11.0 Cultural Resources

11.1 Prehistoric and Historic Settlement in the Delaware Valley

The following narrative is reprinted from Section 4.4 of the 1992 Final Environmental Impact Statement. A more detailed discussion of the historical settlement of the Delaware Valley and the types of cultural resources that may be found in the project area is provided in the cultural resources investigation reports prepared by Cox (1995) and Cox & Hunter (1995). These reports are on file at the Philadelphia District office.

11.1.1 Paleogeography of the Delaware Valley and Estuary

Of the many geological processes affecting a system as complex as the Delaware Estuary, the present form of the estuary is largely the result of two principal events, one occurring over a hundred million years ago and the second occurring during the last twenty thousand years. The first event was the creation of the Fall Zone during the uplift of the Appalachian Mountains. This zone, which generally extends from Baltimore through Newark, Delaware, Philadelphia, and Trenton to New York City, marks the transition between the harder rocks of the Piedmont uplands and the softer sediments of the lower-lying coastal plain. The differences in elevation, stream gradient, and underlying rock structure between the two areas mean that the Fall Zone also represents changes in stream flow pattern and sediment deposition within the Delaware estuary. Not only does it represent the break between tidal and nontidal waters, the rapids coming off the highlands means it also marks the landward limit of ship travel. (Interestingly, many colonial cities were built along the Fall Zone).

The second factor creating the present topography of the Delaware estuary was the dramatic change that took place at the end of the Ice Ages. Circa 15,000 years ago, with so much water locked up in glacial ice, sea level would have been over four hundred feet lower, and the mouth of the Delaware estuary 75 miles farther to the east, than at present. As the ice melted and the glaciers retreated, massive amounts of debris were washed downstream to the Fall Zone and then out over the coastal plains of New Jersey and the Delmarva Peninsula. By 10,000 years ago, the estuary mouth had moved inland to some 10-40 miles offshore, and sea level was rising at a rate of up to 6 feet every 100 years. As the climate continued to ameliorate, the ecology of the Delaware Valley began changing from a glacial environment of tundra and boreal forests to a more transitional environment of mixed forests and grasslands. It was sometime during this period that humans first entered the Delaware Valley. With the continued rise in sea level, the Delaware River and Bay eventually evolved from a freshwater glacial stream to the present drowned estuary system.

11.1.2 Prehistoric Peoples in the Delaware Valley

The archaeological record of the occupation of the Delaware Valley by prehistoric peoples, well summarized by Custer (1984), is consistent with the generalized patterns of cultural development for the Middle Atlantic states. Three major prehistoric periods are recognized: Paleoindian (15,000 years Before Present, or B.P., to 8,500 B.P.), Archaic (8,500 B.P. - 5,000 B.P.), and Woodland (5,000 B.P. - 400 B.P.). The first peoples into the Delaware Valley would have been Paleoindian hunter gatherers. Apart from the Zierdt (Werner 1964) and Shawnee-Minisink (McNett et al., 1977) sites, few Paleoindian period sites have been found in the Delaware Valley, especially in the lower portion of the valley covered by the Philadelphia to the sea project. This low density of sites is partly the result of the low population density and nomadic lifestyle of the peoples from this period, but it is also attributable to the subsequent inundation of many sites by the rising water level in the Delaware Bay during the past 10,000 years, and the burial of sites under thick layers of alluvium and later cultural deposits. Archaic period peoples responded to the changed environmental conditions of the post-Pleistocene by exploiting a greater variety of resources. The archaeological record from this period suggests an increased population size, a greater reliance on processing of plant foods, and exploitation of the newly available estuarine resources of the Delaware River. The relative abundance of sites from this period has led to the definition of the Delaware Valley Archaic complex (Kinsey 1972). Sites are known for the Upper Delaware, but the lack of information from the lower Delaware and Bay area reflects site inundation through sea level rise and the destruction of sites through flooding.

The prehistoric period that is best represented in the Delaware Valley is the Woodland period, which is characterized by the introduction of pottery, increasing cultural diversity, and the evolution of a sedentary lifestyle that increasingly relied on agriculture. Sites from the Woodland period are typically found in estuarine settings, including coastal marshes and brackish rivers. Several National Register listed prehistoric sites have been found in the Delaware River and Bay area within one mile of shore. By the 1600's the Delaware Basin had been settled by the Lenape Indians, one of the tribes of Algonquin Indians.

11.1.3 Historic Settlement of the Delaware Valley

The first recorded European exploration of the Delaware Bay was by Henry Hudson in 1609, under commission from the Dutch East India Company to seek a northwest passage to China and Japan. The following year the area was visited by an English captain in search of food for the settlement of Jamestown, who named the region in honor of the governor of the Virginia colony, the Baron DeLaWarr. The Dutch were the first Europeans to exploit the rich resources of the Delaware Valley and the first to settle in the

area. They quickly set up a fur-trading network with the Indians along the Delaware River, and built outposts, such as Fort Nassau (1623), near present-day Gloucester Point, New Jersey, to support the trade network. In 1630, they also established a short-lived whaling colony named Zwaanendael, near present-day Lewes, Delaware. The Swedes put an end to the Dutch monopoly of the region in 1638 by building Fort Christina, near present-day Wilmington, Delaware. By the 1640's both the Dutch and the Swedes had established outposts as far upriver as Trenton, and battled each other for supremacy in the Delaware Valley. In 1651, the Dutch relocated their headquarters from Fort Nassau to Fort Casimir (now New Castle, Delaware), and founded the town of New Amstel adjacent to it. As the capital of the Dutch colony along the Delaware, New Amstel quickly grew into a thriving trade center. In 1654, the Dutch captured all Swedish posts, only to be conquered by armed British fleets in the 1660's during the Anglo-Dutch wars.

With the Treaty of Westminster in 1674, the British gained control of all Dutch North American colonies, including Delaware Bay. The lack of detailed mapping of the lands around the bay led to ambiguities in the royal grants for these lands, which resulted in long-running disputes over the ownership of lands along the western side of the bay. These disputes were not finally resolved until the eighteenth century, with the creation of the Mason-Dixon line (Heite 1988). By the latter part of the seventeenth century, the typical landholding pattern along the shores of the Delaware consisted of long narrow tracts of land, each fronting along the river. In 1675, John Fenwick, one of the proprietors of western New Jersey, established a settlement at Salem, which quickly became the center of government along the eastern banks of the Delaware. In 1682 William Penn obtained his royal charter for the colony of Pennsylvania, which included a portion of the west bank of the Delaware. With the establishment of Philadelphia as the colony's capital, the political and commercial focus of the western side of the Delaware shifted northward from New Amstel (renamed New Castle under English dominion) to Philadelphia. By 1700, Philadelphia had a population of more than 20,000.

During the ensuing decades, Philadelphia flourished not only as the commercial center in the Delaware Basin, but also as the principal port city on the Atlantic coast, and the center of trade with England. Philadelphia was doubly blessed by its location: the Delaware River and its tributaries provided easy transportation of goods into and out of the city, and the good soils and favorable climate of the region allowed grain, especially wheat, to become the principal export. Grain farming began the process of massive landscape alteration that continued over the next two centuries. Cutting the forests and plowing the soil to create farmland increased soil runoff and increased the silt load carried to the Delaware River and its tributaries. Processing the increasing quantity of grain being produced led to the development of mills to convert the grain into flour. While

the earliest mills were tidally driven, eventually nearly every stream in the basin had been dammed to power a grist mill (Heite 1988). Towns and roads to support agriculture and trading appeared throughout the Delaware estuary, and by the time of the Revolution, the region was flourishing.

The more than one hundred years of English dominion came to an end with the Revolutionary War. Although the British captured Philadelphia in September, 1777, the colonists retained control of the Delaware River and effectively cut off the British from the only supply route available to them. In an effort to gain control of that supply route, the British launched a large fleet of naval warships to defeat the colonial forces controlling the river. Maps prepared at that time document the locations of the defensive structures used by the colonists to defend the river, including three forts and two tiers of submerged river obstructions, known as chevaux-de-frise, along with a fleet of 57 vessels. Several naval engagements between the British and the revolutionary forces took place along the Delaware River south of Philadelphia; more than 44 vessels were lost (Cox 1984).

As the new country entered the nineteenth century, new commercial activities developed in the Delaware Valley. In the upper estuary, the vast pine and hemlock forests supported thriving timber and tannery enterprises, which in turn necessitated more efficient means of transportation. Initially it was possible to simply raft items down the Upper Delaware. However, with the discovery of the rich mineral deposits in the region - coal, sand, clay, limestone, copper, and iron - a more reliable and economical method of transportation was required. There followed a series of transportation developments, all of which had their origin and/or florescence in the Delaware Valley region, beginning with turnpike construction, followed by the canal building era, and culminating with the appearance of the railroads.

By the mid-nineteenth century, the upper Delaware estuary was industrialized and experiencing rapid population growth. The Delaware Bay, however, with its tidal marshes and minimally navigable rivers, was not as well suited to industrial development, but rather remained principally tied to agriculture (Heite 1988) (This distinction between the lower and upper estuaries of the Delaware remains valid today.) The one commercial activity that was common to both the upper and lower estuaries was fishing, an activity that had flourished in the Delaware Basin since humans first settled in the region. Oysters, sturgeon, herring, and shad were abundant in the estuary and supported a thriving fishing industry into the twentieth century, and even up to the present, although at reduced levels.

By the late nineteenth century, industrial development in the Delaware Valley was in full swing. The development of the steam engine brought new industries to the region, ones that were no longer linked directly to the estuary, except as a transportation

corridor (Heite 1988). Steam-powered railroad engines and cars were produced in Philadelphia and Wilmington; the canning industry thrived in Camden and Dover; and steamships were built in Philadelphia and Wilmington. With the invention of the Bessemer process of steel making, steel mills grew into massive industrial complexes at Bethlehem, New Castle, and Trenton. Finally, the success of the DuPont chemical company along the Brandywine River, and the discovery of oil led to a massive chemical and oil refining industry in the Delaware Valley.

11.1.4 Shipping and Shipbuilding

One Delaware Valley industry that deserves special mention is shipbuilding. Shipbuilding has been one of the most important and most famous industries of the Delaware Valley for more than three centuries. By 1700, at least four commercial shipyards were operating in Philadelphia (Cox 1988). Shipyards sprang up all along the Delaware River, and by the Revolutionary War, Philadelphia had eclipsed Boston as the shipbuilding capital of the colonies. John Fitch successfully operated the world's first steamboat along the Delaware River shoreline during the 1780's. By the nineteenth century, the shipyards of the Delaware Valley were the country's leaders in the production of iron-hulled steamships. Naval vessels for the Revolutionary War and Civil War were constructed at Delaware River shipyards. In 1900, the New York Shipbuilding Company began constructing the world's largest self-contained shipbuilding plant in south Camden. With the onset of World War I, the Philadelphia Navy Yard was expanded to become the largest navy yard with the largest drydock in the world. To help with the war effort, the American Shipbuilding Company converted Hog Island, in south Philadelphia, into the site of the largest shipbuilding plant in the world. Shipbuilding in the Delaware Valley is presently at the lowest level it has been since 1700.

Shipbuilding originally started along the Delaware River to enhance trade, which in turn increased settlement throughout the Delaware Valley. Because the Delaware River/Bay is situated roughly halfway between New York Bay and the mouth of the Chesapeake Bay, and provides the only break in a dangerous 295 mile stretch of the Atlantic coast, it was a natural site for port development.

By the colonial period, Delaware Valley port cities were engaged in trade with other colonies, Europe, and the Caribbean. Maritime commerce to and from the port cities along the Delaware River played a major role in the economic development of the entire Delaware Valley, and eventually led to Philadelphia's emergence as the lead port city on the river. In the early 1700's, Philadelphia ranked third behind Boston and New York in the volume of shipping clearing the port, and by the start of the Revolutionary War Philadelphia had surpassed both cities to

become the most active port in North America. With the advent of steamships in the nineteenth century, passenger service became a major port activity.

11.1.5 Navigational Hazards and Improvements

The volume of shipping in the Delaware estuary over the last three centuries, in combination with the navigational hazards in the waterway, inevitably led to shipwrecks. Although the total number of wrecks will never be known, more than 145 documented shipwrecks have occurred in the Delaware River/Bay (Cox 1984). That there were hazards to be overcome in safely navigating the bay and river was soon learned by the early explorers. Soundings of the Delaware estuary, undertaken by the mid seventeenth century, enabled mariners to avoid at least some of the hazards, but better mapping was needed. Although Augustine Herrman, the person to first propose a canal to connect the Delaware and Chesapeake Bays, produced the first reliable map of the Delaware Estuary shoreline in the mid seventeenth century (Heite 1988), the first comprehensive navigational chart, with bottom contours, was not made until 1756 (Cox 1988).

By 1766, a single governmental body, the Wardens of the Port of Philadelphia, was established to direct channel and harbor improvements (GAI 1983). One of their first activities was to authorize the removal of the chevaux-de-frise, submerged wooden frames used by the colonists to defend the river during the Revolutionary War. Most had been removed by 1784, but during channel dredging in the 1940's dredges are reported to have struck one or more of the frames (Cox 1988). One of the earliest improvements to navigation on the Delaware was the 1803 construction of ice piers off New Castle, Delaware. Until the middle of the nineteenth century, the Delaware River froze over almost every winter, and the resulting ice floes posed a serious threat to ships. The ice piers served as refuge for sailing vessels and helped to break up ice floes as they came down the river (Cox 1988). Other early navigational improvements included the stabilization of river banks, the diking and in-filling of low-lying areas, and the removal of islands (GAI 1983).

However, the major navigation hazard in the Delaware River has always been shoaled waters (Cox 1988). Dredging the river to remove shoals and maintain a navigable channel has been ongoing since 1800. At that time limited, man-powered dredging was possible; by the 1840's, steam dredge boats were used to maintain channels and to build harbors (GAI 1983). Currently there are eighteen major shoals or sand bars near the main channel of the Delaware River. Historically, mariners were required to navigate through these shoals in a winding channel. To monitor the locations of shoals and to facilitate safe navigation, the National Ocean Survey and its predecessor has conducted regular hydrographic surveys of the Delaware River and Bay, since at least 1840.

In its natural state, the Delaware River downstream of Philadelphia had a natural depth of 20 feet (deeper in some places) and a controlling depth of approximately 17 feet (Boggs 1929). By the last quarter of the nineteenth century, the typical ocean-going vessel had a draft of 20-24 feet, and could no longer safely negotiate past all the obstructions except at high tide. From 1877 to 1882, several of the major natural obstructions, large portions of the rock shoals between Chester and Marcus Hook and the shoals near Petty Island and Fort Mifflin, were removed. But it was not enough to permit safe passage of deep-draft ships. Finally, in 1885, Congress authorized the permanent and systematic improvement of the Delaware River, and gave the Army Corps of Engineers the responsibility of dredging and maintaining the channel, anchorages, dikes and harbors. The 1885 legislation called for a channel 26 feet deep and 600 feet wide from Philadelphia to deep water in Delaware Bay. The transition from sail to steam power rendered the 26 foot deep channel obsolete and led Congress in 1896 to authorize an increase in channel depth to 30 feet. The existing Delaware River, Philadelphia to the Sea Federal channel project was initially authorized by the Rivers and Harbors Act of 1910 and has been modified several times to its presently authorized forty foot depth.

11.1.6 Fort Delaware, Pea Patch Island

The following brief discussion on the history of Fort Delaware and Pea Patch Island is summarized from Catts, Coleman and Custer (1983). During the early 19th century, Pea Patch Island was an unstable land surface located in the middle of the Delaware River and flooded daily during high tide. However, its strategic position made it an ideal location for a major defensive fortification for the protection of Wilmington, Philadelphia, and the Delaware entrance to the C & D Canal. Construction of fortifications began with the building of an embankment and drainage ditches in 1813-1814 to create a land surface stable enough to be inhabited throughout the tidal cycle. The area enclosed by the embankment initially contained approximately 70 acres and was later expanded to 80 acres.

The real work of fortifying the island began 1815 when construction of a masonry pentagonal-shaped fort was approved. Placement of foundation pilings and grillage was completed in 1819. Many difficulties delayed construction, including wash-outs at high tide, failing foundations and sickness. Construction of the fort was far enough advanced in the fall of 1824 to allow a garrison, one company (52 men) of the 2nd Regiment of Artillery, to take quarters there. Repairs of cracked and settling walls and construction of the barracks and officers quarters continued until 1927, when the fort was finally completed. With its completion, Fort Delaware became the primary defense of the Delaware River. Its armament consisted of 234 guns, 10 howitzers, and 28 carronades. The fort's peace time garrison was never more than 100 men. Garrison duty at Fort

Delaware was anything but pleasant. The troops had to contend with storms, flooding, disease, and boredom. Members of the garrison were constantly employed in repairing the existing embankment walls or construction of new ones.

The new fort didn't last long. In 1831 a fire completely gutted the structure and a subsequent inspection found it to be irreparable. It was decided that a larger fort, based on a new design and supported by stronger foundations, would be built. Between 1834 and 1838, the walls of "old Fort Delaware" were completely torn down and the material placed on the exterior slope of the embankment. Unfortunately, construction of the new fort was soon halted over a lawsuit concerning ownership of the land. This delay lasted for 10 years until the suit was finally settled in 1848.

The construction of the new fort was essentially completed in 1860, creating the largest masonry fort in the United States. In April, 1862, the federal government decided to use Fort Delaware as a prisoner-of-war camp for captured Confederates. The first prisoners to arrive were 250 Virginians captured at Kernstown. Soon after, temporary prison barracks were constructed to accommodate over 2,000 prisoners. By the end of June, 1863, barracks for 10,000 prisoners had been erected outside of the fort. Besides the barracks, the prisoners had the use of a kitchen and bakery, sutler's shop, "sinks" or latrines, and a hospital. The hospital was actually two distinct buildings; a general hospital and a contagious hospital. Both were completed late in the summer of 1863 just in time to receive the tremendous influx of prisoners recently taken at Gettysburg and Vicksburg. By 1865, the majority of the 49 structures located outside of the fort walls supported the prison camp. On the whole, living conditions for both the garrison and the prisoners were poor. Diseases such as smallpox, typhoid fever, scurvy, malaria, and chronic diarrhea were common and prevalent. The end of the war came in April, 1865, and by August, Fort Delaware had been vacated as a Confederate prisoner-of war camp.

By 1870, Fort Delaware, although no more than 10 years old, was considered obsolete. The garrison was withdrawn and the post turned over to the Corps of Engineers. By 1880, the fort was beginning to suffer from neglect and a lack of funds. In 1884 the Wilmington newspaper reported that the population of the island was 20 people (6 families), with half living inside the fort.

Based on the findings of the Endicott Board, a Congressional committee formed in 1890 to survey the condition of coastal defenses in the United States, the decision was made to modernized Fort Delaware again. This new work began in 1894, which included a massive two-story concrete emplacement for 12-inch guns built inside the fort. Within the walls of the new "Endicott" section, there was space for barricks, gun rooms, radio rooms, fire control rooms, ammunition rooms, and a power

house for the engines. By 1900 the majority of the construction was completed and Fort Delaware was now part of a coastal defense system, linking Forts Dupont and Mott, and further down the river, Fort Salisbury.

By the fall of 1901, the Corps of Engineers had turned over the fort to the Artillery for administration and garrison duty. Early in 1904 the Artillery detachment was withdrawn, and once again the island was turned over to the Corps. It was quickly decided to use the island for disposal of dredged material, which was obtained from the new 30 foot channel being built in the Delaware River, in an attempt to protect the island and its new modernized fort from consistant flooding. The island embankment was raised 3 to 5 feet in preparation for filling, as well as selected structures outside the fort. Deposition continued on the island until 1908, when an estimated 2 million cubic yards of fill had been pumped onto the island.

From the First World War to the beginning of the Second World War, Fort Delaware was viewed as an outpost of Fort Dupont. A small detachment of solders from Fort Dupont were stationed there to warn off trespassers, paint mines and other equipment, and to care for the modern guns. Throughout the 1930's, the 621 Coast Artillery Battalion, U.S. Army Reserves, held annual encampments at the fort. Following World War II, Fort Delaware and Pea Patch Island were declared surplus to Army needs and all of the island, except a small 18 acre tract adjacent to the navigation channel on the eastern side, was turned over to the State of Delaware for civilian use. From that time until 1951, when the state turned the island over to the State Park Commission to maintain it, the fort suffered greatly at the hands of vandals and treasure hunters. Much of the damages caused in those brief years is to some extent still being repaired today. Fort Delaware is listed on the National Register of Historic Places.

Failure of the embankment along the southeastern portion of the island in the 1970's initiated severe erosion along the shoreline that continues to the present. This erosion has exposed, and continues to expose, archaeological material and foundations related to the historic military occupation of the fort. In cooperation with Delaware State Parks, the Corps retrieved eight wooden gun carriages from this eroding shoreline in 1991 and completed their conservation under a contract with the State of Delaware in the Spring of 1997. Philadelphia District is working closely with Delaware State Parks and their contractor, S.T. Hudson Engineers, Inc., to review plans and specifications for the placement of shoreline protection and to secure funding for this work under the existing federal project.

11.2 Cultural Resources Investigations

In order to fulfill our responsibilities under the National Historic Preservation Act of 1966, as amended, the Philadelphia District has conducted several cultural resources investigations

to locate significant cultural resources in the project area and to assess potential project impacts on those resources. Beginning in the late 1970's, a cultural resources overview and sensitivity analysis for the Delaware River and Bay from Philadelphia to the sea was prepared in a report entitled "Cultural Resources Overview and Sensitivity Analysis for the Delaware River and Shoreline" (Gilbert/Commonwealth 1979). This study was designed to collect cultural resources data to assist in the preliminary development of a regional dredged material disposal plan for the tidal portions of the waterway. The study identified 162 historic sites and districts within one mile of the Delaware River and Bay area shoreline from Trenton, New Jersey to Lewes, Delaware. The sensitivity analysis was inconclusive regarding the deposition of resources in the main shipping channel. No fieldwork was undertaken. In a follow-up investigation entitled "Delaware River Comprehensive Navigation Study (interim): Cultural Resources Sensitivity Reconnaissance" (GAI Consultants Inc. 1983), researchers assessed the potential for significant cultural resources within several proposed dredging and disposal sites between Wilmington and north of Philadelphia. This study added 30 new historic sites to the 1979 inventory and concluded that "previously dredged deep channels and anchorages have virtually no potential for containing significant cultural remains".

In "Fort Elfsborg 1643: A Background Study of the History of Elsinboro Point or Fort Elfsborg, Elsinboro Township, Salem County, New Jersey and New Castle County, Delaware" (Heite & Heite 1986), the authors attempted to map the location of Fort Elfsborg and concluded that the most likely location was off Elsinboro Point between the high water mark and the main shipping channel. A "Sensitivity Level Investigation of Cultural Resources in the Vicinity of the Main Navigational Channel, Delaware River, Wilmington to the Sea, and a Proposed Deepwater Port" (Cox 1986) assigned cultural resource sensitivity designations of high, medium, or low to three segments of the waterway from Wilmington to the Atlantic Ocean, to facilitate plans for deepening or widening the existing navigation channel and anchorages, and creating a deepwater port. In a continuing effort to identify potential dredged material disposal areas, the Philadelphia District conducted fieldwork in New Jersey and Delaware to assess the cultural resource potential at proposed disposal areas along the Delaware River in 1985. The report of this study is entitled "Preliminary Cultural Resource Reconnaissance Investigation of Thirteen Disposal Areas" (Heite and Heite 1986a).

A remote sensing survey was first conducted in selected project areas in 1987. The results of this work is described in a report entitled "Submerged Cultural Resources Investigations, Delaware River Main Navigational Channel, Philadelphia, PA to Artificial Island, NJ" (Cox 1988). Researchers utilized magnetometer and side-scan sonar to investigate fourteen channel bend-widening locations. Sixty-six remote sensing targets were identified, of

which 6 exhibited strong submerged cultural resources characteristics.

In the following study, entitled "Submerged Cultural Resources Investigations, Delaware River Main Channel Deepening Project, Delaware, New Jersey and Pennsylvania" (Cox 1995), underwater archaeologists conducted ground truthing operations at high probability targets first identified in 1987 (Cox 1988). Two of these submerged targets were determined potentially eligible for listing in the National Register of Historic Places. The first target, E-1, 1:5, was tentatively identified as a rock filled timber crib associated with Revolutionary War period construction. The second target, E-2, 4:16, was identified as the remains of the wood-hulled, side-paddle steamboat "Excelsior" (both of these underwater sites were re-visited in 1994 during the Phase I & II investigation referenced below [Cox & Hunter 1995]). Additional remote sensing surveys were also conducted in project areas not previously investigated for cultural resources. An intense remote sensing survey utilizing magnetometer, side-scan sonar, sub-bottom profile and bathymetric data was conducted in forty-eight separate project locations extending over eighty linear miles. Survey locations were first identified in an analysis presented by Jan Ferguson, District Archaeologist, in the 1992 FEIS, Section 5.1.12, and was later refined by utilizing up-to-date channel depth information and maintenance dredging records. The primary goal of the analysis was to identify all previously undredged project areas that would be impacted by project construction (see Section 11.3.2, below, for a reprint of Ferguson's analysis). The project areas surveyed during this study include, 1) three channel bend widening locations at Liston-Cross Ledge, Cross Ledge-Miah Maull and Miah Maull-Brandywine intersections (all other bend widening locations were previously surveyed by Cox in 1987), 2) thirty-five nautical miles of channel side-slope areas, and 3) 2,200 acres of channel deepening locations. The remote sensing survey identified 154 magnetic and acoustic anomalies and recommended additional Phase II investigation at 11 of these targets (see Figure 11-1).

The final study, prepared in a draft report entitled "Submerged and Shoreline Cultural Resources Investigations, Disposal Areas and Selected Target Locations, Delaware River Main Channel Deepening Project, Delaware, New Jersey & Pennsylvania" (Cox & Hunter 1995), conducted multi-purpose research that included a remote sensing survey of potential underwater disposal areas, low-tide shoreline survey, underwater inspection of 11 previously documented and 2 newly discovered remote sensing targets, and detailed Phase II level recording of two previously identified targets. Target E-1, 1:5 was initially identified as a rock filled timber crib associated with Revolutionary War period construction (Cox 1995). Phase II investigations re-identified the site as a largely intact sectional canal coal barge dating from the period circa 1830-60 and of a type widely used on the Lehigh Canal and Delaware Canal navigation systems. The barge is still filled with large pieces of hand broken coal which

indicates the vessel may have sunk in the 1830s or 1840s. The other target, E-2, 4:16, is the remains of the side paddle-wheel steamer "Excelsior", which was built in Wilmington in 1880 and operated in the Mid-Atlantic region until it burned and sank in 1892. Shoreline structural remains of two lighthouse sites and oyster harvesting related facilities were identified in wetland restoration study areas in New Jersey and Delaware. The results of this investigation, and the others discussed above, are presented in greater detail, as appropriate, in the Environmental Effects Section 11.3, below. All referenced reports are on file at the Philadelphia District office.

11.3 Impacts on Cultural Resources

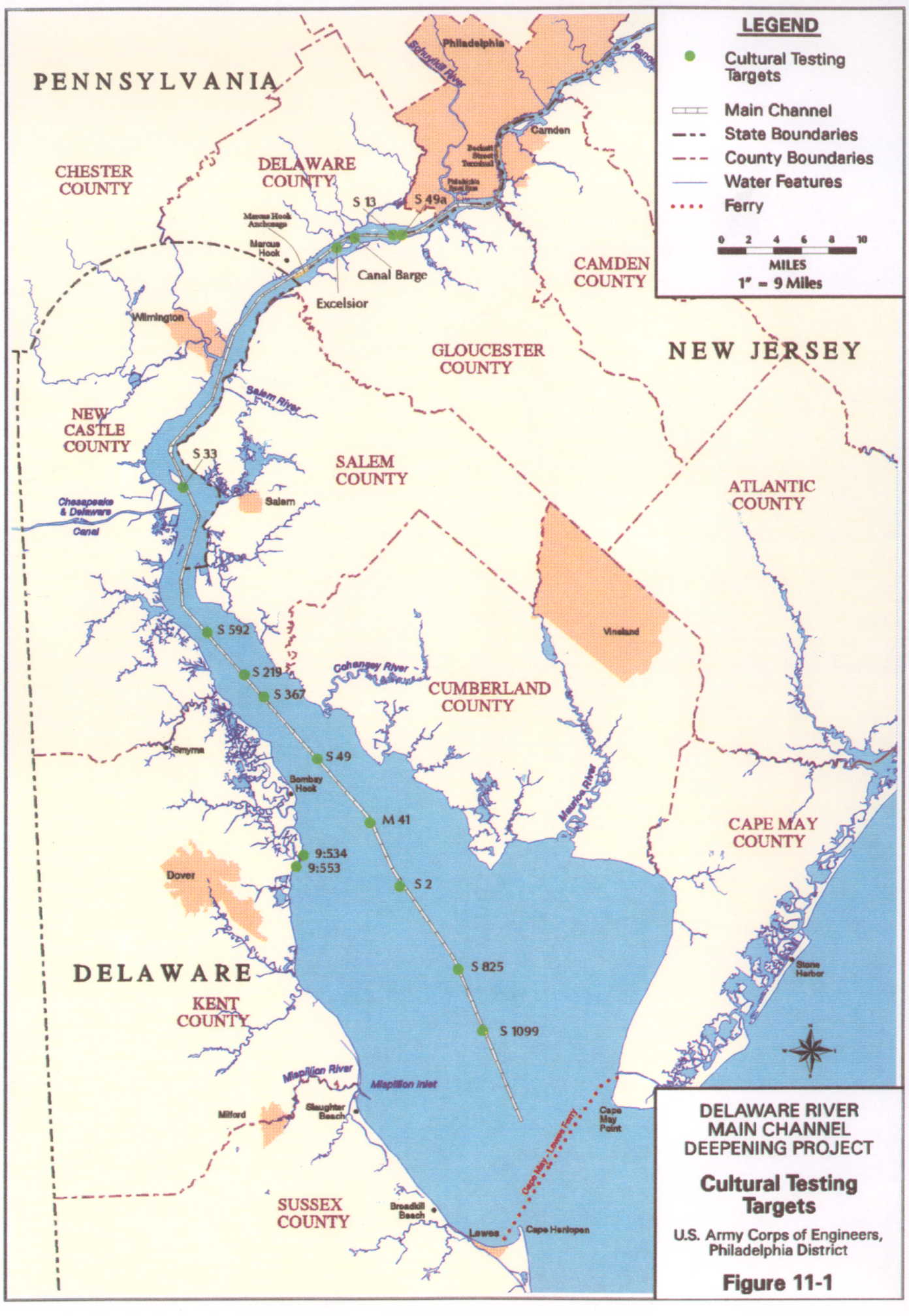
11.3.1 Project Impact Areas for Cultural Resource Review

Proposed project construction has the potential to impact cultural resources in seven areas. These are 1) channel bend widening areas, 2) channel bottom and side-slope locations, 3) one anchorage site, 4)upland dredged material disposal locations, and beneficial use sites including 5) wetland restoration areas and 6) submerged dredged material stockpile locations, and 7) selected shoreline areas. In channel, channel-bend and anchorage areas, potential impacts to historic properties could result from the dredging of bottom sediments. Reactivation, expansion and continued use of existing upland dredged material disposal sites, and the creation of new beneficial use sites and submerged stockpile locations could potentially impact cultural resources during construction and dredged material placement. Higher ship generated waves resulting from deeper draft vessels could increase shoreline erosion of historic archaeological deposits.

11.3.2 Impacts to Cultural Resources

The following revised discussion on potential project impacts to cultural resources is taken largely from the 1992 FEIS (Section 5.1.12). While prehistoric and historic utilization of the Delaware River and Bay has been both extensive and intensive, it is anticipated that dredging the Federal navigation channel has the potential to impact three categories of cultural resources. First, there could be impacts to objects that were placed in the river either as an aid to navigation (e.g., dikes, fixed buoys) or as a hindrance to navigation (e.g., the chevaux-de-frise of the Revolutionary War). Second, channel modification could affect shipwrecks, and third, channel deepening could potentially increase shoreline erosion and destroy significant historic archaeological resources along the southeastern shoreline of Pea Patch Island.

Before examining in detail the potential for effects on these categories of resources, it is necessary to briefly consider why impacts from dredging are not expected for other categories of cultural resources. While many of the shoreline sites utilized by prehistoric peoples would have been inundated by sea level



DELAWARE RIVER MAIN CHANNEL DEEPENING PROJECT

Cultural Testing Targets

U.S. Army Corps of Engineers, Philadelphia District

Figure 11-1

rise, there are a number of reasons why those sites would not be located in the vicinity of the navigation channel. First, the deepest part of the river bed, which would not have been dry land during any of the time that the Delaware Estuary has been occupied by humans. Additionally, although sea level rise has submerged some of the earlier shoreline, landfilling activities along the river banks over the past three centuries of historic settlement have extended the shoreline out into the river along large stretches of the river (Cox 1984). Thus, many previously inundated prehistoric sites may have been destroyed through these activities or may now be buried under landfill. Similarly, many historic period cultural resources along the shoreline, such as piers, wharves, and bulkheads, may also have been destroyed by, or incorporated into, landfilling activities. Other historic period resources remain, but are located either along the present waterfront, or on or alongside the islands in the river, or in the back channels between the islands and the banks of the river. None of these areas will be affected by proposed dredging activities. Thus, there is virtually no likelihood that prehistoric sites or the remnants of any historic shoreline structures would be found in any of the areas proposed for dredging, including bend widening, channel deepening and anchorage deepening locations.

Potential impacts to submerged objects, namely shipwrecks and objects placed in the river to hinder or enhance navigation, were evaluated. Of the several kinds of objects that might have been placed in the river to enhance navigation, none would be expected to be in the channel. Objects such as dikes, ice piers, etc. would have been constructed perpendicular to, or adjacent to, the channel, but not within the channel. Therefore, while deepening the channel would not impact any of these structures, widening the channel, especially at the bends, could conceivably impact them. Similarly, deepening and widening the channel could impact objects that had been deliberately placed in the channel to hinder navigation. In the Delaware River, the most famous examples of such obstructions are the chevaux-de-frise, wooden frames that held upright timbers tipped with iron spikes, used during the Revolutionary War to defend Delaware River forts against British attack. Although most of the chevaux-de-frise were removed in the 1780's (Cox 1988), the Corps encountered remains of several of the frames near Fort Mifflin during the 1930's while dredging the channel down to 40 feet. Although it is possible that one or more of the chevaux-de-frise still remain in the navigation channel, the very nature of the placement of these obstructions (upright in the channel) makes it more than likely that past dredging episodes have removed significant portions of them. It is highly unlikely, therefore, that any intact chevaux-de-frise remain in the navigation channel. Nevertheless, it is possible that even fragments of a chevaux-de-frise could be considered potentially significant.

As discussed in the 1992 FEIS, Section 4.4, ships have traveled through the Delaware Estuary for the last three hundred years.

The Institute for Conservation Archaeology's 1979 landmark study of the potential for submerged cultural resources along the Atlantic coast continental shelf gave the area encompassing the Upper Delaware Bay extending into the Delaware River a "moderately heavy" rating for both known and predicted density of submerged cultural resources. The sheer volume of shipping and the natural hazards present in the Delaware River have resulted in at least 145 documented shipwrecks between Philadelphia and the sea (Cox 1984, Cox & Hunter 1995; Appendix A). The National Ocean Survey's Automated Wreck and Obstruction Information System lists 83 obstructions in that same stretch of the waterway, most of which are reputed to be shipwrecks (AWOIS listing, June 12, 1987). Many of these shipwrecks, if even partially intact, would be significant on the basis of age (rare late eighteenth and early nineteenth century vessels) and/or historical association (e.g., vessels sunk during the Revolutionary War).

In order to better assess the likelihood that implementing the proposed project would actually impact objects or shipwrecks in or adjacent to the navigation channel, it is necessary to briefly review both the sedimentology of the river bottom and the history of channel improvements in the Delaware River. Except for a few locations where there are rock outcrops, the bed of the Delaware River below Philadelphia is generally sand and gravel overlaid with mud and silt. These are predominantly Holocene sediments that are generally less than 30 feet thick; in places, bedrock is within ten feet of the channel bottom.

Rock outcroppings, generally manifested as ledge rock, are encountered near Chester and Marcus Hook, and in the upper portion of Philadelphia Harbor. Geologically, the Delaware River and Bay can be divided into an upper estuary and lower estuary, with the dividing line between the two located near Bowers Beach, Delaware and the Cohansey River in New Jersey. The upper estuary, especially that portion of it below Philadelphia, is a fairly simple tidal river, with a river bottom as described above. The stretch of the river between Marcus Hook, Pennsylvania and Artificial Island, New Jersey is a major depositional area within the estuary. The lower estuary, with its broad coastal marshes, sand beaches, deep estuarine flats of coarse bottom sediments, and numerous mid-bay shoals and channels, is more geologically diverse than the upper estuary (Kraft 1988). The coarse bottom sediments of the lower estuary are thought to have been brought in from upriver at a time of lower sea level, or to have resulted from wave erosion along the shoreline; the present river regimen very seldom moves sand or other coarse material downstream into the lower bay (Kraft 1988). The dominant topographic feature of the lower estuary is the large number of long shoals that point finger-like to the north and west. Tidal forces have created these shoals, many of which have deep troughs between them. While the location of these shoals and troughs was largely determined by stream erosion patterns of the late Pleistocene, the changes in tidal currents that have occurred as a result of sea level rise have led to

changes in the shape of many of the shoals, a process that continues today (Kraft 1988). Both the presence of the shoals and their tendency to undergo modification have long affected navigation in the lower estuary.

The presence of shoals is also a problem in the upper estuary. In its original condition, the Delaware River below Philadelphia was obstructed by numerous bars and shoals which reduced the minimum usable depth to 17 feet at mean low water (House Document No. 733, 1910). Prior to the start of systematic improvement of the river in the 1880's, a ship sailing upriver to Philadelphia needed as much as four days to complete the trip if it had to wait for high tides to pass over the shoals (Boggs 1929). Many of the original shoals have been removed or at least reduced by channel dredging over the last century. Since the start of systematic improvements to the Delaware estuary, over one billion cubic yards of material have been removed. The dredging, combined with the construction of dikes and jetties, has altered the natural regimen of the river with respect to currents, depths, and tidal conditions. Present-day shoaling in the navigation channel is still partly a result of the net transport of sediment downstream, but it is also largely the result of the build up of areas where the ebb and flood flows of material do not take the same course, and a result of sediments sliding from the sides of the channel into the channel, which is causing a gradual lowering of the river bed for some distance on either side of the channel. To maintain the present 40-foot navigation channel, up to 5 million cubic yards are dredged annually.

Systematic improvements to the river began in 1885 and are summarized in Table 5-26 of the 1992 FEIS. It is clear from this table that there has been considerable disturbance to the river bottom over the last century, and in many areas, historic resources that might once have been present would long since have been removed or destroyed. Nevertheless, there are still portions of the river bed that have not been substantially altered and within which the potential for historic resources must be carefully evaluated. These areas include (1) the proposed bend widening areas at the intersections of ranges, which, although adjacent to the present channel, quite likely have not been dredged before, (2) undisturbed channel side-slope areas, and (3) naturally deep areas within the main channel that may have never been dredged or may have only been minimally dredged. It would not be surprising to find shipwrecks in undredged areas adjacent to the channel, such as the locations proposed for bend widening. Typically, a vessel that encounters disaster while navigating the river would be deposited just off the channel, either because a navigational error led the ship off course where it ran aground and was abandoned or because the stricken vessel was able to maneuver to the closest shallow water in an effort to save the crew and the boat (Cox 1986). Despite the significant amount of dredging that has taken place over the last century, there are still areas of the river and bay which are naturally deep, and which therefore may never have been

dredged or may have been only minimally dredged. While surveys of the Delaware River has been conducted since the mid-nineteenth century, many of these early surveys contain insufficient data to accurately determine the depth at any particular location. Systematic dredging of the river began in 1885, with a navigation channel 26 feet deep by 600 feet wide completed in 1898. By 1909 the channel had been deepened to 30 feet, and subsequent deepenings through the 1960's have created the present 40 foot deep channel.

Current maintenance dredging practices for the Delaware River, known as advance maintenance dredging, require dredging deeper than 40 feet (in some cases as deep as 44 or 45 feet), to ensure a minimum 40 foot channel throughout the year. Since the entire channel is now at least 40 feet deep, that was used as the starting depth for researching naturally deep areas; any historic resource that sank in an area of less than 40 feet of water, even though it might have settled some into the river bottom deposits, would most likely not have settled more than a couple of feet, and therefore would have already been impacted, if not destroyed, by previous channel dredging. Dredging operations in 1948 cut through what is believed to have been two shipwrecks during deepening of the Mantua Creek anchorage to 37 feet (Cox 1988). Hydrographic surveys of the Delaware River conducted by the Corps in 1909, just after completion of dredging the 30 foot channel, show seven locations along the channel with depths of 40 feet or greater between Philadelphia Harbor and Bombay Hook Point (U.S. Congress, 1910).

By 1937, after completion of the 35 foot channel and the creation of four anchorage areas, hydrographic surveys show twenty-three areas with depths of at least 40 feet, including the original seven, between Philadelphia and Bombay Hook Point, plus additional deep areas from Bombay Hook point to the mouth of the bay (U.S. Congress 1938). Of the twenty-three deep areas north of Bombay Hook identified in the 1937 survey, only the original seven from the 1909 survey are of concern. Since the remaining deep areas did not show up in the 1909 detailed survey, they are most likely the result of the dredging work in the channel that took place between 1909 and 1937. It is also possible that some of these "new" areas were used as sources of borrow for the creation of disposal areas such as Artificial Island and Killcohook. Any resource that may have been present in these areas prior to their deepening would have been disturbed, if not completely destroyed, by dredging activities.

Therefore, that leaves for consideration the original seven locations with depth of at least 40 feet, plus those areas within the channel in Delaware Bay that were identified as having a depth of 40 feet or greater in the 1937 survey but which were beyond project limits, and therefore not covered, in the 1909 survey. Above Bombay Hook, the deep areas total a little less than nine miles, while in the bay deep areas may cover more than thirty seven miles in length. In addition, the Corps analyzed

hydrographic surveys and old dredging records to determine whether any of these areas are deep as a result of pre-1909 work in the channel, and whether any area has been deepened through dredging work. It is known that considerable quantities of material have been removed from areas in the Delaware River channel and used as fill for the construction of landfill along the shore, and in major highway projects. For the deep areas in the bay, a detailed examination of hydrographic charts identified those areas that are deeper than 50-55 feet and which therefore are below any possible impact as a result of deepening the channel to 45 feet. The results of this analysis identified 62 channel areas that are within the zone of potential impact and which do appear to be naturally deep and not previously dredged. These areas include 17 bend widening areas, 33 channel side-slope locations, and 12 channel deepening sites.

The disposal of dredged material is planned for 13 existing upland dredged material disposal areas (these include 4 inactive and 9 active disposal sites), 2 submerged sand stockpile sites and 2 wetland restoration locations. Reactivation of old disposal areas requires new dike construction and dredged material placement. These activities have the potential to impact prehistoric and historic cultural resources. Each of these sites is located along the shore of the Delaware River at the confluence of tributaries. It is not surprising, therefore, that each site is found in an area rich in prehistoric and historic resources. Submerged sand stockpile locations and wetland restoration areas have the potential to contain cultural resources such as submerged and shoreline shipwreck sites, historic structural remains and archaeological deposits. Placement of dredged material and the excavation associated with berm construction during wetland restoration has the potential to impact surface material and buried archaeological deposits.

11.3.3 Channel Bend Widening Areas

In order to ascertain the presence/absence of potentially significant historic resources at the areas proposed for bend widening, three remote sensing investigations utilizing a combination of magnetometer, side-scan sonar, sub-bottom profiler and underwater diving operations were conducted at 17 range intersections (Cox 1988, Cox 1995, Cox and Hunter 1995). Of the 71 targets identified in bend widening locations, 7 were considered to be high probability targets exhibiting shipwreck characteristics (see Table 11-1). Underwater ground truthing operations were conducted in the summers of 1993 and 1994 on 6 of these targets to determine the nature, extent and potential National Register of Historic Places eligibility of each target (Cox 1995, Cox and Hunter 1995). The seventh high probability location, Target L1:15, was not investigated because of its location outside of the project area. The results of Phase I and Phase II studies found that two of these submerged sites, both in New Jersey waters, are eligible for listing in the National Register of Historic Places. The first target, E-1, 1:5, was

tentatively identified as a rock filled timber crib associated with Revolutionary War period construction (Cox 1995). The site was revisited in 1994 during Phase II investigations and re-identified as an extremely rare and largely intact section of a sectional canal coal barge dating from the period circa 1830-60 (Cox & Hunter 1995). This type of vessel was widely used on the Lehigh Canal and Delaware Canal navigation systems. The barge is still filled with large pieces of hand broken coal, which indicates the vessel may have sunk in the 1830s or 1840s. The second site, E-2, 4:16, was identified as the remains of the wood-hulled, side-paddle steamboat "Excelsior" (Cox 1995, Cox and Hunter 1995). The "Excelsior" was built in Wilmington in 1880 and operated in the Mid-Atlantic region until it burned and sank in 1892.

The Philadelphia District concurs with the researchers findings and considers the "Coal Barge" Site (E-1, 1:5) and the "Excelsior" Site (E-2, 4:16) eligible for listing in the National Register of Historic Places. Detailed underwater mapping of both targets show that each vessel, and its associated debris field, is located just outside of the project area. However, because of their close proximity to the channel's edge, a 200 foot buffer around each site will be established and closely monitored during construction to ensure that both sites are not impacted.

The draft report of the 1993 fieldwork (Cox 1995), which included the results of ground truthing on the 5 targets first identified in 1987, was reviewed by the Pennsylvania, Delaware, and New Jersey State Historic Preservation Office's. Both Pennsylvania and Delaware SHPO's concurred with the reports findings and recommendations (see Pertinent Correspondence section of the Main Report; PASHPO letter dated July 20, 1994, DESHPO letter dated November 21, 1994). In a letter dated February 10, 1995, the NJSHPO also concurred with the report findings that the site of the steamboat "Excelsior" (E-2, 4:16) was eligible for listing in the National Register. Although not considered National Register eligible on the basis of information provided in the report, the NJSHPO recommended further study at Site E-1, 1:5, which was thought to be a timber crib related to Revolutionary War period construction.

Subsequent Phase II investigations conducted in 1994 re-identified Site E-1, 1:5 as a relatively intact mid-19th century sectional canal barge eligible for listing in the National Register and reconfirmed the significance of the "Excelsior" Site E-2, 4:16 (Cox & Hunter 1995). The draft report of this investigation and the District's finding of "No Effect" was submitted to the Pennsylvania, Delaware and New Jersey SHPO's for review and comment in the fall of 1995 (see Pertinent Correspondence section of the Main Report; letters dated September 28, October 6, and October 17, 1995).

Table 11-1. High Probability Remote Sensing Targets.						
Project Location	Target #	State	Phase 1 Remote	Phase 1 Diving	Phase 2 Diving	NR Eligibility
Channel Bend	A4:4	Pennsylvania	Cox 1988	Cox 1995		Not Eligible
Channel Bend	E-1, 1:5 (Coal Barge)	New Jersey	Cox 1988	Cox 1995	Cox & Hunter 1995	Eligible
Channel Bend	E-2, 4:16 (Excel-sior)	New Jersey	Cox 1988	Cox 1995	Cox & Hunter 1995	Eligible
Channel Bend	L3:10	New Jersey	Cox 1988	Cox 1995		Not Eligible
Channel Bend	L1:15	New Jersey	Cox 1988	Not in Project		N/A
Channel Bend	I4:9	Delaware	Cox 1988	Cox 1995		Not Eligible
Channel Bend	M41	Delaware	Cox 1995	Cox & Hunter 1995		Not Eligible
Channel & Side-Slope	S13	Pennsylvania	Cox 1995	Cox & Hunter 1995		Not Eligible
Channel & Side-Slope	S49a	Pennsylvania	Cox 1995	Cox & Hunter 1995		Not Eligible
Channel & Side-Slope	S219	New Jersey	Cox 1995	Cox & Hunter 1995		Not Eligible
Channel & Side-Slope	S367	New Jersey	Cox 1995	Cox & Hunter 1995		Not Eligible
Channel & Side-Slope	S2	Delaware	Cox 1995	Cox & Hunter 1995		Not Eligible
Channel & Side-Slope	S49	Delaware	Cox 1995	Cox & Hunter 1995		Not Eligible
Channel & Side-Slope	S592	Delaware	Cox 1995	Cox & Hunter 1995		Not Eligible

Table 11-1. High Probability Remote Sensing Targets. (Continued)						
Channel & Side-Slope	S33	Delaware	Cox 1995	Cox & Hunter 1995		Not Eligible
Channel & Side-Slope	S1099	Delaware	Cox 1995	Cox & Hunter 1995		Not Eligible
Channel & Side-Slope	S825	Delaware	Cox 1995	Cox & Hunter 1995		Not Eligible
Beneficial Use Site	9:534	Delaware	Cox & Hunter 1995	Cox & Hunter 1995		Not Eligible
Beneficial Use Site	9:553	Delaware	Cox & Hunter 1995	Cox & Hunter 1995		Not Eligible

11.3.4 Channel Deepening and Side-Slope Areas

Thirty-three channel side-slope areas totaling 35 nautical miles and 12 channel deepening locations totaling 2,200 acres were surveyed for submerged cultural resources in 1993 (Cox 1995). No significant cultural resources were located in channel deepening or channel side-slope areas. Analysis of remote sensing data identified 149 magnetic and/or acoustic targets within these locations. Ten of these sites were recommended for further investigation as high probability targets (see Table 11-1). Underwater archaeologists investigated these 10 targets in 1994 and determined that 9 targets exhibited modern debris not considered historically significant (Cox and Hunter 1995). The tenth location, Target M 41, exhibited several modern iron I-beams associated with a large buried ferrous object. The target site is 57 feet deep and is outside of the area of potential impact. The site is well below the proposed project channel depth of 45 feet and will not be subjected to dredging activity.

11.3.5 Marcus Hook Anchorage

The proposed plan of improvement calls for the deepening of the Marcus Hook anchorage to 45 feet. The anchorage is located on the south side of the channel across from Marcus Hook, Pennsylvania and lies in New Jersey, Delaware, and Pennsylvania waters. The current limits of the existing anchorage were created in the late 1950's when the project was dredged to a depth of 40 feet. Proposed anchorage deepening to 45 feet will be restricted to previously dredged areas within the existing

anchorage boundaries. Any historic features or shipwreck sites that may once have been in the anchorage area would have been destroyed during previous dredging episodes. The District anticipates that proposed dredging will have no effect on significant cultural resources. Therefore, no remote sensing investigations were conducted in the Marcus Hook anchorage.

11.3.6 Upland Dredged Material Disposal Sites

Proposed project plans call for the use of 13 upland sites for the disposal of dredged material. Four sites are inactive. The Philadelphia District anticipates that the reactivation of these sites, 15D, 15G, 17G and Raccoon Island, for dredged material disposal will have no effect on significant prehistoric or historic resources. New dike and drainage ditch construction, as well as access and staging locations required during construction, will be limited to existing right-of-way or disposal area interiors containing at least 20 feet of fill. No construction is planned for undisturbed locations outside of, or immediately adjacent to, these existing disposal areas. There is a National Register property, the Salisbury Farm site, located in the vicinity, but it is well outside of the boundaries of disposal site 15D and will not be adversely impacted by the proposed use of site 15D (Heite & Heite 1986). The remaining 9 disposal sites are currently used for the disposal of maintenance dredged material and will not be subjected to new construction. The District anticipates that the continued use of nine active disposal sites, 1) National Park, 2) Oldman's, 3) Pedricktown North, 4) Pedricktown South, 5) Killcohook, 6) Penns Neck, 7) Artificial Island, 8) Reedy Point North and 9) Reedy Point South will have no effect on significant cultural resources. The NJSHPO concurred with the District's findings of "No Effect" for disposal sites 15D, 15G, 17G and Raccoon Island in a letter dated July 28, 1994. The DESHPO also concurred with the District's findings of "No Effect" for the Reedy Point North and Reedy Point South disposal sites in a letter dated August 2, 1994 (see Pertinent Correspondence section of the Main Report).

11.3.7 Submerged Sand Stockpile Locations

Two proposed submerged sand stockpile areas, LC-05 and MS-19, were investigated for cultural resources in 1994 and 1995 (Cox & Hunter 1995, 1995a). A remote sensing survey utilizing magnetometer, side-scan sonar and bathymetric data identified 5 targets in the LC-05 location. Researchers determined that the lack of signature duration, dispersion and intensity of target data suggests that they are associated with either isolated objects or modern debris and do not represent significant cultural resources. No targets were identified in MS-19. Based on the results of these finding, the placement of dredged material in these locations will have "No Effect" on significant cultural resources.

11.3.8 Wetland Restoration Areas

Two proposed wetland restoration areas, Egg Island Point, New Jersey (PN-1a) and Kelly Island, Delaware (LC-09), were investigated for submerged and shoreline cultural resources (Cox & Hunter 1995, 1995a). Proposed construction in the Egg Island Point project area (PN-1a) involves the construction of a 150 acre dredged material containment site located adjacent to the shoreline and immediately east of Egg Island Point, and a 2 mile long staggered geotube erosion control structure west of Egg Island Point. Wetland restoration on Kelly Island, Delaware (LC-9) will also involve construction of a dredged material containment site consisting of dike construction, outflow channel excavation, and dredged material placement.

A low-tide shoreline cultural resources survey in the Egg Island Point project area (PN-1a) identified the second location of the 19th century Egg Island Point Lighthouse. The original 1837 lighthouse site is now located just offshore to the south. No other historic shoreline sites were located in the study area. A remote sensing survey was conducted in a 2 mile long, 290 acre offshore study area extending from Oranoaken Creek south to Egg Island Point. Two targets resembling modern debris or single isolated objects were identified. Remote sensing was not conducted along the shoreline project area east of Egg Island Point. Staggered geotube placement in a previously eroded and highly active offshore surf zone is not anticipated to impact significant cultural resources.

Remote sensing and shoreline cultural resources investigations were also conducted in the Kelly Island (LC-9) wetland restoration project area. A remote sensing survey identified two targets exhibiting shipwreck characteristics within the proposed placement area. Phase 1 ground truthing operations identified these two submerged sites, Target 9:534 and Target 9:553, as debris associated with a modern clam dredge and a navigational buoy. The shoreline survey identified the location of the Port Mahon Lighthouse site and the concrete foundations of a 1940's oyster shucking house. These two historic sites are located well south of the Kelly Island wetland restoration area and will not be impacted by proposed construction. No other cultural resources were identified in the project area.

11.3.9 Fort Delaware, Pea Patch Island

The District has re-evaluated the potential for increased shoreline erosion on Pea Patch Island resulting from the proposed deepening of the Delaware River Main Channel. This research analyzed various data to determine 1), if deepening the channel would increase current velocities and head values, and impact channel side-slope profiles, 2) if vessels using the deepened 45 foot channel would generate larger waves than presently occur with the 40 ft. channel,

and 3) if these predicted changes in current velocities, head values, side-slope profiles and wave heights would detectably increase the shoreline erosion on Pea Patch Island (see Appendix C).

Comparison of model-predicted current velocities for the 40 ft and 45 ft channel geometrics at Pea Patch Island showed negligible velocity differences attributable to the deepened channel. It was thus concluded that the channel deepening will have a negligible effect on current velocities and water levels at the subject shoreline, and there will be no shoreline erosion induced or exacerbated by the channel deepening.

The principal variables considered in the ship wave analysis included vessel shape characteristics, vessel draft, vessel speed, sailing direction, and distance from the shoreline. The analysis assumed that tankers, due to their size, speed, and number of transits, constituted the critical class of vessels for this analysis. Further, based on data developed for the economic analysis of the proposed deepening, it was assumed that the fleet distribution would be identical for the 40 and 45 foot channels, with vessels simply loaded five feet deeper. The results indicated that maximum wave heights at the shoreline of Pea Patch Island would increase in the order of 4 per cent for the case of the design vessel loaded to a five-foot greater depth. Thus it was concluded that the deepening project would not detectably increase the existing shoreline erosion problem related to ship waves.

A review of existing shoreline profiles and hydrographic data adjacent to Pea Patch Island show that the majority of channel depths are well below the proposed new dredging depth of 45 feet. Only minimal new dredging in isolated high spots will occur in the vicinity of Pea Patch Island. This proposed work will not significantly effect the existing channel side-slope profiles and will not result in a movement of the federal channel closer to the island.

Based on the above analyses, it is the opinion of the Philadelphia District that deepening the channel to a depth of 45 feet will not increase shoreline erosion on Pea Patch Island, and consequently, will not impact significant cultural resources along the shoreline.

11.4 Section 106 Coordination

In order to fulfill our responsibilities under the National Historic Preservation Act of 1966, as amended, the Philadelphia District has worked closely with the Pennsylvania, New Jersey and Delaware State Historic Preservation Offices to coordinate extensive cultural resources investigations in the project area. This work involved a synthesis of previous investigations, documentary research, a remote sensing survey, underwater investigations and a shoreline survey (Cox 1988, Cox 1995, Cox &

Hunter 1995, 1995a). Project areas include bend widening, channel deepening, channel side-slope, submerged sand stockpile and wetland restoration areas. Nineteen high probability targets exhibiting cultural resource characteristics were identified out of a total of 225 remote sensing targets documented in project areas. Phase I underwater ground truthing operations and Phase II underwater site investigations identified 2 of these 19 targets as significant cultural resources eligible for listing on the National Register of Historic Places - the Canal Barge Site (E-1, 1:5) and the "Excelsior" Steamboat Site (E-2, 4:16). Both sites are located in New Jersey waters. No significant submerged cultural resources were identified in Delaware or Pennsylvania. Phase I shoreline surveys were conducted in two proposed wetland restoration locations on Egg Island Point, New Jersey (PN-1a) and Kelly Island, Delaware (LC-9). These low-tide surveys identified the remains of lighthouse foundations in both study areas and concrete footings along the shoreline in the vicinity of Port Mahon, Delaware. There are no shoreline or upland project areas located in Pennsylvania. Cultural resources investigations were not conducted in the 13 upland disposal areas and the Marcus Hook Anchorage due to previous dredging and disposal activities at these locations.

Based on the results of cultural resources investigations, the Philadelphia District finds that the proposed project will have "No Effect" on significant cultural resources. The District plans to completely avoid the Canal Barge Site (E-1, 1:5), the "Excelsior" Steamboat Site (E-2, 4:16) and the Egg Island Point Lighthouse Site by placing a 200 foot buffer around each location and then monitoring each site to ensure that no impacts will occur to these sites during construction. Although Phase 1 survey data did not determine the National Register eligibility of the Port Mahon Lighthouse site and the Oyster Shucking House site identified in the Kelly Island (LC-9) study area, both sites are located well south of the wetland restoration construction area and will not be impacted by construction activities.

The draft report of the final cultural resources investigation (Cox & Hunter 1995) and the District's finding of "No Effect" was submitted to the Pennsylvania, New Jersey and Delaware SHPO's in September and October, 1995 (see Pertinent Correspondence section of the Main Report). The Pennsylvania and New Jersey SHPO's concurred with the District's finding in letters dated November 21, 1995 (PASHPO) and December 23, 1996 (NJSHPO).

In a letter dated February 4, 1997, the DESHPO provided a review of the DSEIS and concurred with the District's finding of "No Effect" for Delaware project areas at Reedy Point North and South, Buoy 10, Kelly Island, and sand stockpiling locations MS-19 and LC-5. However, the DESHPO expressed the strong opinion that the project will have an adverse effect on archaeological deposits located along the shoreline of Pea Patch Island. In response to the DESHPO's concerns, the Philadelphia District evaluated the

potential for increased shoreline erosion on Pea Patch Island resulting from deepening the channel to 45 feet. The results of this additional analysis showed that the project will not increase shoreline erosion, and therefore, will not impact the archaeological deposits on Pea Patch Island (see Appendix C). In a letter dated July 2, 1997, the District submitted to the DESHPO the results of this additional work and was asked to provide a second opinion regarding our "No Effect" finding regarding potential project impacts on Pea Patch Island (see pertinent correspondence). Section 106 coordination is continuing with the Delaware SHPO and will be concluded prior to any project construction activity.