Draft
ENVIRONMENTAL ASSESSMENT

LITTLE EGG INLET
SAND RESOURCE BORROW AREA INVESTIGATION

for the

Barnegat Inlet to Little Egg Inlet (Long Beach Island)
Storm Damage Reduction Project
Ocean County, New Jersey

Philadelphia District, U.S. Army Corps of Engineers

April 2016

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1.0 PROJECT DESCRIPTION, PURPOSE, AND NEED

1.1 Introduction

The New Jersey Shore Protection Study addresses coastal erosion and water quality degradation along the ocean coast and back bays of the state of New Jersey (USACE 1990). The study provides recommendations for future beach nourishment and coastal restoration actions and programs to reduce storm damage and minimize the harmful effects of shoreline erosion; the plan also provides recommendations for coastal planners, engineers and resource agencies to reduce degradation of coastal lands and water quality.

Under the New Jersey Shore Protection Study, a Final Feasibility Report and Integrated Environmental Impact Statement (EIS) was completed by the U.S. Army Corps of Engineers Philadelphia District (USACE) in 1999 for the Barnegat Inlet to Little Egg Inlet (Long Beach Island) reach of the New Jersey Atlantic Ocean coastline (Figure 1-1). The 50-year plan selected by the USACE (USACE, 1999) for restoring Long Beach Island (LBI) initially called for the placement of approximately 7.4 million cubic yards (mcy) of sand along approximately 17 miles of coastline from Barnegat Inlet to Little Egg Inlet, including 4.95 mcy for the initial berm placement and 2.45 mcy for dune placement. The berm and dune restoration extends from groin 4 (Seaview Drive, Loveladies) to the terminal groin (groin 98) in Holgate, Long Beach Township. The Barnegat Light area (northern end of the study area) is not included. The Feasibility Report estimated that approximately 2.0 mcy of sand would be needed for periodic nourishment every 7 years over the authorized 50-year period. Since 2006, the USACE has constructed 4.5 miles of the LBI shoreline (*i.e*. within the municipalities of Surf City, Ship Bottom, Harvey Cedars, and the Brant Beach section of Long Beach Township) utilizing sand obtained from the authorized Borrow Areas D1 and D2. North Beach and Loveladies will be completed utilizing sand from Borrow Areas D1 and D2 once the necessary Real Estate is provided by the New Jersey Department of Environmental Protection (NJDEP), and repairing previously constructed sections that were damaged by two recent severe nor'easter storms. The remaining sections of initial construction at the southern end of LBI (*i.e.* the developed part of Holgate and Beach Haven) are scheduled to be completed in 2016 using the proposed Little Egg Inlet Borrow Area.

Several borrow areas located within state waters off the New Jersey coast have been used to supply sand to many beachfront communities; however, many of these sand sources have since been deemed environmentally sensitive and are no longer available for use, whereas the sand in other borrow areas is not beach compatible or said borrow areas do not have sufficient volumetric capacity over the life of the project. Borrow Area D1 is a 683-acre area centered approximately 2.5 miles off Harvey Cedars in state waters, and Borrow Area D2 is a 1034-acre site located directly east of Area D1 in Outer Continental Shelf (OCS) waters. Both of these borrow areas are approved for use for the LBI beachfill project. Pursuant to the National Environmental Policy Act (NEPA: 83 Stat. 852:42 U.S.C. 4321 et seq.), potential impacts of utilizing Borrow Areas D1 and D2 for the Barnegat Inlet to Little Egg Inlet (Long Beach Island) Coastal Storm Damage Reduction project were presented in the 1999 Environmental Impact Statement and the 2014 Environmental Assessment. The current document tiers off of these prior NEPA documents and presents new information pertaining to the project for the proposed use of a 2,050 acre borrow area located offshore and just slightly to the north of Little Egg Inlet. The effects associated with material placement on the LBI project site have been addressed under the previous NEPA documents.

Sand was obtained from Borrow Area D1 for three previous initial construction placements, and in combination with recent post-storm emergency repair and restoration replenishment actions, the remaining capacity of Borrow Area D1 is insufficient for periodic nourishments and future emergency nourishments in the event of significant erosion due to major coastal storms. The Bureau of Ocean Energy Management (BOEM) has sole jurisdiction over OCS sand resources under the OCS Lands Act, and as such was the authorizing agency for the use of 7 mcy of sand to be taken from Borrow Area D2 to complete initial construction of the LBI project's northern sections. Future use of sand resources from Borrow Area D2 requires a renewed lease agreement with the BOEM for each dredging operation. However, future mining rights are neither restricted to one agency nor a particular beach nourishment project. The pumping distances from Borrow Area D2 to the southern portion of the LBI project site would be cost-prohibitive. An additional viable sand source of significant quantity, located closer to the southern portion of the project area, is needed.

Figure 1-1: Barnegat Inlet to Little Egg Inlet (Long Beach Island) project area, New Jersey.

1.2 Purpose and Need

Loss of sand from New Jersey coastal beaches and dunes is a serious problem that affects both the coastal environment and important public and private infrastructure (Figure 1-2). The U.S. Army Corps of Engineers (USACE) has selected beach nourishment as the most effective way to address the problem for the LBI project to stem chronic coastal erosion and restore and enhance hurricane and storm damage protection provided by the beach and dune system.

Figure 1-2: Chronic erosion along Long Beach Island.

To continue maintenance of the project's beach and dune system as authorized, or conduct emergency operations, similar to what occurred after Superstorm Sandy, the USACE must have access to borrow areas of high quality sand material. This EA provides an evaluation of the use of sand resources within the Little Egg Inlet proposed borrow area where shoaling conditions occur.

1.3 Study and Project Authorities

1.3.1 New Jersey Shore Protection Study

The New Jersey Shore Protection Study was authorized under resolutions adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives and the Committee on Environment and Public Works of the U.S. Senate in December 1987. The Senate resolution adopted by the Committee on Environment and Public Works on December 17, 1987 states:

> That the Board of Engineers for Rivers and Harbors, created under Section 3 of the Rivers and Harbors Act, approved June 13, 1902, be, and is hereby requested to review existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentality thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the U.S. Environmental Protection Agency (USEPA) and other Federal agencies as appropriate, develop recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response.

The House resolution adopted by the Committee on Public Works and Transportation on 10 December 1987 states:

> That the Board of Engineers for Rivers and Harbors is hereby requested to review existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentality thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, the development of recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response which is engineeringly, economically, and environmentally feasible.

1.3.2 Long Beach Island Coastal Storm Damage Reduction Project

The Long Beach Island Coastal Storm Damage Reduction Project was authorized by Congress for construction by Section 101 (a) (1) of the Water Resources Development Act of 2000 and cost-shared with the nonfederal sponsor, the New Jersey Department of Environmental Protection. The project is considered an ongoing construction project for purposes of PUBLIC LAW 113–2, issued 29 January 2013; The Disaster Relief Appropriations Act, 2013. PL 113-2, Chapter 4: for "repairs to projects that were under construction and damaged as a consequence of Hurricane Sandy" at full federal expense with respect to such funds (USACE, 2014a).

1.4 Project Location

Little Egg Inlet connects the Atlantic Ocean with the Great Bay along the southeastern coast of New Jersey. The inlet forms a maritime border separating Little Egg Harbor Township in southern Ocean County and Galloway Township in northeastern Atlantic County (see Figure 1-1).

Directly to the north of Little Egg Inlet is the barrier island (Long Beach Island) which stretches along a general axis of orientation aligned in a north-northeast/south-southwest direction approximately 20.8 miles to Barnegat Inlet. The U.S. Fish and Wildlife Service (USFWS) manages the Barnegat Division of the Edwin B. Forsythe National Wildlife Refuge (NWR) in Ocean County on the inland side of Barnegat Bay. The southern tip of Long Beach Island (LBI), which ends at Little Egg Inlet, is a 3-mile long section of the NWR (Holgate Unit) of undeveloped wilderness area with limited public access. To the south and west of Little Egg Inlet is the Brigantine Division of the NWR (Figure 1-3) in Atlantic County. In combination, the Holgate Unit, Little Beach Island, and the northern part of Brigantine Island provide a 10.8-mile gap of natural undeveloped coastal habitat shoreline. With the two divisions combined, the Forsythe NWR encompasses more than 47,000 acres of southern New Jersey protected coastal habitat.

The New Jersey coastline, including Long Beach Island, has a long history of severe erosion and is frequently subject to storm damage from wave attack and storm surge inundation. Long Beach Island is separated from the mainland to the west by shallow, elongated backwaters with salt marshes: Barnegat Bay and Little Egg Harbor. Long Beach Island is a developed urban area consisting of primarily residential homes and small businesses, with herbaceous shrub, beach, dune and tidal wetland perimeter areas. Seashore and water-oriented summer recreation is the predominant land-use including residential rentals and support services for commercial establishments.

Barnegat Bay, a 75-square-mile estuary connects to the south with Little Egg Harbor which in turn connects to Great Bay and Little Egg Inlet. These areas are a crucial link in the Atlantic flyway for migratory waterfowl. These wetlands serve as the winter grounds for waterfowl as well as important nesting, feeding, and migratory habitat for hundreds of species of shorebirds and waterfowl. The contiguous streams and adjacent wetlands of the Barnegat Bay system provide nursery grounds for many coastal fish populations and supports large recreational and commercial fisheries for finfish and shellfish. These resources comprise the centerpiece of a thriving tourist industry and as such, are critical to the economic, as well as environmental health of southern New Jersey.

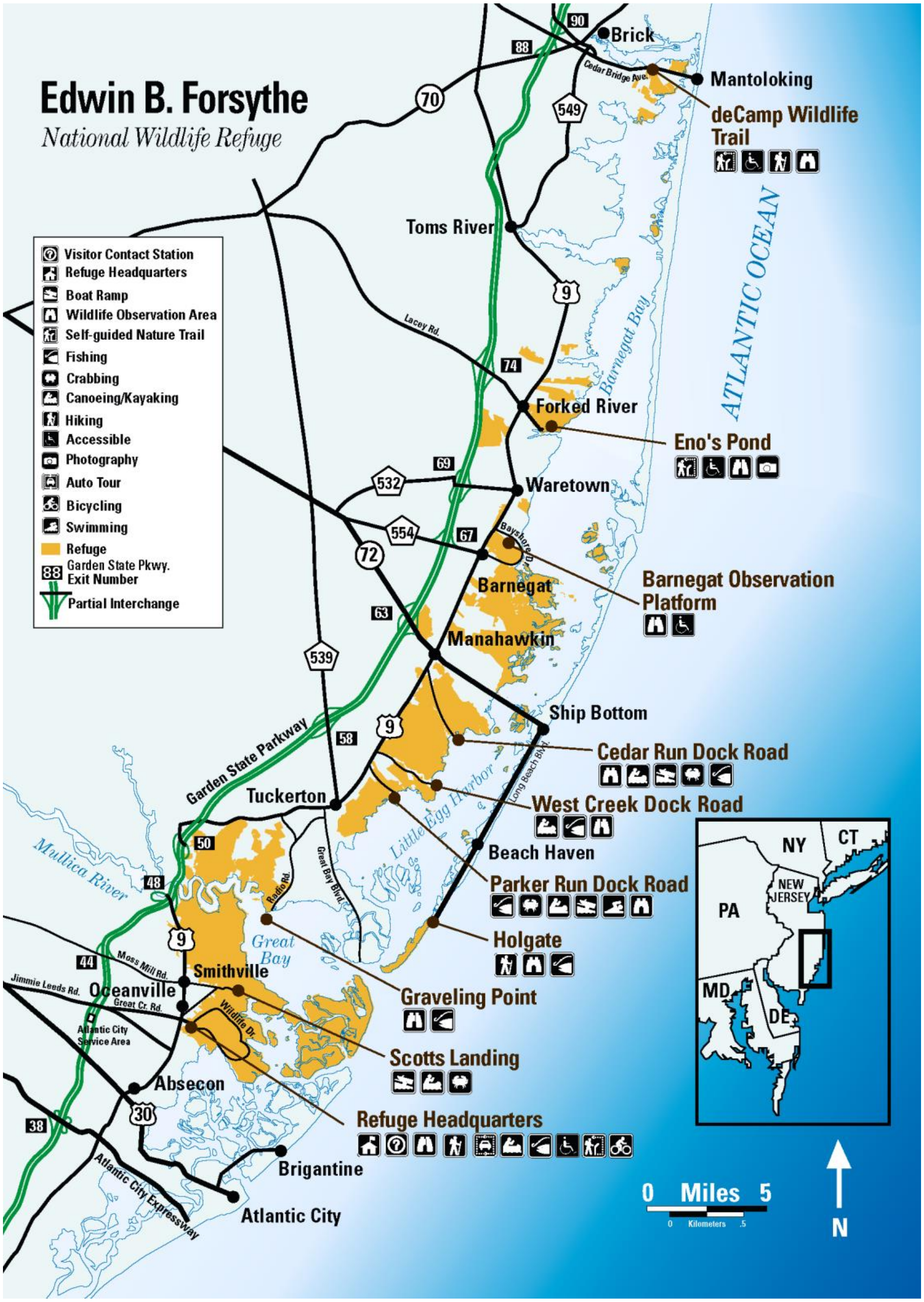

Figure 1-3: Edwin B. Forsythe National Wildlife Refuge.

1.5 Prior Related Studies and Reports

There exist numerous planned, completed, as well as ongoing shoreline erosion protection projects along the New Jersey ocean coast. Various groups, including the Federal government, the State of New Jersey, local municipalities, and private interests, have initiated this type of activity. The USACE reports relevant to this investigation are presented below:

Final Environmental Assessment, Barnegat inlet to Little Egg Inlet (Long Beach Island), New Jersey, Storm Damage Reduction Project, 2014. Under the authority of Section 101(a)(1) of the Water Resources Development Act of 2000 and the Disaster Relief Appropriations Act, Public Law 113-2, issued 29 January 2013, this EA was prepared to evaluate new information and proposed modified actions for the LBI Storm Damage Reduction Project following Hurricane Sandy.

Project Information Report, Rehabilitation Effort for the New Jersey Shore Protection, Barnegat Inlet to Little Egg Inlet, NJ Hurricane/Shore Protection Project, 2012. Under the authority of 33 701n (Public law 84-99) this PIR was prepared to document damage to the project and serves on a nationwide basis to reduce loss of life and property damage under DOD, USACE, FEMA, and other agencies' authorities.

Project Information Report, Rehabilitation Effort for Surf City and Harvey Cedars Shore Protection, Barnegat Inlet to Little Egg Inlet, 2010. This report provides an overview of all pertinent regulations required for supplemental sand placement deemed necessary following severe erosion on the northern end of the project area due to a large number of coastal storms during the winter and spring.

Barnegat Inlet to Little Egg Inlet Feasibility Report and Integrated Environmental Impact Statement – 1999. This report presents the result of a feasibility phase study to determine the magnitude and effect of shoreline erosion problems and an implementable solution to the problems at Long Beach Island, New Jersey. The selected plan for hurricane and storm damage protection is berm and dune restorations utilizing sand obtained from offshore borrow sources, with periodic nourishment every 7 years for a 50-year period of analysis.

Barnegat Inlet to Little Egg Inlet Reconnaissance Study – 1995. This study was the fifth site specific study conducted under the New Jersey Shore Protection Study. This first phase of the Corps' two-phase study planning process (the reconnaissance phase) addressed shoreline erosion and storm damage vulnerability of Long Beach Island, New Jersey. The study determined the potential for a Federal project, action and response which is engineeringly, economically, and environmentally feasible.

New Jersey Shore Protection Study – 1990. The Study was initiated in 1988 to investigate shoreline protection and water quality problems, which exist along the entire coast. Special interest focused on physical coastal processes, those mechanisms occurring in the coastal zone, which result in the movement of water, wind and littoral materials. Upon the conclusion that existing numerical data was insufficient to provide long-term solutions, future comprehensive studies were proposed. The Limited Reconnaissance Phase of the New Jersey Shore Protection Study identified and prioritized those coastal reaches which have potential Federal interest based on shore protection and water quality problems which can be addressed by the USACE. Barnegat Inlet to Little Egg Inlet was one of the reaches identified to undergo the Corp's two-phase planning process.

Barnegat Inlet Phase I General Design Memorandum* – *1981. Phase II GDM - 1984. These design documents were prepared to finalize planning and policy for a modification to the Barnegat Inlet project. Ultimately it was decided to pursue as a correction for a design deficiency with the original inlet jetty configuration. The arrowhead design of 1939-40 did not provide for a sufficiently stable channel and safe navigation through Barnegat Inlet.

New Jersey Inlets and Beaches, Barnegat Inlet to Longport -1974. This recommended the following project for Long Beach Island: beach fill with a 75 ft berm at +10 MLW, construction of one additional groin, modification of seven groins, reimburse the state for recent construction of 14 groins, maintenance of all groins, and periodic nourishment for the beachfill. The project was authorized for PED in 1976 and for construction in 1986.

Miscellaneous Report No. 80-9 Beach Changes at Long Beach Island, New Jersey, 1962-73. Coastal Engineering Research Center (CERC) report 1980. This report documents beach changes during the period after the March 1962 storm and during the time of heavy groin construction until 1972.

Beach Erosion Control Report on Cooperative Study (Survey) of the New Jersey Coast, Barnegat Inlet to the Delaware Bay Entrance to the Cape May Canal - 1957*.* This report eventually became **House Document 86-208** (1959) "Shore of New Jersey -Barnegat Inlet to Cape May Canal, Beach Erosion Control Study" provided for Federal participation in the costs of constructing stone revetment, timber bulkhead, timber groins, extending stone groins, and beach nourishment.

2.0 ALTERNATIVES

As previously mentioned in Section 1.1, this EA tiers directly from the 1999 Feasibility Report and Final EIS that previously considered a full suite of structural and non-structural alternatives to beach nourishment on Long Beach Island. The structural measures that were considered in the 1999 report included bulkheads, seawalls, revetments, offshore breakwaters, groins, beach restoration/nourishment, and beach sills. Nonstructural measures included flood insurance, development regulations, and land acquisition. The selected plan of beach nourishment requires an adequate available sand source for maintenance and emergency beachfill operations for the duration of the 50-year project life. Section 2 describes the various sand source alternatives that have been evaluated, utilized or could be utilized. The alternatives evaluated in this EA cover various sources of beach-quality sand with the purpose of identifying a new borrow area in support of the authorized beach nourishment project.

2.1 Selected Plan

In February 2001, the USACE selected the NED plan for Barnegat Inlet to Little Egg Inlet (LBI) project, which included a combination of dune and berm restoration, with periodic nourishment every 7 years for a 50 year project life. The National Economic Development (NED) plan is the plan which maximizes benefits to the Nation while meeting planning objectives. The NED objective is to increase the value of the Nation’s output of goods and services and improve the national economic efficiency, consistent with protecting the Nation’s environment pursuant to national environmental statutes, applicable executive orders and Federal planning requirements.

In the LBI Project, the USACE proposed to place sand on various stretches of Long Beach Island in phases where the existing berm and dune profiles are below the minimum measurements of the design profile. The completed design plan will provide for a dune with a slope of 1V:5H. This will produce a beach berm width of 125 feet from centerline of dune to the edge of the berm, with approximately 105 feet of dry beach from the seaward toe to mean high water (MHW). The dune elevation is 22 feet NAVD with a 30-foot wide crest and incorporates 347 acres of planted dune grasses and 540,000 linear feet of sand fencing. This plan was chosen because it provided the maximum net storm damage reduction benefits.

A protective dune/berm with periodic nourishment represents the least environmentally damaging structural method of reducing potential storm damages at a reasonable cost. It is generally considered socially acceptable, proven to work in high-energy environments, and is the only engineered shore protection alternative that directly addresses the problem of a sand budget deficit (National Research Council, 1995). The somewhat transient nature of beach nourishment is actually advantageous. Beach fill is dynamic, and adjusts to changing conditions until equilibrium can again be achieved. Despite being structurally flexible, the created beach can effectively dissipate high storm energies, although at its own expense. Costly rigid structures like seawalls and breakwaters utilize large amounts of material foreign to the existing environment to absorb the force of waves. Beach nourishment uses material typical of existing area sand to buffer the shoreline structures against storm damage. Consequently, beach nourishment is more aesthetically pleasing as it represents the smallest departure from existing conditions in a visual and physical sense, unlike groins.

2.1.1 Project History

Initial construction of three sections of the Barnegat Inlet to Little Egg Inlet project has been completed using Borrow Area D1. Figure 2-1 shows the typical landside beachfill operation during construction.

1. In 2006-2007 approximately 886,000 cubic yards (cy) of sand was placed on 8,100 linear feet of beach between North 25th Street in Surf City to South 5th Street in the northern five blocks of Ship Bottom.
2. In 2010 approximately 3,000,000 cy of sand was placed on 10,450 linear feet of beach between 86th street and 500 feet south of Bergen Avenue in Harvey Cedars.
3. In 2012, approximately 1,200,000 cy of sand was placed on 5,200 linear feet in the Brant Beach section of Long Beach Township, between 32nd and 57th Streets.

In addition to the initial construction of the three segments, two emergency repair actions have been conducted in response to a number of severe coastal storms that caused damage to the completed project sections:

1. In 2011 an additional 300,000 cy was placed between North 25th and North 10th Streets in Surf City in response to severe Nor'easter storms that caused severe erosion during the prior two winters.
2. In 2013, the USACE conducted emergency repairs along the completed sections of Long Beach Island, placing approximately 880,000 cy was placed in Brant Beach, approximately 280,000 cy of beachfill in Surf City, and approximately 840,000 cy of beachfill in Harvey Cedars. The borrow area was D1.

In March 2015, the Philadelphia District issued a contract to complete the remaining initial construction within the municipalities of Ship Bottom, Beach Haven, and Long Beach Township. The construction is expected to take about 4 months. The USACE anticipates completing this initial construction of the project in 2016. Barnegat Inlet to Little Egg Inlet Storm Damage Reduction project's 50-year project life initiated in 2005. The target project completion year is 2055. Under the 2014 EA, approximately 7.8 million cubic yards (mcy) was proposed to be placed on the remaining (unconstructed) sections of the project reaches, obtaining approximately 0.8-1.0 mcy from Borrow Area D1 and 7.0 mcy from offshore Borrow Area D2 under the authority and agreement of BOEM (USACE, 2014a). Although the design plan remains the same as described in both the 1999 EIS and 2014 EA, quantity estimates have been updated for completion of initial construction to 8.4 mcy. An additional borrow area located in proximity to the southern reaches of the project area is needed for the life of the project. This EA evaluates the plan to obtain sand fill from the Little Egg Inlet borrow area to meet this requirement and future periodic nourishments. Sand placed on the southernmost sections of the project area (Long Beach Township) would be obtained from the proposed Little Egg Inlet borrow area and sand placed on the more northern reaches of the project area would be obtained from the previously authorized and permitted borrow areas D1 and D2, located offshore of Harvey Cedars.

Figure 2-1: Beachfill along Brant Beach, Long Beach Island in 2012.

2.2 Alternative Borrow Areas

There are no known economically viable land sources of sand for the large quantities of beach fill required. Inlet, nearshore, and offshore sand sources are the only economically viable borrow areas alternatives. Barnegat Inlet, a Federally-maintained channel, is dredged three times a year by the dredge Currituck with approximately 100,000 cubic yards removed each time. The median grain size of this material is adequate for beach purposes along LBI but quantities limit the cost effectiveness of using the inlet as a sand source. The quantities of sand dredged at any one time for maintenance is very small in comparison to the quantity needed for beach nourishment.

Potential nearshore and offshore borrow areas A-G were originally identified by Meisburger and Williams in the 1982 USACE Coastal Engineering Research Center (CERC) report entitled "Sand Resources on the Inner Continental Shelf off the Central New Jersey Coast". Borrow Area G was determined to have incompatible material based on the 1982 report, and thus, was not considered any further during the feasibility phase. Seven offshore borrow areas were identified in the 1999 Feasibility Report and EIS including borrow areas A, B, C, D, E, F and Barnegat Light Inlet. Borrow area D included areas D1 and D2, the latter of which extended onto the OCS. Borrow Area C and F were not considered further due to the interference of AT&T submarine telecommunication cables. Borrow areas A, B, D and E, located within three miles of the Long Beach Island coast, were determined to be the most feasible and cost-effective sources of sand (Figure 2-2):

Borrow Area "A". Site A is an ebb shoal located 0.25 statute miles offshore from Barnegat Inlet and is about 845 acres. This site is approximately 3.0 miles long by 1.5 miles wide. Borrow area A is considered a back-up source of material due to its moderate compatibility with the beach material. This site has an estimated 2,200,000 cubic yards (cy) of suitable material.

Borrow Area "B". Site B is about 272 acres and centered off Loveladies at a distance of about 1.7 statute miles. It is approximately 2.2 miles long with a width of 0.8 miles. This site has approximately 3,640,000 cy of suitable material for the proposed beach fill.

Borrow Area "D" (now referred to as D1). Site D was initially identified as 567 acres and most recently as a 683-acre site centered approximately 2.5 miles off Harvey Cedars and has a length of 1.3 miles and width of 0.6 mile (the shape of D1 was adjusted slightly before initial construction due to additional subsurface information). After completion of the currently scheduled nourishment in 2015/2016 to pump approximately 0.8 mcy of sand, there will be approximately 1.9 mcy of material remaining.

Borrow Area "D2" is 1034 acres and located directly east of Area D1 in Outer Continental Shelf waters. The Bureau of Ocean Energy Management (BOEM) has sole jurisdiction over OCS sand resources under the OCS Lands Act, and as such must authorize each use of the proposed borrow areas. BOEM is currently serving as a cooperating agency with the USACE for completion of initial construction of the LBI project with a Memorandum of Agreement for the USACE to dredge 7.0 mcy of sand from Area D2 in 2016.

Borrow Area "E" is 400 acres in size and centered off Ship Bottom at a distance of about 1.0 statute mile and has an approximate length of 2.5 miles and width of 0.3 mile. This site has approximately 9,350,000 cy of suitable material for beach fill.

In 1999, the selected plan for LBI project proposed to use Borrow Areas A, B, D1 and E for initial construction and periodic nourishment. In general, subsurface investigations indicated that shoals contained the proper grain size material that was compatible with the sand material on the beaches (USACE/Alpine 1996; Duffield Associates 1998). Subsurface investigations in 1982, 1996, and 1998 indicated that finer material existed outside of the shoals. Nine vibracores were collected in 1998 east of Barnegat Inlet, Harvey Cedars, and Beach Haven Crest (Duffield Associates, 1998). Predominantly granular materials were encountered in a majority of the vibracores obtained, with some fine-grained materials in two vibracores. In 2002, another 19 vibracores were taken at locations offshore of Harvey Cedars in Borrow Areas D1 and in Borrow Area D2, ranging in distance from two to six miles from the coast (Duffield Associates, 2002). D2 was a northeast extension of the D1 borrow area, extending on to the OCS (Figure 2-2). BOEM issued a Memorandum of Agreement with USACE to permit the dredging of 7.0 mcy from D2 (1 July 2014) for the LBI project. The majority of the vibracore samples had significant quantities of granular materials in the initial 10 feet below the mudline. D2 core locations located closest to shore were observed to contain relatively thin layers of fine-grained materials in the uppermost 2 feet of material obtained in the core. While the thickness of the fine-grained stratum is relatively thin, the areal extent of these materials is unknown. The northwestern, or shoreward boundary of Area D1 may not offer material suitably coarse-grained for beachfill material.

Of the above-mentioned borrow areas, only Borrow Area D1 has been used in the initial partial construction of the LBI project; and subsequent to the 2014 EA and BOEM approval, Borrow Area D2 will be utilized. Borrow Areas A, B, D1, and E, located 0.25 to 2.5 miles offshore, offer varying available quantities and compatibility characteristics, but no longer meet the design quantities needed and/or dredging these areas is not considered environmentally acceptable. Area A has been eliminated because of its moderate grain size compatibility and the greater likelihood for environmental impacts associated with repeat dredging in a productive inlet system. The USACE proposed to use Area B every seven years after initial construction, dredging approximately 167,000 cy each. In comparison, Area E was expected to contribute 379,000 cy for initial construction and 794,000 cy every 7 years until depleted. Borrow Areas B and E have been effectively eliminated over environmental impacts concerns, resulting in the reduction of available sand source by approximately 12 mcy. Area B and E were ruled out as they are located partially in areas that have been identified by the NJDEP as Prime Fishing Areas, as defined by the Rules on Coastal Zone Management N.J.A.C. 7:7E, as amended July 18, 1994.

Telecommunication cables pass through Borrow Area D1 limiting the available area (volume) to dredge. It was estimated that approximately 1.9 mcy of compatible sand resources remained in Borrow Area D1 for the 2016 initial construction completion. However, in 2006, the USACE pumped approximately 880,000 cy of sand onto Surf City. Unknown at the time, the D1 Borrow Area contained significant quantities of discarded military munitions. Over 1,150 munitions items were recovered by the USACE or turned in by citizens from the Surf City beach. The USACE entered into an agreement with the NJDEP (nonfederal sponsor) to use munitions screening on all beach nourishment dredging projects, regardless of the source location of the material. Munitions screening on both the dredge intake and discharge points screen out substrate particles larger than the screen openings, thereby reducing available quantities for placement. Three previous initial construction placements combined with recent post-storm emergency repair and restoration replenishment actions have reduced the remaining capacity of Borrow Area D1 to an amount insufficient for even one periodic nourishment cycle and insufficient for future emergency nourishments in the event of significant erosion due to major coastal storms.

Borrow Area D2, located in Outer Continental Shelf waters about 2.5 to 3.0 miles offshore, is a viable sand source for the northern portion of the LBI project. The site has been approved for use for the LBI project for 7.0 mcy. Future use of sand resources from this site requires a renewed lease agreement with the BOEM for each dredging operation. However, future mining rights are neither restricted to one agency nor a particular beach nourishment project. Borrow Areas D1 and D2 are more than 14 miles away from the southern project placement reaches. The pumping distances from Borrow Area D2 to the southern portion of the LBI project site would be cost-prohibitive. An additional viable sand source of significant quantity, located closer to the southern portion of the project area, is needed. Due to subsequent nor-easters, including the most recent ones in the fall of 2015 and winter of 2016, approximately 1-2 mcy of sand fill from the proposed Little Egg Inlet Borrow Area is proposed to complete to full design template and provide an available source for future cycle nourishment and emergency FCCE repairs.

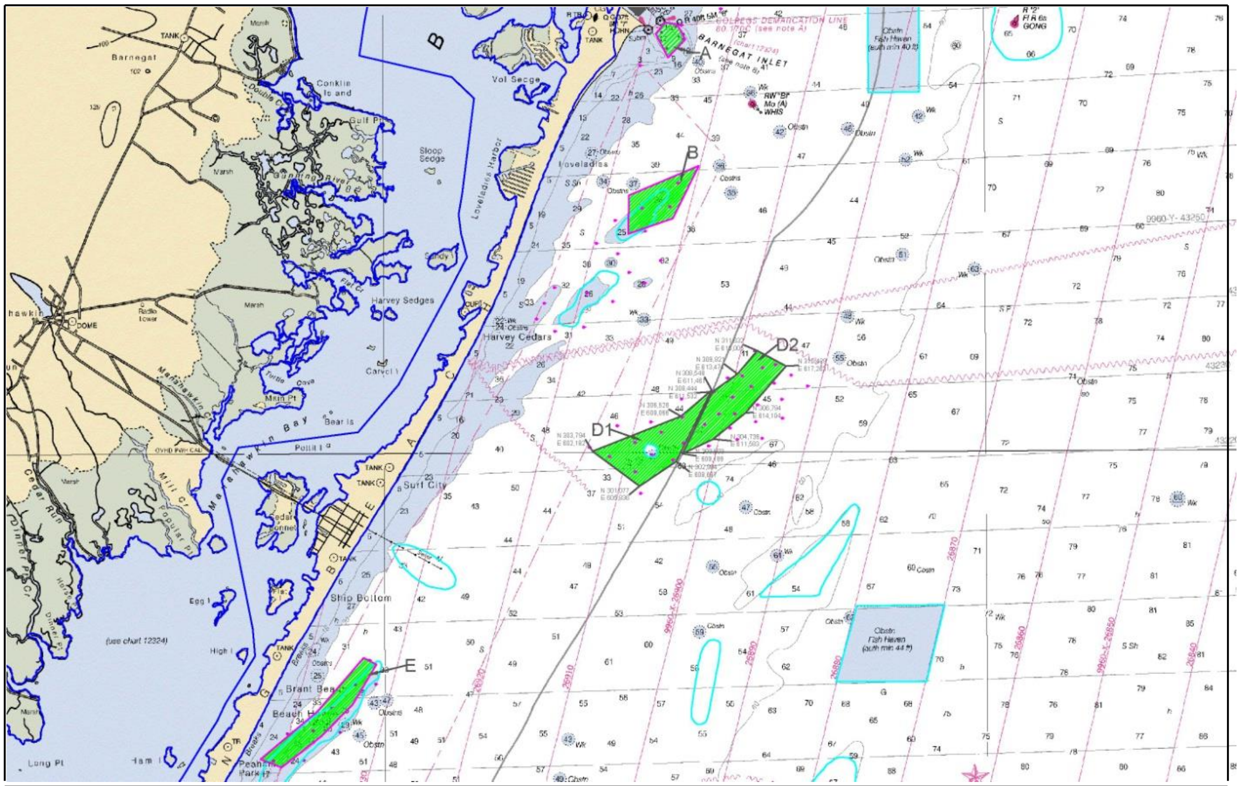

Figure 2-2: Originally proposed borrow areas for the Barnegat Inlet to Little Egg Inlet Storm Damage Reduction project (USACE, 1999).

2.3 Alternative Plans Considered

2.3.1 No Action

Project construction of the LBI beach nourishment project was initiated in 2006 and initial construction of the remaining beach segments is scheduled to be completed by the spring of 2016. Beach nourishment projects serve to protect coastal infrastructure because their template is designed to offer sufficient elevation and length of a beach berm and vegetated dune system to function in a naturalized state. The 50-year project entails periodic nourishment cycles approximately every 7 years and any unforeseen emergency supplemental beachfills as a result of excessive storm damage. The No Action Alternative would eliminate any future nourishment cycles. The impacts to resources of the No Action Alternative are presented in the EIS (USACE, 1999) and for purposes of brevity, are not included herein. Additionally, Little Egg Inlet would continue to shoal, posing increasing navigational hazards to marine craft and a reduction in tidal flushing to the backbay natural habitats.

Without the use sand resources from the proposed Little Egg Inlet Borrow Area, and no other identified viable borrow areas available for LBI's 50 year project life, the No Action Alternative would render the project incapable of providing the intended storm protection and undermines the resiliency and integrity of the constructed portions of the project.

The New Jersey coast also serves the added benefit as a recreational resource, generating a tourism industry as well as natural wildlife habitat areas in addition to providing major shipping and commercial fishing industries. Decades of coastal developments have interrupted the natural and necessary movement of sediment and interfered with coastal processes, and combined with sea level rise, erode protective sand dunes. Shoaling within and adjacent to Little Egg Inlet has created a navigational hazard. The inlet will continue to shoal with or without the occurrence of dredging for beach nourishment purposes. Under the No Action alternative, coastal communities will continue to be vulnerable to winds and high waves, and ultimately, flooding.

2.3.2 Beach Nourishment using Borrow Areas Identified for Other New Jersey Storm Damage Reduction Projects

Five different borrow areas have been identified and evaluated for the *Manasquan Inlet to Barnegat Inlet Storm Damage Reduction Project, Ocean County, New Jersey* (USACE, 2014b): Borrow Areas A, B, D,E, and F2. Similar to the LBI project, the Manasquan Inlet to Barnegat Inlet beach nourishment project requires large quantities of sand for initial construction and periodic nourishment during its 50 year project life. The total sand quantity estimates for this project to the north of Barnegat Inlet in 2002 were 10,689,000 cy for initial construction and 961,000 cubic yards (cy) for periodic nourishment every 4 years (11.5 mcy). Beach profile surveys were subsequently conducted again in 2013 and quantities updated to higher beachfill quantity estimates for the selected plan (39,000 cy more for initial construction and 403,000 cy more for periodic nourishment cycles, as well as approximately 1.8 mcy for emergency replacements, totaling more than 28.9 mcy over the life of the project). It should be noted that periodic nourishment quantities are an estimate, and that they may vary depending on variable erosion rates and storm frequency. Only areas of the beach that fall below the design template are supplemented with dredged sand for any given nourishment cycle. Currently, all of the identified borrow areas provide sufficient sand resources to conduct initial construction of the Manasquan Inlet to Barnegat Inlet project but capacity is insufficient for future periodic or emergency nourishments for the project's 50-year life. Additionally, all of the borrow areas identified for the Manasquan Inlet to Barnegat Inlet project are more than 15 miles away from the LBI placement site. Borrow Area E, the closest site to the LBI project area is 9 miles northeast of Barnegat Inlet, the northernmost portion of the LBI project. The maximum distance for which dredged material can be hydraulically dredged and pumped is about 4 miles without booster pumps and about 6 miles with boosters. For further distances, a hopper dredge would be required, which vastly increases production time, thereby potentially prolonging operations and is thereby cost-prohibitive.

South of LBI is the Brigantine Inlet to Great Egg Harbor Inlet, Brigantine Island project. This project provides flood and coastal storm damage reduction with berm and dune restoration along 1.8 miles of Brigantine Island coastline, fronting the northernmost third of the city. The USACE pumped 667,000 cy of sand from Brigantine Inlet, located approximately 16 miles south of the center of the LBI beach nourishment project. The distance of this project's borrow area from LBI's nourishment project renders it cost-prohibitive.

2.3.3 Preferred Plan: Beach Nourishment using Little Egg Inlet Borrow Area

The USACE has worked extensively with the New Jersey Department of Environmental Protection (NJDEP) and the New Jersey Geologic and Water Survey (NJGWS) over the past 20 years to identify potential sand sources necessary for storm damage reduction projects all along the New Jersey Coast.

These investigations have encompassed extensive areas both in state waters (<3nm) and federally regulated waters. Studies in federal waters (>3nm) have been coordinated with the Bureau of Ocean Energy Management (BOEM) as well. This work has included vast geotechnical and geophysical investigations, bathymetric mapping and laboratory analyses. Based on these cooperative efforts, the District believes Little Egg Inlet is an area that has the greatest potential as a sustainable borrow source for the LBI project for future nourishments due to the large quantity of highly compatible sand and given the typical infilling that occurs in the inlet environment. It is anticipated that only relatively small portions within the limits of the proposed delineated borrow area would be dredged for any for particular nourishment cycle, and hence, dredging operations, in conjunction with the recharging nature of inlet dynamics through longshore transport, impacts to benthos and/or the hydrodynamics of the inlet and shoal complex are anticipated to be minimal.

As previously discussed, several borrow areas located within state waters off the New Jersey coast have been used to supply sand to beachfront communities; however, many of these sand sources have been deemed environmentally sensitive and are no longer available for use, whereas the sand in other borrow areas is not beach compatible or said borrow areas do not have sufficient volumetric capacity over the life of the project. Vibracores taken from the Little Egg Inlet study area in 2014 show that there is up to 10 feet depth of high quality sand within the delineated boundaries of the borrow area (Figure 2-3). Assuming a theoretical uniform cut dredging depth of -5 feet NAVD88, the site is estimated to contain approximately 17.2 mcy of suitable beachfill material; a dredge cut of -7.5 feet NAVD88, would yield approximately 25.8 mcy of suitable beach fill sand. Due to longshore transport processes, Little Egg Inlet is a deposition area and will continue to replenish over time.

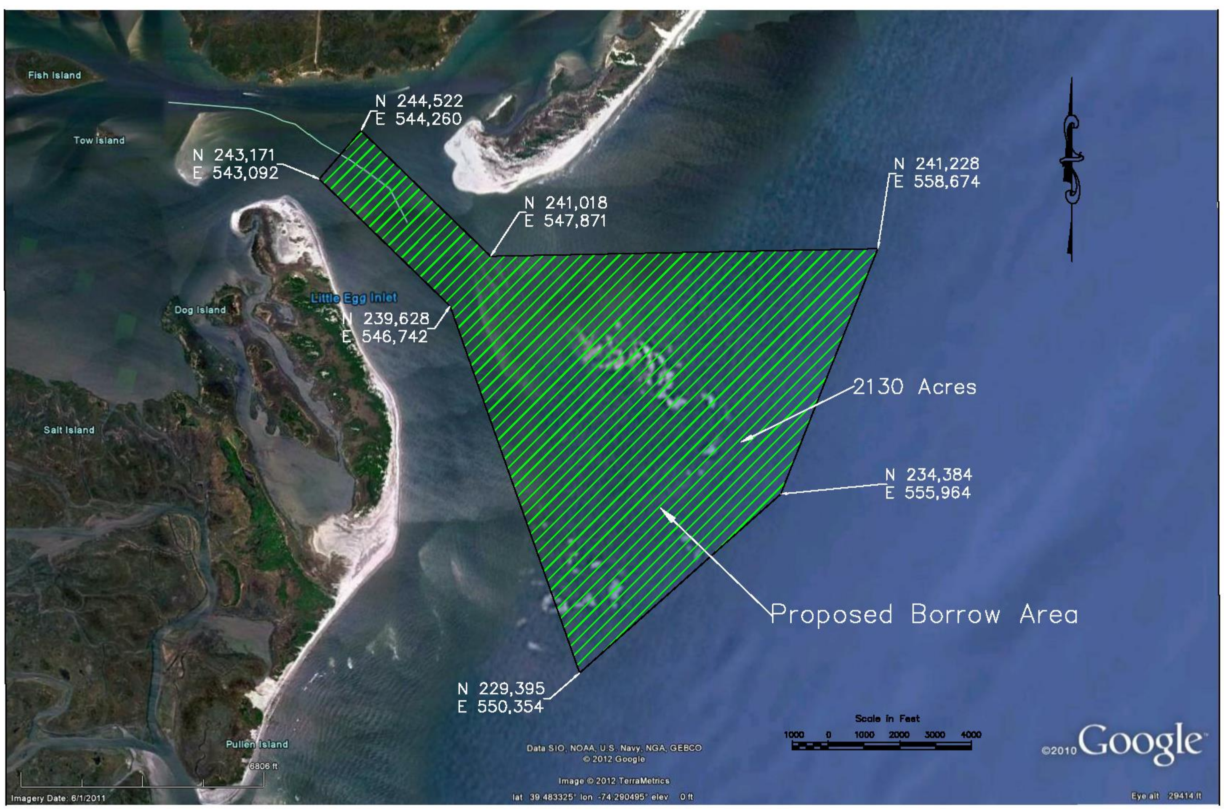

Figure 2-3: Aerial view of the Little Egg Inlet study area.

The LBI storm damage reduction project design plan remains the same as described in the 1999 EIS and 2014 EA: dune and beach berm of uniform cross section; a 125-foot wide beach berm at elevation +8.0 North American Vertical Datum (NAVD) and a dune at an elevation of +22 feet NAVD. The dune is 30-feet wide at its crest with 347 acres of planted dune grasses and 540,000 linear feet of sand fencing. The total length of the dune/berm system is approximately 16.9 miles long. Approximately 1.9-2.0 mcy of sand will be required for periodic nourishment, on average, at 7-year intervals for a period of 50 years. Emergency beach placement operations following significant storm damage would require additional sand quantities. An additional 20-25% is typically estimated as needed to account for potential losses during the dredging operation due to sediment characteristic variability, shoreline change prior to construction, and settlement/erosion due to storms during construction.

Dredging of sand from within the limits of the Little Egg Inlet borrow area would be accomplished by a cutter suction dredge. Cutter suction, or hydraulic dredges, are floating platforms equipped with a rotating cutter that excavates the sea floor, feeding the loosened material into a pipe and pump system that transports the material and water slurry up to typical distances of six miles. Transport distances beyond this range become more costly and hopper dredges are required.

Trailing suction hopper dredges are designed to vacuum material from the sea floor through drag arms that load the material into the hold of the vessel (3,600 CY to 6,500 CY). The cargo of sand is then sailed to a pump-out location where the material is pumped ashore by the ship (or the pump-out station). Some areas within the proposed Little Egg Inlet borrow area have treacherous shoals, rendering the area too shallow for trailing suction hopper dredges and will not be utilized for the Little Egg Inlet borrow area. Both dragheads and cutterheads are required to be screened on intakes and baskets. The hole size on the intake screens is 1 ¼” while the mesh on the baskets is ¾”. The screening device on the dredge intake or in-pipeline section prevents the passage of any material greater than 1 ¼”in diameter. The maximum allowable opening is 1-1/4” x 6 “.

Current depths in Little Egg Inlet range considerably across 3,288 acre delineated area of analysis. Within the inlet itself, current depths range between -26 to -47 feet NAVD88. Immediately offshore, significant shoaling has occurred and depths are considerably lower, ranging from -5 to -25 feet NAVD88, with the majority of the area less than 12 feet deep, depending on the tidal cycle (April 2015 survey). Hydraulic cutter suction dredges can cut lanes approximately 200 feet wide and about 5 feet deep with each pass. Typically, dredges cut only a small section and do not impact the entire bottom surface area of the borrow site. A proposed dredging narrow, elongated dredging area configuration is proposed and serves to minimize impacts to infaunal and epibentic organisms. The proposed dredging area is located approximately 0.37 to 2.0 miles offshore of the inlet mouth along the northern border of the borrow area (more discussion is provided in Section 4). Dredging is estimated to take approximately 4 months.

Little Egg Inlet is ideally located as a borrow source for the LBI beachfill project, situated at the southern end of Long Beach Island and about 3 miles from the southern end of the project area. The area naturally recharges through southwesterly longshore transport processes. Approximately 2.0 mcy of sand will be required every 7 years for periodic nourishment, depending on how frequent significant storm events erode the LBI project template. In order to complete initial construction, the USACE proposes to hydraulically dredge sand from the proposed Little Egg Inlet borrow area for placement on the southern end of the project in Holgate while hopper dredges are simultaneously dredging to complete construction on the northern reaches (Loveladies & North Beach) using Borrow Areas D1 and D2 (USACE, 2014).

3.0 AFFECTED ENVIRONMENT

The affected environment evaluated includes the proposed borrow area, the area inside, and the immediate nearshore areas just outside of Little Egg Inlet, and the adjacent beach and saltmarsh habitats located north, west, and south of the inlet (Figure 2-1.) Given that there is a complete description of all Storm Damage Reduction project-related resource areas in the 1999 EIS and also for Borrow Area D1 and D2 in the 2014 EA for dredging operations within the borrow areas as well as placement operations on Long Beach Island, the current EA tiers off of these prior NEPA documents. The current EA presents only those existing environmental resources of the newly proposed areas that would be affected if any of the alternatives were implemented as well as recent information obtained from natural resource agencies. This section, in conjunction with the description of the "no-action" alternative, forms the baseline conditions for determining the environmental impacts of the proposed action and reasonable alternatives presented in Section 4.0.

3.1 Terrestrial

The general environment surrounding Little Egg Inlet include the Holgate spit of land (3.5 miles), a barrier beach on the southernmost end of Long Beach Island and Little Beach Island (6 miles), located on the opposite bank of Little Egg Inlet. Both of these are part of the Edwin B. Forsythe National Wildlife Refuge (NWR). Approximately 80% of the Forsythe NWR is classified as salt marsh. Behind the Holgate spit of barrier beach is the Great Bay Boulevard Wildlife Management Area (WMA), managed by the New Jersey Department of Environmental Protection's Division of Fish and Wildlife and offering of 5,346 acres of saltmarsh habitat. The Great Bay Boulevard WMA is recognized as one of the largest untouched marshes in New Jersey.

Holgate and Little Beach Island are designated and administered as National Wilderness Areas. The two refuge units represent two of the few remaining undeveloped barrier beaches in New Jersey. The Holgate Unit is closed to all public access from April 1 to August 31 to ensure undisturbed nesting conditions for Federal and state-listed shorebirds. A permit is required to visit Little Beach Island due to its environmental sensitivity. Situation behind Holgate is the Great Bay Boulevard Wildlife Management Area west/northwest of Little Egg Inlet.

The dominant salt marsh species surrounding Little Egg Inlet on the Forsythe Wildlife Refuge lands are salt marsh cordgrass (*Spartina alterniflora*) and salt-meadow grass (*Spartina patens*). The salt marshes are interlaced with small tidal streams, mudflats, and ponds.

The Forsythe Refuge was designated as a "wetland of international importance" under the Ramsar Convention Treaty of 1971. It is one of only 17 such sites in the United States. Of the refuge's 47,000 acres, 80% is salt marsh, the most productive land cover. These natural habitats provide essential nesting and feeding area for rare species of birds. Beach slope and dunes fronting the refuge are constantly shifting due to wave action and winds. Beach grasses stabilize dunes and provide important cover for wildlife.

The Bass River winds through the refuge, feeding into the Mullica River and into Great Bay and to Little Egg Inlet. These rivers pass through the Pinelands National Reserve (and state-designated Pinelands Area). Population of the Pinelands National Reserve is approximately 870,000 and of the state-designated

Pinelands area, approximately 312,000 (2010 US Census). New Jersey's cranberry production and virtually all of its blueberry production occur within the Pinelands. The Great Bay/Little Egg Inlet system is one of the few remaining undeveloped estuaries on the East Coast (Rice, 2014).

3.1.1 Dunes and Nearshore Habitat

The ocean moderates the continental climate within the coastal weather zone of the project area. The average monthly temperature is 35 degrees F in January, the coldest month of the year and 75 degrees F in July, the hottest month of the year. The vegetation growing season is about 245 days, with an average temperature of 43 degrees F and average annual precipitation is 42.6 inches (USFWS, 2004). New Jersey Atlantic beaches, including the refuge property on both sides of Little Egg Inlet, and the nearshore waters provide a dynamic environment heavily influenced by the tidal flows and long-shore currents. Beaches and dunes are linked together to form the "littoral active zone". Even though there is active sand exchange occurring between them, the two systems are quite distinct. The beach/surf zone being a marine, wave-driven system, and the dune field a primarily wind-driven terrestrial ecosystem. The intertidal zone has shifting sands and pounding surf dominating the habitat. Organisms within this zone have evolved to have special locomotory, respiratory, and morphological adaptations that enable them to survive in this extreme habitat. They are agile, mobile and capable of resisting long periods of environmental stress. These organisms tend to be rapid burrowers with high rates of reproduction and short (1 to 2 years) life spans (Hurme and Pullen, 1988). Dominant marine intertidal species are presented in Section 3.2.4.2 Benthic Resources.

Coastal dune fauna displays high diversity. In typical undisturbed beach profiles along the Atlantic Coast of New Jersey, the primary dune is the first dune landward from the beach. The flora of the primary dune are adapted to the harsh conditions present such as low fertility, heat, and high energy from the ocean and wind. The dominant plant on these dunes is American beachgrass (*Ammophila breviligulata*), which is tolerant of salt spray, shifting sands and temperature extremes. American beachgrass is a rapid colonizer that can spread by horizontal rhizomes, and also has fibrous roots that can descend to depths of 3 feet to reach moisture. Beachgrass is instrumental in the development of dune stability, which opens up the dune to further colonization with more species like seaside goldenrod (*Solidago sempervirens*), sea-rocket (*Cakile edentula*) and beach cocklebur (*Xanthium echinatum*).

The secondary dunes lie landward of the primary dunes, and tend to be more stable resulting from the protection provided by the primary dunes. The increased stability also allows an increase in plant species diversity. Some of the plant species in this zone include: beach heather (*Hudsonia tomentosa*), coastal panic grass (*Panicum amarum*), saltmeadow hay (*Spartina patens*), broom sedge (*Andropogon virginicus*), beach plum (*Pnmus maritima*), seabeach evening primrose (*Oenothera humifisa*), sand spur (*Cenchrus tribuloides*), seaside spurge (*Ephorbia polygonifolia*), joint-weed (*Polygonella articulata*), slender-leaved goldenrod (*Solidago tenuifolia*), and prickly pear (*Opuntia humifusa*).

3.1.2 Birds

Migratory shorebirds are a Federal trust resource responsibility of the USFWS. Many species of shorebirds inhabit the beach during the spring and fall migrations, although most are even more likely to be found on protected wetland areas located around the perimeter of the proposed project area on Long Beach Island. Shorebirds feed on small individuals of the resident infauna and other small organisms brought in with waves. Common shorebird species include the sanderling (*Calidris alba*), semi-palmated sandpiper (*Calidris pusilla*), dunlin (*Calidris alpine*), semi-palmated plovers (*Charadrius semipalmatus*), short-billed dowitcher (*Limnodromus griseus*), willet (*Catoptrophorus semipalmatus*), greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), and ruddy turnstone (*Arenaria interpres*). The Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge, on the southern end of Long Beach Island, and Little Beach Island on the southern side of Little Egg Inlet provide important resting and feeding areas for migrating shore birds.

Colonial nesting shorebird habitat is increasingly under pressure from development and human disturbance along New Jersey's Atlantic beaches. Nesting birds such as common tern (*Sterna hirundo*), least tern (*Sterna antillarum*), black skimmer (*Rynchops niger*), and American oystercatcher (*Haematopus palliatus*) are frequent spring and summer inhabitants on unvegetated dunes and upper beaches within the study area. For a comprehensive list of colonial nesting waterbirds, raptors, and migratory songbirds that visit the barrier island and surrounding marshes in Barnegat Bay, Manahawkin Bay, and Little Egg Harbor adjacent to Long Beach Island, please refer to the EIS (USACE, 1999) and the USFWS Planning Aid Report (USFWS, 2016-Appendix D). Several species of gulls are common along New Jersey's shores, and are attracted to forage on components of the beach wrack such as carrion and plant parts. These gulls include the laughing gull (*Larus atricilla*), herring gull (*L. argentatus*), and ring-billed gull (*L. delawarensis*). For a detailed list of birds that occur within the Forsythe Wildlife Refuge see www.fws.gov/uploadedFiles/Forsythe_Bird_Brochure_for_web.pdf.

Several bird species are protected by the Endangered Species Act (ESA) and are discussed further in Section 3.3 of this report.

3.1.3 Wildlife

The Forsythe NWR and NJDEP WMAs provides protected coastal wilderness habitat on the north, south and western boundaries of Little Egg Inlet. The area provides one of the last few remaining undeveloped barrier beaches in the state. The beach areas adjacent to Little Egg Inlet provide fragile habitat for birds, reptiles, and mammals. Common species include American toad (B*ufo americanus*), common snapping turtle (*Chelydra serpentine*), eastern diamondback terrapin (*Malaclemys terrapin terrapin*), northern diamondback terrapin (*Malaclemys T. terrapin*), raccoon (*Procyon lotor*), white-footed mouse (*Peromyscus leucopus*), house mouse (*Mus musculus*), and eastern cottontail (*Sylvilagus floridanus*). A more extensive listing of amphibian, reptilian, and mammalian species is provided in Section 2.3 of the EIS (USACE, 1999).

3.2 Marine

3.2.1 Water Quality

Water quality in Little Egg Inlet, Barnegat Inlet, and the Atlantic Ocean are generally good. Exceptions are occasional waste discharges or the unlikely offshore oil spills. Intentional overboard discharge of solid waste and sewage from recreational boats may degrade water quality in the bay. The primary cause of non-point source pollution, such as run-off of petroleum products or fertilizers is related to development on land and/or the activities that result from land development but the region around Little Egg Inlet is undeveloped wildlife refuge land. Residential development is a few miles away both to the north and south of the inlet. The USFWS manages the beach areas for rare birds that depend on them by limiting, and in some areas, prohibiting public access during nesting season.

Little Egg Inlet is found within the Mid-Atlantic Bight (MAB), one of four subregions of the Northeast Continental Shelf. Each subregion reflects different underlying oceanographic conditions and fishery management boundaries with varying water temperature and salinity. Within the MAB, temperature stratification varies greatly between summer and winter. The water column is vertically well-mixed, with surface water temperatures of 14°C (57°F) at the surface and 11°C (52°F) at depth in the winter. During the summer, the water is generally 25°C (77°F) near the surface and 10°C (50°F) at depths greater than 656 feet (Paquette *et al*., 1995). The pH of the marine seawater is relatively stable due to the presence of the CO2- carbonate equilibrium system which maintains a pH between 7.5 and 8.5. The major chemical parameters of marine water quality include pH, dissolved oxygen, and nutrient concentrations. Salinity in the MAB generally ranges from 28 to 36 parts per thousand (ppt) over the continental shelf. Lower salinities are found near the coast and in the backbay waters, and the highest salinities are found near the continental shelf break. Marine seawater salinity is generally highest during the winter and lowest in the spring.

Water quality measurements taken 29 July 2013 (Scott, 2014) indicated that very little surface to bottom stratification existed within the water column at the Little Egg Inlet borrow area and were all within the expected range for this area (Table 3-1). Surface water temperature was less than one degree higher than bottom water temperature. Salinity, conductivity, pH, and dissolved oxygen (DO) also displayed little to no water column stratification. Turbidity was a bit higher near the bottom as is expected due to water currents and proximity to fine sediments.

Table 3-1. Water quality measurements taken while sampling within the Little Egg Inlet borrow area on July 29, 2013.

Depth (m)	Temperature (°C)	Conductivity (mS/cm)	Salinity (ppt)	pH	DO (mg/l)	Turbidity (NTU)
0.7	23.31	47.60	31.01	7.98	7.55	1.8
1.8	22.88	47.72	31.11	7.97	7.26	2.9
2.6	22.68	47.75	31.14	7.97	7.19	3.7
3.3	22.57	47.76	31.14	7.96	7.16	3.9
4.2	22.55	47.76	31.14	7.96	7.14	4.0
4.6	22.54	47.75	31.14	7.96	7.11	4.8

3.2.2 Sound

Predominant noises in the proposed borrow area consist of crashing waves and shorebirds. In a recent study done on in-water noise of a beach nourishment dredging project at Wallops Island, VA, background sound pressure levels (SPLs) averaged 117 decibels (dB) across all sampling days, sites, water depths and weather conditions. Minimum measured sound levels ranged from 91 dB to 107 dB depending on sampling location and water depth; maximum levels ranged from approximately 128 dB to just under 148 dB (Reine, 2014). Highest SPLs were found at frequencies of less than 200 hertz. The authors note that sea state and the associated sounds generated by waves interacting with the survey vessel likely contributed to the elevated readings.

3.2.3 Upper Marine Intertidal

A sediment sampling program was conducted in 2011, in coordination with the New Jersey Beach Profile Network (NJBPN) to monitor shoreline change and create a grain size distribution map (Flynn, 2011). Samples were collected at the high tide line at a depth of approximately 6 inches at each station spaced 1 mile apart. The average median grain size is classified as medium sand according to the Wentworth classification system (o.25-0.50mm), and near the upper limit of values for medium sand before being classified as coarse sand.

The upper marine intertidal zone is sparsely populated by invertebrates, however, more biological activity is present in comparison to the upper beach. Organic inputs are derived primarily from the ocean in the form of beach wrack, which is composed of drying seaweed, tidal marsh plant debris, decaying marine animals, and miscellaneous debris that washed up and deposited on the beach. The beach wrack provides a cooler, moist microhabitat suitable to crustaceans such as the amphipods *Orchestia* spp. and *Talorchestia* spp., which are also known as beach fleas. Beach fleas are important prey to ghost crabs. Various foraging birds and some mammals are attracted to the beach fleas, ghost crabs, carrion and plant parts that are commonly found in beach wrack. The birds include gulls, shorebirds, fish crows, and grackles.

3.2.4 Nearshore Marine

The following paragraphs discuss geomorphology and biological resources associated with New Jersey nearshore coastal waters adjacent to the inlet.

3.2.4.1. Geomorphology

The USACE has conducted studies to examine the magnitude and direction of longshore sediment transport at Long Beach Island and adjoining shores. Sediment transport estimates were computed from 1838 through to 1975 by Greenhorne & O'Mara, Inc. (1975). The gross longshore sediment transport values varied from as low as 0.5 million to almost 2.0 million cubic yards (cy) per year, with a net southward transport which varied from 50,000 to 400,000 cy/year. Reversals in longshore sediment transport contribute significantly to both the short- and long-term behavioral patterns of the Long Beach Island shoreline.

As part of the New Jersey Alternative Long-Term Nourishment Study (NJALTN), the USACE developed a regional sediment budget from Cape May Point to Manasquan Inlet using the software tool SBAS 2004 (Sediment Budget Analysis Systems developed by the USACE Engineering Research and Development Center (ERDC). A sediment budget represents an accounting of sediment movement, both natural and mechanical, within a defined area over a specified time. Sediment sources are such things as beachfills, longshore transport, shoreline erosion, and inlet shoal growth. Sediment sinks are such things as longshore transport, shoreline accretion, dredging, and inlet shoal reduction. A regional sediment budget can be a useful tool in investigating observed coastal changes and estimating future changes and management alternatives that take into account a regional strategy. The NJAKTN study evaluated shoreline position and wave data for the period of analysis 1986-2003. Additional input data included dredging records, borrow area dredging records, beachfill project quantities, and inlet bathymetry surveys. The study area was divided into 28 control volume areas (typically one for each inlet and each barrier island land mass). The control volumes for Long Beach Island and Island Beach were split in order to reduce reach lengths.

The NJALTN study calculated a sediment source of 360,000 cubic yards/year (cy/yr) of southerly longshore sediment transport from LBI and 295,000 cy/yr of northerly longshore sediment transport from N. Brigantine Island. The sediment sinks were 95,000 cy/yr of sand bypassing to Long Beach Island; 240,000 cy/yr of sand bypassing to N. Brigantine Island. A shoreline accretion of 83,000 cy/yr at the southern tip of LBI, and 237,000 cy/yr of shoal growth were assumed in order to balance the control volume since hydrographic survey data covering the inlet did not exist.

Long Beach Island was divided into three control volumes to reduce reach lengths used in the NJALTN analysis. Long Beach Island South extends from Little Egg Inlet to the town of Surf City. The sediment sources were 295,000 cy/yr of southerly longshore sediment transport from the Long Beach Island control volume, 95,000 cy/yr of sand bypassing Little Egg Inlet, and 185,000 cy/yr of shoreline erosion (there were no beachfills from 1986 to 2003 for this control volume). The Long Beach Island North control volume extended from Surf City north to Loveladies. The sediment sources were 105,000 cy/yr of southerly longshore sediment transport from the Long Beach Island Nodal control volume, 205,000 cy/yr of northerly longshore sediment transport from the Long Beach Island South control volume, and 53,000 cy/yr of beachfill. The sediment sinks were 295,000 cy/yr of northerly longshore sediment transport to the Long Beach Island control volume, 285,000 cy/yr of southerly longshore sediment transport to the Long Beach Island South control volume, and an assumed offshore loss of 20% (15,000 cy/yr) from beachfills. There is a nodal point in the northern part of Long Beach Island at Barnegat Light where the net sediment transport reverses from southerly to northerly due to the shadowing effects of Long island. The calculation of the longshore sediment transport using updated WIS wave hindcast has verified this commonly known belief.

Uptegrove *et al*. (2015) developed high resolution marine seismic profiles with vibracore data from 1 to 10 kilometers off the coast of Brigantine to map the surficial geology and the land/sea interface. Their research showed that intermittent storms, as well as the southern and southeastern residual current flow drive the southward net longshore drift across the region. Longshore currents continue to reshape the deltaic deposits into ridges, increasing shoal relief and elongating the southern end of LBI. These processes transport significant sediment, resulting in extensive accumulation and preservation of sand to the south of LBI in and around Little Egg Inlet. From Barnegat Light to Beach Haven, an average net transport of 93,467 cubic yards/year of sand to the southwest was computed using December 1997 shoreline data (USACE, 1999), prior to the more recent beachfill placement operations on LBI, north of Little Egg Inlet.

Aerial photography dating back to 1874 illustrates the dynamic ever-changing condition of the barrier island/inlet system in this area. The Little Beach Haven Inlet didn’t breach Long Beach Island until 1920, creating Tuckers Island. By 1933, the southernmost end of Long Beach Island (*i.e*. Holgate), the inlet’s north shore, had migrated more southward and Tuckers Island began to erode by 1940. By 1956, Tuckers Island is gone and Beach Haven Inlet has migrated southward to combine with Little Egg Inlet. The dominant longshore transport direction along this portion of the New Jersey coast is to the southwest. The southwest transport moves sand along the shoreline of Long Beach Island, past the developed community of Holgate, and towards the Holgate spit on National Wildlife Refuge lands. Elongation growth of the Holgate spit continues southwest to the present. Little Beach Island, on the inlet’s south side, is also subjected to the dominant longshore transport. Little Beach was historically positioned more southwest when the inlet was much wider. Little Beach has migrated northeast over the observed 141 year period through the accumulation of sand. This dynamic system is indicative of the large quantities of sand that are transported alongshore, and indicates that a configuration that exists at any given time is subject to the type of transformations documented herein, and is subject to large potential changes over periods of years to decades or in the case of severe storms: days. Sand has shifted continuously and Little Beach has alternatively built up and eroded and repositioned-typical morphological changes of an inlet/ocean dynamic environment.

For a more detailed historical description of the geomorphological changes that have occurred in and around the Little Egg Inlet complex since 1874, refer to the reports and aerial photographs provided in Appendix B.

3.2.4.2. Benthic Invertebrates

Typical invertebrate infauna of the beach intertidal zone that have evolved to survive in high energy, disruptive habitat include the mole crab (*Emerita talpolida*), haustorid amphipods (*Haustorius* spp.), coquina clam (*Donax variablilis*), and spionid worm (*Scolelepis squamata*) (Scott and Bruce, 1999). The epifaunal blue crab (*Callinectes sapidus*), and lady crab (*Ovalipes ocellatus*) are also found in the intertidal zone. These invertebrates are prey to various shore birds and nearshore fishes.

Little Egg Inlet, Great Bay and Little Egg Harbor are designated as shellfish growing areas approved for harvest (New Jersey Department of Environmental Protection, 2015). The following species are reported to occur in the vicinity of the study area: bay scallop (*Argopecten irradians*), eastern oyster (*Crassostrea virginica*), hard clam or northern quahog (*Mercenaria mercenaria*), dwarf surf clam (*Mulinia lateralis*), softshell clam (*Mya arenaria*), and blue mussel (*Mytilus edulis*) (U.S. Fish and Wildlife Service, 2004). However, of these listed bivalve species, only *M. edulis* was collected in the 2013 sampling efforts within the proposed borrow area. Other bivalves collected are listed in Table 3-2.

Versar, Inc. conducted an assessment of benthic macroinvertebrates for the proposed Little Egg Inlet sand borrow area (Scott, 2014). The report focused on dredging impacts to living resources in the area, including the potential disruption to commercial and recreational fisheries. Seventeen randomly-selected sampling stations were sampled within the Little Egg Inlet borrow area (Figure 3-1). Benthic and sediment samples for the borrow area study were collected with a 0.044-m^2 stainless steel, Young grab sampler. Samples collected for benthic macroinvertebrates were sieved through a 0.5-mm screen and preserved in a 10% solution of buffered formaldehyde stained with rose bengal. Sediment samples for analysis of grain-size and total organic content (TOC). Water quality measurements were taken throughout the water column within the Little Egg Inlet borrow area to document the current conditions the day of sampling. Measurements included dissolved oxygen concentration (DO), salinity, conductivity, temperature, pH, and turbidity.

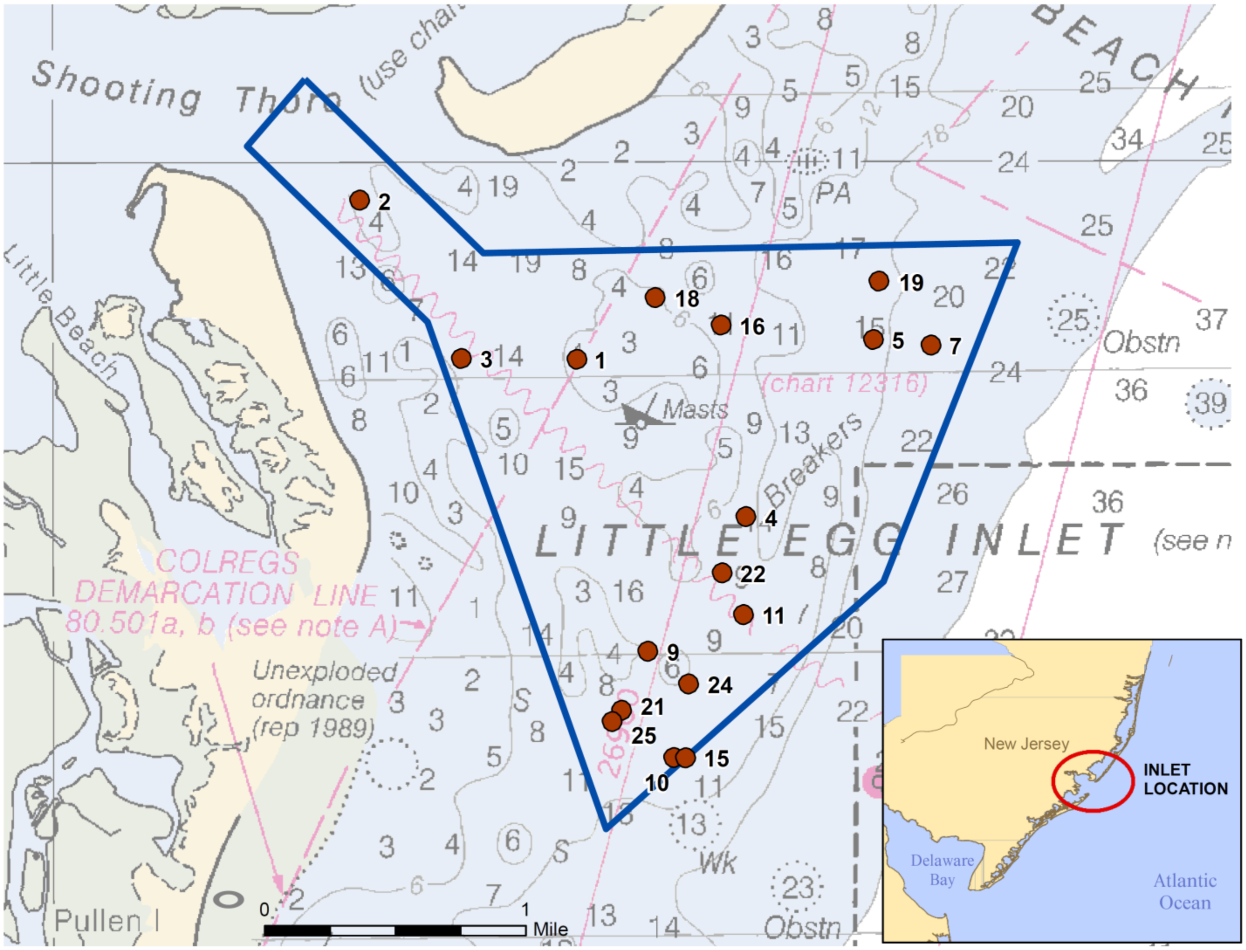

Figure 3-1: Location of the 17 benthic stations sampled within the Little Egg Inlet borrow area, NJ in July 2013 (Scott, 2013).

The benthic study was conducted in July during the high productivity period of the year. Results of both the surf clam and benthic surveys suggest that population densities within the inlet are generally lower in the southern portion of the borrow area than in the northern portion of the borrow area. The benthic community is typical of high energy nearshore habitats. The community has low numbers of taxa but certain species were found in high abundances. The high abundance species are typically found in large numbers along the New Jersey coastline and are active burrowers in nearshore subtidal sand habitats. These species have opportunistic life history characteristics that include short-lived, high fecundity and high productivity that result in high abundance but low biomass and allows them to thrive in turbulent environments.

Forty four (44) total taxa were collected from the 17 sampling stations within the Little Egg Inlet borrow area. Of these, thirty seven (37) taxa are classified as infauna taxa while seven (7) are considered as epifauna taxa (Table 3-2). Ten (10) of the taxa had specimens that were over 2 cm in length. These larger taxa were only found at 3 or less stations and station LEH-05 had the most taxa with sizes greater than 2 cm in length (5 taxa).

Table 3-2. Taxa collected from the Little Egg Inlet borrow area, New Jersey, sampled in July 2013, including the number of stations where taxa were collected and the taxa containing specimens greater than 2 cm in length. Epifaunal taxa are highlighted in yellow.

Taxonomic Group	Species	Number of Stations Found	Total Collected (#/m^2)	Station with specimens > 2cm
Annelida : Polychaeta	*Amastigos caperatus*	1	22.7	
	Aricidea wassi	1	22.7	
	Asabellides oculata	2	45.5	LEH-07, 19
	Dispio uncinata	4	181.8	LEH-05
	Nephtys bucera	4	159.1	LEH-04, 18
	Nephtys picta	1	68.2	
	Notocirrus spiniferus	3	68.2	LEH-02, 05, 07
	Onuphis eremita	1	22.7	LEH-07
	Paraonis fulgens	1	22.7	
	Polygordius jouinae	1	90.9	
	Scolelepis squamata	8	181.8	
	Scoloplos rubra	1	22.7	
	Sigambra tentaculata	1	113.6	
	Spiochaetopterus costarum	2	90.9	
	Spiophanes bombyx	3	250.0	
Arthropoda : Amphipoda	*Acanthohaustorius millsi*	15	7000.0	
	Americhelidium americanum	2	90.9	
	Bathyporeia quoddyensis	6	1795.4	
	Microprotopus raneyi	2	68.2	
	Parahaustorius attenuatus	5	159.1	
	Parahaustorius longimerus	13	3272.7	
	Protohaustorius deichmannae	7	6977.3	
	Rhepoxynius hudsoni	2	136.4	
Arthropoda : Cumacea	*Mancocuma stellifera*	4	545.5	
	Oxyurostylis smithi	1	45.5	
Arthropoda : Decapoda	*Crangon septemspinosa*	1	22.7	
	Euceramus praelongus	1	22.7	
	Ovalipes ocellatus	1	22.7	LEH-24
	Pagurus longicarpus	4	136.4	
	Pinnixa chaetopterana	1	22.7	
Arthropoda : Isopoda	*Ancinus depressus*	1	22.7	
	Chiridotea caeca	8	568.2	
Arthropoda : Mysidacea	*Americamysis bigelowi*	2	68.2	
Arthropoda : Tanaidacea	*Tanaissus psammophilus*	6	568.2	
Mollusca : Bivalvia	*Donax variabilis*	11	1272.7	

	Ensis directus	2	68.2	LEH-05
	Mytilus edulis	1	22.7	
	Petricola pholadiformis	1	318.2	
	Spisula solidissima	14	4386.3	LEH-05, 15
	*Angulus agilis**	7	909.1	
Nemertina	*Carinoma* spp.	2	250.0	LEH-05, 07
	Carinomella lactea	1	159.1	
	Micrura leidyi	4	113.6	LEH-16
* *Angulus agilis* was formally named *Tellina agilis*				

Grain-size analysis was performed according to ASTM Method D422-63. Sieve sizes ranged from 4.75 mm (U.S. Standard Sieve No. 4) to 63 µm (U.S. Standard Sieve No. 230). Sediments were categorized by Wentworth's classifications (Table 3-3). Total organic content (TOC) was measured by weight loss upon ignition at 500 °C for 4 hours after obtaining a dry weight by drying the sample to a constant weight for 24 hours at 60 °C.

Table 3-3. Sieve sizes used for sediment particle distribution and the Wentworth sediment size categories (Buchanan, 1984)

Sieve Number	Sieve Size	Wentworth Size Category
4	4.75-mm	Pebble
10	2.00-mm	Granule
20	850-µm	Very Coarse Sand
40	425-µm	Coarse Sand
60	250-µm	Medium Sand
140	106-µm	Fine Sand
200	75-µm	Undefined
230	63-µm	Very Fine Sand
	< 63-µm	Silt-Clay

Sediments within the borrow area were mostly in the fine to coarse sand category with very little silt/clay particles or very coarse to gravel particles (Table 3-4; Figure 3-2). Although all of the stations were classified as sand stations, a few differences in the percentages within various sand categories were detected between the stations. Six stations (3, 11, 19, 21, 22, and 25) had predominantly sands in the coarse category (eight stations had a mix of fine to medium sands but had a higher amount of fine sands than the other stations. Three stations had a mix of medium to coarse sands).

Table 3-4. Sediment characteristics for each station sampled in the Little Egg Inlet borrow area in July 2013 (Scott, 2014).

Station	Fine Sands (%)	Medium sands (%)	Coarse Sand to Gravel (%)
Predominantly Fine to Medium Sands			
LEH-02	17.76	61.14	16.63
LEH-05	10.10	74.35	15.01
LEH-07	13.55	81.43	3.94
LEH-09	0.51	72.85	26.64
LEH-10	5.94	88.05	5.70
LEH-15	3.43	92.35	4.10
LEH-16	4.97	81.91	12.99
LEH-18	1.37	78.11	20.48
Mix Medium to Coarse Sands			
LEH-01	0.24	56.86	42.89
LEH-04	0.29	52.27	47.44
LEH-24	0.37	43.16	56.43
Predominantly Coarse Sands			
LEH-03	0.16	27.64	72.18
LEH-11	0.22	21.25	78.52
LEH-19	3.61	31.05	65.03
LEH-21	0.07	33.41	66.51
LEH-22	0.23	32.19	67.57
LEH-25	**0.08**	**33.12**	**66.80**

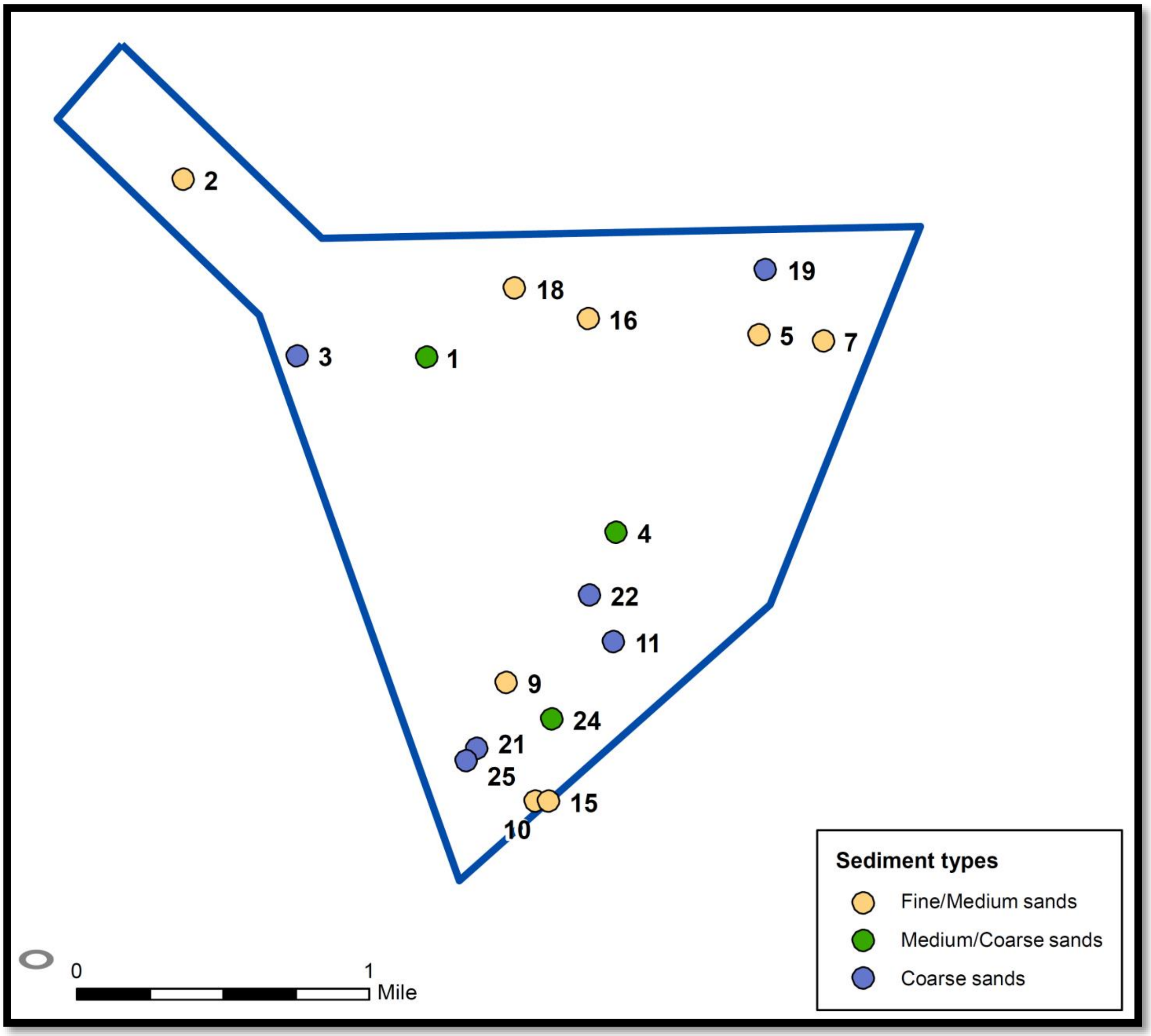

Figure 3-2: Surface sediment characteristics at benthic macroinvertebrate sampling sites in the Little Egg Inlet borrow area sampled in July 2013 (Scott, 2014).

Figure 3-3 depicts the location of the 20 hydraulic clam dredge tracks conducted by Versar, Inc. on 30 July 2013 using a 1 foot knife width hydraulic clam dredge (Scott, 2014).

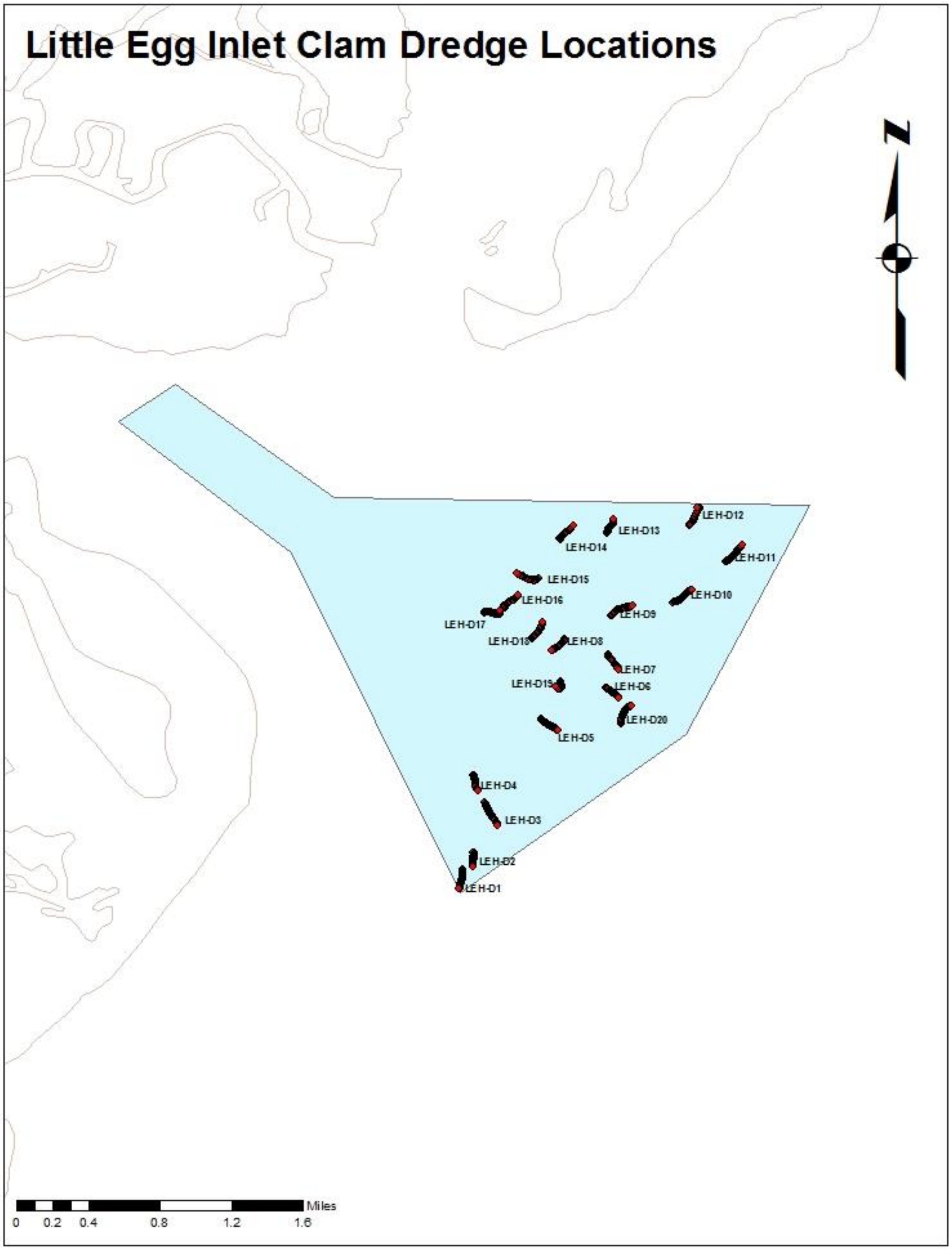

Figure 3-3: Adult surf clam sampling locations and tow tracks for the 20 stations trawled on July 30, 2013 in the Little Egg Inlet borrow area.

The methods for both the Little Egg Inlet benthic community study and the surf clam (*Spisula solidissima*) survey followed those utilized for previous USACE benthic invertebrate evaluations conducted for other beach nourishment borrow areas so that biological data could be compared to previous and future studies in and around the region. Results of both the 2014 surf clam and benthic surveys suggest that population densities are, in general, lower in the southern portion of the borrow area than in the northern portion of the borrow area. Previous benthic community composition studies were conducted for the four LBI nearshore borrow areas and an LBI reference area in 1998 and found to be similar (Scott and Kelley, 1998). The full benthic evaluation report can be found in the Environmental Appendix of the EIS (USACE, 1999). Additional benthic evaluations were conducted following release of the 1999 EIS (Versar, 2008, Scott, 2012) and can be found in the 2014 EA for the LBI beach nourishment project (USACE, 2014a).

Adult female blue crabs (*Callinectes sapidus*) overwinter at the mouths of New Jersey inlets in winter, generally December through March, so they are in position to release their eggs in spring in a location that will allow their eggs to be carried into the ocean. The crabs burrow into surficial sediments as water temperature declines and overwinter in a dormant, immobile state until water temperatures rise above approximately 10 degrees C in spring. Steimle *et al*. (2000) has documented that juvenile blue crabs are a food source for several state and federally managed fish species including winter flounder, little skate, winter skate, scup, and summer flounder.

3.2.4.3 Finfish

The coastal water and inlets of New Jersey provide habitat for a wide variety of fish. Federally managed species, under the purview of the National Marine Fisheries Service (NMFS), are discussed further in the Essential Fish Habitat subsection below. Fish species in the Atlantic Ocean off the coastline of LBI and Little Egg Inlet include, but not limited to American eel (*Anguilla rostrata*), white perch (*Morone americana*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), fluke (*Paralichthys dentatus*), bluefish (*Pomatomus saltatrix)*, spot (*Leiostomus xanthurus*), summer flounder (*Paralichthys dentatus*), northern puffer (*Sphoeroides maculatus*), weakfish (*Cynscion regalis*), Atlantic menhaden (*Brevoortia tyranus*), scup (*Stenotomus chrysops*), striped bass (*Monroe saxatilis*), spiny dogfish (*Squalus acanthias*), and winter flounder (*Pseudopleuronectes americanus*). Other fish found that may be found within the area, many which are important forage fish, include bay anchovy (*Anchoa mitchilli*), Atlantic silverside (*Menidia menidia*), three spine stickleback (*Gasterosteus aculeatus*), northern pipefish (*Syngnathus fuscus*), winter skate (*Raja ocellata*), clearnose skate (*Raja eglanteria*), southern stingray (*Dasyatis americana*), and northern kingfish (*Menticirrhus saxatilis*).

Nearshore and offshore areas along the Atlantic coast provide a migratory pathway and spawning, feeding and nursery area for many fish sought by sport fishermen common to the Mid-Atlantic region including black sea bass (*Centropristis striata*), striped bass, summer flounder, winter flounder, bluefish, Atlantic mackerel (*Scomber japonicus*), tautog (*Tautoga onitis*), scup, Atlantic menhaden, weakfish, and American shad (*Alosa sapidissma*). In addition, shipwrecks and artificial reefs along the coast provide habitat for a variety of fish including: Atlantic cod (*Gadus morhua*), red hake (*Urophycis chuss*), spotted hake (*Urophycis regia*), white hake (*Urophycis tenuis*), black sea bass, pollock (*Pollachius virens*), mackerel, and bluefish. Shoal areas along the Atlantic coast are very productive areas for finfish. Such bathymetric contours provide important structure and feeding areas for finfish (Nairn *et al*., 2007;

Slacum *et al*., 2006). Groins also provide structure within nearshore shallows that provide sites for attachment of sessile organisms on which finfish feed.

The Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265), and amended as a Reauthorization Act (P.L. 109-479), have established Regional Fishery Management Councils to exercise sound judgment in the stewardship of fishery resources and develop Fishery Management Plans (FMPs).

3.2.4.4 Essential Fish Habitat

In accordance with provisions of the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA) and the 1996 Sustainable Fisheries Act, federal agencies are required to consult with NMFS regarding actions that may adversely affect Essential Fish Habitat (EFH). EFH is defined as "*those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity*." *Waters* consist of aquatic areas and their associated physical, chemical, and biological properties that are currently utilized by fishes and may include areas historically used. *Substrate* is defined as sediment, hardbottom, structures beneath the waters, and any associated biological communities. *Necessary* means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. *Spawning, breeding, feeding*, or *growth to maturity* includes all habitat types used by a species throughout its life cycle. Only species managed under a Federal FMPs are protected under the MSA (50 Code of Federal Regulations [CFR] 600). The act requires federal agencies to consult on activities that may adversely influence EFH designated in the FMPs.

The Atlantic Fishery Management Council and the National Marine Fisheries Service have identified EFH for the species listed in Table 3-5. Shoals attract many different fish species, including some of species and species groups that fall under EFH. The Atlantic Ocean along New Jersey's coast provides habitat that supports a wealth of species including commercially and recreationally important fish and shellfish and endangered and threatened species. Regional Fishery Management Councils are required to describe, identify, conserve and enhance areas designated as EFH. In addition, the councils must minimize adverse effects of fishing on EFH. These actions taken by the councils are to be informed by recommendations from NMFS. EFH descriptions currently exist for species in the proposed project area.

Little Egg Inlet is identified in the lower corner of EFH 10' x 10' Square (Coordinates: North 39^{o} 40.0 N; East 74^{o}10.0 W; South 39^{o}30.0 N; West 74^{o}20.0 W) (Guide to Essential Fish Habitat Designations http://www.greateratlantic.fisheries.noaa.gov/hcd/webintro.html)

> Square Description: *The waters within the square within the Inland New Jersey Bays estuary and the Atlantic Ocean affecting the following: east of new Jersey from Surf City, NJ., southeast to Beach Haven Inlet along most of Long Beach, past Ship Bottom, NJ., Brant Beach, NJ., Beach Haven Crest, NJ., Peahala Park, NJ., Spray Beach, NJ., to Beach Haven, NJ. Also, within southwest Manahawkin Bay and Little Egg Harbor (except for the western part), affecting the following islands: Cedar Bonnet, Flat, Egg, High, Ham, the Marshelder Is. Shelter, Barrel, Hither, and Story, and the wetlands along the coast from just north of Mill Creek, south past Popular Pt., Cedar Run, Horse Pt., Dinner Pt., Dinner Pt. Creek, Westcunk Creek, Long Pt., Parker Cove, Parker Run, Edge Cover east of Tuckerton, NJ., Jeremy Pt., and Shooting Thorofare around Big and Little Sheepshead Creek, West Creek, and Parkertown, NJ.*

Table 3-5. Summary of Species with EFH designations in the 10 Min. X 10 Min. Square within the Study Area (Guide to Essential Fish Habitat Designations: www.greateratlantic.fisheries.noaa.gov)

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Atlantic cod *(Gadus morhua)*				X
Red hake *(Urophycis chuss)*	X	X	X	
Redfish *(Sebastes fasciatus)*				
Winter flounder (*Pleuronectes americanus*)	X	X	X	X
Windowpane flounder *(Scopthalmus aquosus)*	X	X	X	X
Atlantic sea herring *(Clupea harengus)*			X	X
Bluefish *(Pomatomus saltatrix)*			X	X
Long finned squid *(Loligo pealei)*				
Short finned squid *(Illex ilecebrosus)*				
Atlantic butterfish *(Peprilus tricanthus)*			X	
Summer flounder *(Paralicthys dentatus)*		X	X	X
Scup *(Stenotomus chrysops)*			X	X
Black sea bass *(Centropristus striata)*			X	X
Surf clam *(Spisula solidissima)*				
Ocean quahog *(Artica islandica)*				
Spiny dogfish *(Squalus acanthias)*				
King mackerel *(Scomberomorus cavalla)*	X	X	X	X
Spanish mackerel *(Scomberomorus maculatus)*	X	X	X	X
Cobia *(Rachycentron canadum)*	X	X	X	X
Dusky shark *(Charcharinus obscurus)*(SOC)			X	X
Sand tiger shark (*Odontaspis taurus*) (SOC)				
Sandbar shark *(Charcharinus plumbeus)*(HAPC)			X	X
Tiger shark *(Galeocerdo cuvieri)*			X	
Bluefin tuna (*Thunnus thynnus*)				X
Smooth dogfish (*Mustelus canis)*			X	X
Scalloped hammerhead shark (*Sphyrna lewini)*			X	X
Clearnose skate (*Raja eglanteria*)			X	X
Little skate (*Raja erinacea*)			X	X
Winter skate (*Raja ocellata*)			X	X

SOC: Species of Concern
HAPC: Habitat Area of Particular Concern

Note: for a summary of EFH and general habitat parameters for Federally-managed species see http://www.greateratlantic.fisheries.noaa.gov/hcd/efhtables.pdf

Sand tiger and dusky sharks are listed as Species of Concern (NMFS letter dated 4 April 2013, updated K. Greene, pers. comm. 2015, 13 April 2016). Species of Concern are those species that the NMFS has concerns regarding their status and threats, but for which insufficient information is available to indicate a need to list the species under the Endangered Species Act. Additionally, the mouth of Little Egg Harbor Inlet and Great Bay have been designated as a Habitat Area of Particular Concern (HAPC) for sandbar shark (NMFS letter dated 13 April 2016). HAPCs are discrete subsets of EFH that provide important ecological functions and/or are especially vulnerable to degradation. Little Egg Harbor Inlet provides access to/from Great Bay, known important pupping and nursery grounds for the sandbar shark. Great Bay averages about 5 feet in depth, and provides extensive areas of estuarine substratum covered with algae and vascular plant beds in areas shallower than 3 feet. Extensive areas (3,355 acres)

of intertidal sandflats and mudflats occur within this estuary, the result of the sediment load from the Mullica River and the movement of sand in through Little Egg Inlet.
Andromous fish species such as alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), and striped bass (*Morone saxatilis*) transit the inlet to reach spawning and nursery habitat. Because landing statistics and the number of fish observed on annual spawning runs indicate a drastic decline throughout most of their range since the mid-1960s, these species are designated as Species of Concern (SOC). The catadromous American eel (*Anguilla rostrata*) spawns in the Sargasso Sea and transit the inlet as elvers and inhabit freshwater areas until they return to the sea as adults. The stocks are at or near historically low levels due to a combination of historical overfishing, habitat loss, food web alterations, predation, turbine mortality, environmental changes, toxins, and contaminants and disease (ASMFC, 2012).

3.3 Threatened and Endangered Species

Endangered species are those whose prospects for survival are in immediate danger because of a loss or change of habitat, over-exploitation, predation, competition or disease. Threatened species are those that may become endangered if conditions surrounding the species begin or continue to deteriorate. Species may be classified on a Federal or State basis. There are several listed or notable species of special concern that can be found along the New Jersey coast; most of these are transient in the area.

The Federally-listed seabeach amaranth (*Amaranthus pumilus Rafinesque*) was listed as threatened throughout its range in 1993. Historically, this species occurred on coastal barrier island beaches from Massachusetts to South Carolina. By 1987, the plant was extirpated from nearly three-fourths of its earlier range (Hancock and Hosier, 2003). Although the species recolonized much of those former areas between 1990 and 2000, populations in the recolonized states dropped sharply after an initial surge. Numbers remain low and local extirpations still occur (USFWS. 2016).

Primary habitats include overwash flats on the accreting ends of islands, lower foredunes, and the upper strand on non-eroding beaches (landward of the wrack line). The species has established small temporary populations in sound-side beaches, blowouts in foredunes, and inter-dunal areas as well as on sand and shell material deposited for beach nourishment. The plant is dependent on a terrestrial, upper beach, sparsely vegetated habitat that is not flooded during the growing season (USFWS, 2014). Seabeach amaranth is an annual, meaning that the presence of plants in any given year is dependent on seed production and dispersal during previous years. Seeds germinate from April through July. Flowering begins as early as June and seed production begins in July or August. Seeds are dispersed by wind and water. Seabeach amaranth is intolerant of competition; consequently, its survival depends on the continuous creation of newly disturbed habitats. Prolific seed production and dispersal enable the colonization of new habitats as they become available. A continuous supply of newly created habitats is dependent on dynamic and naturally functioning barrier island beaches and inlets (USFWS 1996).

An occurrence of seabeach amaranth was documented at the Holgate Unit of the Forsythe NWR in 2015 within 1.5 miles of the proposed study area. Seabeach amaranth at Forsythe NWR has never exceeded four plants for each year between 2000 and 2015. Numbers of seabeach amaranth on refuge lands are anticipated to increase in the next few years as the Forsythe NWR is participating in a range-wide project to sow seeds of this species within NWRs from Massachusetts to South Carolina (USFWS, 2016).

The piping plover (*Charadrius melodus*) is a Federally-listed endangered small pale shorebird on sandy beaches along the Atlantic and Gulf coasts. There are known nesting occurrences of the piping plover located on the Forsythe NWR both at Holgate and Little Beach Island adjacent to the study area. These small, territorial shorebirds are present on the Forsythe NWR shore between March and the end of August (USFWS, 2016). Piping plovers have been listed as a threatened species since 1986 and continue to struggle in New Jersey to recover their population. They nest above the high tide line usually on sandy ocean beaches and barrier islands, but also on gently sloping foredunes, blowout areas behind primary dunes, washover areas cut into or between dunes, the ends of sandspits, and deposits of suitable dredged sand beachfill. Adults and chicks feed on marine invertebrates in the intertidal zone of ocean beaches and the shorelines of coastal ponds, lagoons, and salt marshes USFWS, 2016). According to Kisiel (2009), inlets play a crucial role in piping plovers' nesting site selection, as optimal habitat in New Jersey is mostly limited to the number of un-stabilized inlet areas which, in turn, affects the ability of piping plovers to recover in New Jersey.

The Conservation Wildlife Foundation of New Jersey (Pover, 2015) reported a second consecutive year of robust chick productivity in the state of New Jersey breeding pairs increased 17% in 2015, as compared to 2014 to 108 pairs, but still remains below the long-term average (118 pairs). The region comprised of North Brigantine Natural Area and the Holgate and Little Beach Units of the Edwin B. Forsythe National Wildlife Refuge accounted for the second largest concentration area after Northern Monmouth County. Holgate had the largest jump in abundance for any individual site, doubling its breeding pairs to 24 in 2015. This increase was likely the result of highly suitable overwash habitat created by Hurricane Sandy.

Another shorebird species, the red knot (*Calidris canutus*) was listed as threatened 12 January 2015. Although primarily found along the Delaware Bay shorelines between mid-May through early June, and in fall (late-July through October), small numbers of red knots may occur in New Jersey year-round. These shorebirds fly up to 9,000 miles from south to north every spring and reverse the trip every autumn. The migrating birds break up their spring migration into non-stop segments of 1,500 miles or more, resting and feeding at stop-over sites or staging areas. The USFWS (2016) indicates that red knots occur in the vicinity: Holgate, Little Beach, and nearby state lands during both spring and fall migrations. Their preferred nonbreeding habitat are tidal inlets. Along the Atlantic Ocean coast, dynamic and ephemeral habitat features, such as sand spits, islets, shoals, and sandbars, are utilized.

The roseate tern (*Sterna dougallii*) is a medium-sized tern and primarily tropical but breeds in scattered coastal localities in the northern Atlantic temperate zone. The USFWS included the North Atlantic breeding population on its list of federally endangered species in 1987, including New Jersey because of declines resulting from human activity, gull competition, and predation. Both the roseate tern and Forster's tern (*S. forsterii*) are fairly common in New Jersey (www.Conservewildlifenj.org). The USFWS New Jersey field office does not cite the roseate tern in the 2016 Planning Aid Report to the USACE for this study. In the 2005 BO, the roseate tern is described as occasionally occurring in the Philadelphia District Program Area but is transient.

The bald eagle (*Haliaeetus leucocephalus*) was listed as a Federally-endangered species throughout the United States in 1978. Most bald eagle nests are located in large wooded areas associated with marshes and other water bodies. Based on improvements in bald eagle population figures for the contiguous United States, the U.S. Fish and Wildlife Service removed the bald eagle from the Endangered Species list in June 2007. The New Jersey Department of Environmental Protection, Division of Fish and Wildlife reported that there were more than 119 pairs of bald eagles within the state in 2012. Although the bald eagle has been removed from the Endangered Species list, the species is still protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. These laws prohibit killing, selling or otherwise harming eagles, their nests, or eggs. The bald eagle has remained a state-listed species in New Jersey.

Peregrine falcons (*Falco peregrinus*) were placed on the Endangered Species list as endangered in 1984, however, like the bald eagle, their numbers in the Northeast region have been steadily increasing (Steidl *et al*., 1991). The peregrine falcon was removed from the Endangered Species list in August 1999. The bird continues to be protected by the Migratory Bird Treaty Act, which prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests except when specifically authorized by the Interior Department. The peregrine falcon remains a state-listed species in New Jersey. The peregrine falcon is known to nest on the Barnegat Division of Edwin B. Forsythe National Wildlife Refuge in Stafford Township, Ocean County, New Jersey, north of Little Egg Inlet.

There are currently 34 bird species state-listed as endangered or threatened species in New Jersey. A few of these, such as the black skimmer (*Rynchops niger*), the least tern (*Sternula antillarum*), and the roseate tern (*Stena dougallii*) are likely to occur in the Little Egg Harbor area. The piping plover and roseate tern are state-listed endangered species as well and occur in the area. Several raptors occur in the vicinity of the project area and include the state-listed endangered northern harrier (*Circus cyaneus*), short eared owl (*Asio flammeus*), osprey (*Pandion haliaetus*), gull-billed tern (Gelochelidon nilotica), Caspian tern (*Hydroprogne caspia*) and barred owl (*Strix varia).* The state listed threatened black rail (*Laterallus* jamaicensis) nests in emergent tidal marshes in the surrounding area. The state species of special concern, the American oystercatcher (*Haematopus palliates*) is known to occur in the vicinity of the study area. Bird species that forage along the edges of marshes and nest in the vicinity include the state-listed (threatened) yellow-crowned night heron (*Nyctanassa violacea*) and the black-crowned night heron (*Nycticorax nycticoras*); and the state species of special concern, the little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), snowy egret (*Egretta thula*), and glossy ibis (*Plegadis falcinellus*) (USFWSS, 2016).

The study area is located within the summer range of the northern long-eared bat. During the summer, northern long-eared bats typically roost singly or in colonies underneath bark, crevices, or hollows of both live and dead trees and/or snags (typically 2:3 inches dbh). The northern long-eared bat is opportunistic in selecting roosts, selecting varying roost tree species throughout its range. During the winter, northern long-eared bats predominately hibernate in caves and abandoned mine portals.

There are five Federally-listed threatened or endangered sea turtles that can occur off the coast of New Jersey's ocean coast. The endangered Kemp's ridley turtle (*Lepidochelys kempii*), leatherback turtle (*Dermochelys coriacea*) and hawksbill turtle (*Eretmochelys imbricata*), and the threatened green turtle (*Chelonia mydas*) and loggerhead turtle *(Caretta caretta*). With the exception of the loggerhead these species breed further south from Florida through the Caribbean and the Gulf of Mexico. The loggerhead may have historically nested on coastal barrier beaches. No known nesting sites are within the project area. All five species of sea turtles are listed in the State of New Jersey.

There are six Federally-listed species of endangered whales that have been observed along the New Jersey Atlantic coast. The North Atlantic right (*Eubalaena* glacialis), fin whale (*Balaenoptera physalus*), and humpback whale (*Megapter novaeangliae*) are found seasonally in waters off New Jersey. The sperm whale (*Physeter catodon*), Sei (*Balaenoptera borealis),* and blue whale *(Balaenoptera musculus*) may be present in deeper offshore waters. These are migratory animals that travel north and south along the Atlantic coast. All six species of whales are listed in the State of New Jersey. There are no areas within the project area designated as critical habitat for marine mammals.

The shortnose sturgeon (*Acipenser brevirostrum*) is a Federally-listed endangered species of fish that is also state listed in New Jersey. The shortnose sturgeon is an anadromous species that inhabits marine and estuarine waters, but spawns in freshwater. Shortnose sturgeon occur primarily in the Delaware River but may occur in the nearshore ocean waters (Brundage and Meadows, 1982).

In April 2012, NMFS added the Atlantic sturgeon (*Acipenser oxyrinchus*) to the Federally- endangered list. Atlantic sturgeon has been recommended for endangered status listing in New Jersey. Atlantic sturgeon spawn in the freshwater regions of the Delaware River. By the end of their first summer the majority of young-of-the-year Atlantic sturgeon remain in their natal river while older subadults begin to migrate to the lower Delaware Bay or nearshore Atlantic Ocean. An acoustic tagging study conducted between 2008-2011 (Brundage and O'Heron, in press) found a few subadults, tagged within the Delaware River, in the Hudson River, Potomac River and off Cape Hatteras in the second year of the study. Older subadult Atlantic sturgeon are known to undertake extensive marine migrations, returning to their natal river in the late spring, summer, and early fall months (Dovel and Berggren, 1983).

Alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) were designated as candidate species for listing under the ESA in 2011. Candidate species are those petitioned species that are actively being considered for listing as endangered or threatened under the ESA, as well as those species for which NMFS has initiated an ESA status review (NMFS letter, dated 4 April 2013). More information on these species and NMFS' Candidate Species program can be found at: http:///www.nmfs.noaa.gov/pr/species/esa/other.htm.

The harbor porpoise (*Phocoena phocoena*) and the bottlenose dolphin (*Tursiops truncatus*) are New Jersey species of special concern. These species, as are all marine mammals, are protected under the Marine Mammal Protection Act. While mid-Atlantic waters are the southern extreme of their distribution, stranding data indicate a strong presence of harbor porpoise off the coast of New Jersey, predominately during spring. The northern diamondback terrapin (*Malaclemys terrapin terrapin*), considered a "species of special concern", is known to occupy Barnegat Bay. The diamondback terrapin occupies brackish tidal marshes and nests on sandy bay beaches.

3.4 Cultural Resources

3.4.1 Prehistoric Background

Paleoindian and Archaic sites in New Jersey are most often found on river terraces, often at confluences, overlooking wide expanses of land. As sea levels rose, the mouths of rivers were drowned; creating bays, estuaries, and salt marshes that migrated over the low slope of the retreating coastal plain.

Some of these settings would have been attractive to humans for settlement or exploitation, and some will be good for the preservation of sites, such as in lee and back bay paleoestuarine settings, where organic rich sedimentation protects earlier or contemporary deposits from transgressive erosion. These settings are also likely for middens along margins, as well as weir features (Connaway, 2007).

While remote sensing with sidescan and magnetometer can result in the identification of specific wrecks, there is no remote sensing technology that can identify arrays of prehistoric artifacts. Instead, the protocol is to identify submerged landforms that are likely to have been used for habitation or procurement when the area was exposed, or specific features formed by human behavior that are large enough to be remotely sensed, such as shell middens or rock weir features.

Paleolandscapes can be exposed on the seafloor and apparent during examination of sidescan sonar data, but others, particularly in the Little Egg survey area, are buried under layers of sediments; in which case, penetration of the seabed by subbottom profiler is necessary.

Analysis of seismic data utilizes criteria such as linearity, strength of reflection (as indicated by the darkness and thickness of reflectors), and uniformity of reflector patches to determine differences in the stratigraphy. Strong reflectors are indicative of sediment characteristics that reflect more sound energy and will typically show up as lines of high contrast in the subbottom image, including indurated surfaces or peat beds (Plets *et al*. 2007). Likewise, weaker reflectors are indicative of sediments that attenuate the sound with little reflection, particularly sand and shell beds.

Areas of interest for prehistoric archaeological sites include the margins of stream channels, lakes, ponds, other water bodies, and the margins or shoals of estuarine environments. Channel facies will show up as a series of concave-shaped reflectors. Other potential reflectors include deltaic features (wedges) and foreset beds that are indicated by the presence of alternating layers of varying reflective properties with indicated slope.

The Project Area was available for human presence from the earliest people in the region to about 4,000 calYBP (calibrated years before present). Middle and Late Archaic sites and materials, if present, are most likely to be found. However, there is significant sediment cover over the Project Area, and there is evidence for transgressive truncation of paleochannels in the seismic data. Submerged prehistoric archaeological sites can exist in forms ranging from in situ preservation to complete disintegration into transgression deposits. Because of their size, density, and potential in offshore reworked sediments, chipped-stone, ground stone tools, and fossil bone can be expected in the dredge beach replenishment slurry.

3.4.2 Historic Background

Geographically situated adjacent to the entrance to the Port of New York, one of the world's busiest shipping ports, the coastline of New Jersey furnishes the unwary mariner with a multitude of hazards in the form of rocks, shoals, and sand bars—all the worse to meet up with in treacherous weather. As early as 1640, New Jersey claimed her first shipwreck with the grounding of a Dutch vessel at Sandy Hook during a severe storm (Downey, 1983:3).

There are no major ports along the coast of New Jersey from Delaware Bay to New York Harbor, just small, ever-changing inlets. However, a consistently high amount of ship traffic between these two ports occurred during the Historic period. In 1855, Lieutenant George Meade, a government engineer, estimated as many as 6,000 ships per year passed by the Barnegat Bay area (Dolan Research, 2001a). There were few options available to ships in distress along this route, one of which being Absecon Inlet (at present day Atlantic City), and a few smaller inlets such as Barnegat, Manasquan, and Little Egg.

Nevertheless, entering these and other inlets, particularly during a storm, could be quite hazardous and, as presented below, there were many wrecks on the approaches to the Jersey shore.

Lesser ports along the Jersey shore, including Little Egg along with Absecon, Barnegat, and Manasquan inlets, were used primarily by commercial fisherman up through much of the twentieth century. Presently, the majority of vessel traffic in and out of these and lesser ports consists of personal recreational vessels and a steadily shrinking number of commercial fisherman and head boats.

Absecon Inlet, the larger of the nearby inlets, was developed primarily as the harbor for Atlantic City in the late nineteenth century. Merchants transporting various goods (lumber, ice, coal, brick, and fish) to and from the various local waterfront communities had long used the inlet, but pleasure vessels became an increasingly larger component of the traffic by the end of the nineteenth century. Until the establishment of navigational aids in the inlet in the late nineteenth century, the high energy and constantly changing nature of the shoals made navigating the inlet hazardous. In 1911, the USACE surveyed the inlet, constructed a jetty, and began maintaining the channel at a 12-foot depth.

Barnegat Inlet provided an access point to the settlements surrounding Barnegat Bay. As early as 1684, the area was recognized for its rich fishing grounds, which were exploited as the area's main economic staple well into the twentieth century. Settlement was sparse in this region until the beginning of the eighteenth century, when William and John Cranmer reportedly were residing in the area opposite the inlet (Fischer, 1889:233). Settlement in the area increased after Cranberry Inlet, near Toms River, closed naturally in 1812, and vessel traffic was directed through Barnegat. In the latter half of the nineteenth century, Barnegat became known as a beach resort community, with construction booming after the third one-quarter of the nineteenth century.

3.4.3 Previous Investigations

Numerous archaeological investigations have been conducted along the New Jersey Atlantic coast related to beach replenishment by the USACE, and include surveys of the beach and nearshore areas, along with offshore sand borrow areas. A comprehensive survey was conducted by Dolan Research at three proposed offshore borrow areas north of Brigantine Inlet and along a 12-mile section of beach on Long Beach Island (Dolan Research, Hunter Research, and Enviroscan, 1999). Twelve targets were identified and recommended for further investigation. Subsequent investigation identified two shipwreck sites and one submerged buoy.

In 1998 and 1999, Dolan Research conducted two beach replenishment surveys along the coast of Long Beach Island in Ocean County. The 1998 project included a marine remote sensing survey of three proposed offshore sand borrow areas and four nearshore sand deposit areas. Three potentially significant targets were located in the nearshore study area and one in one of the offshore borrow areas. The offshore target was identified as a large navigation buoy (Dolan Research and Hunter Research, 1998). The 1999 project included the survey of an 83-acre offshore borrow area (Area A) and four onshore sand placement areas totaling 10 linear miles distance. Two targets were recommended for further investigation. One was unidentified and one was identified as a bell buoy with a bronze bell. Both targets were recommended for avoidance (Dolan Research, 1999).

An extension of the above projects was conducted by Dolan Research in 2001 (Dolan Research, 2001).

This Phase I, Phase Ib, and Phase II survey examined a second borrow area off Long Beach Island in a Phase I marine remote sensing survey, as well as Phase Ib and Phase II level investigations of 11 targets previously recommended for further investigation (Dolan Research, Hunter Research, and Enviroscan 1999) including two wreck sites. Results of the survey indicated no significant targets in the offshore borrow area. Evaluation of the 11 targets, five of which were located in the nearshore area and six in the beach/tidal zone, determined that none of the beach targets were associated with significant submerged cultural resources, and of the remaining three, two were cables and one was not relocated. Evaluation of the two wreck sites indicated they appeared to meet NRHP standards. However, neither site was recommended for further investigation as it was determined that placement of additional sand atop the wrecks would not impact them negatively. Two additional targets were determined to be submarine cables and six more were determined to be non-significant.

Further archaeological examination of beach replenishment areas was undertaken in 2003 by Dolan Research and Hunter Research, Inc. for the USACE. This study involved the examination of one proposed sand borrow area off Barnegat Light and four segments of the Atlantic coastline of Long Beach Island, both on the shore and in the nearshore area totaling 5.75 miles (Dolan Research, Hunter Research, and Enviroscan, 2003). The survey identified six targets of historical interest, including four on the shoreline and two in the nearshore area. One of these targets appeared in the sidescan record to be a shipwreck. Although the targets were not investigated further in order to determine their source, it was concluded that additional sand placed atop the already buried targets would not impact any historic resources in a negative manner, and no further work was recommended. A target previously located during another survey was investigated and determined to be the remains of a bell buoy, which were not recommended for further investigation.

3.4.3.1 Brigantine Inlet to great Egg Harbor Inlet

Several surveys in the vicinity of offshore Great Egg Harbor Inlet and Ocean City were performed by Dolan Research in 1994 and 1996 (Dolan Research and Hunter Research, 1995; 1997).

The 1994 study examined a pair borrow areas situated in the vicinity of Absecon Inlet, with Borrow Area 1 in the inlet and Borrow Area 2 1.5 miles offshore. The survey located five targets designated potentially significant and recommended for avoidance. The following year, a 76-acre addition to one of the two borrow areas was surveyed by Dolan Research, and the previously recommended five targets were investigated (Dolan Research and Hunter Research, 1997). Two new targets were located in the expanded borrow area, one of which was determined to be a sunken vessel. Of the previously identified five targets, three were determined to be sunken vessels and recommended for avoidance. This made a total of five targets recommended for avoidance or further investigation.

Another survey, including both Phase I and Phase Ib investigations were conducted along a 1.85-mile stretch of Brigantine Beach. The survey did not locate any targets considered significant, but it did relocate a target found during a previous survey. Evaluation of this target determined it to be a modern in-line diesel engine from a small boat; therefore it was not considered historically significant (Dolan Research, 2001b).

A similar survey was conducted for an additional five borrow areas off Absecon Island in 2004 by

Dolan Research (Dolan Research, 2004). The survey did not locate any potentially significant targets. However, it did relocate a target recommended for avoidance or further investigation during one of the previous surveys (Target 8A; Dolan Research and Hunter Research 1997:534). Dolan Research recommended increasing the buffer zone from 300 feet to 500 feet.

In 2010, a submerged cultural resources survey was conducted of the New Proposed Absecon Island Borrow Area located immediately offshore Atlantic City, New Jersey. Conducted by Dolan Research for the Philadelphia District, USACE, the investigation resulted in the location of eight magnetic anomalies and six sidescan sonar targets, none of which were considered potentially significant (Dolan Research, 2010).

3.4.4 Other Surveys

In 2000, Polaris Imaging surveyed the planned route of the Atlantica-1 submarine fiber optic cable across Little Egg Harbor from Long Beach Island to Tuckerton, and from Beach Haven on Long Beach Island east to the 3-mile limit. The survey and subsequent diver testing of targets revealed anomalies with sources such as pipelines, cables, modern trash, and debris, but no potential historic resources. No further investigation was recommended.

Another survey was conducted in the Beach Haven/Tuckerton area, this one in 1999 (Ball, 1999) by Archaeological Investigations Northwest, Inc. Done as part of the TAT-14 transatlantic fiber optic cable, this project surveyed two proposed alignments off Manasquan and two off Beach Haven. This particular report focused on the analysis of data from the Beach Haven alignments (Segments G and L). Seven anomalies and two sidescan sonar targets were identified. The report concluded that all targets were non-significant and it did not recommend further investigation.

Another Ocean County telecommunications cable survey was undertaken in 1990 by Alan Mounier (1990). The proposed cable crossed Little Egg Harbor and Long Beach Island north of Tuckerton and Beach Haven. No potentially significant cultural resources were located during the investigation.

A Phase Ia study (*i.e*., a literature review) was conducted of selected portions of the New Jersey Intracoastal Waterway in Cape May, Ocean, and Atlantic counties for the State of New Jersey (Dolan Research and Hunter Research 2003). The purpose of the review was to identify existing cultural resources in 26 sites selected by the State of New Jersey for various improvement projects including channel maintenance, beach replenishment, and habitat improvement. Only one historic property was located in the 26 areas, but the study recommended a full Phase I survey of any area prior to construction.

R. Christopher Goodwin & Associates preformed a remote sensing survey offshore of Atlantic City, New Jersey in 2009 (Nowak *et al.*, 2010). Located within the Wind Energy Area and south of the current Project Area, the survey was in preparation for the Bluewater Wind Meteorological Data Collection Facility in Outer Continental Shelf (OCS) Blocks 6935 and 6936. Remote sensing equipment used included a magnetometer, subbottom profiler, sidescan sonar, multi-channel seismic reflection survey, and bathymetry. Seven targets were identified in the area, but were not considered potentially significant. The survey suggested a low probability of prehistoric sites in the project area and no cultural resources were identified. No further investigations were recommended.

In February 2011, a systematic Phase I marine remote sensing survey was conducted for the proposed Fishermen's Energy, LLC wind energy project located offshore Atlantic City, New Jersey in New Jersey State waters (Robinson, 2011). Immediately adjacent to the onshore end of the Central Hub connector, the survey located 17 sidescan sonar targets and 136 magnetic anomalies, all of which were considered to be non-significant. In addition to these targets, the survey recorded an absence of paleolandforms conducive to the presence of prehistoric site location.

Just to the north, Tyco Electronics Subsea Communications, LLC (TE SubCom) of Morristown, New Jersey conducted a remote sensing survey of their planned GlobeNet Segment 5 Fiber Optic Replacement Project (Lydecker *et al.*, 2012). As proposed, the project would re-use the existing shore end submarine fiber optic cable spans offshore Beach Haven, New Jersey and St. David's Bay, Bermuda. Operations included the performance of sidescan sonar, subbottom profile, and swath bathymetry surveys for the entire 1,000-meter wide corridor. A magnetometer survey was then conducted over the centerline of the as-engineered (selected) route and two additional wing lines offset 30 meters on either side from the as-engineered cable route, for a total magnetometer survey corridor width of 200 feet. Panamerican was contracted to conduct an archaeological assessment and analysis of geophysical survey data of a 75.6-nautical-mile length of proposed cable burial section on the U.S. Continental Shelf. Archaeological review of the data indicated a total of 152 magnetic anomalies, 32 sidescan sonar contacts, and four subbottom features were recorded during the survey. Extensive review and analysis of all the 152 magnetic anomalies indicated that none were considered representative of potentially significant submerged cultural resources, the majority representing single point source objects. Additionally, extensive review and analysis of the sonar contacts indicated none of the acoustic images had any potential historical significance. Many of the targets consisted of very small, isolated objects and all but one lacked associated magnetics. Potential impacts to prehistoric cultural resources were considered minimal to none, and therefore, Panamerican recommended that no additional avoidances were necessary with respect to submerged prehistoric cultural resources. However, Panamerican did recommend that when the post-lay burial video inspection would be conducted of these areas, the video be reviewed archaeologically to identify any potential materials possibly kicked up from the process that would indicate the presence of a site.

3.5 Air Quality and Greenhouse Gases

Ocean County borders Little Egg Harbor to the north and Atlantic County to the south. The immediate LBI project placement area is residential and developed while the land closest to the proposed Little Egg Inlet borrow area is undeveloped. In addition to the applicable regulated pollutants, each Federal Agency project's NEPA assessments must consider and evaluate greenhouse gases (GHGs) consistent with the Council on Environmental Quality (CEQ) revised draft guidance on the consideration of GHGs emissions and the effects of climate change (CEQ 2014) (https://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa/ghg-guidance). The Long Beach Island beachfill project will produce temporary pollutant emissions associated with diesel fuel equipment relating to dredging and sand placement activities. The localized emission increases from the diesel powered equipment will last only during the project's construction period and then end when the project is over, thus any potential impacts will be temporary in nature. The potential effects of construction emissions for the project, including GHG emissions and climate change are presented in Sections 4.5 and 4.9 with tables in Appendix F.

3.5.1 Air Quality

The Brigantine Division of the Forsythe Refuge tracks air quality and indicates that the low altitude ozone levels within the refuge are high. The Brigantine Wilderness Area was designated in 1978 by Congress as a Class I air quality area, giving it special protection under the Clean Air Act. Since the Wilderness Area lies within a highly industrialized airshed, with air pollution coming from many sources, damage to vegetation has occurred (*e.g*. stippling and chlorosis). Rainfall in the area can be acidic (pH < 5.0 at sampling locations in New Jersey at times).

Based on the National Ambient Air Quality Standards (NAAQS), Ocean and Atlantic County is currently classified (40CFR§81.331) as "marginal" nonattainment for the 2008 8-hour ozone standard, maintenance for the 2006 particulate matter less than 2.5 microns ($PM_{2.5}$) standard, and maintenance of the carbon monoxide (CO) standard. The counties are part of the Ozone Transport Region. Ozone is controlled through the regulation of its precursor emissions, which include oxides of nitrogen (NO_x) and volatile organic compounds (VOCs). Sulfur dioxide (SO_2) is a precursor for $PM_{2.5}$. Because of these designations, and since the project is a Federal Action taken by the USACE, this project triggers a General Conformity Review under 40CFR§93.154.

The emissions associated with the original project were estimated as part of the General Conformity Review for the resulting Statement of Conformity (SOC). Since the drafting of the SOC (USACE, 2014), additional storm damage from Jonas and Joaquin storms has resulted in the need for an additional 1.8 million cubic yards of sand placement associated with LBI. This additional placement is anticipated to increase the total 2016 project emissions by 221 tons NO_x, 7.4 tons VOCs, with the anticipated totals for the project being 1,199 tons NO_x and 39 tons VOCs. CO and SO_2 are slightly increased over the previous EA's (USACE, 2014) estimates. The additional work is anticipated to be completed in calendar year 2016. See Section 4.5 and Appendix F for further information on emissions estimates.

3.5.2 Greenhouse Gases

The temporary LBI beachfill construction project is in response to severe storm actions that eroded beaches along the New Jersey coast line, which is an anticipated effect of climate change. It is important to note that CEQ 2014 does not mandate mitigation, only consideration of the effects of the proposed action and consideration of climate change when selecting proposed alternatives and mitigation of other environmental impacts.

The CEQ 2014 guidance on the consideration of GHGs in NEPA reviews focuses on two key points: 1) the potential effects of the proposed action on climate change as indicated by its GHG emissions, and 2) the implications of climate change for the environmental effects of the proposed action. Projects that emit more than 25,000 metric tons of carbon dioxide equivalents (CO_2e) emissions on an annual basis should provide quantitative estimates. The LBI project (originally 7.8 million cubic yards) is estimated to emit 67,966 metric tons of CO_2e, the additional storm damage (1.8 million cubic yards) is estimate to emit 15,685 metric tons of CO_2e, for a total of 83,651 metric tons of CO_2e. The project is anticipated to be completed in a 2 year period, resulting in the short term increase of 30,536 tonnes in 2015 and 53,115 tonnes in 2016. See Section 4.5 and Appendix F for further information on GHG emissions estimates.

3.6 Hazardous, Toxic, and Radioactive Waste

The proposed borrow area is located in an undeveloped area. In January 2013 the USACE SAW vessel Snell collected eight vibracores in the proposed Little Egg Inlet borrow site and a sieve analysis was completed. The vibracores were 20 foot deep samples and primarily consisted of poorly graded sand except for one location in the northeast of the borrow area that contained clay below a depth of six feet. Six additional cores to further characterize the area are scheduled to be taken in January 2016.

In accordance with NJDEP regulations dredged material with 90% or greater sand (*i.e.* 90% or more retained on the 240 sieve) is not required to undergo chemical analytical sampling. All of samples of grain size of the proposed borrow area possesses material tested 99% sand. Typical contaminants (*e.g.* heavy metals, hydrocarbons) that would pose a contaminant concern in dredged material typically adhere to fine grained sediments (*i.e.* those passing the 240 sieve). As Little Egg Inlet has not historically been a port and is used by mainly pleasure craft, the likelihood of sunken vessels with on-board contaminants, fuel, chemicals, waste, is low. An archaeological assessment was completed in 2013 to identify any possible wreck sites and develop buffers to avoid impacting them during dredging operations.

3.7 Socioeconomics

Over the past fifty years, the coastal counties of New Jersey have shifted from traditional maritime activities such as fishing and boating, to a more service-oriented, and tourism-dependent economy. A key to economic growth in the coastal states has been the strength of the travel and tourist industry. The literature on beach quality suggests that coastal tourism is dependent on clean, broad, and sandy beaches (Klein *et al*., 2004).

New Jersey has a maritime and service-oriented tourism-dependent economy along its coast. The economic impact of the Travel and Tourism industry in New Jersey is dynamic, contributing $30 billion in economic activity each year and generating 416,000 jobs, making it the second largest private sector employer. The Jersey Shore encompasses 127 miles of ocean beaches with scenic views that run from Sandy Hook to Cape May. In addition to the sandy beaches, the coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of visitors each year. The four counties that make up the Shore region of the state (Atlantic, Cape May, Ocean, and Monmouth) account for more than 72% ($21.6 billion) in annual economic activity. Beach erosion is the No. 1 concern that beach tourists have about beaches (Hall and Staimer, 1995).

Visitors from other states account for 64 percent of tourism expenditures. In-state travelers account for 20 percent, followed by business travelers at 11 percent and international visitors at 1 percent. The Most of the tourists come from major nearby metropolitan centers: Philadelphia, Newark, and New York City. Over the past 30 years, the development of casinos and related industries has created a large influx of people. This has spurred the rapid construction of housing and support infrastructure (*e.g.* roads, malls, plazas, utility towers and corridors). The Forsythe Wildlife Refuge receives over 300,000 visitors per year. The predominant public uses of the refuge are hunting, fishing, clamming, crabbing, wildlife observation, environmental education, and boating. The Brigantine impoundment area accounts for about one-half of the Refuge visitors, as it is renowned as a premier birding site in North America. Kerlinger (1995) showed that birders alone annually add about $4 million to the local economy.

Environmental Justice. Executive Order 12898 of 1994 and the Department of Defense's Strategy on Environmental Justice of 1995 direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations. The U.S. Environmental Protection Agency (EPA) provides a mapping tool (http://www.epa.goov/environmentaljustice/mapping.html) to identify low-income and minority populations within a given project area. The lands adjacent to Little Egg Inlet are part of the Edwin B. Forsythe National Wildlife Refuge and wilderness areas. The southernmost end of the Long Beach Island project (Long Beach Township) placement area is more than 3.5 miles to the north and the northernmost section of the City of Brigantine is more than 6 miles to the south (see Figure 1-3). Little Egg Township (west of the refuge) is more than 6 miles from the inlet. Populations by race within these communities are reported to be 93-100% Caucasian with 6-9% of the population having income levels below the poverty line.

4.0 ENVIRONMENTAL EFFECTS

This Section address the environmental impacts of the No Action Alternative and the potential impacts that may result from dredging to the environment in and around the Little Egg Inlet proposed Borrow Area. As mentioned previously, in the interest of brevity this document tiers directly from the 1999 Final Feasibility Report and Final EIS and the 2014 Final Environmental Assessment (USACE 1999, 2014). Environmental impacts to the placement areas for the LBI beachfill project and all previously proposed Borrow Areas, including the approved Borrow Areas D1 and D2, can be found in the 1999 EIS and 2014 EA, and are not included in this EA (USACE, 1999; 2014).

4.1. Terrestrial

4.1.1 Dunes and Nearshore Habitat

Under the No Action scenario, hydrodynamic changes to the shoreline habitat that have been observed over the long-term will continue to occur. The Holgate spit of land (3.5 mile southernmost end of Long Beach Island) and Little Beach Island (6 miles), located on the opposite bank of Little Egg Inlet, are part of the Edwin B. Forsythe National Wildlife Refuge. Interior to the Holgate spit of barrier beach is the Great Bay Boulevard Wildlife Management Area (WMA), managed by the New Jersey Department of Environmental Protection's Division of Fish and Wildlife and offering of 5,346 acres of saltmarsh habitat, one of the largest parcel of saltmarsh in New Jersey. The two refuge units represent two of the few remaining undeveloped barrier beaches in New Jersey. The Holgate Unit is closed to public access from April 1 to August 31 to ensure undisturbed nesting conditions for Federal and state-listed shorebirds. Little Beach is also one of only a few uninhabited barrier islands of sand and trees on the East Coast. A permit is required to visit Little Beach Island due to its environmental sensitivity.

Under the No Action plan and the preferred plan of dredging and beach placement, the Holgate Unit is expected to continue to grow southwesterly in length due to natural longshore transport and move landward (see Appendix B for an historical review). It is possible that the inlet might migrate over time, or breaches to occur in nearby locations due to severe storm events. Due to concerns for dredging impacts to the adjacent shorelines, raised by the U.S. Fish and Wildlife Service and Barnegat Bay Partnership during the review period, the Corps reconfigured the proposed borrow area to remove the portion closest to the inlet, thereby reducing the total size of the delineated borrow area by 80 acres (Figure 4-1). The Great Bay Boulevard WMA is not anticipated to be impacted by the proposed dredging within the Little Egg Inlet borrow area due to its location interior of the growing Holgate barrier beach spit and the relatively stable nature of Little Egg Inlet as well as the distance offshore (0.37 to 2 miles) where the proposed dredging will occur. Aerial photography shows Little Beach continuing to accrete sand and advance seaward (northeast) and elongate over time, but has shown periodic periods of decay, most likely due to significant storm events, over the 141 year time period observed (Appendix B).

Subsequent to initial construction for Brigantine Island's beachfill project (2006) and Absecon Island's beachfill projet (2003), approximately 1.6 mcy and 1.0 mcy of sand have accumulated south of the Federal beachfill area, respectively. In essence, more sand is being added through longshore transport downdrift of the beachfill construction areas than what is being removed through background erosion processes. A similar process is expected after construction of the Long Beach Island project towards the vicinity of Little Egg Inlet. Corps beachfill projects are monitored annually after placement operations to evaluate sand replenishment needs and the movement from the project template through longshore

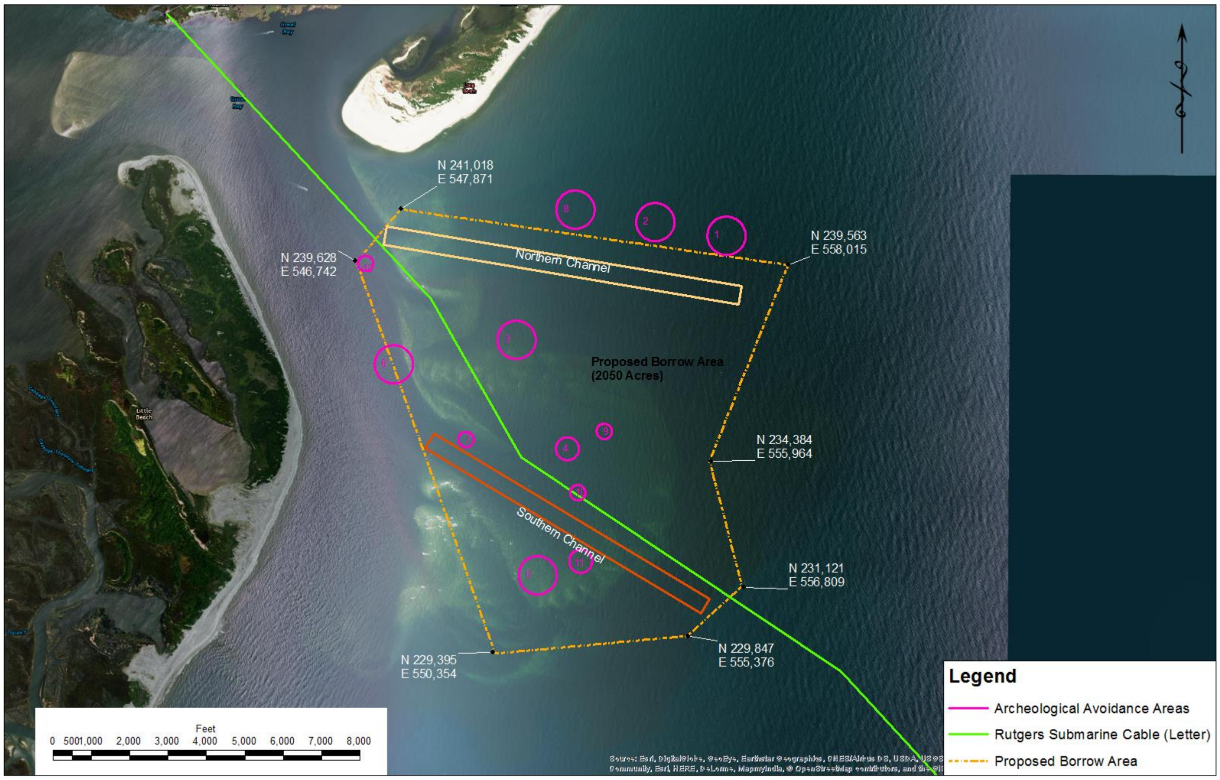

Figure 4-1: Revised borrow area configuration.

transport processes. Transport quantities can vary somewhat over short periods of time depending on the effect of varying weather conditions on sand transport. Based upon the District's extensive beachfill project history and monitoring experience, the most applicable inlet to draw similarity conclusions for Little Egg Inlet would be Hereford Inlet, located south of Seven Mile Island (Avalon and Stone Harbor). Stone Harbor has been the recipient of numerous beachfills since initially constructed in 2003. Predominate longshore transport is to the south along Stone Harbor and beachfill for Stone Harbor is dredged from Hereford Inlet's authorized borrow area. Beachfill placed on Stone Harbor migrates south via dispersion and ultimately returns to Hereford inlet. This return of sediment contributes to the borrow area infilling rate. Three recent examples of Hereford Inlet's borrow area infilling include surveys from October 2010, December 2012 and August 2014 where 101%, 107% and 105% of the dredge material returned to the borrow area within 18-24 months. Understanding the magnitude of the quantity of sediment being placed along Long Beach Island (regardless if the source is from the offshore borrow areas D1/D2 or Little Egg Inlet,) an accelerated rate of sediment transport is expected into the Little Egg Inlet area. This influx of sediment is predicted to infill any dredged borrow area in time frames very similar to what has been observed at Hereford Inlet, significantly limiting any temporary minor impacts to waves or shoreline change.

Based on hydrodynamic modeling conducted to assess potential impacts to the dune and nearshore habitat due to dredging sand from the inlet, and longshore transport of sand at other nearby beach placement projects, minimal to no adverse impacts to the neighboring shorelines, are expected. The southern tip of Long Beach Island and the inlet's ebb shoals are accretion zones. General estimates of net sediment transport along Long Beach Island are significant, approximately 100,000-200,000 cu/year towards the south (Cialone and Thompson, 2000) and expected to continue due to the southerly longshore transport from nourished areas northward. A USACE (2006) Regional Sediment Budget study of the New Jersey Atlantic coast estimated a net longshore transport to the south of 265,000 cy/year in the study area for the period 1986 to 2003, prior to beachfill placement on LBI. Post-placement beachfill operations will likely result in greater quantities of sand carried southerly towards Little Egg Inlet due to the net longshore transport to the south/southwest.

Inlet beaches and dunes, as well as the intertidal zone are dynamic high-energy areas, subject to the forces of wind, waves, and currents. Typically, sand moves offshore in the winter and returns on-shore in the spring and summer. Overwashes can occur during storm events-natural processes that will continue to occur after dredging. No adverse impacts to intertidal benthic habitat or to terrestrial vegetation are expected. Numerical modeling studies (presented in Section 4.2.3.1 below) indicate that through these dynamic shoreline processes, the Holgate spit and Little Beach Island will continue to undergo the changes that have been observed in recent years in the absence of significant coastal storm events that significantly erode or reshape coastline.

4.1.2 Birds

It is likely that under the No Action scenario, impacts to bird habitat along the shorelines adjacent to Little Egg Inlet would continue to occur as a result of storm-induced flooding, erosion, and loss of habitat.

For the selected plan, dredging activities offshore of the inlet area would have minimal to no effects on birds as they are highly mobile and can avoid the area during active dredging, if disturbed by noise. The dredge will be positioned about 2,000 to 11,000 feet (0.37 to 2 miles) offshore of the inlet's shorelines such that birds that use the shoreline for feeding, resting, and breeding are not likely to be adversely affected by dredge's offshore presence or dredging activities. Pursuant to the Fish and Wildlife Coordination Act, the USACE contracted the USFWS to prepare a Planning Aid Report (PAR) to provide an ecological characterization of natural resources within the study area (Appendix D). The PAR identifies concerns for potential impacts to designated wilderness areas of the Little Egg Inlet shoreline of the Forsythe NWR and provides species lists and recommendations for the protection of state and Federally-listed threatened and endangered species, species of special concern, and migratory birds present in the study area.

Combined, the refuge wilderness units represent some of the few remaining undeveloped barrier beaches in New Jersey. The Holgate Unit is a 3.5-mile long beach on the northern shore of Little Egg Inlet that provides habitat for dozens of shorebirds and is closed to all public access from April 1 to August 31 to ensure undisturbed nesting conditions for shorebirds. Little Beach Island, on the southern shore of the inlet, is a 6-mile long windswept spit of sand and trees and is one of only a few uninhabited barrier islands on the East Coast. A permit is required to visit Little Beach Island due to its environmental sensitivity. Little Egg Harbor connects with Great Bay in the interior of the refuge. This area is recognized as one of the largest untouched marshes in New Jersey (USFWS, 2016). Adverse impacts to these habitats are not anticipated to result from offshore dredging in the proposed Little Egg Inlet Borrow Area based on historical, current and expected sediment transport processes to the study area and other New Jersey coastal beach placement projects, current and future beachfill placement operations on LBI to the north, and results of a numerical modeling study that was completed to address the potential long-term impacts specific to these shoreline habitats (see Section 4.2.3.1 below).

4.1.3 Wildlife

As with birds that utilize the immediate shoreline of the inlet, both the No Action alternative as well as the preferred plan to dredge offshore within the proposed borrow area are not likely to have an adverse effect on wildlife species that frequent the beaches, such as skunk, diamondback terrapin, opossum, and fox. Most wildlife in the area are either transient in nature or very adaptable, and utilize the shoreline for foraging. The Holgate beach is more than 3.5 miles long while Little Beach is over 6 miles long of undeveloped sand spit. Wildlife present in these expansive habitats are unlikely to be adversely impacted by noise generated by the offshore dredge sitting a third of a mile to 2 miles offshore. Marine wildlife are presented in Sections 4.2 and 4.3 below.

4.2 Marine

4.2.1 Water Quality

Under the No Action scenario, water quality within the inlet and adjacent offshore area would continue to be influenced by natural factors. Water turbidity is dependent on weather conditions and depths and can be significantly elevated during and shortly after storms.

Under the preferred plan, dredging poses a short-term effect on water turbidity during excavation. Dissolved oxygen (DO), pH, and temperature all influence the welfare of living organisms in water; without an appreciable level of DO, many kinds of aquatic organisms cannot exist (Priest, 1981). Dredging operations can create turbidity plumes that will dissipate after a short period in ocean currents. The borrow material, given its large grain size, is not expected to be chemically contaminated. Generally, the larger the grain sizes the smaller the area of impact. Turbidity resulting from any plumes is expected to be localized and temporary in nature. Studies of past dredging projects indicate that the extent of the sediment plume is generally limited to between 1,640-4,000 feet from the dredge (hopper) and that elevated turbidity levels are generally short-lived, on the order of an hour or less (Barnard, 1978; USACE, 1983; Hitchcock *et al*., 1999; MMS, 1999; Anchor Environmental, 2003; Wilber *et al*., 2006).

The length and shape of the plume depend on the hydrodynamics of the water column and the sediment grain size. Given that the dominant substrate at the proposed borrow site is sand, it is expected to settle rapidly and cause less turbidity and oxygen demand than finer-grained sediments. No appreciable effects on DO, pH, or temperature are anticipated because the dredge material has low levels of organics and low biological oxygen demand. Additionally, dredging activities within and just outside an inlet are expected to result in minimal impacts to the water column because inlet hydrodynamics are subject to mixing and exchange with oxygen rich surface waters. Any resultant water column turbidity would be short term (*i.e.* present for approximately 1 hour) and would not be expected to extend more than a thousand feet from the dredging operation.

4.2.2 Sound

No impacts to sound would result from the No Action plan. Ambient noise in the vicinity is typical of undeveloped dynamic ocean environments (*i.e.* breaking surf and bird vocalization) and passing vessels. Noise generated by recreational users of the refuge and wilderness areas is low and would remain the same. Motorized vessels utilizing the inlet generate low to moderate levels of noise and would be expected to remain the same. Underwater sound levels generated by dredges may impact marine fish, turtles and mammals. The issue of noise associated with dredging has been expanded into issues relating to aerial sound. The U.S. Fish and Wildlife Service (USFWS) has raised concerns regarding the impact of aerial noise (and also equipment lighting at night) with nesting piping plovers (*Charadrius melodus*). Within several small inlets in Massachusetts, a hopper dredge approaching to within 100 meters of piping plover nests was suspected of causing the species to abandon nesting activities (Reine and Dickerson, 2014). At its closest point to the shoreline, the dredge will be situated twice this distance offshore.

Project-related noise of dredging consists of the dredge engine and the sound of dredged material passing through the pipe. Hydraulic suction dredging involves raising loosened material to the sea surface by way of a pipe and centrifugal pump along with large quantities of water. Suction dredgers produce a combination of sounds from relatively continuous sources including engine and propeller noise from the operating vessel and pumps and the sound of the drag head moving across the substrate. Based upon data collected by Reine *et al*. (2012), sediment removal and the transition from transit to pump-out would be expected to produce the highest sound levels as an estimated source level (SL) of 172 decibels (dB) at 3 feet. The two quietest activities would be seawater pump-out (flushing pipes) and transiting (unloaded) to the placement site, with expected SLs of approximately 159 and 163 dB at 3 feet, respectively. Based upon attenuation rates observed by Reine *et al*. (2012), it would be expected that at distances approximately 1.6-1.9 miles from the source, underwater sounds generated by the dredges would attenuate to background levels. However, similar to in-air sounds, wind (and corresponding sea-state) would play a role in dictating the distance to which project-related underwater sounds would be above ambient levels and potentially audible to nearby receptors.

Reine and Dickerson (2014) studied underwater sounds generated by a small hydraulic cutterhead dredge in the Stockton Deepwater shipping channel in California. Sounds produced by hydraulic cutterhead dredges are essentially continuous in nature with some interruptions to raise the cutterhead for inspection/flushing. They analyzed 1) the sound frequency characteristics of the excavation process, 2) the received sound pressure levels at various distances from the source, 3) the predicted source level, and 4) ambient sound sources in the study area.

Ambient noise can be described as sounds that occur in the environment without distinguishable sources. Ambient noise is continuous, but with considerable variation, on time scales ranging from several seconds to over the course of an entire year. In the Stockton Deepwater Harbor study, Reine and Dickerson (2014) found most of the sound energy fell below 1000 Hz, but more commonly at frequencies ranging from 100 Hz to 350 Hz. The NMFS is currently developing guidelines for determining sound pressure level thresholds for fishes and marine mammals. Based on a few existing studies, the NMFS current thresholds for determining impacts to marine mammals is centered around root-mean-square (rms) received levels between 180 and 190 dB re 1 μPa for potential injury to cetaceans and pinnipeds, respectively, and 160 dB re 1 μPa for behavioral disturbance/harassment from an impulsive noise source (e.g. pile driving), and 120 dB re 1 μPa for a continuous noise source (*e.g.*

dredging). At no time during the Stockton Deepwater Harbor study did received or calculated sound pressure levels exceed the 180- or 190-dB criteria for potential injury for cetaceans and pinnipeds. Received levels did not surpass 150 dB re 1µPa and calculated source levels (all data combined) did not exceed 153 dB re 1 µPa-1 m (combined data). The 120-dB re 1 µPa proposed threshold for behavioral disturbance/harassment from a continuous noise source such as dredging was reached and frequently exceeded by ambient conditions in the absence of dredging activities.

Although a hopper dredge will not be used for dredging within the proposed Little Egg Inlet Borrow Area, Robinson *et al.* (2011) carried out an extensive study of the noise generated by a number of trailing suction hopper dredgers during marine aggregate extraction. Source levels at frequencies below 500 hertz (Hz) were generally in line with those expected for a cargo ship travelling at modest speed. Clarke *et al*. (2002) and Thomsen *et al*. (2009) found engine and propeller noise similar to that of large commercial vessel as well. Noise levels are not sufficient to cause hearing loss or other auditory damage to marine mammals (Richardson et al., 1995). Some observations in the vicinity of dredging operations and other industrial activities have documented avoidance behavior while in other cases, animals seem to develop a tolerance for industrial noise (Malme *et al*., 1983; Richardson *et al*., 1995). The dredging process is interspersed with quieter periods when the dragheads are raised to allow the dredge to change positions mobile marine species, with individuals moving away from the disturbance, thereby reducing the risk of physical or physiological damage. Accordingly, any resulting effects would be negligible.

4.2.3 Upper Marine Intertidal and Nearshore Environment

4.2.3.1. Geomorphology

DeAlteris *et al*. (1976) studied historical changes in the bathymetry of Little Egg and Beach Haven Inlets to assess long-term stability or variability. Beach Haven Inlet was found to be geographically unstable due to the steady southwestward elongation of Long Beach Island. In contrast to Beach Haven Inlet, Little Egg Inlet is geographically stable; only the outer inlet channel through the ebb tidal delta has migrated. Little Egg Inlet is also considered hydraulically stable, as the inlet throat cross-sectional area has remained relatively constant since the 1920s. Little Egg Inlet, in combination with the Beach Haven Inlet, acts most of the time as a dual inlet system without an intervening barrier island between the two. When Beach Haven Inlet breaches Long Beach Island, it produces a short-lived barrier segment, known locally as Tuckers Island. When Little Egg and Beach Haven are one inlet, they produce a powerful hydraulic system that can carve a channel to 60-foot depths. The historical record shows that the cycle of growth and decay of the Long Beach Island southern spit occurs on an interval of 60 to 80 years. Between 1860 and 1976, 3.16 miles of shoreline were deposited, destroyed, and two thirds rebuilt by the motion of Beach Haven Inlet. Caldwell (1966) estimates the net littoral drift in this area to be approximately 500,000 cubic yards per year to the south. These dynamic processes are described in greater detail in Appendix B and are expected to continue to occur under the No Action scenario.

For the preferred plan to dredge the proposed Little Egg Inlet borrow area, dredge cut depths lanes are approximately 200 feet wide and about 5 feet deep with each pass. Seabed filling typically occurs following dredging events due to natural current processes and storms. Post-dredging bathymetric surveys typically demonstrate no substantial changes in borrow area sediment relative to pre-dredging conditions.

Numerical Modeling Study. To assist in the investigation of potential impacts to the inlet shorelines from dredging within the proposed Little Egg Inlet Borrow Area, the Philadelphia District USACE applied a numerical modeling study as part of the assessment. The numerical modeling evaluation was conducted by the USACE Engineer Research and Development Center's Coastal and Hydraulics Laboratory (ERDC-Frey *et al*., 2015). Numerical modeling can be used as a tool to assist in the analyses of expected changes within and around Little Egg Inlet from several borrow area scenarios. Consequences of the borrow area scenarios were evaluated in terms of normalized wave energy density changes and anticipated shoreline changes. The combined modeling efforts of the wave model, STWAVE, and the shoreline change model, GenCade, did not yield any significant impacts for any of the potential dredging scenarios contemplated for the Long Beach Island (LBI) beachfill project. The following provides a brief summary description of the numerical modeling efforts. Appendix C presents the ERDC report in entirety.

Historical sediment transport rates and shoreline change were investigated to estimate the range of sediment transport into and out of the Little Egg Inlet, and established the baseline scenarios for the wave and shoreline change modeling. The study found gross transport rates into the inlet that ranged between 500,000 cy/year to almost 2 million cy/year and the net transport to average about 265,000 cy/year to the southwest from LBI. The period of 2002 to 2007 was chosen to represent typical conditions to compare calculated shoreline change to the calibrated available wave data. The strong southwest transport is illustrated by the fact that the Holgate spit has been growing in length through longshore transport processes for decades before any beachfill placement operations began on Long Beach Island. The longshore transport values used in the modeling (*i.e*. 100,000 cy and 250,000 cy) are considered to be conservative estimates of net transport into the inlet vicinity. The study area is likely to continue to experience the historic rates of sand transport which are higher than what was modeled as the average conditions. All of the historical estimates of net southerly longshore transport were calculated during years prior to any beach nourishment operations at Long Beach Island. It is expected that with the initial construction adding approximately 2 million cubic yards of sand within 3-4 miles north of the inlet and the future periodic nourishment along the shoreline of LBI for the project life, the net longshore sediment transport to the south into the Little Egg Inlet complex will continue.

In total, six potential borrow scenarios were evaluated with the nearshore numerical wave model, STWAVE. The potential borrow volumes modeled using the nearshore numerical wave model ranged from 1.2 million cubic yards, (mcy) to 3.0 mcy. The wave modeling was used to numerically transform the offshore waves to the nearshore zone. The output from the STWAVE stations, breaking wave height and direction, which are required to calculate longshore sediment transport, were used as wave input for the GenCade modeling to accurately estimate the associated shoreline response. The wave modeling results showed that the normalized wave energy densities along the adjacent shorelines showed no significant change. The development and application of these numerical models is described in the ERDC report.

After the calibrated and observed shoreline change rates per year were compared, four dredging scenarios were numerically modeled further with the GenCade shoreline change model. In order to have a better understanding of the effects of dredging from the proposed Little Egg Inlet borrow area and the movement of sand, the following dredging alternatives were modeled: 1) initial volume of 1.2 mcy; 2) initial volume of 2.2 mcy; 3) initial volume of 3.0 mcy; and 4) 1.0 mcy dredged every 7 years. The duration of each simulation was for 10 and 33 years to represent the full length of the time-series from STWAVE. The model shows that inlet shoal evolution factors into adjacent shoreline effects.

Multiple runs with the four dredging scenarios were modeled to assess changes in shoreline, including some that entailed behavioral differences in the net transport term (*e.g.* continuous; over just 1.9 miles; or delays until after 5 years, *etc*.). It is important to note that other than the shoal volumes, the inlet in the model remains the same throughout the entire simulation. This means that the inlet cannot technically migrate in the model. Because Little Egg Inlet is unstructured, (*i.e.* no jetties), it is free to migrate. Holgate spit growth is also not explicitly incorporated in the model, although it is already known that it is elongating.

Based on historic sediment transport data and the results of the current modeling study, net sand transport to the southwest (*i.e.* towards the Holgate/Little Egg Inlet region) will continue after completion of the current initial construction of the Federal beachfill and subsequent future periodic nourishments. A series of aerial photography dating back to 1874, and historical summary descriptions of both inlet shorelines (*i.e.* Holgate spit and Little Beach Island), are presented in Appendix B. These photographs demonstrate the morphological changes that have occurred in the area over the last 141 years. Additionally, USACE beachfill projects are monitored subsequent to placement operations to evaluate sand replenishment needs and the movement of sand from the project template through longshore transport processes. Quantities can vary somewhat over short periods of time depending on the effect of weather and current conditions. Based on post-construction surveys conducted at two nearby beachfill projects Brigantine Island (2006) and Absecon Island (2003), approximately 1.6 million cubic yards (mcy) and 1.0 mcy of material have accumulated south of these Federal beachfill project areas, respectively within 12-18 months. The significant amounts suggest that sediment is being added through longshore transport downdrift of the beachfill construction sites than what is being removed through background erosion processes. A similar experience is expected after construction of the Long Beach Island project.

The natural net sediment transport to the southwest will replenish the inlet's ebb shoals and likely increase or augment available habitat for beach nesting and foraging shorebirds. A continual sand supply to the area will also increase the probability of overwash areas occurring with reduced risk of wilderness areas eroding and/or breaching during severe storm events. The significant overwash areas that occurred as a result of the recent coastal storms Joaquin (October 2015) and Jonas (January 2016) within the Forsythe wildlife refuge are evidence that this area is susceptible to a significant breach. Although there are limitations within the model, the results show that as long as the historically documented net sand transport to the southwest continues to move into the Little Egg Inlet area from Long Beach Island, there will be no significant adverse impacts on the adjacent shorelines from the proposed dredging within the Little Egg Inlet borrow area.

4.2.3.2 Benthic Invertebrates

Benthic macroinvertebrates will not be adversely impacted under the No Action alternative. Benthic invertebrate species of the intertidal and nearshore zone include deposit feeders and carnivores. Most of the organisms inhabiting these dynamic coastal zones, including inlets, are highly mobile and respond to stress by displaying large diurnal, tidal, and seasonal fluctuations in population densities (Reilly *et al*., 1983).

Despite the resiliency of marine infaunal and epibenthic organisms, the initial effect of dredging under the preferred plan will result in some population losses. The benthic community resources inhabiting the Little Egg Harbor borrow area are typical of high energy near-shore habitats. The community had low numbers of taxa but certain species were found in high abundances. These high abundance species are typically found in large numbers along the New Jersey coastline and are active burrowers in near-shore sub tidal sand habitats. These species have opportunistic life-history characteristics that include short-lived, high fecundity and high productivity that result in high abundance but low biomass and allow them to thrive in such turbulent environments. These same characteristics also provide the species found in the Little Egg Harbor borrow area the means to recover quickly from anthropogenic activities such as sand dredging. Previous studies conducted in near-shore borrow areas along the New Jersey shore documented similar pre-dredge benthic community patterns and species and concluded that sand dredging within the borrow area had little to no adverse long-term impacts on the benthic community.

Community composition within the Little Egg Inlet proposed borrow area is similar to that for other nearshore borrow areas. Benthic communities can vary seasonally and over the long-term, particularly in high energy inlet environments. The most abundant taxa of nearshore sand shoals consist of common Arthropods such as amphipods and isopods. Polychaete species were second-most populous and, like other invertebrates in the dynamic marine environment, possess opportunistic life-history characteristics. Such taxa typically have short life cycles of one year or less, rapid growth, and the ability to produce multiple broods per year. These life-history characteristics lead to populations with natural boom and bust abundance patterns that can occur even on a microhabitat scale.

Although the primary ecological impact of dredging a sand borrow site is the physical removal of existing benthic community organisms, the mechanical disruption of the substrate may generate suspended sediments and increase turbidity near the dredging operation and result in reduced light penetration temporarily. Inlets, by nature, are highly dynamic environments with natural turbidity due to strong currents. In spite of the physical disruption of the habitat from dredging portions, recolonization of the benthic community can be rapid, typically taking from a few months to a few years (Brooks *et al*., 2006; Saloman *et al*., 1982; Van Dolah *et al*., 1984). Recovery of infaunal communities after dredging has been shown to occur through larval transport, along with juvenile and adult settlement, but can vary based on several factors including seasonality, habitat type, size of disturbance, and species' life history characteristics (*e.g*., larval development mode, sediment depth distribution) (Thrush *et al*., 1996; Zajac and Whitlatch, 1991).

Recolonization rates depend on the availability of recruiting larvae, suitable conditions for settlement, mobile organisms from nearby beaches, migration of organisms, and substrate characteristics post-dredging. The benthic community can, however, be somewhat different from the original community. Periodic nourishment of the LBI project is scheduled to occur every 7 years. The ability of a dredged area to recover its epibenthic and infaunal species is enhanced by the dredging practice of leaving adjacent areas along cutterhead tracks undisturbed. Macrofaunal recovery is usually rapid after dredging operations cease. Recolonization of dredged areas may occur within one or two seasons from neighboring sections. Initial recolonization is dominated by opportunistic taxa whose reproductive capacity is high, and flexible environmental requirements allow them to occupy disturbed areas (Boesch and Rosenberg, 1981; McCall, 1977). Highly mobile organisms, such as amphipods, can escape to the water column and can directly resettle after dredging operations are completed (Conner and Simon, 1979). Mobile polychaetes are intermediate of amphipods and bivalves in their capacity to resettle directly after dredging. Bivalves are the least mobile organisms, although pelagic larvae of these species can result in high recruitment. Larval recruitment and horizontal migration from adjacent, unaffected areas initially recolonize the disturbed area (Van Dolah *et al*., 1984; Oliver *et al*., 1977).

Most studies indicate that dredging had only temporary effects on the infaunal community, and in some studies, differences in infaunal communities were attributed to seasonal variability or to hurricanes rather than to dredging (Posey and Alphin, 2002). Within months to years, and if environmental conditions permit, the initial surface-dwelling opportunistic species would be replaced by benthic species that represent a more mature community (Bonsdorff, 1983). Scott (2012) resampled undredged areas within Borrow Area D2 as well as resampled Borrow Area D1 (dredged both in 2008 and 2010) offshore of Harvey Cedars, LBI. D2's expansion area (formerly referred to as Borrow Area D3) was initially sampled. Cluster analyses detected benthic population groups associated with the surface sediments collected from each station. These same patterns between benthic community composition and sediment type existed at revisited sampling sites in Borrow Area D1 and D2. The overall benthic community composition, even within these sub-habitats, consists of species that can easily recruit after dredging disturbances.

Dredging may uncover sediments that are different in structure and changes in sediment characteristics can cause a shift in the corresponding benthic community. Five stations resampled in Area D1, which was subjected to two dredging events, suggested a slight shift in surface sediment habitat (*i.e.* coarse sand/gravel to fine/medium sand mix). The benthic community inhabiting these 5 sites in 2012 clustered separately from these same 5 sites sampled in 1997. However, these differences detected are also influenced by time. Stations sampled in nearby un-dredged Area D2 also had differing benthic communities in 2000 compared to 2011 (Scott, 2012). This suggests that although differences in benthic communities occur due to sediment variations, temporal variations in substrate are more likely the greater contributor to differences detected in the benthic community.

The USACE has conducted living resource evaluations at inlets, nearshore and offshore regions of the New Jersey Atlantic Ocean coast for over 20 years (Stone and Webster, 1991; Kropp, 1995; Chaillou and Scott, 1997; Scott and Kelly, 1998; Scott, 2004, 2007, 2008; 2012). The majority of abundant taxa found in these benthic communities exhibited the same opportunistic life history strategies with fast-growing, short life-cycles of one year or less, allowing these organisms to recover rapidly and recruit into areas disturbed by dredging. Cluster analyses showed groups influenced more by station proximity and sediment type with no apparent influence from dredging operations occurring from two or more years previous, where dredging does not result in any significant changes to substrate type. For example, two stations sampled in 2005, collected from within an area at Great Egg Harbor Inlet dredged in 2003, closely grouped with nearby stations sampled in 1997 and 2003 that were undisturbed (Scott, 2007). Additionally, a reanalysis of the 2003 data collected specifically from dredged and undisturbed areas substantiated the conclusion that the benthic community did not display impacts 2-years post-dredging (Scott, 2004).

Similar results were found in these studies with respect to surf clam recruitment. The adult clams sampled in 1997 and 1998 were consistent with nearby areas and clams reaching adult sizes (Scott and Bruce, 1999; Scott and Kelley, 1998). When juvenile clam abundances collected since 1995 were mapped, the high recruitment ability of the clams was apparent within the Great Egg region. Areas of high recruitment and low recruitment were apparent but did not appear to be affected by previous sand dredging. The area of highest clam recruitment over the 10-year database was in the southwest corner of the borrow area where two past dredging operations had occurred.

The NJDEP's longterm annual stratified random surf clam sampling program demonstrates this as well. Versar's (2009) compilation of the NJDEP longterm data compared surf clam densities in three strata. Average surfclam densities were consistently lower in the outermost strata, relative to the middle strata (1-2 miles offshore) and were generally highest in the inshore strata (0-1 mile offshore). Densities of the adult surf clam have been declining since 1997 in all three strata, as documented by the NJDEP adult surf clam surveys, but appear to drop off significantly in the outermost sampling zone. The Scott (2012) study showed that recruitment of clams in dredged areas continues to be similar to areas that are undredged. Juvenile surf clams collected from the dredged area D1 were similar to Area D2 which has not been dredged.

The proposed dredging plan can mitigate impacts by limiting the surface area that is disturbed by the draghead. This allows for quicker benthic community recovery due to recruitment from neighboring unimpacted areas. Based on the existing benthic community found occurring within the offshore areas, it is expected that these organisms will recover quickly after dredging operations cease, provided the sediment substrate is not significantly altered and benthic studies conducted in these areas both prior to and after two dredging events demonstrated subtle changes in sediment characteristics with a slight shift in corresponding benthic community composition. No long term effects are expected as the benthic community that naturally exists in the area is dominated by species with opportunistic life histories and exhibit rapid recruitment capabilities.

4.2.4.2 Finfish

No impacts to finfish would result under the No Action scenario. Fish species presently occurring in the project area would continue to utilize the area.

Under the propose plan to dredge, the overall effect to the bathymetry of the shoal system is expected to be temporary and negligible. Dredging from shallow inshore waters as well as deeper waters may have limited and short-term impacts on finfish. With the exception of some small finfish and early developmental stages, most bottom dwelling and pelagic fishes are highly mobile and capable of avoiding turbidity impacts of dredging and placement. Due to suspension of food particles in the water column, some finfish are attracted to the turbidity plume created by the dredge cutterhead.

A literature review was conducted by the Engineer Research and Development Center (ERDC) to evaluate studies on turbidity impacts on finfish resulting from hydraulic cutterhead suction dredging (Reine, 2014). Plumes generated during the removal of sand by hydraulic cutterhead suction dredge can be characterized as narrow bands of moderately elevated TSS concentrations. Rapid settling, particularly sand particles, restricts the spatial extent of the plume to a near-field phenomenon and has shown not to impede fish migration into inlets. TSS concentrations at the cutterhead in studies were found to be only 5 to 10 mg/l above background levels, 30 meters from the point of excavation. These levels are insignificant to cause behavioral changes, injury or mortality to any fish species. Based on the current state of knowledge, hydraulic pipeline dredging during sand removal is unlikely to cause significant negative effect to any fish species in the project area (Reine, 2014).

The primary impact to fisheries is the disturbance of benthic communities. As mentioned above, the loss of benthos within the dredge's path disrupts food resources in the impact areas. This effect is expected to be temporary, as noted above, due to the documented rapid recolonization that can occur in these highly dynamic environments. Depending on the time of year, benthos food resources can recolonize from dredged areas rather quickly (*e.g.* within a year) via larval recruitment as well as from immigration of adults from adjacent, undisturbed areas (Burlas *et al*., 2001); Posey and Alphin, 2002; Byrnes *et al*., 2004). Recovery should be most rapid if dredging is completed before seasonal increases in larval abundance and adult activity in the spring and early summer (Herbich, 2000). Opportunistic benthic species are adapted to exploit suitable habitat when it becomes available post-dredging.

An abundance of prey resources for feeding fish is provided by the constant swimming and burrowing activities of the amphipods, polychaetes, and small clams due to the wave actions and currents in this nearshore borrow area. Additionally, the commonality of the dominant Little Egg Inlet borrow species along the entire New Jersey coast allows for an abundant supply of nearby organisms capable of recruiting to and undergoing rapid recovery in areas disturbed by dredging.

Some disruption in the feeding patterns of fish in the area may occur with dredging operations but this disruption is anticipated to be over a very portion of the offshore borrow area during any given dredging event, and short-lived based on the ability of the benthic community to quickly recolonize the area. Although the surf clam evaluations suggest that a viable commercial fishery population does not exist within the borrow area, significant shoaling and access safety preclude this area for a fishery.

4.2.4.3 Essential Fish Habitat

Essential Fish Habitat (EFH) is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" and covers all habitat types utilized by a species throughout its life cycle. The Magnuson-Stevens Fishery Conservation and Management Act (Public Law 104-267) requires all Federal agencies to consult with National Marine Fisheries Service (NMFS) on all actions, or proposed actions, permitted, funded, or undertaken by the agency, that may adversely affect EFH.

No impacts to EFH would occur under the No Action alternative.

Dredging within the Little Egg Inlet borrow area has the potential to impact EFH several ways: by direct entrainment of eggs and larvae; the creation of higher suspended sediment levels in the water column, reduce feeding success for site-feeding fish; and reduce water oxygen levels. All of these impacts are temporary in nature, during the actual dredging period. Substrate conditions typically return to preconstruction conditions and the benthic community recovers through recolonization. Impacts to fish species with designated EFH can occur within inlets and estuaries as a variety of fish species migrate in and out of inlets, such as summer flounder. The revised Little Egg Inlet borrow area encompasses approximately 2,050 acres. Dredging is proposed to occur in just a small portion of the delineated borrow area bottom approximately 2,000 to 11,000 feet offshore just north of the inlet. The offshore area would be impacted by the dredge cutterhead in any given dredging operation roughly every 7 years, allowing for both finfish migration past the dredging operation into the inlet as well as benthic recovery. Dredging within the borrow site will not diminish topographic variability and will not create deep pits that allow for anoxia or siltation, environments unsuitable for recolonization, and the inlet shoal system regenerates naturally.

As previously mentioned, there are a number of Federally-managed fish species where essential fish habitat (EFH) was identified for one or more life stages within the project impact area. Fish occupation of waters within the project impact areas is highly variable spatially and temporally. The majority of the species occupy both nearshore and offshore waters. In addition, different life stages tend to occupy different regions (*e.g.* open ocean pelagic waters vs. shallower inshore waters); some are more oriented to bottom or demersal waters. Also, seasonal abundances are highly variable, as many species are highly migratory.

In general, adverse impacts to Federally-managed fish species may stem from alterations of the bottom habitat, which result from dredging in the borrow area. EFH can be adversely impacted temporarily through water quality impacts such as increased turbidity and decreased dissolved oxygen content in the dredging and placement locations. These impacts would subside upon cessation of construction activities. More long-term impacts to EFH involve physical changes to the bottom habitat, which involve changes to bathymetry, sediment substrate, and benthic community as a food source.

One concern with respect to physical changes involves the potential loss of prominent sandy shoal habitat within the borrow site due to sand mining for beach replenishment. Shoals are generally regarded as areas that are attractive to fish, including the Federally-managed species, and are frequently targeted by recreational and commercial fishermen. It is reasonable to expect that the increased habitat complexity at the shoals and adjacent bottom would be more attractive to fish than the flat featureless bottom that characterizes much of the mid-Atlantic coastal region (USFWS, 1999).

Other physical alterations to EFH involve substrate modifications. An example would be the conversion of a soft sandy bottom into a hard clay bottom through the removal of overlying sand strata. This could result in a significant change in the benthic community composition after recolonization, or it could provide unsuitable habitat required for surfclam recruitment or spawning of some finfish species. This could be avoided by correlating vibracore strata data with sand thickness to restrict dredging depths to avoid exposing a different substrate. Based on the vibracore data, dredging depths would be considered to minimize the exposure of dissimilar substrates. Biological impacts on EFH are more indirect involving the temporary loss of benthic food prey items or food chain disruptions.

In conclusion, of the species identified with Fishery Management Plans, and highly migratory pelagic species that may occur in the vicinity, the potential for adverse impacts to EFH is considered temporary and minimal. The proposed project could impact surf clams although the numbers that occur in the inlet are very low. The neonate and juvenile stages of several shark species are predominately located in shallower coastal waters but are highly mobile and able to avoid the dredge during active pumping. The proposed dredging location is located sufficiently offshore and to the north of the inlet's throat that the likelihood of temporary elevated turbidity at the dredge is not likely to pose any (temporary) interference with fish migration in and out of the inlet. The inlet throat, at its minimal width is 4,200 feet wide between the southwest end of the Holgate spit and the northeast end of Little Beach Island, such that dredging offshore and to the north of the inlet will not impede fish migration. Given the current scour depths surpassing 42 feet in the inlet throat, it is likely that currents through the inlet are as high as 3 to 4 knots, making the inlet throat itself unlikely habitat for EFH species, and in particular neonate or juvenile sandbar sharks other than as a transit corridor between the Great Bay/Mullica River estuary and the Atlantic Ocean.

The effect on surfclams and other benthic organisms (that include food prey items) in the proposed borrow area is considered to be temporary as benthic studies have demonstrated recolonization following dredging operations from adjacent areas where the benthic community is left intact. This is in contrast to the extended time period required for recruitment of benthic organisms in deep holes that alter hydrographic characteristics of the habitat. The total impact to EFH is considered minimal due to the fact that only a small portion of the total borrow area is proposed for utilization during each 7 year periodic nourishment cycle.   Sand characteristics within Little Egg Inlet are similar to the sand resources occurring in adjacent areas along the LBI coastline and neighboring inlets.

A review of EFH designations and the corresponding 10’ x 10’ squares, which encompasses the Little Egg Inlet and nearshore vicinity was completed. The evaluation of the potential direct or indirect impacts associated with this project on EFH species is provided in Table 4-1.

Table 4-1: Direct and indirect impacts on Federally-managed species and Essential Fish Habitat (EFH) in the 10 minute squares of the study area (NOAA, 1999)

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
1. Atlantic cod *(Gadus morhua)*				**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. **Indirect:** Temporary disruption of benthic food prey organisms.
3. Red hake *(Urophycis chuss)*	Eggs occur in surface waters; therefore, no direct or indirect effects are expected.	Larvae occur in surface waters; therefore, no direct or indirect effects are expected.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge. **Indirect:**Temporary disruption of benthic food prey organisms.	
4. Redfish (*Sebastes fasciatus*)	n/a			
6. Winter flounder (Pseudop*leuronectes americanus*)	Eggs are demersal in very shallow waters of coves and inlets in Spring. Dredging may have some effect on eggs if construction occurs during Spring .	Larvae are initially planktonic, but become more bottom-oriented as they develop. Potential for some to become entrained during dredging borrow areas.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge. **Indirect:** Temporary disruption of benthic food prey organisms.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. **Indirect:** Temporary disruption of benthic food prey organisms.
8. Windowpane flounder *(Scopthalmus aquosus)*	Eggs occur in surface waters; therefore, no direct or indirect effects are expected.	Larvae occur in pelagic waters; therefore, no direct or indirect effects are expected.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge. **Indirect:** Temporary disruption of benthic food prey organisms.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. **Indirect:** Temporary disruption of benthic food prey organisms.

10. Atlantic sea herring *(Clupea harengus)*			**Direct:** Occur in pelagic and near bottom. Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge. **Indirect:** None, prey items are planktonic.	**Direct:** Occur in pelagic and near bottom. Physical habitat in borrow site should remain basically similar to pre-dredge conditions. **Indirect:** None, prey items are primarily planktonic.
12. Bluefish *(Pomatomus saltatrix)*			**Direct:** Juvenile bluefish are pelagic species. No significant direct effects anticipated. **Indirect:** Temporary disruption of benthic food prey organisms.	**Direct:** Adult bluefish are pelagic species. No significant direct effects anticipated. **Indirect:** Temporary disruption of benthic food prey organisms.
13. Long finned squid *(Loligo pealei)*	n/a	n/a	**Direct:** Adult squids tend to be demersal during the day and pelagic at night. There is a potential for entrainment.	**Direct:** Adult squids tend to be demersal during the day and pelagic at night. There is a potential for entrainment.
14. Short finned squid *(Illex ilecebrosus)*	n/a	n/a		
15. Atlantic butterfish *(Peprilus tricanthus)*			**Direct:** Juvenile butterfish are pelagic species. No significant direct effects anticipated. **Indirect:** Temporary disruption of benthic food prey organisms.	
16. Summer flounder *(Paralicthys dentatus)*		Larvae occur in pelagic waters; therefore, no direct or indirect effects are expected.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge. **Indirect:** Temporary disruption of benthic food prey organisms.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. **Indirect:** Temporary disruption of benthic food prey organisms.
17. Scup *(Stenotomus chrysops)*	n/a	n/a	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of juveniles could be expected from entrainment into the dredge. **Indirect:** Temporary disruption of benthic food prey organisms.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults should be capable of relocating during impact. **Indirect:** Temporary disruption of benthic food prey organisms.

18. Black sea bass *(Centropristus striata)*	n/a		**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Offshore sites are mainly sandy soft-bottoms, however, some pockets of gravelly or shelly bottom may be impacted. Some mortality of juveniles could be expected from entrainment into the dredge. Some intertidal and subtidal rocky habitat may be impacted due to sand partially covering groins along the shoreline. **Indirect:** Temporary disruption of benthic food prey organisms.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Offshore sites are mainly sandy soft-bottoms, however, some pockets of gravelly or shelly bottom may be impacted. Some intertidal and subtidal rocky habitat may be impacted due to sand partially covering groins along the shoreline. **Indirect:** Temporary disruption of benthic food prey organisms.
19. Surf clam *(Spisula solidissima)*	n/a	n/a	**Direct:** Complete removal within borrow site during dredging. Exposure of similar substrate is expected to allow for future recruitment. **Indirect:** Temporary reduction in reproductive potential.	**Direct:** Complete removal within borrow site during dredging. Similar substrate would allow for recruitment. **Indirect:** Temporary reduction in reproductive potential.
20. Ocean quahog *(Artica islandica)*	n/a	n/a		
21. Spiny dogfish *(Squalus acanthias)*	n/a	n/a		
22. King mackerel *(Scomberomorus cavalla)*	**Direct Impacts:** Eggs are pelagic, therefore no adverse impacts are anticipated. **Indirect Impacts:** None anticipated.	**Direct Impacts:** Larvae are pelagic, therefore no adverse impacts are anticipated. **Indirect Impacts:** None anticipated.	**Direct Impacts:** Juveniles are pelagic, therefore no adverse impacts are anticipated. **Indirect Impacts:** Minor indirect adverse effects on food chain through disruption of benthic community, however, mackerel are highly migratory.	**Direct Impacts:** Adults are pelagic and highly migratory, therefore no adverse impacts are anticipated. **Indirect Impacts:** Minor indirect adverse effects on food chain through disruption of benthic community, however, mackerel are highly migratory.
23. Spanish mackerel *(Scomberomorus maculatus)*	**Direct Impacts:** Eggs are pelagic, therefore no adverse impacts are anticipated. **Indirect Impacts:** None anticipated.	**Direct Impacts:** Larvae are pelagic, therefore no adverse impacts are anticipated. **Indirect Impacts:** None anticipated.	**Direct Impacts:** Juveniles are pelagic, therefore no adverse impacts are anticipated. **Indirect Impacts:** Minor indirect adverse effects on food chain through disruption of benthic community, however, mackerel are highly migratory.	**Direct Impacts:** Adults are pelagic and highly migratory, therefore no adverse impacts are anticipated. **Indirect Impacts:** Minor indirect adverse effects on food chain through disruption of benthic community, however, mackerel are highly migratory.

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
24. Cobia *(Rachycentron canadum)*	**Direct Impacts:** Eggs are pelagic, therefore no adverse impacts are anticipated. **Indirect Impacts:** None anticipated.	**Direct Impacts:** Larvae are pelagic, therefore no adverse impacts are anticipated. **Indirect Impacts:** None anticipated.	**Direct:** Cobia are pelagic and migratory species. No significant direct effects anticipated. **Indirect:** Temporary disruption of benthic food prey organisms.	**Direct:** Cobia are pelagic and migratory species. No significant direct effects anticipated. **Indirect:** Temporary disruption of benthic food prey organisms.
25. Dusky shark *(Charcharinus obscurus)*		**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Mortality from dredge unlikely because embryos are reported up to 3 feet in length). Therefore, the newborn may be mobile enough to avoid a dredge or placement areas. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites.		
26. Sandbar shark *(Charcharinus plumbeus)*		**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. However, some mortality of larvae may be possible from entrainment into the dredge or burial in nearshore, but not likely since newborns are approx. 1.5 ft. in length and are considered to be mobile. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Juveniles are mobile and are capable of avoiding impact areas. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults are highly mobile and are capable of avoiding impact areas. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites.

27. Tiger shark *(Galeocerdo cuvieri)*		Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Mortality from dredge or fill placement unlikely because newborn are reported up to 1.5 feet in length. Therefore, the newborn may be mobile enough to avoid a dredge or placement areas. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites.	**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Juveniles are mobile and are capable of avoiding impact areas. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites.	

MANAGED SPECIES	**EGGS**	**LARVAE**	**JUVENILES**	**ADULTS**
28. Clearnose skate (*Raja eglanteria*)			**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredged conditions. Juveniles are highly mobile, and most are capable of avoiding impact areas. Some entrainment into dredge is possible. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow area and placement sites.	**Direct**: Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults are highly mobile and are capable of avoiding impact areas. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites.
29. Little skate (*Raja erinacea*)			**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredged conditions. Juveniles are highly mobile, and most are capable of avoiding impact areas. Some entrainment into dredge is possible. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow area and placement sites.	**Direct**: Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults are highly mobile and are capable of avoiding impact areas. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites.

30. Winter skate *(Raja ocellata)*			**Direct:** Physical habitat in borrow site should remain basically similar to pre-dredged conditions. Juveniles are highly mobile, and most are capable of avoiding impact areas. Some entrainment into dredge is possible. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow area and placement sites.	**Direct**: Physical habitat in borrow site should remain basically similar to pre-dredge conditions. Adults are highly mobile and are capable of avoiding impact areas. **Indirect:** Temporary disruption of benthic food prey organisms and food chain within borrow and placement sites.

The proposed plan to dredge sand from an offshore area adjacent to Little Egg Inlet may cause an adverse effect on EFH by reducing benthic organisms within a limited area where dredging will take place. This impact is expected to occur in a small portion of the offshore area and is temporary as benthic organisms recruit from neighboring non-dredged areas to recolonize the dredged area within a few seasons. Dredging is not expected to pose any adverse effect on water quality. The project area is a high energy environment subject to near constant water circulation, tidal and wind-driven currents, and longshore transport that continually shifts sand and influence bottom topography.

In the ERDC literature review of dredging impact studies on finfish (Reine, 2014), the conclusions drawn include: 1) plumes generated by hydraulic cutterhead suction dredge are too small to cause migratory blockage of anadromous fish into the inlet; 2) concentration levels at the cutterhead when dredging sandy sediment are less than 10 mg/l, which pose no harm to any estuarine fish species; and 3) maximum TSS concentration estimated at the open-water discharge site are at or below 100 mg/l and only within the immediate vicinity of the dredging operation (30 m) and are insufficient to cause any harmful effect unless the most sensitive of the anadromous fish species purposely spent 24 or more hours within the dredge plume. Based on the current state of knowledge, hydraulic pipeline dredging of sand is unlikely to cause any negative effect to any fish species in the project area.

Concerns that dredging operations within estuarine waterways impede fish migrations and spawning have existed for decades and is the most commonly cited reason for environmental windows (Reine, Dickerson and Clarke, 1998). Many inlets along the New Jersey Coast are corridors into bays for a variety of both state and federally managed species such as Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*, Atlantic silversides (*Menidia menidia*), bay anchovies (*Anchoa mitchilli*), summer flounder (*Paralichthys dentatus*), and winter flounder (*Pseudopleuronectes americanus*). The few references that exist neither substantiate nor refute such concerns.

4.3 Threatened and Endangered Species

The No Action alternative would not result in any additional impacts to listed species other than those that presently occur as a result of naturally occurring shifting sand movement in a highly dynamic oceanic environment and significant storm events that reshape the topography of coastal terrestrial and intertidal marine habitats.

A programmatic Biological Opinion (BO) was prepared by the National Marine Fisheries Service for all dredging projects within the Philadelphia District (NMFS, 2014), pursuant to the Endangered Species Act (ESA). The BO evaluated impacts of dredging projects on sturgeons, sea turtles, and marine mammals. From June through November, New Jersey's coastal waters may be inhabited by transient sea turtles, especially the loggerhead (Federally listed threatened) or the Kemp's ridley (Federally listed endangered). Sea turtles have been known to be adversely impacted during dredging operations that have utilized a hopper dredge. Endangered whales, such as the Right whale, may also transit the study area. Marine mammals are unlikely to be physically injured by dredging activities because they generally do not rest on the bottom and can avoid contact with dredging vessels and equipment. However the North Atlantic right whale (*Eubalaena glacialis*) are particularly susceptible due to their surface resting and slow swimming habitats. Vessel strikes account for the large number of confirmed right whale deaths (Glass *et al*., 2009).

Since 2007, the Philadelphia District has been required to use UXO (munitions) screening for all beach nourishment jobs. The use of these screens renders the need for turtle monitors on hopper dredges ineffective. NMFS has agreed with this position. Any applicable requirements with respect to whales identified in the Biological Opinion will also be followed to minimize impacts.

Since the implementation of NMFS's original Biological Opinion in 1996 for dredging within the Philadelphia District, no sea turtles, whales or sturgeon have been taken during dredging in offshore and inlet borrow areas along the Atlantic Coast. Prior to the implementation of the UXO screening, all hopper dredging from June through November included turtle monitoring, which equates to approximately 15 years of monitoring in these areas with no takes.

The 2014 BO also covers potential adverse impacts to applicable populations of Atlantic sturgeon (added to the endangered species list in 2012) as well as sea turtles and whales. The Philadelphia District will comply with the terms and conditions, reasonable and prudent measures, and monitoring and reporting requirements as outlined in the BO.

A programmatic Biological Opinion (BO) was also prepared by the U.S. Fish and Wildlife Service in 2005 for all coastal beach projects in New Jersey within the jurisdiction of the Philadelphia District (USFWS, 2005). The BO evaluates potential impacts to piping plovers and seabeach amaranth associated with dredging, beach nourishment or ecosystem restoration activities along the coast of New Jersey. The Terms and Conditions and Reasonable and Prudent Measures outlined in the BO recommend seasonal restrictions, bird monitors, and buffer zones at beach placement sites. Although no placement activities will occur at Little Egg Inlet's shorelines, the District will continue coordination with the USFWS Galloway Field Office and the Edwin B. Forsythe NWR in order to be in full compliance with the ESA for dredging at the Little Egg Inlet borrow area.

Section 7(a)(2) of the ESA requires every federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat Although the proposed Little Egg Inlet borrow area was not a named approved borrow area in the Service's December 2005 Programmatic (Tier 1) *Biological Opinion on the Effects of Federal Beach Nourishment, Re-nourishment, Stabilization, and Restoration Activities along the Atlantic Coast of New Jersey within the Corps, Philadelphia District on the Federally Listed (threatened) Piping Plover (Charadrius melodus) and Seabeach Amaranth (Amaranthus pumilus)* (PBO), the Terms and Conditions and Reasonable and Prudent Measures outlined in the 2005 BO would apply to the proposed use of the Little Egg Inlet borrow area for the protection of piping plover and seabeach amaranth for the Long Beach Island restoration activities. Dredging activities offshore of the inlet area would have minimal, insignificant and discountable on piping plover utilizing the shoreline of the Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge and Little Beach for feeding, resting, or nesting due to the distance of the working dredge from the shoreline. Species utilizing these shorelines have evolved with the naturally dynamic processes of shifting, accreting and receding sand deposits of the coastal habitat. The working dredge will be located sufficiently offshore (about 2,000 to 11,000 feet) and not likely to adversely affect these species on shore.

A study completed in Monmouth County, New Jersey by Amy S. Green Environmental Consultants (2009) monitored noise levels of various anthropomorphic activities on piping plovers such as resting, preening, foraging, incubating, foraging with chicks and found that the species did not exhibit an alert reaction at dBA levels for pedestrians walking and talking, small planes and jets flying overhead for dBA levels between +3.1 to +18.4 dBA. One low flying helicopter (+16.2 dBA) did result in an alert reaction by an incubating plover but was quickly dismissed, resulting in continuation of the activity that was interrupted. Primary behavioral aberrations observed in piping plovers occurred when a noise increase was associated with a visual stimulus of movement. The dredge will be, for the most part, stationary at a considerable distance offshore. No tender vessels will be approaching the shore in the proposed borrow area.

Additionally, the proposed dredging of ebb shoals is not likely to significantly change or adversely affect longshore transport processes that would result in impacts to beach habitat. Numerical modeling of the shoreline response to dredging a small section of the proposed borrow area resulted in a negligible effect of +/- 10% wave energy density change (see Section 4.2.3.1 and Appendix C and E).

The Federally-listed plant species*,* seabeach amaranth may be found along undeveloped shorelines in overwash flats or lower foredunes of accreting beaches of the Holgate and Little Beach Units of the refuge. One occurrence was documented at the Holgate Unit within 1.5 miles of the proposed study area (USFWS, 2016). The USACE has determined that obtaining dredged material from the Little Egg Inlet borrow area is not anticipated to adversely affect shorebirds or seabeach amaranth habitat.

On 12 January 2015, the USFWS listed the *rufa* red knot as Federally-threatened under the Endangered Species Act (ESA). Small numbers of red knots may occur in New Jersey year-round, while larger numbers of birds rely on Delaware Bay and Atlantic Coast stopover habitats during the spring (mid-May through early June) and fall (late-July through October) migration periods, respectively. The District conducted a red knot survey from Manasquan Inlet to Cape May Point over a three month period in the fall of 2014. Only 20 red knots were observed during the survey period. As concluded for the piping plover, the USACE has determined that the red knot is not expected to be adversely impacted by a dredge working 2,000 to 11,000 feet offshore in an environment characterized as a dynamically changing shoreline of Holgate, Little Beach and nearby state beaches. The dredge is, for the most part, stationary, anchored offshore, while commercial and recreational vessels travel in and out of Little Egg Inlet daily, passing closer to the north and south banks of the inlet where migratory shorebirds and beach nesting species occur. Although it is unlikely that any of these bird species would be impacted by dredging occurring offshore within the proposed areas of Little Egg Inlet borrow area, the presence of these species will require the implementation of protective measures including bird monitoring during operations occurring between 15 March through 15 August to ensure that shorebirds are not adversely affected by the working dredge offshore.

The USFWS is currently drafting a proposed critical habitat rule for the red knot. The Little Egg Inlet proposed borrow area overlaps with areas under consideration for the proposed designation as critical habitat. The USFWS anticipates that the proposed critical habitat rule will be published by the summer of 2016. In order to avoid delays or interruption of the Long Beach Island beach placement project, the USACE has consulted with the USFWS' endangered species coordinator (6 April 2016). The USFWS has advised that a critical habitat conference be held after the USFWS identifies those areas that are under consideration for designation. For the same reasons described above for the piping plover, the USACE has determined that the proposed dredging within the Little Egg Inlet borrow area is not likely to adversely affect critical habitat for the red knot. Although a conference is not required under Section 7 if the proposed action is not likely to jeopardize the continued existence of a proposed species or destroy or adversely modify proposed critical habitat, the Corps intends to request a conference with the USFWS once their critical habitat designation areas have been identified.

For the same reasons indicated above, the state-listed birds that also utilize these shorelines (and Tucker's Island west of Holgate) for nesting and feeding are not anticipated to incur adverse impacts due to dredging immediately offshore with the proposed Little Egg Inlet borrow area. They include the endangered least tern (*Sterna antillarum*) and black skimmer (*Rhyncops niger*), and the state species of special concern American oystercatcher (*Haematopus palliates*). The state-listed (threatened) osprey (*Pandion haliaetus*), and the state-listed species of special concern the common tern (*Sterna hirundo*), gull-billed tern (*Gelochelidon nilotica*), and Caspian tern (*Hydroprogne caspia*) occur within the study area. Located interior to the barrier beachs are marshes where birds forage include the state listed (threatened) yellow-crowned night-heron (*Nyctanassa violacea*) and black-crowned night heron (*Nycticorax nycticorax*); and the state species of special concern the little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), snowy egret (*Egretta thula*), and glossy ibis (*Plegadis falcinellus*).

The study area is located within the summer range of the northern long-eared bat. During the summer, northern long-eared bats typically roost singly or in colonies underneath bark, crevices, or hollows of both live and dead trees and/or snags (typically 2:3 inches dbh). During the winter, northern long-eared bats predominately hibernate in caves and abandoned mine portals. No adverse effects to the northern long-eared bat are expected from project implementation. The study area does not provide any opportunities for bats to roost or hibernate (USFWS, 2016).

Pursuant to Section 7 consultation of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.), the USACE will consult with the USFWS prior to all future dredging and sand placement activities. Additionally, Federal agencies have a responsibility under various federal statutes and Executive Orders (EOs) to protect, conserve, and manage migratory birds. Migratory birds are a federal trust resource responsibility and are protected pursuant to the Migratory Bird Treaty Act (MBTA), as amended.

4.4 Cultural Resources

4.4.1 Little Egg Inlet Borrow Area Investigation

In June of 2013 the USACE contracted Tetratech, Inc., who subcontracted Panamerican Consultants, Inc.

to conduct archival research of the project area, and performed a comprehensive remote sensing survey designed to detect the presence or absence of potentially significant cultural resources within the Project Area. A total of 299 magnetic anomalies, 39 sidescan sonar targets, and several subbottom impedance contrast features were recorded during the current survey. Employing target analysis, magnetic anomalies were assessed for potential significance based on magnetic deviation (above and/or below ambient background), duration (distance in feet, along a trackline, ananomaly influences the ambient background), type (monopole [negative or positive influence], dipole [negative and positive influence], or complex), and association with other magnetic anomalies (*i.e*., clustering) and/or sidescan sonar contacts. Sidescan sonar contacts, as visual images, were assessed for linearity, height off bottom, size, associated magnetics, backscatter characteristics, and visual surface associations (*i.e.,* bridge bents, buoys, *etc*.). Subbottom features were assessed as to feature type, and association with other subbottom features and sidescan targets.

After an extensive review and analysis of the data, a total of 12 clusters or targets were identified as potentially significant based on signal characteristics. Presented in Table 4-3, and consisting of 11 magnetic anomaly clusters, seven with associated sonar contacts and four without, as well as one sonar contact without associated magnetics, all have the potential to represent historically significant resources. Four of these clusters represent wrecks, two of which appear to be the remains of large, historic, wooden sailing vessels. None of the subbottom features have the potential for submerged prehistoric sites.

At the time of the marine investigation, the parameters for the proposed dredging project were unknown (*i.e.,* depth and area of dredging), therefore it was not known if any of these potentially significant cultural resources will be adversely impacted by project activities. Panamerican recommended that the USACE, Philadelphia District determine the exact parameters of the project impact and subsequently determine if any of the potentially significant targets will be adversely impacted. Avoidance zones are presented in Table 4-2 and illustrated in Figure 4-2for use if they can be avoided. Panamerican further recommended that if the potentially significant sites cannot be avoided, that the targets be further investigated to determine if they indeed do represent cultural resources sites. Additionally, two small sections within the borrow area were unable to be surveyed, as they were too shallow or dry land. Possibly containing additional potentially significant targets, if the areas will be employed for borrow material, monitoring of the dredging activities should be conducted by a certified maritime archaeologist.

Table 4-2: Avoidance zones for potentially significant clusters and targets.*

Cluster/ Target	Type	Associated Anomalies	Associated Sonar Contacts	Avoidance Center	Avoidance Radius	Avoidance Easting	Avoidance Northing
1	Wreck	4, 5, 6, 7, 8, 9 10	17, 18, 19, 20	C-18	500 feet	556409	240312
2	Wreck	19, 20, 21, 23	12, 13, 14	C-14	500 feet	554547	240668
3	Marked Wreck	131, 140, 146, 155, 155	21	C-21	500 feet	550917	237585
4	Wreck	208, 213	36, 37, 38	C-38	300 feet	552248	234738
5	Unknown	284, 285, 286, 288, 289, 290		M-288	500 feet	551471	231426
6	Unknown Structure	263, 264	30, 33, 34, 35	M-263	500 feet	547707	236948
7	Unknown Structure	266	29, 31	M-266	200 feet	549595	234981
8	Unknown	34. 36, 38, 40		M-38	500 feet	552457	240995
9	Unknown	147, 151, 156		M-151	200 feet	553211	235190
10	Unknown	242, 243, 245		M-243	200 feet	552518	233586
11	Unknown	270, 272, 273, 276, 278		M272	300 feet	552593	231794
12	Structure		00	C-00	200 feet	546967	239587

***Coordinates in NAD83 New Jersey State Plane East U.S. Survey Feet.**

On June 16, 2014, the USACE coordinated the report with the New Jersey State Historic Preservation Office. Specific parameters of the project, such as depth and location of dredging, were not defined at that time, it was not known if any of the resource would be impacted by project activities. Therefore, the SHPO concurred with continued coordination to ensure that no historic properties would be adversely impacted.

The No Action Alternative would pose no impacts to identified sites. Of the six proposed dredging models, each alternative will avoid all listed sensitive anomalies by a sufficient margin. The USACE currently propose to buffer each sensitive anomaly along with professional monitoring to ensure avoidance of adverse impacts to historic properties. There will be no dredging or anchoring within each buffer zone. This NEPA document will be coordinated with the SHPO for their review and comment.

Reasonable effort has been made during the investigation to identify and evaluate possible locations of historic archaeological sites and potential prehistoric site locations. However, the possibility exists that evidence of prehistoric and historic resources may yet be encountered within the Little Egg Inlet Sand Source Borrow Area. Should any evidence of historic resources be discovered during dredging activities, it is recommended that all work in that portion of the Project Area to cease immediately. Should questionable materials be uncovered during dredging, procedures contained in the Section 106 implementing regulations 36CFR800 will take effect.

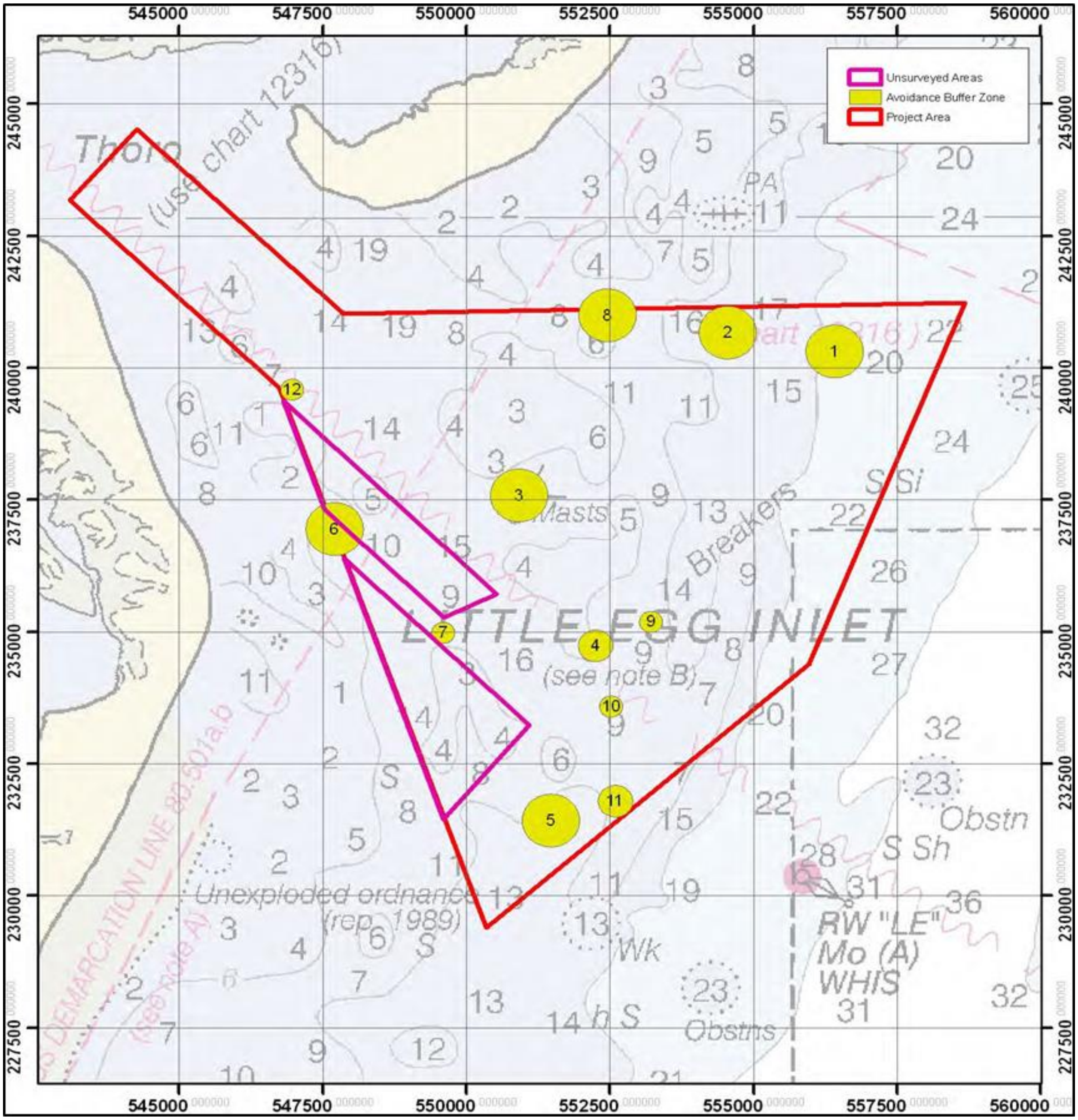

Figure 4-2: Avoidance zones for the 12 potentially significant Little Egg Inlet Borrow Area targets. Grid is 2,500 feet.

4.5 Air Quality and Greenhouse Gases

The potential impacts from the LBI construction project relating to air quality and GHGs are discussed in the following subsections.

4.5.1 Air Quality

The utilization of the proposed Little Egg Inlet borrow area is not anticipated to significantly impact the estimated emissions nor change the findings under General Conformity calculated for the two borrow areas located offshore at the northern end of the project. There are anticipated increases in emissions due to additional storm damage, which again does not change the findings under General Conformity. The previous LBI EA (USACE, 2014) determined that the project exceeded General Conformity thresholds for NO_x and therefore an SOC was developed for the project.

Under the SOC, the USACE will demonstrate conformity with the New Jersey State Implementation Plan by utilizing the emission offset options listed below. The demonstration can consist of any combination of options, and is not required to include all or any single options to meet conformity. The options for meeting general conformity requirements include the following:

a. Emission reductions from project and/or non-project related sources in an appropriately close vicinity to the project location. In assessing the potential impact of this offset option on the construction schedule, USACE recognizes the possibility of lengthening the time period in which offsets can be generated as appropriate and allowable under the general conformity rule (40CFR§93.163 and §93.165).
b. Use of a portion of the Department of Defense Joint Base McGuire and Lakehurst State Implementation Plan emissions budget, as determined by the NJDEP, and in coordination with the United States Environmental Protection Agency (EPA).
c. Use of Clean Air Interstate Rule (CAIR) ozone season NOx Allowances (or equivalent) with a distance ratio applied to allowances, similar to the one used by stationary sources found at N.J.A.C 7:27-18.5(c) Table 2.
d. Use of Surplus NOx Emission Offsets (SNEOs) generated under the Harbor Deepening Project (HDP). As part of the mitigation of the HDP, USACE and the Port Authority of New York & New Jersey developed emission reduction programs coordinated through the Regional Air Team (RAT). The RAT is comprised of the USACE, NJDEP, EPA, New York State Department of Environmental Conservation, and other stakeholders. SNEOs will be applied in concurrence with the agreed upon SNEO Protocols to ensure the offsets are real, surplus, and not double counted.

As stated in Section 3.5, an additional 1.8 million cubic yards of sand are needed to replace sand that was eroded by two additional storms. The increase in NOx emissions (estimated at 225 tons) will be added to the current project commitments under the existing SOC and its mitigation will be coordinated and tracked by the Regional Air Team (RAT). See Appendix F for the signed SOC.

Since the LBI construction project is short-termed and the NOx emissions increases associated with the entire project, including more recent storm damage, will be fully offset in each calendar year, the project will conform to the SIP and therefore will not produce any significant impacts on air quality nor affect the areas attainment status of the NAAQS. Locally, the impacts of the project are mitigated by the fact that the dredging will take place immediately offshore and the dredge hydraulically pumping material where prevailing coastal winds will reduce the potential for any short-term local impacts from the diesel engines onboard the dredge.

4.5.2 Greenhouse Gases

While the project is anticipated to exceed the 25,000 metric tons CO_2e CEQ 2014 indicator level, the project will not provide a mid nor long-term source of GHG production; in fact, it will help reduced GHGs. The very nature of the LBI beachfill project is to enhance the resiliency of the coastline by constructing dunes and a beach berm to combat rising sea levels, erosion and flood damages to infrastructure. The project includes the planting of beachgrass to restore vegetation lost through erosion, which will contribute to carbon sequestering and dune structural resiliency during storms. The protection of the ecosystem provided by the beachfill project will enable it to continue to sequester carbon through sustainable vegetation growth as a result of the project and will minimize future storm damage further inland and associated reconstruction emissions. Therefore, it is anticipated that the project will have a net-benefit long-term local impact related to climate change.

4.6 Hazardous, Toxic, and Radioactive Waste

The No Action Alternative would not pose any impacts from hazardous, toxic, or radioactive waste (HTRW).

The preferred plan to dredge sand from the Little Egg Inlet borrow area is not expected to result in the identification and/or disturbance of HTRW. The surrounding area is not developed and possesses coarse-grained material in a high-energy area which is unlikely to be contaminated with HTRW (USACE, 1994). It is possible that small caliber UXO may be encountered in the borrow area during dredging operations, and as a safety precaution, the Corps requires that a screen be placed over the drag head to effectively prevent any of the UXO from entering the pipeline (and/or being subsequently placed on the beach). The screen is made of vertical metal bars with a gap of no more than 1.5 inches.

The contractor would be responsible for proper storage and disposal of any hazardous material, such as oils and fuels, used during dredging. The U.S. EPA and U.S. Coast Guard regulations require the treatment of waste (*e.g.*, sewage, gray water) from dredge plants and tender/service vessels and prohibit the disposal of debris into the marine environment. The dredge contractor will be required to implement a marine pollution control plan to minimize any direct impacts to water quality from construction activity.

4.7 Socioeconomics

Little Egg Inlet connects the Atlantic Ocean with Great Bay and the Intracoastal Waterway. It provides maritime access to these water bodies by both recreational and commercial boaters. Following Hurricane Sandy, and more recent storms (Joaquin in October 2015 and Jonas in January 2016), which shifted sand shoals and washed barrier island sand into the inlet and the Intracoastal Waterway, navigational hazards within the inlet have increased. Under the No Action Alternative, significant storm events will continue to shift shoal sand, potentially impacting both shoreline habitats and navigational safety of Little Egg Inlet.

The objective of the proposed plan is to provide a suitably located sand source for beachfill operations along the southernmost portion of the LBI placement site, while minimizing impacts to adjacent lands. In doing so, the placement operations will more resiliency for the developed portions of the LBI shoreline against future storm events, flooding damages, and sea level rise. During dredging operations, the immediate area surrounding the dredge plant would be restricted for boaters for public safety.

Environmental Justice. Under Executive Order 12898 of 1994 and the Department of Defense's Strategy on Environmental Justice of 1995, the study area was evaluated for potential adverse impacts of dredging the proposed Little Egg Inlet borrow area to human health or environmental effects to minority and/or low-income populations. The EPA Environmental EJ Mapper was utilized to identify low-income and minority populations within residential areas north, south and west of the proposed borrow area. The Edwin B. Forsythe National Wildlife Refuge and adjacent wilderness areas occupy more than 47,000 acres of land immediately adjacent to the inlet on all three sides (see Figure 1-3). Residential communities are located 3-6 miles away from the inlet and the proposed dredging area is located 0.37 to 2.0 miles offshore. Neither the No Action alternative nor the proposed plan to dredge within the Little Egg Inlet offshore borrow area will pose any adverse impacts to minority or low-income residential communities.

4.8 Environmental Regulations

The Barnegat Inlet to Little Egg Inlet Shore Protection Project has adhered to the following environmental quality protection statutes and other environmental review requirements.

Archeological Resources Protection Act of 1979, as amended	Full
Clean Air Act, as amended	Full
Clean Water Act of 1977	Full
Coastal Barrier Resources Act	Full
Safe Drinking Water Act	Full
Coastal Zone Management Act of 1972, as amended	Full
Endangered Species Act of 1973, as amended	Full
Estuary Protection Act	Full
Federal Water Project Recreation Act, as amended	N/A
Fish and Wildlife Coordination Act	Full
Land and Water Conservation Fund Act, as amended	N/A
Magnuson-Stevenson Act, Essential Fish Habitat	Full
Marine Mammal Protection Act	Full
Marine Protection, Research and Sanctuaries Act	Full
Migratory Bird Treaty Act	Full
National Historic Preservation Act of 1966	Full
National Environmental Policy Act, as amended	Full
Rivers and Harbors Act	Full
Watershed Protection and Flood Prevention Act	N/A
Wild and Scenic Rivers Act	N/A
Coastal Barrier Resources Act	Full
EO 11988, Floodplain Management	Full
EO 11990, Protection of Wetlands	Full
EO 12114, Environmental Effects of Major Federal Actions	Full
EO 12898, Environmental Justice	Full
EO 13186, Protection of Migratory Birds	Full

4.9 Areas of Concern

Although not directly related to the proposed plan, Sea Level Rise (SLR) due to climate change has been predicted to be greater in the Mid-Atlantic Region than points north and south on the eastern seaboard. How fish and wildlife species adapt to changes in habitat physical and chemical conditions associated with climate change may adversely affect their populations. While variation in weather is a natural occurrence, and coastal areas are notoriously subjected to extreme weather events, persistent changes in the frequency, severity, or timing of storms at key locations (*e.g.* shorebird stop-over areas) may pose an added threat to species (USFWS, 2013). Under the No Action Alternative and the proposed dredging plan, predicted impacts due to SLR are expected to continue. The project itself is in part an adaptive measure designed to protect against the long-term effects of climate change, particularly increased storm intensity and higher mean sea levels. The project entails planting 347 acres of Cape American beach grass (*Ammophila breviligulata*) and saltmeadow cord grass (*Spartina patens*), offsetting greenhouse gases (GHG) through carbon sequestering and adding structural resiliency of the dunes, and in turn, the infrastructure behind them, against storm events and flooding. As such, the limited short-term increase in GHG emissions will result in a net longer-term benefit that outweighs the potential effect of the emissions on the climate.

Little Egg Harbor and the immediate vicinity encompassing the Edwin B. Forsythe Wildlife Refuge is designated by the USFWS as System Unit NJ-07P under the Coastal Barrier Resources Act (CBRA) of 1982. The Act was passed to render natural areas ineligible for new federal expenditures and prohibit development. CBRA encourages the conservation of hurricane prone, biologically rich coastal barriers. Little Egg Harbor and vicinity is classified as an “Otherwise Protected Area” (OPA). The only Federal expenditures that are prohibited within an OPA System Unit is Flood Insurance. The No Action scenario would not pose any additional impacts to the status of the project area under the CBRA.

The preferred plan to utilize sand dredged from Little Egg Inlet would not create or encourage development of the area and surrounding lands would continue to provide natural habitat for fish and wildlife. Dredging does pose temporary adverse impacts on water quality and on aquatic organisms in the immediate area of impact. Dredging would increase turbidity at the point of dredging during operations (offshore) and for a short-time after dredging ceases. Many existing benthic organisms will be removed by dredging in the proposed borrow area. These disruptions are expected to be of short duration and of minor significance if rapid recolonization by the benthic community occurs. Dredging would consequently temporarily displace a food source for some finfish in a relatively small section of the proposed delineated borrow area. Scott and Kelley (1998) and Scott (2012) showed that benthic organisms in nearshore borrow areas rapidly recover (*i.e*. within two years) after multiple dredging areas in borrow areas along the New Jersey Coastline.

Concerns regarding the potential impacts of dredging on shoreline habitat for Federally-listed threatened and endangered species will be addressed with each successive endangered species consultation with the USFWS prior to each dredging cycle. All reasonable and prudent measures and terms and conditions, as outlined in the USFWS’ Programmatic Biological Opinion will be followed.

For marine species, the NMFS recommends limiting hydraulic dredging during the period of lowest biological activity. The use of munitions screens on dredge water intake ports and baskets at the outfall pipe reduces the likelihood of negatively impacting marine species. Based on coordination with the NMFS, the USACE will continue to employ measures to reduce the potential for impacts to marine species. The Reasonable and Prudent Measures, Habitat Conservation Recommendations, and Terms and Conditions of the Biological Opinion provided by the NMFS in June 2014 for shore protection projects will be followed.

There is a fiber optic research cable buried within the Little Egg Inlet borrow area vicinity that will have 500 foot buffers established on both sides where dredging is prohibited. The contractor will be required to contact the cable owner (*i.e*. Rutgers University Marine Field Station) to discuss the dredging work plan, obtain restrictions on the laying of submerged pipeline, anchoring and any other dredging operations around these cables.

4.10 Environmental Constraints

Appropriate measures will be taken to ensure that any dredging activities are consistent with local, regional, state, and Federal regulations. Dredging within the Little Egg Inlet borrow area will not have a disproportionately high adverse effect on minority or low income populations and is in compliance with EO 12898. The project would generally have beneficial social and economic effects and would generally affect all persons equally.

4.11 Unavoidable Adverse Environmental Impacts

The unavoidable adverse impact of the No Action Alternative of no dredging within Little Egg Inlet, with insufficient alternative sand sources available within a reasonable distance to the placement site, would be continued erosion of the existing beach, which would result in loss of beach and dune habitat and eventually damage to structures. Increased flooding would occur as beach loss continues. As the risk of storm damage increases, property values would decrease. The unavoidable adverse impact of dredging is a temporary decrease in water quality and benthic community standing stocks within the borrow area where dredging occurs. It is anticipated that these communities would recover in time and the displacement of benthic invertebrates is temporary. The proposed plan is not anticipated to adversely impact fish passage in and out of Little Egg Inlet as dredging will occur 0.37 to 2.0 miles offshore of the inlet. Visual, noise, and air quality impacts that may occur during dredging operations are temporary and will cease upon completion of the dredging operation.

4.12 Short-term Uses of the Environment and Long-term Productivity

The use of available sand within Little Egg Inlet for use in beach nourishment purposes will positively affect the economy of the project area by maintaining recreational beaches and further storm protection to the communities and natural beach and dune habitat over a 50-year period of analysis. Ebb shoals provide an ideal sand source for borrow material as natural longshore transport processes continually replenish the shoals. Longshore transport rates will continue to carry sand towards the undeveloped Holgate and Little Beach Island Units of the Edwin B. Forsythe National Wildlife Refuge. Overwashes that occurred during Hurricane Sandy resulted in enhanced habitat for nesting shorebirds in the Little Egg Inlet region. Stone Harbor has been the recipient of numerous beachfills since initially constructed in 2003. Predominate longshore transport is to the south along Stone Harbor and beachfill for Stone Harbor is dredged from Hereford Inlet's authorized borrow area. Beachfill placed on Stone Harbor migrates south via dispersion and ultimately returns to Hereford inlet. This return of sediment contributes to the borrow area infilling rate. Three recent examples of Hereford Inlet's borrow area infilling include surveys from October 2010, December 2012 and August 2014 where 101%, 107% and

105% of the dredge material returned to the borrow area within 18-24 months. This influx of sediment is predicted to infill any dredged area within the proposed Little Egg Inlet borrow area in time frames very similar to what has been observed at Hereford Inlet.

Numerical modeling indicates that no significant impacts to the adjacent inlet shorelines are expected with longshore transport to the south from the placement site.

4.13 Irreversible and Irretrievable Commitments of Resources

Dredging involves the utilization of time and fossil fuels, which are irreversible and irretrievable. Impacts to the benthic community would not be irreversible, as benthic communities would reestablish with cessation of dredging activities. Sand is expected to continue to travel south under natural longshore transport processes, thereby continually replenishing the shoal complex adjacent to Little Egg Inlet and its shorelines.

4.14 Cumulative Effects

Cumulative impacts, as defined by CEQ regulations, is the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Before 1930, the Federal government's involvement in shore erosion was limited to protection of public property. With the enactment of the River and Harbor Act of 1930 (Public Law 71-520, Section 2), the Chief of Engineers was authorized to make studies of the erosion problem, in cooperation with municipal and state governments, in efforts to prevent further erosion. Until 1946, the Federal aid was limited to studies and technical advice. In 1946 and 1956, the law was amended to provide Federal participation in the cost of a project and allowed limited contribution to the protection of privately owned shores which would benefit the public.

There are several Federal navigation projects in inlets and beachfill projects along the New Jersey ocean coast, as well as some at the state and municipal levels that utilize inlet shoals or nearshore and offshore areas. Since November of 2012, several of the authorized and constructed projects within the Philadelphia District have had beachfill placement to offset sand losses incurred during storm Sandy. These projects include portions of Long Beach Island, Brigantine Island, Absecon Island (Atlantic City and Ventnor), Townsends Inlet to Hereford Inlet (Avalon and Stone Harbor), and Cape May City. The Ocean City – Peck Beach (northern Ocean City) project and Lower Cape May Meadows project were scheduled for renourishment at the time Hurricane Sandy struck, and that work has been completed. The remaining authorized, but uncompleted Federal projects are Long Beach Island (under contract), Absecon Island (Margate & Longport), Great Egg Harbor Inlet to Townsends Inlet (southern Ocean City, Strathmere (part of Upper Township), and Sea Isle City), and Manasquan Inlet to Barnegat Inlet (Point Pleasant Beach, Bay Head, Mantoloking, Brick Township, Toms River Township, Lavallette, Seaside Heights, Seaside Park, and Berkeley Township).

These projects have all used either inlet borrow sites or offshore borrow sites, which have impacted over 3,000 acres of marine habitat. Little Egg Inlet has not been used as a sand borrow source previously. In recent years, the New Jersey Coast has been affected by catastrophic coastal storms, most notably Hurricane Sandy in October 2012 and the nor'easters in September-October 2015 and

January 2016. In response to the devastation of the Atlantic coastal communities in New Jersey from Hurricane Sandy, the USACE and the Federal Emergency Management Agency (through aid to State and local municipalities) have undertaken unprecedented measures to repair and/or restore the affected beaches under P.L. 84-99 Flood Control and Coastal Emergencies (FCCE) and P.L. 113-2: Disaster Relief Appropriations Act.

Although more than 3,000 acres of marine habitat has been identified as sand borrow area for beach nourishment projects along the New Jersey coast, studies have demonstrated that these area, and the species that inhabit them recover quickly to both natural environmental impacts (*i.e.* storms, predation) or dredging. The cumulative effect of these combined activities is expected to be temporary and minor on resources of concern such as benthic species, beach dwelling flora and fauna, water quality, and essential fish habitat. This is due to the fact that flora and fauna associated with beaches, intertidal zones and nearshore zones are adapted to and resilient to frequent disturbance as is normally encountered in these highly dynamic and often harsh environments. Dredging a sand source from the proposed Little Egg Inlet borrow area would result in a positive socioeconomic benefit to the region by restoring beaches and dunes to developed portions of LBI subjected to erosion and flooding due to storm events in the face of climate change and sea level rise. The sand placed along the LBI shoreline also serves as a source, through natural longshore transport, to the undeveloped portion of LBI's southern end (Holgate) and on Little Egg Inlet's southern shore (Little Beach Island) which together provide two of the few remaining undeveloped barrier beaches in the state of New Jersey. Numerical modeling studies of various dredging scenarios at the Little Egg Inlet site show no significant impact to adjacent shorelines and ebb shoals adjacent to the inlet with material placed on LBI. With the large volumes of sand that move towards the Little Egg Inlet area through natural southerly longshore transport, the shoal complex and shoreline will continue to accumulate sand.

A protective dune/berm with periodic nourishment represents the least environmentally damaging structural method of reducing potential storm damages at a reasonable cost. It is generally considered socially acceptable, proven to work in high-energy environments, and is the only engineered shore protection alternative that directly addresses the problem of a sand budget deficit (National Research Council, 1995).

The majority of adverse impacts associated with all these projects are related to the temporary disturbance to the benthic community, and do not represent a permanent loss of marine benthic habitat. The borrow areas for each project would be impacted incrementally over the 50-year project life with each periodic nourishment cycle, usually every 7 years (until 2055). It is anticipated that the benthic community in dredged areas would begin to recolonize from neighbor areas and recover within two years after disturbance.

The cumulative impacts on Essential Fish Habitat (EFH) are not considered significant. Like the benthic environment, the impacts to EFH are temporary in nature and do not result in a permanent loss in EFH. Some minor and temporary impacts would result in a loss of food source in the affected areas. Turbidity-related impacts are not expected to impact essential fish habitat for fish larvae as the inlet and shoal area is naturally turbulent with breaking waves and strong currents approaching land and dredging is proposed to occur offshore and not within the inlet itself. Dredging activities will occur between 2,000 to 11,000 feet offshore of the inlet's shoreline and would not impede anadromous fish migrations into the inlet.

The Federally endangered Atlantic sturgeon is not likely to be in the immediate study area but if so, would probably leave the area during dredging operations. The dredging contractor must adhere to the Terms and Conditions as described in the Biological Opinion (NMFS, 2014) that reduce the likelihood of adverse effects to sturgeon, sea turtles, and marine mammals. The numerical modeling study (Frey *et al*. 2015) showed that dredging is not likely to significantly impact shoreline geomorphology under various dredging scenarios. Shoaling through longshore transport to the south will continue to occur, thereby providing a continued recharge effect to sand resources in and adjacent to the inlet where listed bird species habitat occurs. Noise impacts of dredging are not expected to be significant as the dredge is not near the shoreline such that feeding, resting, or nesting birds should not be impacted by noise disturbance.

Projects of a restorative nature using beachfill dredged from nearshore or offshore borrow areas are becoming increasingly common in coastal areas of high development as they become more susceptible to erosive forces and climate change. Numerous beach nourishment projects have been studied along the Atlantic Ocean coast of New Jersey since the 1960s by local, State, and Federal interests. Depending on site-specific circumstances, such as the methods utilized to alleviate coastal erosion and ensuing storm damages and the existing ecological and socioeconomic conditions, it is difficult to gauge the net cumulative effects of these actions. The scientific literature generally supports beachfill projects using nearby marine borrow areas over hardened structural alternatives. If properly planned, associated impacts are short-term, and have minor ecological effects.

5.0 EVALUATION OF 404(b)(1) GUIDELINES

I. Project Description
A. Location
1.Little Egg Inlet connects the Atlantic Ocean with the Great Bay along the southeastern coast of New Jersey. The inlet forms a maritime border separating Little Egg Harbor Township in southern Ocean County and Galloway Township in northeastern Atlantic County.

B. General Description
1. The Little Egg Inlet area is an accretion zone. Significant quantities of sand are carried southward by longshore transport processes, creating shoals immediate offshore of the inlet. The ebb shoals create a hazard to navigation. The proposed plan is to dredged sand from the shoals for placement on the authorized shore protection project on Long Beach Island. The New Jersey coastline, including Long Beach Island, has a long history of severe erosion and is frequently subject to storm damage from wave attack and storm surge inundation. Long Beach Island is separated from the mainland to the west by shallow, elongated backwaters with salt marshes: Barnegat Bay and Little Egg Harbor.

C. Authority and Purpose
1. The authority for the project is The New Jersey Shore Protection Study which was authorized under resolutions adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives and the Committee on Environment and Public Works of the U.S. Senate in December 1987.

2. The purpose of the current study is to evaluate Little Egg Inlet as a future sand source for completing initial construction and for future periodic nourishment of the Barnegat Inlet to Little Egg Inlet Storm Damage Reduction project. To continue maintenance of the project's beach and dune system as authorized, or conduct emergency operations, similar to what occurred after Superstorm Sandy, the USACE must have access to borrow areas of high quality sand material within a reasonable distance to the placement site. Sand obtained from the Little Egg Inlet proposed borrow area is ideally suited for placement on the southernmost portion of the authorized project. The Little Egg Inlet shoals self-replenish via longshore transport.

D. General Description of Dredged or Fill Material
1. The proposed dredged material is mostly in the fine to coarse sand category with very little silt/clay particles or very coarse to gravel particles as defined by the Unified Soil Classification System.

E. Description of Proposed Discharge Site

1. The proposed discharge site is comprised of an eroding berm and dunes along the coastline of Long Beach Island, Ocean County, New Jersey. The placement site evaluation is provided in USACE (1999) and USACE 2014).

2. The proposed discharge site is unconfined with placement to occur on a shoreline area.

3. The type of habitat present at the proposed location is intertidal and beach habitat.

4. Approximately 2.0 mcy of sand is required for periodic nourishment every 7 years over the remaining 40 years of the authorized 50-year period.

5. The US Fish and Wildlife Service (USFWS, 1996) stated that they do not consider beach nourishment on the Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge necessary. Hence, the Holgate Unit (northern end of the refuge) was not included in the project. Due to the fact that both ends of the project terminate at a groin, no tapers would be needed. The template for the plan is a dune at elevation +22 ft NAVD, with a 30 foot dune crest width, 1V:5H slopes from dune crest down to a berm at elevation +8 ft NAVD, a berm width of 125 feet from centerline of dune (105 feet of dry berm from toe of dune to MHW), 1V:10H slopes from the berm to MLW, and maintenance of the profile shape from MLW to depth of closure (occurring at approximately -29 ft NAVD). Average dune widths for LBI are already at +29 feet NAVD. Dune elevations are at 19 feet on average while berm width averages are at 111 feet. As part of the berm and dune restoration approximately 1,030.85 acres would be covered; of these, approximately 365.10 acres would be above mean high water (MHW) and 665.75 acres would be below MHW. The elevation of MHW is 1.5 feet in NAVD datum. The above surface areas extend from the inland toe of the dune to MHW and from MHW to depth of closure at - 29.0 feet NAVD.

F. Description of Placement Method

1. A hydraulic dredge would be used to excavate the borrow material from the borrow area. The material would be transported using a pipeline delivery system to the berm and dune restoration site. Subsequently, final grading would be accomplished using standard construction equipment.

II. Factual Determination

A. Physical Substrate Determinations

1. The final proposed elevation of the beach substrate after fill placement would be +8.0 feet NAVD at the top of the berm and +22.0 feet NAVD at the top of the dune. The proposed profile of the berm would be 10H:1V from the toe of dune to MLW, and maintenance of the profile shape from there to the depth of closure. The dune would have a 1V:5H slope from dune crest down to the berm.

2. The sediment type involved would be sand.

3. Dredging within the proposed Little Egg Inlet borrow area would result in removal of some benthic organisms where the dredge cutterhead impacts the bottom. Recolonization of adjacent unaffected areas is expected to occur within 1-2 years.

4. Actions taken to minimize impacts include use of standard construction practices to minimize turbidity and erosion.

B. Water Circulation, Fluctuation and Salinity Determinations

1. Water. Consider effects on:

a. Salinity - No effect.
b. Water Chemistry - No significant effect.
c. Clarity - Minor short-term increase in turbidity during dredging.
d. Color - No effect.

e. Odor - No effect.
f. Taste - No effect.
g. Dissolved gas levels - No significant effect.
h. Nutrients - Minor short-term effect
i. Eutrophication - No effect.
j. Others as appropriate – None.

2. Current patterns and circulation

a. Current patterns and flow - Circulation predicted to be altered 10% or less temporarily within the immediate dredged area during and shortly after operations. Numerical modeling shows that the natural circulation processes would continue post-dredging and post-placement north of Little Egg Inlet and resume the natural character of the area.
b. Velocity – Less than a 10% effect on wave energy density was predicted by numerical modeling temporarily during infilling period.
c. Stratification – natural thermal stratification occurs beyond the mixing region created by the surf zone and would remain the same.
d. Hydrologic regime - The regime is largely marine and oceanic. This would remain the case following construction of the proposed project.

3. Normal water level fluctuations - the tides are semidiurnal with a mean tide range of 4.1 feet and a spring tide range of 5.0 feet in the Atlantic Ocean. The proposed dredging would not affect the tidal regime.

4. Salinity gradients - There should be no significant effect on the existing salinity gradients.

5. Actions that would be taken to minimize impacts - the borrow area would be excavated in a small portion of the borrow area during any given dredging cycle. The delineated borrow area is 2050 acres. Natural hdrologic processes in place prior to dredging would continue to shape the inlet shoals in the same manner.

C. Suspended Particulate/Turbidity Determinations

1. Expected changes in suspended particulate and turbidity levels in the vicinity of the borrow site - there would be a short-term elevation of suspended particulate concentrations during dredging operations. Tidal and wave currents would quickly dissipate elevated levels of particulate concentrations that are typical in high energy environments such as ocean inlets.

2. Effects (degree and duration) on chemical and physical properties of the water column

a. Light penetration - Short-term, limited reductions would be expected in the vicinity of dredging activity.
b. Dissolved oxygen - There is a potential for a temporary decrease in dissolved oxygen levels but the anticipated low levels of organics in the borrow material should not generate a high, if any, oxygen demand.
c. Toxic metals and organics - Because the borrow material is essentially all fine sand as defined by the Unified Soil Classification System, no toxic metals or organics are anticipated.
d. Pathogens - Pathogenic organisms are not known or expected to be a problem.
e. Aesthetics – Dredging activities would result in a minor, short-term degradation of aesthetics.

3. Effects on Biota

a. Primary production, photosynthesis - Minor, short-term effects related to turbidity.

b. Suspension/filter feeders - Minor, short-term effects related to suspended particulates in the immediate dredging area.

c. Sight feeders - Minor, short-term effects related to turbidity.

4. Actions taken to minimize impacts include selection of area possessing clean sand with a small fine grain component and low organic content. Standard construction practices would also be employed to minimize turbidity and erosion.

D. Contaminant Determinations

The discharge material is not expected to introduce, relocate, or increase contaminant levels at either the borrow area or placement sites. This is assumed based on the characteristics of the sediment, the proximity of borrow sites to sources of contamination, the area's hydrodynamic regime, and existing water quality.

E. Aquatic Ecosystem and Organism Determinations

1. Effects on plankton -The effects on plankton should be minor and temporary, and mostly related to light level reduction due to turbidity. Significant dissolved oxygen level reductions are not anticipated.

2. Effects on benthos – The effects on the benthic community would be minor and temporary in the immediate area to be dredged, when the fill material is excavated and for a short period post-dredging until elevated turbidity abates. The loss is somewhat offset by the expected rapid opportunistic recolonization from adjacent areas that would occur following cessation of dredging.

3. Effects on Nekton - Only a temporary displacement is expected as the nekton would probably avoid the active work areas.

4. Effects on Aquatic Food Web - Only a minor, short-term impact on the food web is anticipated. This impact would extend beyond the dredging period until recolonization of the dredged areas has occurred.

5. Effects on Special Aquatic Sites - No wetlands would be impacted by the project.

6.Threatened and Endangered Species - Several species of threatened and endangered sea turtles may be in the vicinity depending on time of year. Sea turtles have been known to become entrained and subsequently destroyed by suction hopper dredges. However, current practices require the use of screens placed on the dredge cutterhead as well as the beach discharge pipe, for the prevention of ordnance deposition on beaches. This method serves to minimize impacts to sea turtles as well, and has been coordinated with the National Marine Fisheries Service.

The piping plover and the red knot, Federal and state threatened species, are not anticipated to be impacted by dredging noise or visual disturbance due to the distance offshore where the proposed dredging is to take place. This bird nests on ocean beaches and nesting sites have occurred along the shoreline surrounding Little Egg Inlet. Coordination with the USFWS is required and to implement a plan to minimize potential impacts to nesting plovers, least terns and black skimmers.

Atlantic sturgeon are not likely to be in the immediate study area but if so, would probably leave the area during dredging operations. Shortnose sturgeon are not expected to occur in the project area.

No impacts to seabeach amaranth will occur.

The Terms and Conditions of the Biological Opinions (NMFS, 2014; USFW, 2005) will be followed to minimize the potential impacts to threatened and endangered species.

7. Other wildlife - The proposed plan may affect Essential Fish Habitat of several fish species and in particular, winter flounder. Studies on turbidity levels resulting from dredging in sand environments is not significant to cause adverse impact to fishes. Impacts to benthic food resources are limited to the immediate area of dredging and temporary. Recolonization of benthic organisms occurs within one to two seasons from adjacent non-dredged bottom habitat. The proposed project is not likely to impact other wildlife. Numerical modeling did not indicate any significant impact of dredging to the adjacent shoreline. Marine wildlife are expected to avoid the dredging area during operations. Terrestrial wildlife on the inlet shores are not likely to be affected by the noise generated by the dredge sitting offshore.

8. Actions to minimize impacts - Impacts to benthic resources will be minimized at the borrow area by limiting dredging to a specific small section of the proposed borrow area and serve a positive benefit by reducing hazardous shoals to navigation within a specified channel configuration while leaving adjacent ebb shoals intact. Employing cutterhead intake screens minimizes the potential for impacts to Federal and state threatened or endangered sea turtles. Noise disturbance to the Federal and state threatened piping plover is not likely since the dredge will not be close to the shoreline.

F. Proposed Placement Site Determinations

1. Mixing zone determination

- a. Depth of water - zero to 33 feet mean low water
- b. Current velocity - predominate current is longshore current which is wave dependent for its velocity
- c. Degree of turbulence – Heavy.
- d. Stratification – None.
- e. Discharge vessel speed and direction - Not applicable.
- f. Rate of discharge – Not applicable.
- g. Dredged material characteristics – fine to medium grained sand as defined by the Unified Soil Classification System.
- h. Number of discharge actions per unit time - Continuous over the construction period.

2. Determination of compliance with applicable water quality standards - a Section 401 Water Quality Certificate and consistency determination concurrence with New Jersey's Coastal Zone Management Program will be obtained prior to initiation of construction.

3. Potential effects on human use characteristics

- a. Municipal and private water supply - No effect.
- b. Recreational and commercial fisheries - Short-term effects during dredging.
- c. Water related recreation - Short-term effect during dredging.
- d. Aesthetics - Short-term effect during dredging.
- e. Parks, national and historic monuments, national seashores, wilderness areas, *etc*. - minor temporary aesthetics impacts during dredging operations.

G. Determination of Cumulative Effects on the Aquatic Ecosystem – No long-term effects anticipated. Short-term 10% impact to wave energy densities.

H. Determination of Secondary Effects on the Aquatic Ecosystem - Any secondary effects would be minor, insignificant, and short in duration.

III. Finding of Compliance or Non-Compliance with the Restrictions on Discharge

A. No significant adaptation of the Section 404(b)(1) Guidelines was made relative to this evaluation.

B. The alternative measures considered for accomplishing the project are detailed in Section VII of the 1999 *Barnegat Inlet to Little Egg Inlet Feasibility Study and Environmental Impact Statement.*

C. A Section 401 Water Quality Certificate and Federal Consistency Determination will be obtained from the New Jersey Department of Environmental Protection.

D. The proposed dredging operations would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

E. The proposed dredging would comply with the Endangered Species Act of 1973. Formal consultation with the NMFS has been completed. Formal (Tier 2) consultation with the USFWS will be completed prior to each dredging cycle.

F. The proposed dredging would not violate the protective measures for any Marine Sanctuaries designated by the Marine Protection, Research, and Sanctuaries Act of 1972. The proposed dredging is in compliance with the regulations of the Coastal Barrier Resources Act.

G. The proposed dredging would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. Significant adverse long-term effects on life stages of aquatic life and other wildlife dependent on the aquatic ecosystem; aquatic ecosystem diversity, productivity, and stability; and recreational, aesthetic, and economic values would not occur.

H. Appropriate steps to minimize potential adverse impacts of dredging on aquatic systems include selection of borrow material that is low in silt content, has little organic material, and is uncontaminated.

I. On the basis of the guidelines, dredging the proposed Little Egg Inlet borrow area is specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem.

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