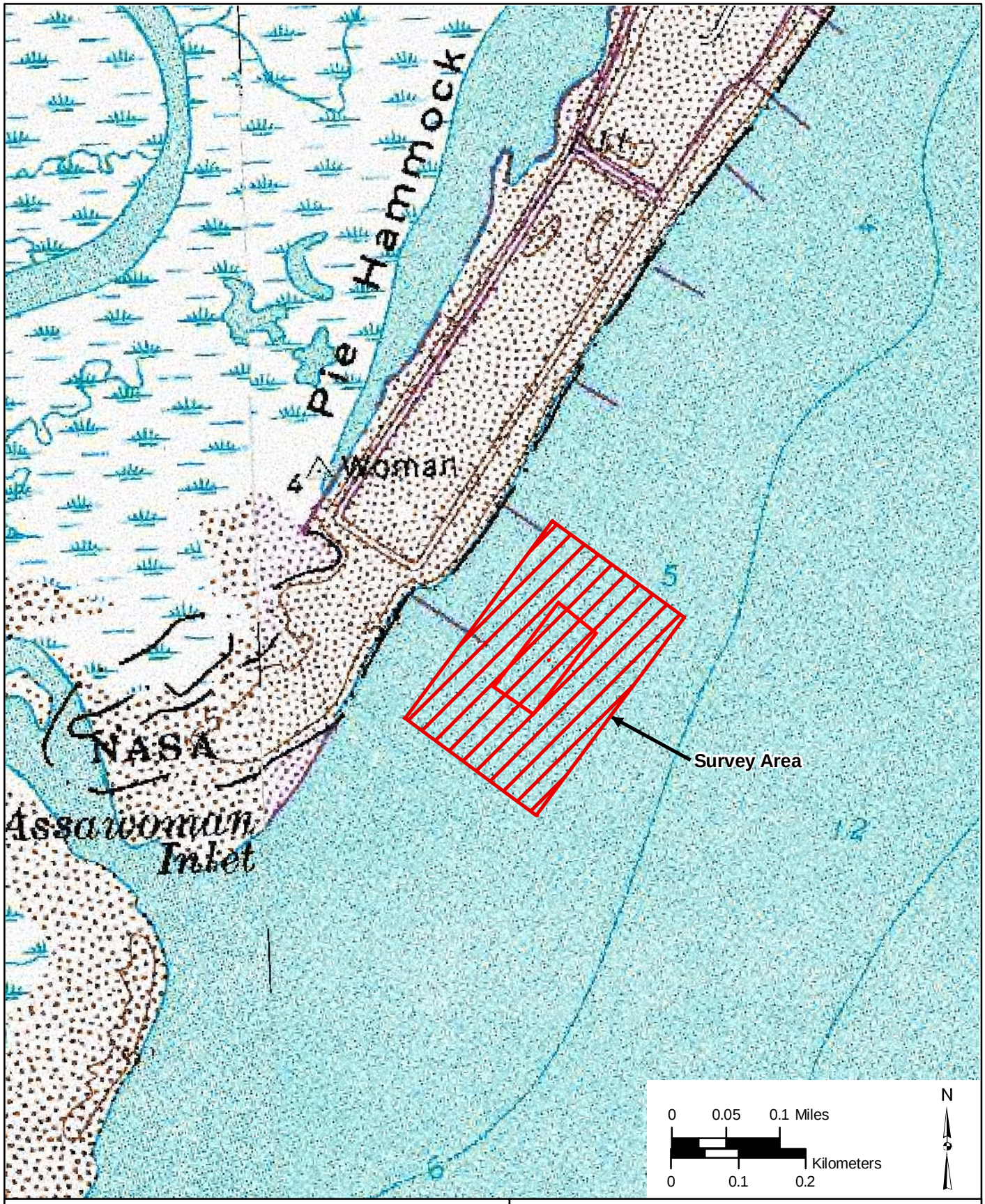

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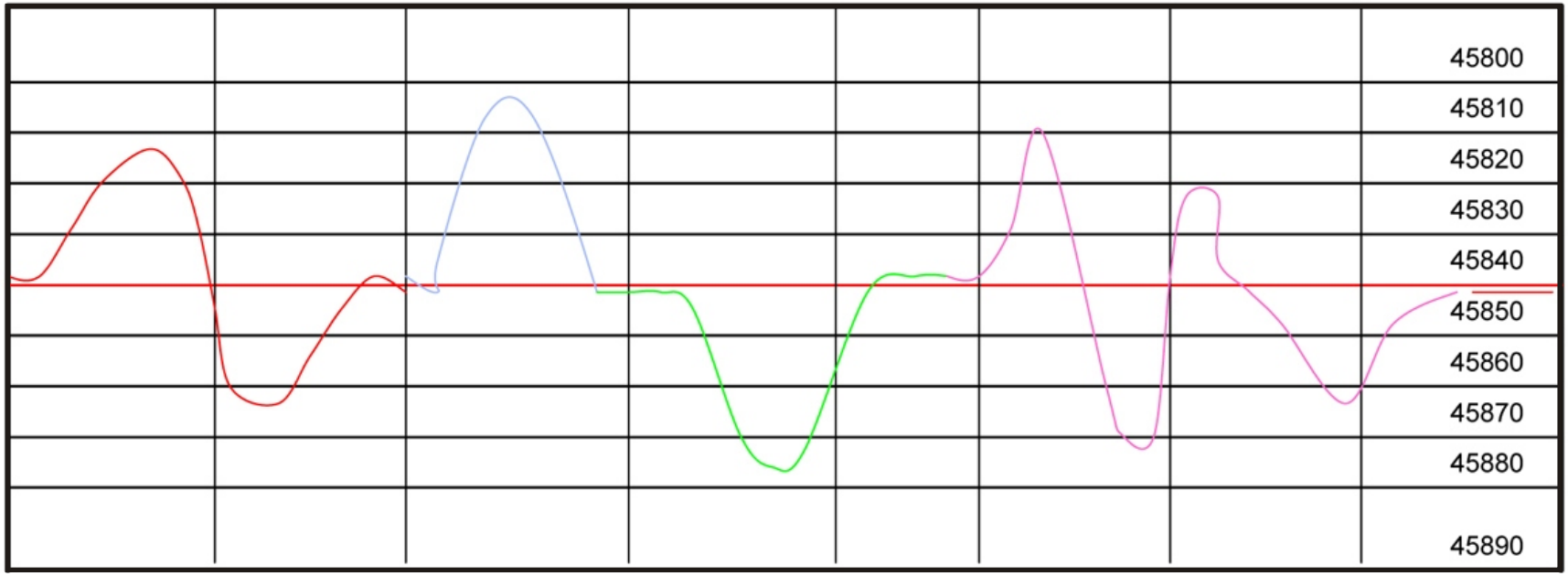
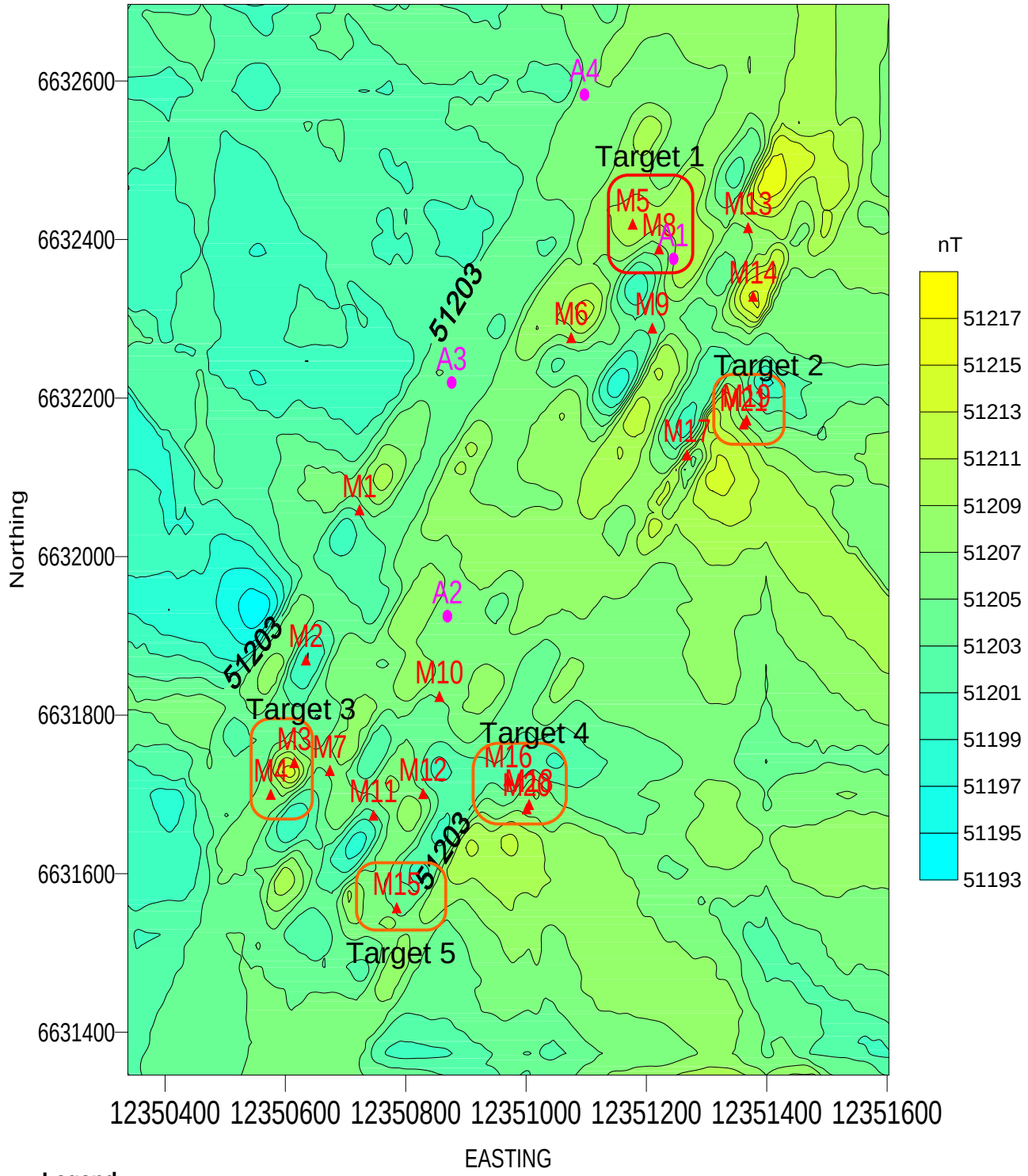
Magnetic Signatures



Dipole **- Monopole** **+ Monopole** **Multi-component**

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resources Surveys and Geotextile Tube Monitoring	**Illustration Showing Four Magnetic Signature Types**	
SCALE	N/A		**PROJECT NO.** 15299035
SOURCE	URS		**FIGURE NO.** 5-5



Legend

- Acoustic Anomaly
- Magnetic Anomaly
- Target Cluster

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resources Surveys and Geotextile Tube Monitoring	**Breakwater Magnetic Contours, Anomalies and Target Plots**	
SCALE	N/A	**PROJECT NO.**	15299035
SOURCE	URS	**FIGURE NO.**	6-1

Plate 5-1. Rock Seawall Along Wallops Island Shoreline, Facing South

Plate 5-2. Wallops Island Beach Located Northeast of the Seawall, Facing South

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resource Surveys and Geotextile Tube Monitoring	**Project Photographs**	
SCALE	N/A	**PROJECT NO.**	15299035
SOURCE	URS	**PLATE NO.**	5-1 and 5-2

Plate 5-3. Wallops Island Beach Located Southeast of the Seawall, Facing South

Plate 5-4. View of Proposed Beach Groin Location, Facing SE

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resource Surveys and Geotextile Tube Monitoring	**Project Photographs**	
SCALE	N/A	**PROJECT NO.**	15299035
SOURCE	URS	**PLATE NO.**	5-3 and 5-4

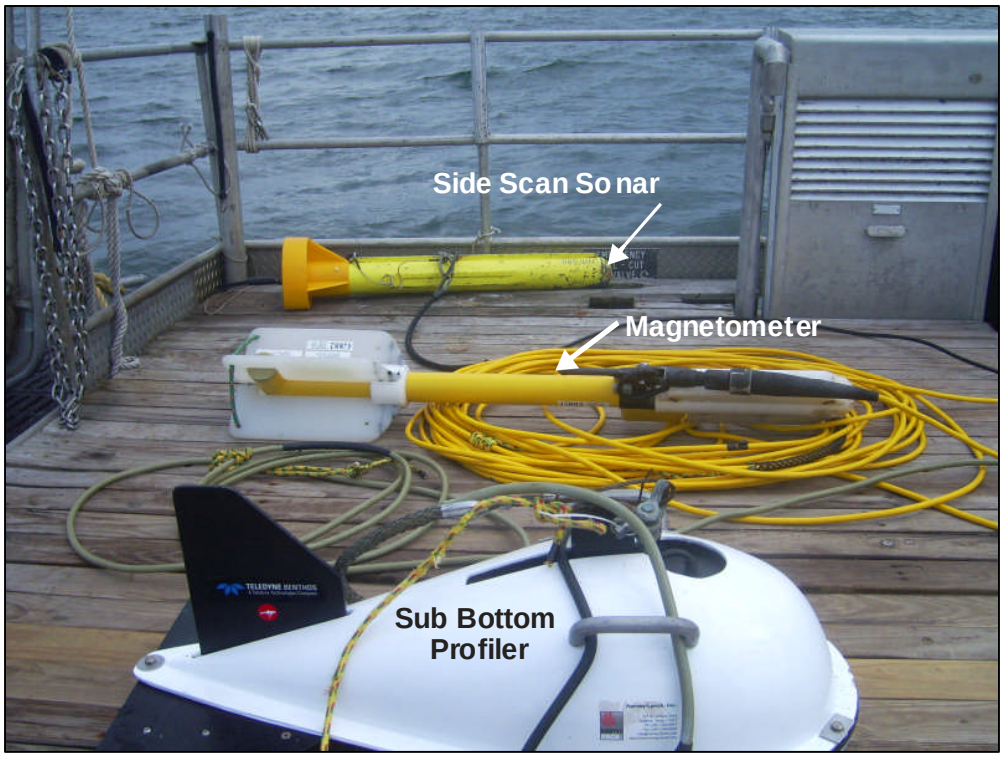


Plate 5-5. View of Survey Equipment

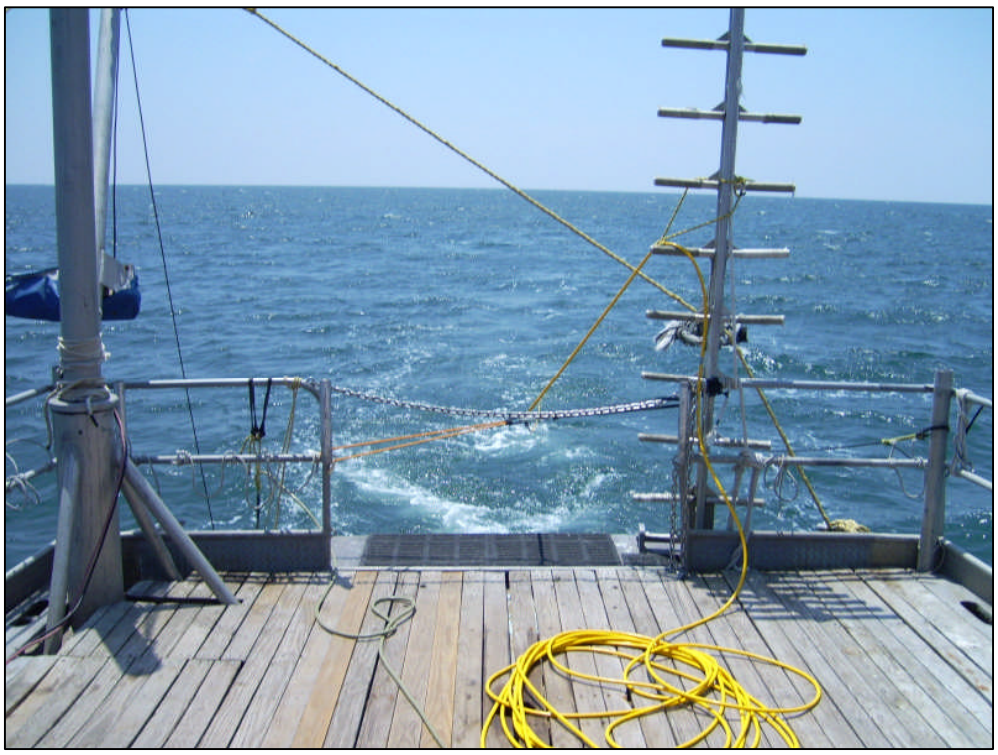


Plate 5-6. View of Survey Conditions

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resource Surveys and Geotextile Tube Monitoring	**Project Photographs**	
SCALE	N/A	**PROJECT NO.**	15299035
SOURCE	URS	**PLATE NO.**	5-5 and 5-6

Plate 6-1. Debris Noted During Pedestrian Survey of the Wallops Island Shoreline

Plate 6-2. Caisson Foundation Posts Noted During Pedestrian Shoreline Survey, Facing SE

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resource Surveys and Geotextile Tube Monitoring	**Project Photographs**	
SCALE	N/A	**PROJECT NO.**	15299035
SOURCE	URS	**PLATE NO.**	6-1 and 6-2

Plate 6-3. Pier Remnants Noted During Pedestrian Shoreline Survey, Facing SE

Plate 6-4. Geotextile Tube Corridor Grading, Facing South

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resource Surveys and Geotextile Tube Monitoring	**Project Photographs**	
SCALE	N/A	**PROJECT NO.**	15299035
SOURCE	URS	**PLATE NO.**	6-3 and 6-4

Plate 6-5. Northern Sand Slurry Pits and Backdirt Pile, Facing SW

Plate 6-6. Southern Sand Slurry Pit, Facing SE

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resource Surveys and Geotextile Tube Monitoring	**Project Photographs**	
SCALE	N/A	**PROJECT NO.**	15299035
SOURCE	URS	**PLATE NO.**	6-5 and 6-6

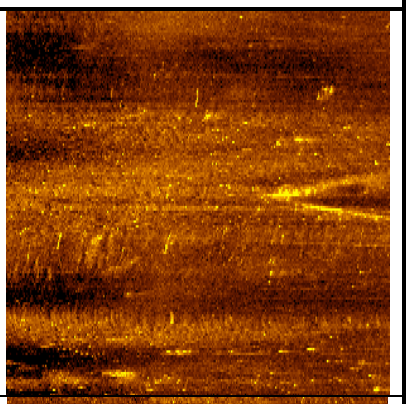
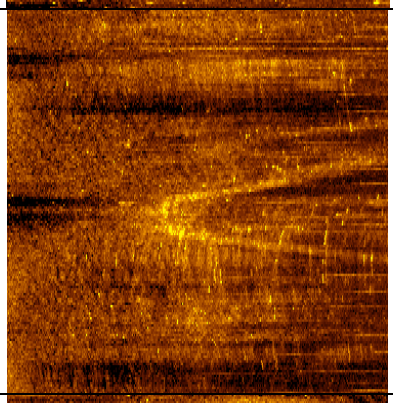
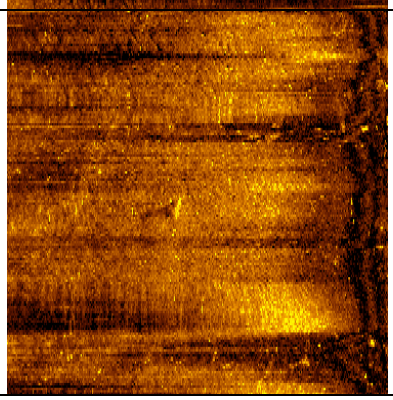
Plate 6-7. Construction Waste at the Western End of the Beach Groin Survey Area, Facing NW

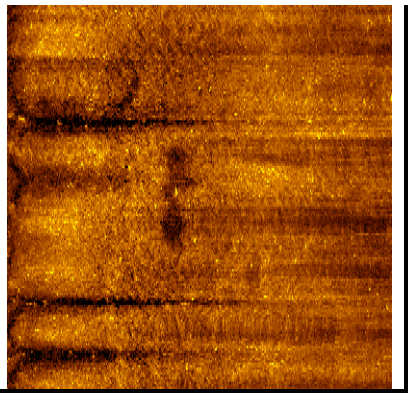
Plate 6-8. Concrete Rubble and Rebar Strewn Over the Beach Groin Survey Area, Facing East

PROJECT	NASA WFF Shoreline Restoration and Protection Program: Proposed Groin, Breakwater and Shoreline Cultural Resource Surveys and Geotextile Tube Monitoring	**Project Photographs**	
SCALE	N/A	**PROJECT NO.**	15299035
SOURCE	URS	**PLATE NO.**	6-7 and 6-8

Appendix A:

Side Scan Sonar Anomalies

Anomaly Number	Block/ Line	Magnetic Association	Dimensions L x W x H (Ft)	Identification	Image
A1	Breakwater L4_1	M5 and M8	22 ft x.6ft	Pipe Segment	
A2	Breakwater L9_1		70 ft x 20ft x 1.5	Cable or Wire Rope	
A3	Breakwater L9_2		5ft x 1ft x 1.2ft	Concrete Debris	

A4	Breakwater L10_1		24ft x 7ft x.75ft 19ft x 10ft x 1.5ft	Scatter of Two Buried Objects	

Appendix B:

Qualifications of Investigators

Jean Bernard (J.B.) Pelletier has over 20 years experience in marine geophysics, nautical archaeology, marine and terrestrial remote sensing, remotely operated vehicle operation and maintenance, underwater photography and video, technical diving, and diving safety. He is URS' Lead Nautical Archaeologist and Marine Remote Sensing Specialist. He exceeds the Secretary of the Interior's Professional Qualification Standards for Archaeology. Mr. Pelletier is an expert in the use of side-scan sonar, sub bottom profilers, single-beam echo sounders, and marine magnetometers and gradiometers. He also has extensive knowledge of Hypack Max software for data collection and interpretation. He has served a wide array of Federal, State, and private sector clients including the: USACE; U.S. Navy; MMS; National Oceanic and Atmospheric Administration; Delaware, Rhode Island, Florida, and Maryland DoTs; Maryland Department of Natural Resources; Maryland Port Authority; and BP. He received his M.A. in History and his B.A. in Geological Sciences from the University of Maine.

Anthony Randolph has 15 years of experience in cultural resources management, and exceeds the *Secretary of Interior Standards for Archaeology* (36CFR Part 61). Mr. Randolph has extensive experience in the management and execution of archaeological investigations. He has managed reconnaissance and investigations on prehistoric, historic and maritime sites throughout the eastern United States, Caribbean, and Europe. He also has extensive experience as an archaeological conservator through positions at Mariners Museum, and the government of Portugal. He received his Masters Degree in Anthropology from Texas A&M University in 2003 and his Bachelor's Degree in Neuroscience/Anthropology from the University of Pittsburgh in 1993.

Bridget Johnson has a broad background in historic and archaeological research. She has extensive experience in data collection and management for archaeological and historical projects. Ms. Johnson has extensive experience conducting historic research on a variety of topics and regions throughout the United States. Specialized experience includes the creation of three dimensional models of archaeological sites both terrestrial and underwater, as well as the management of archaeological collections. She received her Masters degree in Anthropology from Texas A&M University in 2008 and her Bachelors degree in History and Archaeology from St. Mary's College of Maryland in 2006.

Appendix C:

VDHR Response Letter to Archaeological Monitoring of Geotextile Tube Installation

Code 228 January 24, 2007

Ms. Kathleen Kilpatrick
Federal Review and Compliance Coordinator
Virginia Department of Historic Resources
2801 Kensington Avenue
Richmond, Virginia 23221

Subject: **Request for Project Review** – Geotextile Tubing Installation,
Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Virginia

Dear Ms. Kilpatrick:

The National Aeronautics and Space Administration (NASA) has recently initiated emergency measures to slow the current rate of erosion along the coast of Wallops Island. The ocean is encroaching substantially toward launch pads, infrastructure, and test and training facilities belonging to NASA, the U.S. Navy, and the Mid-Atlantic Regional Spaceport (MARS) at a rapid rate. Currently, assets on Wallops Island are valued at over $800 million and are increasingly at risk from larger than normal storm events, storm waves, and flooding damages. The risks to WFF could cause the interruption of missions supported by the facility and/or permanent loss of capabilities supported by the facility. At this time, NASA is installing geotextile tubes (GeoTubes®) along the southern portion of the beachfront (Photograph 1). Because this Undertaking has the potential to effect historic resources, NASA is initiating consultation with the Virginia Department of Historic Resources (VDHR) in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations as provided in 36 CFR Part 800.

Previous studies in this area included the creation of an archaeological predictive model for potential pre-historic and historic sites in the vicinity (which was approved by VDHR in a letter dated December 3, 2003). In December 2004, the *Historic Resources Survey and Eligibility Report for Wallops Flight Facility* (URS/EG&G) was submitted to VDHR and included an evaluation of structures in the area for National Register eligibility. The information gathered from these reports was the basis for the current evaluation of the affected beachfront.

Current plans consist of installing approximately 1,402 meters (4,600 feet) of GeoTubes® from the southern terminus of the seawall to the camera station at the southern end of NASA property (Figure 1). This project area falls within the moderate sensitivity zone for historic archaeology, a sensitivity model approved by VDHR in a letter dated December 4, 2003. The tubes are 14 feet wide, 5.5 feet high and have a 34 foot circumference (Figure 2). GeoTubes®

are composed of durable textile material formed into long cylinders that are filled with sand. The tubes, which are used instead of hard structures such as riprap, are normally placed in the backbeach parallel to the shore. Two temporary staging areas for sand and slurry have been created: one at the northernmost boundary of the GeoTube® line and the second midway down the beachfront. These two slurry pits will be restored after the project is complete. Water would be pumped through one temporary pipe extending from Hog Creek and one temporary pipe extending from the Atlantic Ocean.

On January 22, 2007 on behalf of NASA, a URS Senior Archaeologist and Architectural Historian inspected the current GeoTube® installation work in progress. An Area of Potential Effect (APE), taking into consideration viewsheds for adjacent structures and ground disturbing activities associated with the proposed work, was created (Figure 3). The topography of this portion of the beachfront prevents the visibility of the GeoTubes® from off the beach because of the severe level of erosion at the highwater mark (Photographs 2 and 3). Three buildings are located on the beach within the APE, one of which was surveyed for its National Register eligibility in *Historic Resources Survey and Eligibility Report for Wallops Flight Facility*, 2004 URS/EG&G (Table 1 and Figure 3). The two remaining buildings within the APE are not eligible for listing in the National Register. These buildings, an abandoned concrete block storage unit (Wallops # Z-42; Photographs 4 and 5) and operating Launch Control Center (Wallops # Z-40, Photograph 1), are ineligible for the National Register as they do not meet the 50-year criterion for listing nor do they embody the necessary exceptional importance to be listed under Criteria Consideration G.

Building Name	Date of Construction	National Register Eligibility Determination
Launch Control Center (WFF #Z-40)	1960	Ineligible for Listing on the National Register – less than 50 years of age.
Tracking Camera No. 2 (WFF #Z-35)	1951	Surveyed in 2004, *Historic Resources Survey and Eligibility Report for Wallops Flight Facility*, URS/EG&G, and found ineligible for listing on the National Register (VDHR # 001-0027-0122).
Vacant Storage Unit (WFF #Z-42)	1969	Ineligible for Listing on the National Register – less than 50 years of age.

Table 1 – Buildings within the Area of Potential Effects (APE)

Ground disturbances includes the preparation of the 4,600 ft corridor for the placement of GeoTubes® and the excavation of two sand slurry pits to facilitate GeoTube® filling. Approximately 1,000 ft of the northern portion of the GeoTube® corridor had been machine graded during the time of site visitation. Visual observations of this segment of the corridor revealed no artifacts or evidence of culturally derived features. In general, machine grading was shallow (< 1 ft below ground surface) and did not extend below the recent accumulation of storm related sand deposit on the beach (Photographs 7 and 8). Accordingly, the potential for the discovery of artifacts or intact cultural deposits was very low in the area of the GeoTube® corridor.

Monitoring of the northern sand slurry pit involved the inspection of fill material (i.e. backdirt). Actual excavation monitoring of the north pit was not possible as GeoTube® filling

was already in progress (Photograph 9). However, an inspection of the backdirt pile surrounding the pit did not reveal any cultural material. In general, dark yellowish brown loamy sand representing A-horizon soils were observed at the base of backdirt pile, while pale brown sands with light to moderate shell fragments comprised the remaining bulk of the backdirt accumulation (Photograph 10). The sand deposits containing shell is consistent with natural unconsolidated beach deposits. No cultural materials were apparent in this area.

An examination of soil profile from the southern sand slurry pit was possible. The rectangular pit measured approximately 40 by 13 ft, with its long axis perpendicular to the adjacent roadway to the west. Maximum depth of the pit extended approximately 6 ft below ground surface. Upon initial inspection it was clear that an abrupt soil anomaly and an associated dense scatter of lumber and trash were present along the southwest portion of the profile (Photograph 11). Sections of 2 by 4 ft and 2 by 6 ft machine milled lumber were also present in the backdirt pile (Photograph 12). A closer examination of the pit profile and backdirt revealed that most of the associated trash consisted of modern aluminum and plastic soft drink containers, as well as what appeared to be plastic electrical fittings and rubber cable sheathing. Personal communication with Shari Silbert (WICC Team Member) indicated that this area was used to construct an asphalt pad for the operation of a modern electrical panel. A portion of the pad and electrical panel is still present immediately south of the southern sand slurry pit. A reconnaissance of the general area revealed a wide scatter of similar material on the surface, along with a number of other utility related material and cabling. As the materials encountered in the southern slurry pit do not constitute an archaeological resource, no impacts to any cultural resources have been sustained as a result of the ongoing construction activity in this area.

Because there were no historic structures identified within the APE and because the archaeological review of recent ground disturbance in the area found no archaeological resources NASA concludes that no historic or prehistoric resources are affected by the emergency measures on the beachfront. NASA is requesting that VDHR review this project and concur with the finding that no historic properties are affected by the emergency measures on the beachfront.

If you have any questions of comments regarding this portion of the project, please contact me, Kent Stover, at 757-824-1342 or Shari Silbert, at 757-824-2327.

Sincerely,

Kent Stover
Facility Historic Preservation Officer

Enclosures:
(1) VDHR Project Review Application Form
(1) VDHR DSS Map of Project Area
(2) Area of Potential Effect (APE) Map for GeoTube® Installation
(3) Photographic Log

Requesting a Project Review from the Department of Historic Resources

The Department of Historic Resources (DHR) is Virginia's State Historic Preservation Office (SHPO). Section 106 of the National Historic Preservation Act of 1966, as amended, requires federal agencies to consult with the SHPO and others who may have knowledge of historic properties in identifying known historic properties which may be affected by a federal undertaking, and in determining the need for further survey efforts to identify previously unrecorded historic properties. Information on Section 106 and the text of the Section 106 regulations are available on the web site of the Advisory Council on Historic Preservation (www.achp.gov).

THIS APPLICATION MUST BE COMPLETED FOR ALL FEDERAL UNDERTAKINGS AND SUBMITTED TO THE VIRGINIA DEPARTMENT OF HISTORIC RESOURCES FOR REVIEW. A federal undertaking is defined in the Section 106 regulations as "a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval; and those subject to State or local regulation administered pursuant to a delegation or approval by a Federal agency." **This form may also be used to obtain the comments of DHR as part of a state review process**. Please provide a completed form even in cases where project information is included in a separate document, such as an Environmental Impact Report. Environmental documents may be submitted as attachments to the form if they provide an important part of the project description.

A program specific review application form for cell tower projects is available on DHR's website along with several other attachments to the project review application relating to the rehabilitation and demolition of historic structures which are intended to streamline the process.

Before You Complete the Project Review Application Form

1. Determine if your project constitutes an undertaking that has the potential to impact historic properties, assuming such historic properties were present (for the definition of an undertaking, go to the Section 106 Regulations, Definitions section, 36 CFR 800.16, on the web at www.achp.gov/regs.html).
2. Determine the Area(s) of Potential Effect (APE) for the project. For the purposes of Section 106, the area of potential effect (APE) is defined as the entire geographical area in which changes may occur to historic properties if any are present. The APE for archaeological resources may be different than for architectural resources. The viewshed of historic properties often extends well beyond their boundaries and is often an important contributing element to their historic significance. Therefore, projects which alter the landscape drastically - large scale subdivisions, highway construction - or those which insert a large, intrusive structure into the landscape – cell towers, water towers – must take into account the surrounding viewshed when determining the APE. A field inspection of the project area will help to establish the APE. Establishing the APE is the responsibility of the federal agency in consultation with DHR. When acting on the behalf of a federal agency, the APE that is presented to DHR must be the APE that is approved by that agency. The boundaries of the APE should be clearly described and indicated on a U.S.G.S. quad map (original or clear copy). If there are two different APEs – one where ground disturbance is going to occur and one where viewshed is the only concern, for instance, these should be clearly indicated.
3. Gather information to identify the historic properties within or adjacent to the APE that may be affected by your project. Information on recorded historic properties is available in the DHR Archives, and this information **must** be collected prior to submitting project review application. The Archives are open to the public, and the only charges for use are 15 cents per page for copies. If it is not possible to visit the DHR Archives, the archivist will provide information on recorded properties for a fee (telephone the Archives at 804-367-2323, extension 125 for more information). Please be aware that survey in Virginia is far from complete, and the absence of historic resources in DHR records does not necessarily mean that no historic

properties are present. Information that should be considered in the identification process may also be available in other repositories, such as county planning offices and historical societies. On-site inspections are an essential component of the identification process. Photographs of the subject property and any nearby properties that may be over 50 years old should be provided with your project review application. Please attach the available information on recorded historic properties within the APE and documentation resulting from field inspection to the project review application form. If no historic properties are recorded in the APE, and if no potentially historic properties were observed during field inspection, note this on the application form.

4. Following the identification process, you should complete the project review application form in its entirety by referring to the following instructions. Attach or enclose the required additional information, and submit your application packet to DHR. The Department of Historic Resources will respond to your request within 30 days.

How to Complete the Project Review Application Form

I. GENERAL PROJECT INFORMATION

1. Indicate if the project, or any part thereof, has been previously reviewed by DHR and if so, insert the file number. If we know that a project has been previously reviewed, we can often avoid asking for duplicate information.

2-3. Complete this section in its entirety providing the name and location (independent city or town and county) of the project. If your project involves work on a specific building, please include the street address of the building.

4. Refer to the attached list of agencies and their abbreviations and indicate the abbreviation(s) for the federal and/or state agencies involved in the project (permitting, licensing, funding, etc.). If more than one agency is involved, one must be designated the lead agency for Section 106 compliance. If the appropriate agency is not included on the list, please write the full agency name in the space provided.

5-6. It is important that complete mailing addresses be provided for both the lead federal or state agency contact and the applicant.

II. PROJECT LOCATION AND DESCRIPTION

7. Indicate the name of the USGS quadrangle on which your project area is located. An original or clear photocopy of the 7.5 minute USGS topographic quadrangle, or a **clearly labeled** portion thereof, showing the exact boundaries of the project location, and the project's Area(s) of Potential Effect (APE) **must** be attached to this application. Do **not** reduce or enlarge the map. Topographic maps may be downloaded free of charge from Topozone© (www.topozone.com).

8. Indicate the acreage of the project area.

9. Indicate if an architectural or archaeological survey has been conducted as part of the identification process or in a different context by consulting DHR's Archives. Indicate the author, title, and date of the report and if a copy of it is on file at DHR. If a survey has been completed and a copy is not on file, a copy should be included with the application materials.

10. During the identification stage of the Section 106 process you should determine the presence/absence of structures 50 years old or older. Indicate if the Archives search revealed any historic properties in the APE and if the site inspection revealed any properties over 50 years of age within or adjacent to the project area which may or may not be recorded at DHR. The date of construction for structures is often indicated in county or state tax records. Photographs of all structures over 50 years of age must be included with the application materials.

MAIL COMPLETED FORM AND ATTACHMENTS TO:
Virginia Department of Historic Resources
Attention: Project Review
2801 Kensington Avenue, Richmond, VA 23221
www.dhr.virginia.gov

11-12. These questions are designed to help DHR determine if your project needs to be reviewed by an architectural historian or an archaeologist or both. If the answer to either of these questions is *yes*, a complete explanation is required in the Description.

13. Description. Attach a detailed description of the project area and the proposed undertaking, making sure to include the following information:

a) Description of the existing land use. Include photographs of the project area.

b) Description of any recent modifications to the landscape. [Note: If the existing landscape appears to be markedly different from that shown on the attached quad map, please include information to that effect explaining what changes have occurred since the map was last updated.]

c) For projects involving the rehabilitation, alteration, or demolition of a structure over 50 years of age, a detailed description of the extent of the proposed alterations, along with photographs, architectural and engineering drawings, project specifications, and maps will be required.

d) Detailed project description that includes the precise location of all construction, destruction, and other proposed disturbance, the horizontal and vertical dimensions of all above and below ground construction, and the nature and extent of any previous disturbances – i.e. it is in a plowed field or disturbed VDOT right-of-way – within the APE.

Please Note: A complete project review application consists not only of the fully completed form, but also a completed Archives search, a USGS topographic map with the APE marked, a detailed project description, and all required photographs and project plans. A checklist is provided at the end of the application. Accurate and complete information will help in obtaining a timely response. If all required materials are not submitted, you will receive notification that your application is incomplete and the 30-day review period will not begin until all necessary materials are received.

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COMMONLY USED FEDERAL AND STATE AGENCIES AND ABBREVIATIONS

Federal Agencies

Advisory Council on Historic Preservation	ACHP
Department of the Interior, Bureau of Land Management	BLM
Central Intelligence Agency	CIA
Department of Defense, Army Corps of Engineers	COE
Drug Enforcement Administration	DEA
Department of Defense	DOD
Department of Defense, Army	Army
Department of Defense, Navy	Navy
Department of Defense, Marines	Marines
Department of Defense, Air Force	Air Force
Department of the Interior	DOI
Department of Justice	DOJ
Department of Labor	DOL
Defense Security Service	DSS
Department of Education	ED
Department of Commerce, Economic Development Administration	EDA
Environmental Protection Agency	EPA
Department of Transportation, Federal Aviation Administration	FAA
Federal Bureau of Investigation	FBI
Federal Communications Commission	FCC
Federal Deposit Insurance Corporation	FDIC
Federal Emergency Management Agency	FEMA
Department of Energy, Federal Energy Regulatory Commission	FERC
Federal Highway Administration	FHWA
Federal Railroad Administration	FRA
Department of Transportation, Federal Transit Administration	FTA
Department of Housing and Urban Development	HUD
General Services Administration	GSA
Department of Health and Human Services	HHS
Interstate Commerce Commission	ICC
Library of Congress	LC
Metropolitan Washington Airports Authority	MWAA
National Aeronautics and Space Administration	NASA
National Capital Planning Commission	NCPC
National Endowment for the Humanities	NEH
National Imagery and Mapping Center	NIMA
Nuclear Regulatory Commission	NRC
Department of Commerce, National Oceanic and Atmospheric Administration	NOAA
Department of the Interior, National Park Service	NPS
Department of Agriculture, Natural Resources Conservation Service	NRCS

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Comptroller of the Currency	OCC
Department of the Interior, Office of Surface Mining	OSM
Department of Agriculture, Rural Development	RD
Rural Utilities Service	RUS
Small Business Administration	SBA
Smithsonian Institute	SI
Surface Transportation Board	STB
Technology Administration	TA
Tennessee Valley Authority	TVA
United States Coast Guard	USCG
United States Department of Agriculture	USDA
United States Department of Commerce	USDOC
United States Department of Energy	USDOE
Department of Agriculture, Forest Service	USFS
Department of the Interior, Fish and Wildlife Service	USFWS
United States Geological Survey	USGS
United States Postal Service	USPS
Department of Veterans Affairs	VA

State Agencies

Christopher Newport University	CNU
Central Virginia Community College	CVCC
College of William and Mary	CWM
Department of Criminal Justice Services	DCJS
Department of Conservation and Recreation	DCR
Department of Environmental Quality	DEQ
Department of Game and Inland Fisheries	DGIF
Department of General Services	DGS
Department of Housing and Community Development	DHCD
Department of Historic Resources	DHR
Department of Juvenile Justice	DJJ
Department of Mental Health, Mental Retardation and Substance Abuse Services	DMHMRSAS
Department of Mines, Minerals and Energy	DMME
Department of Motor Vehicles	DMV
Department of Accounts	DOA
Department of Corrections	DOC
Department of Education	DOE
Department of Forestry	DOF
Department of Veterans Affairs	DVA
Frontier Culture Museum of Virginia	FCM
Germanna Community College	GCC
Gunston Hall	GH
George Mason University	GMU
James Madison University	JMU

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John Tyler Community College	JTCC
Jamestown-Yorktown Foundation	JYF
Medical College of Virginia	MCV
North Carolina Department of Transportation	NCDOT
Norfolk State University	NSU
Old Dominion University	ODU
Piedmont Virginia Community College	PVCC
Radford University	RU
State Corporation Commission	SCC
Science Museum of Virginia	SMV
Tidewater Community College	TCC
Thomas Nelson Community College	TNCC
University of Mary Washington	UMW
University of Virginia	UVA
Virginia Community College System	VCCS
Virginia Commonwealth University	VCU
Department of Agriculture and Consumer Services	VDACS
Department of Health	VDH
Department of Transportation	VDOT
Virginia Employment Commission	VEC
Virginia Institute of Marine Science	VIMS
Virginia Museum of Fine Arts	VMFA
Virginia Military Institute	VMI
Virginia Museum of Natural History	VMNH
Virginia Outdoors Foundation	VOF
Virginia Port Authority	VPA
Virginia Polytechnic Institute and State University	VPISU
Virginia Resources Authority	VRA
Virginia School for the Deaf and Blind	VSDB
Library of Virginia	VSLA
Department of State Police	VSP
Virginia State University	VSU
Virginia Western Community College	VWCC
Wytheville Community College	WCC
West Virginia Department of Transportation	WVDOT

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Virginia Department of Historic Resources
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Project Review Application Form

This application must be completed for all projects that will be federally funded, licensed, or permitted, or that are subject to state review. Please allow 30 days from receipt for the review of a project. All information must be completed before review of a project can begin and incomplete forms will be returned for completion.

I. GENERAL PROJECT INFORMATION

1. Has this project been previously reviewed by DHR? YES ___ NO X DHR File # _____

2. Project Name Geotube Installation Along Wallops Island, Wallops Flight Facility

3. Project Location

City	Town	County
Wallops Island		Accomack

4. Specify Federal and State agencies involved in project (providing funding, assistance, license or permit). Refer to the list of agencies and abbreviations in the instructions.

Lead Federal Agency NASA

Other Federal Agency _____

State Agency _____

5. Lead Agency Contact Information

Contact Person	Kent Stover, Facility Historic Preservation Officer		
Mailing Address	NASA Wallops Flight Facility Wallops Island, VA 23337		
Phone Number	757-824-1342	**Fax Number**	757-824-1831
Email Address	Dalton.K.Stover@nasa.gov		

6. Applicant Contact Information

Contact Person	Shari Silbert, Environmental Scientist		
Mailing Address	EG&G NASA Wallops Flight Facility Wallops Island, VA 23337		
Phone Number	757-824-2327	**Fax Number**	757-824-1819
Email Address	Shari.A.Silbert@nasa.gov		

II. PROJECT LOCATION AND DESCRIPTION

7. USGS Quadrangle Name Wallops Island

8. Number of acres included in the project A length of 4,600 feet of shoreline approximately 14 feet in width running parallel to the ocean.

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9. Have any architectural or archaeological surveys of the area been conducted? **YES_X_ NO___**

If yes, list author, title, and date of report here. Indicate if a copy is on file at DHR.
1. *Cultural Resources Assessment, NASA Wallops Flight Facility,* URS/EG&G, Nov 2003 – copy on file at DHR
2. *Historic Resources Survey and Eligibility Report, Wallops Flight Facility,* URS/EG&G, Dec. 2004 – copy on file at DHR
3. *Integrated Cultural Resource Management Plan for NASA Wallops Flight Facility,* URS/EG&G, Dec. 2006 – copy on file at DHR

10. Are any structures 50 years old or older within or adjacent to the project area? **YES_X_ NO___**
Three buildings are located within the APE. Two of these are less than 50 years of age. The third was constructed in 1951 and was previously evaluated for its National Register eligibility. It was found ineligible for listing in the National Register in *Historic Resources Survey and Eligibility Report, Wallops Flight Facility,* URS/EG&G, Dec. 2004 (VDHR # # 001-0027-0122).
If yes, give date(s) of construction and provide photographs.
See attached photo log for photographs of the three buildings within the APE.

11. Does the project involve the rehabilitation, alteration, removal, or demolition of any structure, building, designed site (e.g. park, cemetery), or district that is 50 years or older? If *yes*, this must be explained fully in the project description. **YES___ NO_X_**

12. Does the project involve any ground disturbance (e.g. excavating for footings, installing sewer or water lines or utilities, grading roads, etc.)? If *yes*, this must be explained fully in the project description.
The project involved the excavation of two sand slurry pits and the preparation of a 4,600 ft corridor for placement of a geotextile tube as part of an ongoing beach restoration project. **YES_X_ NO___**

(Please see attached letter report.)

13. DESCRIPTION: Attach a complete description of the project. Refer to the instructions for the required information. See attached DOPAA and Reconnaissance Level Archaeology Survey for further information.

To the best of my knowledge, I have accurately described the proposed project and its likely impacts.

__Kristin Leahy, URS Corp._____ _____1/23/07___
Signature of Applicant/Agent Date

The following information must be attached to this form:

_X_ Completed DHR Archives search
_X_ USGS map with APE shown
_X_ Complete project description
_X_ Any required photographs and plans

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____ No historic properties affected _____ No adverse effect

____ Additional information is needed in order to complete our review.

____ We have previously reviewed this project. A copy of our correspondence is attached.

Comments: _____

_____

_____

_____

Signature_____ Date _____

Phone number _____ DHR File # _____

This Space For Department Of Historic Resources Use Only

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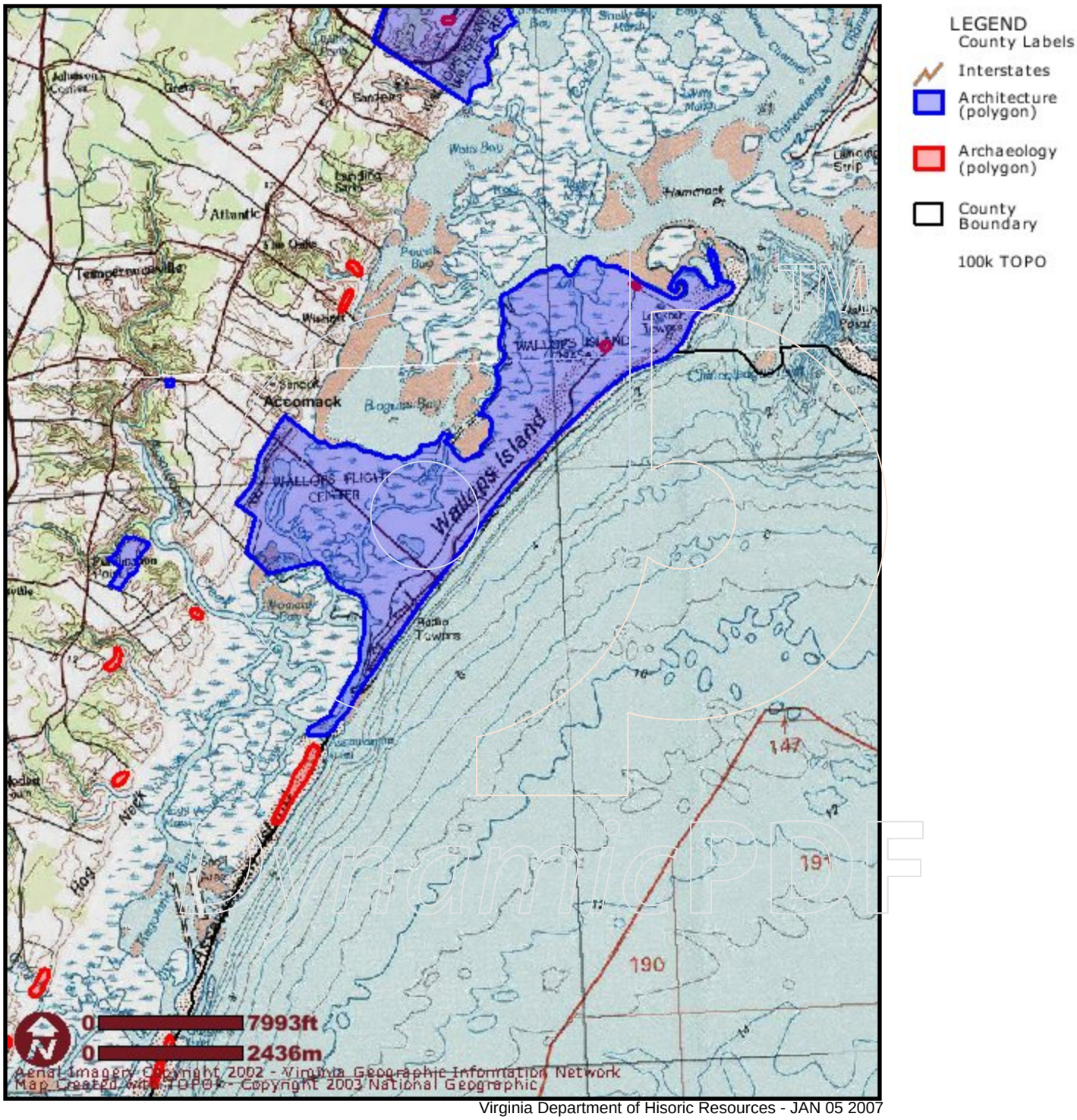
Evaluating unlicensed DynamicPDF feature. DynamicPDF.com [1:0:s1]

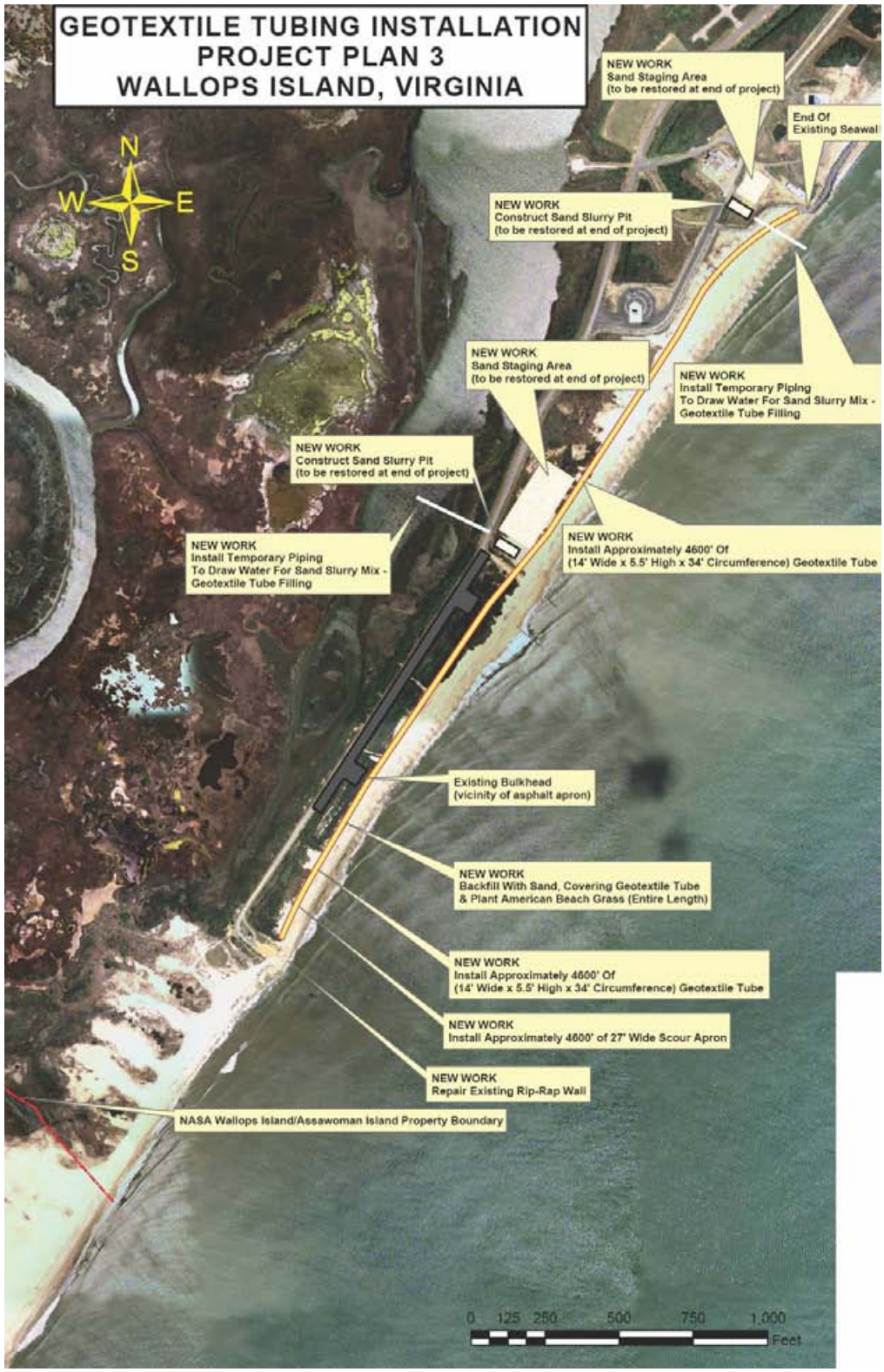
Virginia Department of Historic Resources Data Sharing System, 01/23/2007



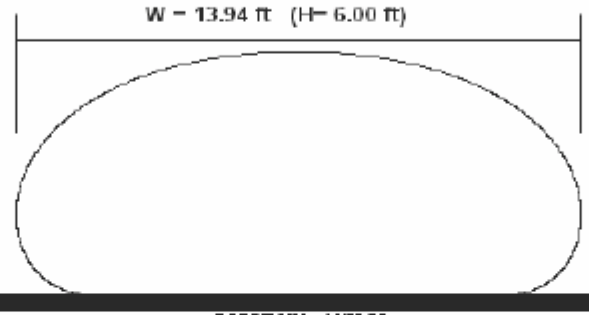
Virginia Department of Hisoric Resources - JAN 05 2007

Wallops Island

Geotube installation along beachfront of Wallops Island.



CLIENT NASA	TITLE **Geotube Installation**	
PROJ Wallops Flight Facility Shoreline Restoration – Geotube Installation	URS	PROJ NO 15299035
		FIGURE **1**



Miratech

ver02s

SOFFTWIN - 11/29/06

GIVEN C = 34.00 ft H = 6.00 ft SPG = 1.60 FS = 4.00

DENSITY OF SLURRY	=	99.84 pcf
TUBE CIRCUMFERENCE, C	=	33.99 ft
EX PRESS -TOP OF TUBE, P	=	1.323 ft (water) 0.5732 psi
WORKING CIRCUM FORCE, Tcir	=	95.57 lbs/in 1146.8 lbs/ft
WORKING AXIAL FORCE, Tax	=	71.33 lbs/in 855.91 lbs/ft
TOTAL HEIGHT OF TUBE, H	=	6.005 ft
TOTAL WIDTH OF TUBE, W	=	13.94 ft
BASE CONTACT WIDTH OF TUBE	=	10.37 ft
END AREA OF TUBE	=	70.76 sq ft 77.00 % FULL
TUBE VOLUME, V	=	2.621 cu yd/ft 529.3 gal/ft
FABRIC AREA TO VOL RATIO,R	=	1.441 sq yd/cu yd
BASE PRESSURE	=	4.737 psi 10.93 ft (water)
REQ'D CIRCUM STRENGTH T	=	382.3 lbs/in 4587.4 lbs/ft
REQ'D AXIAL STRENGTH	=	285.3 lbs/in 3423.6 lbs/ft

TenCate Geotube

NASA - Wallllops Island

No warranty or guarantee, expressed or implied, is made regarding the performance of any product, since the manner of use and handling are beyond our control.
This document should not be construed as engineering advice and the final design will be the responsibility of the project engineer and/or registered engineer.

CLIENT NASA

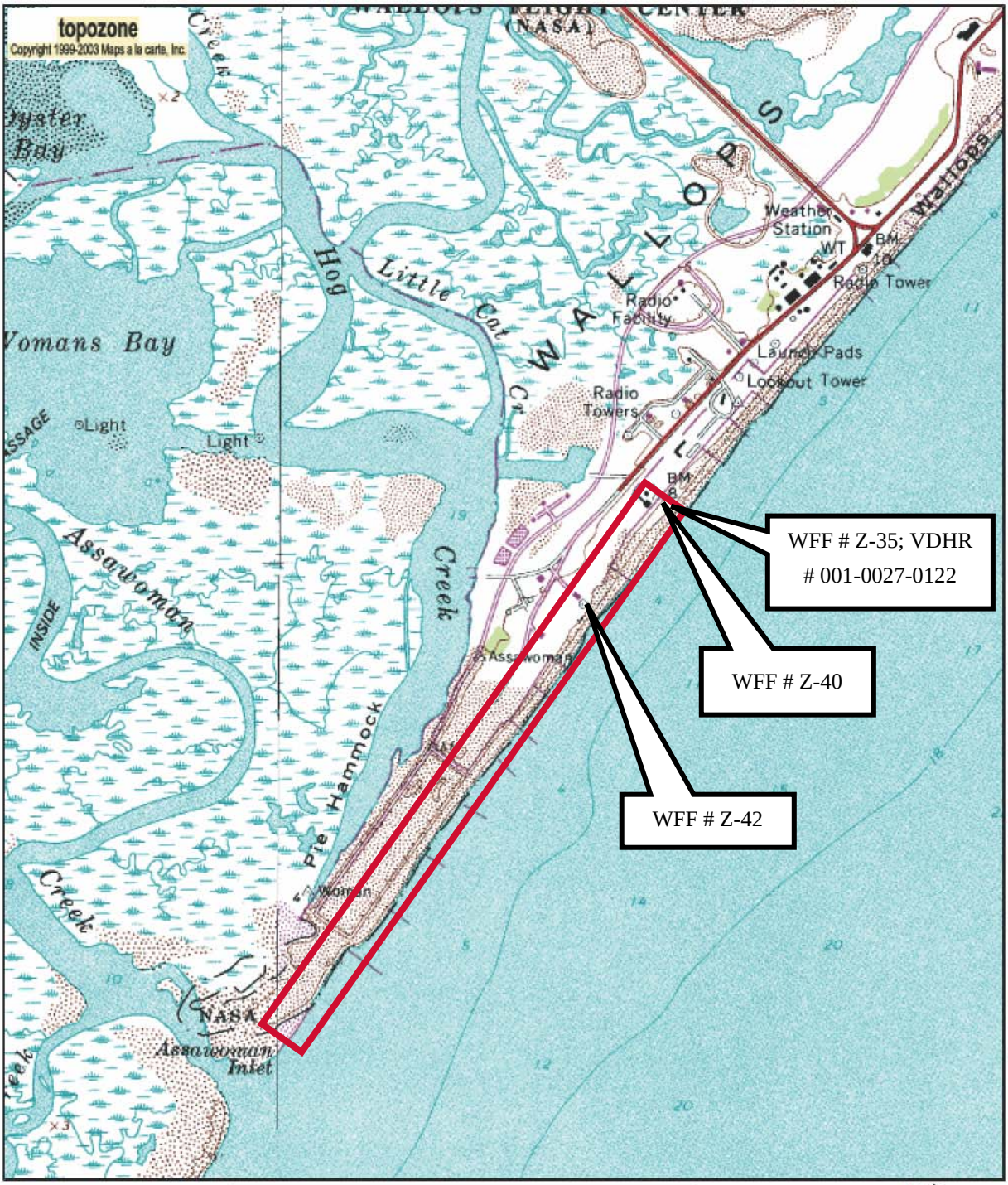
PROJ Wallops Flight Facility Shoreline Restoration Program

TITLE **Geotube Dimensions – Wallops Flight Facility**

URS

PROJ NO 15299035

FIGURE 2



0 0.3 0.6 0.9 1.2 1.5 km

0 0.1 0.2 0.3 0.4 0.5 mi

UTM 18 456737E 4187125N (NAD27)

USGS Wallops Island (VA) Quadrangle

Projection is UTM Zone 18 NAD83 Datum

M=-11.561
G=-0.301

CLIENT NASA	TITLE **Geotube Installation – Structures located within the Area of Potential Effects (APE)**
PROJ Wallops Flight Facility Shoreline Restoration – Geotube Installation	URS
	PROJ NO 15299035
	FIGURE **3**

PHOTOGRAPHIC LOG

Client Name: NASA	Site Location: Wallops Flight Facility, Wallops Island, Accomack County, Virginia	Project No. 15299035

Photo No.	Date:
1	1/22/07

Direction Photo Taken:

Northeast

Description:

Photograph of Geotube Construction at Northernmost end of APE. Two of three buildings within identified APE in background - Launch Control Center (WFF #Z-40) and Tracking Camera No. 2 (WFF #Z-35; VDHR # 001-0027-0122).

Photo No.	Date:
2	1/22/07

Direction Photo Taken:

Southwest

Description:

Photograph of Beach Erosion to high water mark.

PHOTOGRAPHIC LOG

Client Name: NASA	Site Location: Wallops Flight Facility, Wallops Island, Accomack County, Virginia	Project No. 15299035

Photo No.	Date:
3	1/22/07

Direction Photo Taken:

Northeast

Description:

View of beachfront from southernmost end of anticipated Geotube construction. Note that no structures are found in the vicinity of the beachfront at the southernmost end of the project area APE.

Photo No.	Date:
4	1/22/07

Direction Photo Taken:

Northeast

Description:

Photograph of vacant storage building (Z-42).

PHOTOGRAPHIC LOG

Client Name: NASA	Site Location: Wallops Flight Facility, Wallops Island, Accomack County, Virginia	Project No. 15299035

Photo No.	Date:
5	1/22/07

Direction Photo Taken:

Southwest

Description:

Photograph of vacant storage building (Z-42). Note level of sand deposited into vacant building during previous storm events.

Photo No.	Date:
6	1/22/07

Direction Photo Taken:

Southwest

Description:

Geotube construction from northern limit of APE. Note vacant storage building (Z-42) south of current construction along beachfront.

PHOTOGRAPHIC LOG

Client Name: NASA	Site Location: Wallops Flight Facility, Wallops Island, Accomack County, Virginia	Project No. 15299035

Photo No.	Date:
7	1/22/07

Direction Photo Taken:

Southwest

Description:

Geotube Corridor Grading

Photo No.	Date:
8	1/22/07

Direction Photo Taken:

Northeast

Description:

Geotube grading showing present beach surface.

PHOTOGRAPHIC LOG

Client Name: NASA	Site Location: Wallops Flight Facility, Wallops Island, Accomack County, Virginia	Project No. 15299035

Photo No.	Date:
9	1/22/07

Direction Photo Taken:

North

Description:

Northern sand slurry pit.

Photo No.	Date:
10	1/22/07

Direction Photo Taken:

West

Description:

Northern sand slurry pit and backdirt pile.

PHOTOGRAPHIC LOG

Client Name: NASA	Site Location: Wallops Flight Facility, Wallops Island, Accomack County, Virginia	Project No. 15299035

Photo No.	Date:
11	1/22/07

Direction Photo Taken:

Northwest

Description:

Southern sand slurry pit.

Photo No.	Date:
12	1/22/07

Direction Photo Taken:

South

Description:

Southern sand slurry pit

____ No historic properties affected ___✓___ No adverse effect

____ Additional information is needed in order to complete our review

____ We have previously reviewed this project A copy of our correspondence is attached

Comments: _____

Signature _____ Date 25 Jan 07

Phone number 804-367-2323 x140 DHR File # 2007-0087

This Space For Department Of Historic Resources Use Only

MAIL COMPLETED FORM AND ATTACHMENTS TO:

Virginia Department of Historic Resources
Attention: Project Review
2801 Kensington Avenue, Richmond, VA 23221
www.dhr.virginia.gov