FINDING OF NO SIGNIFICANT IMPACT

Use of Outer Continental Shelf Sand from Sandbridge Shoal in the Sandbridge Beach, VA Erosion Control and Hurricane Protection Project

Introduction

Pursuant to the National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500-1508), the U.S. Army Corps of Engineers (USACE) Norfolk District, in coordination with the Bureau of Ocean Energy Management (BOEM), prepared an environmental assessment (EA) to determine whether authorizing use of Outer Continental Shelf (OCS) sand from Sandbridge Shoal in the Sandbridge Beach Erosion Control and Hurricane Protection Project would have a significant effect on the human environment and whether an environmental impact statement (EIS) should be prepared. Pursuant to the Department of the Interior (DOI) regulations implementing NEPA (43 CFR 46), BOEM has independently reviewed the EA and has determined that the potential impacts of the proposed action have been adequately addressed.

Proposed Action

BOEM's proposed action is the issuance of a negotiated agreement to authorize use of Sandbridge Shoal so that the project proponents, the USACE and the City of Virginia Beach, can obtain up to 2,000,000 cubic yards of OCS sand for a beach nourishment project at Sandbridge Beach in southeastern Virginia. The USACE's proposed action is construction of the project. Initial construction of the beach nourishment project occurred in 1998. Maintenance construction occurred during 2003 and 2007. This represents the fourth construction cycle.

The project is needed to continue to provide storm protection and reduce erosion along five miles of Sandbridge Beach. The Sandbridge Beach Erosion Control and Hurricane Protection Project is authorized by the Water Resources Development Acts of 1974, 1992, and 2000, as amended. The purpose of BOEM's proposed action is to respond to the project sponsors' request for use of OCS sand under the authority granted to the Department of the Interior by the Outer Continental Shelf Lands Act (OCSLA). The legal authority for the issuance of negotiated noncompetitive leases for OCS sand and gravel is provided by OCSLA (43 U.S.C. 1337(k)(2)).

Alternatives to the Proposed Action

In March 1992, the U.S. Army Corps of Engineers (USACE) completed a Final Feasibility Report and EA evaluating economic, engineering, and environmental concerns. A number of structural and non-structural alternatives were considered. Beach nourishment was selected as the preferred alternative, and the USACE identified Sandbridge Shoal as the preferred borrow area. Supplemental EAs were prepared by the Minerals Management Service (MMS) in 1997, 2001, and 2006 to support use of OCS sand from Sandbridge Shoal. These environmental documents described the affected environment and evaluated potential environmental effects resulting from the proposed action. Both agencies found no significant impacts for the three previous dredging cycles provided identified mitigation measures were implemented.

Alternatives to beach nourishment were re-considered in scoping for this EA, but ultimately eliminated. Two practical alternatives were considered and analyzed by BOEM for this project:

A) authorize use of the OCS borrow area and B) the No Action alternative. The potential impacts resulting from BOEM's no action, or not issuing the negotiated agreement, would actually depend on the course of action subsequently pursued by the project proponents. The options considered include:

(a) identification and use of another alternative offshore borrow location of comparable sand quantity and quality,
(b) identification and use of onshore sources of comparable sand quantity and quality, or
(c) not constructing the project.

The No Action alternative would not fully meet the Project's purpose and need and address the storm protection needs in a timely manner. Alternative, economically-viable borrow areas with sufficient beach compatible sediment have not been identified at this time, despite regional resource evaluation studies. Option (a) would not minimize overall environmental effects as potential effects would be comparable, or potentially worse, depending on the borrow location. Option (b) is not considered to be viable, as upland sources of needed quality and quantity are limited in the project area. In the case of the no project option, coastal erosion would continue, sea turtle and shorebird nesting habitat would deteriorate, the recreational amenity associated with the public beach would be severely affected, and the likelihood and frequency of property and storm damage would increase.

Environmental Effects

The EA evaluates potential environmental effects resulting from the issuance of a negotiated agreement. The connected actions of conveyance and placement of the sand are considered. The EA and FONSI identify all mitigation and monitoring necessary to avoid, minimize, and/or reduce and track any foreseeable adverse impacts that may result from all phases of construction. A subset of mitigation, monitoring, and reporting requirements, specific to activities under BOEM jurisdiction, will be incorporated into the negotiated agreement to avoid, minimize, and/or reduce and track any foreseeable adverse impacts (Appendix A).

Significance Review

Pursuant to 40 CFR 1508.27, BOEM evaluated the significance of potential environmental effects considering both CEQ context and intensity factors. The potential significance of environmental effects has been analyzed in both spatial and temporal context. Potential effects are generally considered reversible because they will be minor to moderate, localized, and short-lived. No long-term significant or cumulatively significant adverse effects were identified. The ten intensity factors were considered in the EA and are specifically addressed below:

1. Impacts that may be both beneficial and adverse.

Potential adverse effects to the physical environment, biological resources, cultural resources, and socioeconomic resources have been considered. Adverse effects to benthic habitat and communities in the borrow area are expected to be reversible. Short-term and local effects on fish habitat and fishes are expected within the dredged area due to reduction of benthic habitat and prey, as well as changes in shoal morphology and burial of existing benthic habitat in the fill area. Dredging operations will be performed to avoid the creation of deep pits in the borrow area. Potential effects to sea turtles, marine mammals, Atlantic sturgeon, and cultural resources in the vicinity of operations have been reduced through tested mitigation, such as sea turtle deflector use, observers, and cultural resource buffers. Effects to nesting, foraging, and swimming sea turtles and transitory marine mammals will be monitored. Temporary displacement of or behavior modification of birds near the borrow areas or beach placement could occur. Overall, less than 100 acres of beach and dune habitat and nearshore subaqueous habitat are expected to be impacted. Impacts would be short-term, localized and temporary and should have no lasting effects on bird populations in the area. Temporary reduction of water quality is expected due to turbidity during dredging and placement operations. Best management practices for erosion and turbidity controls will be used pursuant to the requirements of the Virginia Water Protection Permit. Small, localized, temporary increases in concentrations of air pollutant emissions are expected, but the short-term impact by emissions from the dredge or the tugs would not affect the overall air quality of the area. A temporary increase in noise level and a temporary reduction in the aesthetic value offshore during construction in the vicinity of the dredging would occur. For safety reasons, navigational and recreational resources located in the vicinity of the dredging operation would temporarily be unavailable for public use. There would also be beneficial impacts from increased storm protection and an improved recreational beach. Over the long-term, there would be newly created shorebird and sea turtle nesting habitat.

2. *The degree to which the proposed action affects public health or safety.*

The proposed activities are not expected to significantly affect public health. Construction noise will temporarily increase ambient noise levels and equipment emissions would decrease air quality in the immediate vicinity of placement activities. The public is typically prevented from entering the segment of beach under construction, so recreational activities will not be occurring in close proximity to operations. Dredging operations will be performed in accordance with an environmental protection plan, addressing marine pollution, waste disposal, and air pollution. The USACE will be conducting inspections to ensure compliance with the plan.

3. *Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.*

No prime or unique farmland, park lands, designated Wild and Scenic reaches, or wetlands would be impacted by implementation of this project. No critical habitat for the listed species is located within the project area. Sandbridge Shoal has been designated as Essential Fish Habitat (EFH) for 22 federally managed species and is a habitat area of particular concern (HAPC) for sandbar sharks. Dredging may affect feeding success of EFH species due to turbidity, habitat perturbation, and loss of benthic prey. Impacts to EFH would occur on Sandbridge Shoal, but the limited spatial and temporal extent of dredging will not adversely affect EFH on a broad scale. Cultural resources are described in more detail below.

4. *The degree to which the effects on the quality of the human environment are likely to be highly controversial.*

No effects are expected that are scientifically controversial. Effects from beach nourishment projects, including dredging on the OCS, are generally well studied. The effects analyses in the EA has relied on the best available scientific information, including information collected from previous dredging and nourishment activities in and adjacent to the project area. Numerous studies and monitoring efforts have been undertaken in the vicinity of Sandbridge Shoal evaluating the effects of dredging and beach nourishment on shoreline change, habitat condition, benthic communities, and fish.

5. *The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.*

Beach nourishment is a common solution to coastal erosion problems along the mid-Atlantic coast. Beach nourishment in Virginia Beach and Sandbridge Beach has been ongoing for several decades. No significant adverse effects have been documented during or as a result of these past operations. The project design is typical of beach nourishment operations. Mitigation and monitoring efforts are similar to that undertaken for past projects and have been demonstrated to be effective. The effects of the proposed action are not expected to be highly uncertain, and the proposed activities do not involve any unique or unknown risks. Military munitions have been dredging during previous construction cycles. The dredge plant equipment will be outfitted with screening devices to exclude entrainment and placement on the beach of any military munitions. The USACE Military Munitions Design Center will also provide a safety specialist to oversee safety and training.

6. *The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.*

No precedent for future action or decision in principle for future consideration is being made in BOEM's decision to authorize re-use of the Sandbridge Shoal for this construction cycle. BOEM considers each use of a borrow area on the OCS as a new federal action. The Bureau's authorization of the use of the borrow area does not dictate the outcome of future leasing decisions. Future actions will also be subject to the requirements of NEPA and other applicable environmental laws.

7. *Whether the action is related to other actions with individually insignificant but cumulatively significant impacts.*

Significance may exist if it is reasonable to anticipate cumulatively significant impacts that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. The EA identifies those actions and potential impacts related to underlying activities. The EA concludes that the activities related to the proposed action are not reasonably anticipated to incrementally add to the effects of other activities to the extent of producing significant effects. Because the seafloor is expected to equilibrate, sand moving alongshore and will slowly accumulate offshore, the proposed project provides an incremental, but localized effect on the reduction of offshore sand resources. Although there will be a short-term and local decline in benthic habitat and populations, both are expected to recover within a few years. No significant cumulative impacts to benthic or fish habitat and associated communities are expected from the continued use of the borrow area, although NMFS Habitat Conservation Division has expressed some concern over the repetitive use if dredging will re-occur at intervals more frequent that the expected time recovery of benthic communities.

8. *The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.*

The proposed action is not expected to adversely affect historic resources. Bottom-disturbing activities may occur during proposed construction activities. An archaeological clearance survey was performed and potential historic or cultural properties have been identified in the borrow area. Avoidance buffers have been applied to protect potential resources. A remote sensing survey will be performed in advance of construction activity to establish use corridors for pump-out and conveyance operations. No known archaeological resources are located in the placement area. The USACE, acting as the lead agency for complying with the National Historic Preservation Act, coordinated with the Virginia Division of Historic Resources. BOEM will require implementation of a chance-finds procedure which calls for immediate cessation of operations and notification in the event of an unanticipated discovery of a cultural resource. BOEM and the USACE work with Virginia Division of Historic Resources should shipwreck or prehistoric remains be unexpectedly discovered. No significant impacts to cultural resources in the project area (borrow, pump-out, or placement areas) are anticipated with implementation of the measures to protect identified resources.

9. *The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.*

Nesting and swimming sea turtles, Atlantic sturgeon, piping plovers, and roseate terns may be present in the project area during and after construction operations and may be adversely affected if present. However, no take of any of these species has been documented during past construction cycles. The USACE will comply with all requirements of biological opinions and concurrences associated with this project provided under the Endangered Species Act (ESA) from both U.S. Fish and Wildlife Service (U.S. FWS) and National Marine Fisheries Service (NMFS) to minimize effects. U.S. FWS and NMFS have determined that the proposed action will not jeopardize these species' continued existence.

If a hopper dredge is used for dredging operations, potential impacts to sea turtles could occur. To minimize the risk to sea turtles, standard sea turtle protection conditions will be implemented such as the use of a state-of-the-art rigid deflector draghead, screening and/or observers, and/or novel monitoring techniques. The full scope of monitoring will depend on the dredge plant and screening being used. For example, additional monitoring may be required to detect entrainment of sturgeon if a cutterhead dredge is used. The full scope of mitigation measures is detailed in NMFS' biological opinion. Monitoring for nesting sea turtles will also occur during beach construction operations. Construction operations will be modified and protective measures implemented if sea turtle nests or crawls are observed.

Sperm whales, Blue whales, Humpback whales, Fin whales, North Atlantic right whales, and shortnose sturgeon occur only rarely in the project area, and therefore, the likelihood of adverse impacts are very low and the chances of the proposed action affecting them are discountable. Seabeach amaranth is not expected to be in the project area.

10. Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.

The USACE and City of Virginia Beach must comply with all applicable Federal, State, and local laws and requirements. The dredging contractor is required to provide an environmental protection plan that verifies this compliance. BOEM and the USACE have undertaken the necessary consultations with NMFS, USFWS, and other state agencies. The Virginia Department of Environmental Quality (VDEQ) concurred with the consistency determination prepared by the USACE. A Virginia Marine Resources Commission Permit and Virginia Water Protection Permit were obtained by the City of Virginia Beach. The proposed action is in compliance with the Marine Mammal Protection Act. Marine mammals are not likely to be adversely affected by the project and incorporation of safeguards to protect threatened and endangered species during project construction would also protect marine mammals.

Consultations and Public Involvement

The USACE served as the lead Federal agency coordinating public involvement. The EA was subject to a public comment period. Pertinent correspondence with Federal and state agencies are provided in Appendix C of the EA. After signature of this Finding of No Significant Impact (FONSI), a Notice of Availability of the FONSI and EA will be prepared and published by BOEM in the Federal Register or by other appropriate means. The EA and FONSI will be posted to BOEM web site [http://www.boem.gov/Non-Energy-Minerals/Marine-Minerals-Program.aspx].

Conclusion

BOEM has considered the consequences of issuing a negotiated agreement to authorize use of OCS sand from Sandbridge Shoal in the Sandbridge Beach Erosion Control and Hurricane Protection Project. BOEM independently reviewed the attached EA (Attachment 1) and finds that it complies with the relevant provisions of the CEQ regulations implementing NEPA, DOI regulations implementing NEPA, and other Marine Mineral Program requirements. Based on the NEPA and consultation process coordinated cooperatively by the USACE and BOEM, appropriate terms and conditions enforceable by BOEM will be incorporated into the negotiated agreement to avoid, minimize, and/or mitigate any foreseeable adverse impacts (Appendix A).

Based on the evaluation of potential impacts and mitigating measures discussed in the EA, BOEM finds that entering into a negotiated agreement, with the implementation of the mitigating measures, does not constitute a major Federal action significantly affecting the quality of the human environment, in the sense of NEPA Section 102(2)(C), and will not require preparation of an EIS.

[signature] 9/14/12

James F. Bennett
Chief, Division of Environmental Assessment

Date

September 2012

Note to Readers:

The U.S. Army Corps of Engineers – Norfolk District (USACE) completed the attached Final Environmental Assessment (EA), *Sandbridge Beach Erosion Control and Hurricane Protection Project*, in June 2009. The Minerals Management Service (MMS), a predecessor to the Bureau of Ocean Energy Management (BOEM), served as a cooperating agency during preparation of the EA. In August 2009 the USACE issued a Finding of No Significant Impact. The MMS did not issue an independent Finding of No Significant Impact at that time. Construction of the Sandbridge Beach Erosion Control and Hurricane Protection Project was anticipated to occur in 2010; however, construction was delayed when funding was not authorized. With funding secured, the USACE is now proposing to move forward with construction of the project in late 2012.

BOEM has adopted the attached EA and issued a Finding of No Significant Impact. Prior to adopting the EA, BOEM followed the Department of the Interior regulations (43 CFR 46) concerning the adoption of National Environmental Policy Act (NEPA) documents. BOEM determined the EA was relevant to the proposed action, independently evaluated its adequacy, and supplemented the EA as needed.

The USACE and BOEM contacted relevant federal and state resources to determine whether there were new circumstances or new information that would result in significantly different effects if BOEM authorized use of Outer Continental Shelf (OCS) sand resources from Sandbridge Shoal in construction of the project at this time. The USACE, as lead agency, independently prepared a Record of Environmental Consideration in August 2012 and determined that no supplemental analysis was necessary. BOEM revised EA Appendices A and C and prepared a detailed Finding of No Significant Impact addressing the new information.

In February 2012, the five distinct population segments of the Atlantic sturgeon were listed as endangered under the Endangered Species Act (ESA). In April 2012 the USACE and BOEM re-initiated formal consultation with the National Marine Fisheries Service (NMFS) consistent with the requirements of Section 7 of the ESA. NMFS issued a revised biological opinion, addressing not only Atlantic sturgeon, but all listed species that could be adversely affected by the proposed action, including marine mammals and sea turtles. Information about the endangered and threatened species and the Section 7 consultation was not revised in Chapters 6 and 7 of the EA since the document had already been finalized. Instead, BOEM appended the 2012 biological assessment and resulting biological opinion. While the biological assessment and biological opinion present new information, that information does not alter the effects conclusions of the EA concerning potentially significant effects to endangered and threatened species.

Final

ENVIRONMENTAL ASSESSMENT
SANDBRIDGE BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT

VIRGINIA BEACH, VIRGINIA

Prepared by
U.S. Army Corps of Engineers, Norfolk District
Planning and Policy Branch
Environmental Analysis Section
In cooperation with
Minerals Management Service, Herndon VA
Leasing and Environmental Divisions

June 2009

Appendices Revised September 2012
Bureau of Ocean Energy Management

ENVIRONMENTAL ASSESSMENT
SANDBRIDGE BEACH EROSION CONTROL
AND
HURRICANE PROTECTION PROJECT
VIRGINIA BEACH, VIRGINIA

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ENVIRONMENTAL ASSESSMENT
SANDBRIDGE BEACH EROSION CONTROL
AND
HURRICANE PROTECTION PROJECT
VIRGINIA BEACH, VIRGINIA
June 2009

1.0 INTRODUCTION

Sandbridge Beach is located on a barrier island, along coastal southeast Virginia separating the Atlantic Ocean on the east from Back Bay, a shallow freshwater sound, to the west. It is a residential community of year round residents, rental properties, and summer homes located approximately 5 miles south of Virginia Beach's "resort strip." Several major storms, nor'easters, and hurricanes have struck the area in past years causing severe losses of sand and coastal flooding; the oceanfront is susceptible to wave attack on the beach berm and dunes. During the initial development of Sandbridge as a residential community, sand dunes were lowered, and in some cases, removed for construction near the shoreline. A Phase I Advanced Engineering and Design Study for Beach Erosion and Hurricane Protection at Virginia Beach, including Sandbridge Beach, was authorized by Section 1(a) of the Water Resources Development Act of 1974 (Public Law 93-251, 93rd Congress, H.R. 10203, 7 March 1974). In March 1992, the U.S. Army Corps of Engineers (USACE) completed a Final Feasibility Report and Environmental Assessment (EA) for Sandbridge evaluating economic, engineering, and environmental concerns. Beach nourishment actually began in 1998, partially funded through a Special Service Tax District (SSD) where property owners pay an extra $0.06 property tax per $100 assessed property valuation for beach fill. The Sandbridge SSD funds, in addition to hotel taxes and other sources, go into a fund which provides the city's share of funding for long-term Federal beach restoration and maintenance projects (City of Virginia Beach, 2007); the Federal government contributes up 50% of the costs.

This EA was prepared by USACE, Norfolk District in cooperation with the U.S. Department of Interior, Minerals Management Service (MMS), to present the impacts that could potentially result from beach nourishment of the oceanfront at Sandbridge and the associated source of beach borrow material for continuing beach nourishment and hurricane protection. Several beach nourishment projects have been completed since original construction; the most recent USACE project concluded in October 2007. The MMS prepared supplemental EA's in 1997, 2001, and 2006 to support the extraction and use of Outer Continental Shelf (OCS) sand from Sandbridge Shoal. The MMS found no significant impacts for the three previous dredging cycles, provided that identified mitigation measures were implemented. The purpose of this (updated) EA is to evaluate whether the proposed action has the potential for creating significant impacts to the environment, and consider any changes to the affected environment that may have occurred since the original EA, and would thereby warrant a more detailed study on impacts, mitigation, and alternative courses of action. The original EA was prepared by USACE in 1992 and resulted in a Finding of No Significant Impact. The evaluations are based on Federal, State, and local statutory requirements and an assessment of USACE environmental, engineering, and economic regulations and criteria.

2.0 <u>NATIONAL ENVIRONMENTAL POLICY ACT of 1969 (NEPA) CONSIDERATION</u>

The NEPA and Title 40 of the Code of Federal Regulations, Parts 1500-1508 (40 CFR 1500-1508) require Federal agencies to consider the potential environmental consequences of proposed actions and alternatives. Executive Order (EO) 11514, Protection and Enhancement of Environmental Quality (amended by EO 11991), provides a policy directing the Federal government to take leadership in protecting and enhancing the environment.

The MMS has jurisdiction over mineral resources on the Federal Outer Continental Shelf (OCS). Public Law 103-426, enacted October 31, 1994, gave MMS the authority to convey, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for shore protection, beach or wetlands restoration projects, or for use in construction projects funded in whole or part or authorized by the Federal government. The USACE invited the MMS to participate as a cooperating agency pursuant to 40 CFR 1501.6. As a cooperating agency, the MMS participated in the scoping process and developed information and prepared environmental analyses for which MMS had special expertise. The MMS also participated in: the required Endangered Species Act (ESA) Section 7 consultation; the Magnuson-Stevens Fishery and Conservation Management Act Essential Fish Habitat consultation (Section 305); the National Historic Preservation Act (NHPA) Section 106 process; and the Coastal Zone Management Act Section 307 consistency process.

3.0 <u>PURPOSE AND NEED FOR THE PROPOSED ACTION</u>

The purpose of the proposed action is to provide protection from erosion induced damages including limited protection to the beach and to residential structures from storm damage. The Sandbridge oceanfront is vulnerable to direct wave attack during storms when greater than normal tide levels overtop the backshore. The city of Virginia Beach, in its April 2002 Beach Management Plan, identified Sandbridge Beach as "having extremely high erosion rates….and damage to private property and public infrastructure from storm events has occurred with increasing frequency and cost." Renourishment would reinforce the beach berm in anticipation of northeasters and hurricanes over the 50-year project life.

4.0 <u>DESCRIPTION OF THE PROPOSED ACTION</u>

The proposed action would involve beach nourishment at the Sandbridge oceanfront, an area approximately 5 miles long and 125 feet wide. The specific beach area covered extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north to Back Bay National Wildlife Refuge to the south (Figure 1). The project dimensions include a 50-foot wide berm at an elevation of 6 feet North American Vertical Datum (NGVD) with a foreshore slope of approximately 1:20 (one vertical value to 20 horizontal) for a distance of approximately 5 miles (Figure 2). The designated borrow area is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea (Figure 3). There are two selected borrow areas within Sandbridge Shoal, Area B to the north and Area A to the south; depths range from 30 to 65 feet. The area between the two borrow areas is off limits due to the presence of a buried Navy submarine communications cable. Beach quality sand would most likely be removed by trailing suction hopper dredge. The hopper dredge is equipped with dragheads and a hopper which collects sand. When the hopper is full, material is transported to a pump out buoy located offshore (Figure 4). The material would then be pumped through a discharge pipeline, which runs along the ocean floor, and up onto the beach where bulldozers and graders will distribute the material. Approximately 1.5 to 2.0 million cubic yards (cy) of beach quality sand would be placed on the beach approximately every 3 years depending upon weather conditions, availability of funding, and behavior of subsequently placed material at the project site. The cycle may occur less often, but probably no less than once every 5 years.

5.0 ALTERNATIVES TO THE PROPOSED ACTION

5.1 Structural and Non-structural. Alternatives that were presented, evaluated, and ultimately eliminated in the previous EA (prepared in 1992) and given consideration in this (updated) EA incorporated both structural and non-structural plans.

5.1.1 Hard Structure Alternatives. The structural plans included seawalls, offshore breakwaters, groins, and a combination of seawalls and raising the beach berm. A massive seawall would be effective in minimizing tidal flooding damage to structures behind the seawall; however, consideration was given to the proposed structure's effect on the fronting beach. If the beach were lost, the seawall would be vulnerable to wave attack. An offshore breakwater plan was evaluated in a previous district report and determined to be unfeasible because of cost; protecting the entire shoreline would require thousands of feet of massive breakwater. A system of groins could reduce erosion at the beach, although such a measure would not be compatible with the recreational uses at Sandbridge. A combination of seawall construction and raising the beach berm could provide for increased storm protection and an effective hurricane protection measure but was determined not to be cost effective for the entire project length.

5.1.2. Non-Structural Alternatives. The non-structural plans considered flood plain regulations, flood proofing and permanent evacuation, and forecasting warnings. The City of Virginia Beach has flood plain regulations that control the type and locations of development along the shoreline, which is an important measure to control and limit the potential for future damage. Flood proofing would not have any impact on the existing erosion problem, and permanent evacuation would not be acceptable to the local residents and is not economically justified. There is an evacuation route from Sandbridge and residents, tourists, and business proprietors receive warnings from the National Weather Service by radio and television on predicted storm events.

Neither one nor a combination of the alternatives discussed above provided an acceptable solution in terms of feasibility and/or economics, environmental, and technical concerns, to the existing beach erosion and hurricane protection needs. Thus, the structural and non-structural alternatives were eliminated from further consideration as a viable solution to coastal erosion and storm problems at Sandbridge Beach.

5.2 No Action Alternative. Implementation of the no action alternative would result in continued degradation and erosion of the oceanfront, which is exposed to high wave energy during storm events. The average erosion rate is estimated to range from about 250,000 cy to 350,000 cy per year. The highest erosion rates occur in the mid-part of the project area between Dam Neck and the fishing pier. An erosion rate over the 50-year planning period is expected to approximate that of the historical average (USACE, 1992). Both Category 1 and Category 2 storms have struck the Virginia Beach coastline from 1994 to 2004; thus, it is likely that over the next several decades more such storms can be anticipated. Although the occurrence of two storms, Category 1 or above, striking the coastline in a single season is rare, multiple northeasters striking the coastline in a single season is far more common and can result in significant beach erosion. Without a project, storms would continue to inflict expensive damages from erosion and storm surge along the oceanfront, and large portions of the beach would continue to be vulnerable. Therefore, the "no action" alternative was deemed unacceptable and not considered further.

6.0 AFFECTED ENVIRONMENT

6.1 Environmental Setting:

6.1.1 Climate. Virginia Beach is temperate with moderate seasonal changes. Winters are generally mild, and summers, though long and quite warm, are frequently tempered by cool periods resulting from winds off the Atlantic Ocean. The average annual temperature in the city is 60 degrees Fahrenheit. Average annual precipitation is 44.63 inches with even distribution throughout the year; average monthly amounts range from 5.74 inches in July to 2.62 inches in November. Droughts, when they occur, are more common in summer months. The Bermuda High, located in the North Atlantic’s subtropical gyre, produces southwesterly winds during summer with speeds of 2 to 3 meters (m) per second. In winter, that same system weakens and moves southwardly. The Icelandic Low system, located in southern Greenland, creates winds that move west to northwest with speeds averaging 3 to 5 m per second in winter.

Hurricanes, tropical storms, and northeasters occasionally occur within the project area. Hurricanes and tropical storms are less frequent and are seen only during the summer and fall months, as they are generated by air mass collision dynamics in the tropical latitudes. Northeasters can occur during any season, but normally occur during the winter, spring, and fall and are more numerous than hurricanes and tropical storms. All three are capable of causing expensive beach erosion and rapid seaward movement of beach sand.

6.1.2 Geology and Soils.

6.1.2.1 General Vicinity & Placement Site. Virginia Beach is a nearly flat city with an average elevation of 12 feet above sea level. In its former natural state, it was bisected by about a dozen creeks, bays, and inlets with fringe marshes and limited acreage of adjacent nontidal wetlands. In addition, the inland areas of Virginia Beach are comprised of a mosaic of hydric soils and nonhydric soils, with hydric predominating. The sandy loam soil of the city is fertile, and a variety of crops are still harvested in the southern half of the city. Potatoes, corn, wheat, soybeans, and fruit are common products. Large areas of hydric soil in the city currently used in agriculture and timber production are termed “mineral flats” because of their lack of relief, seasonal high water tables, and perched water tables. Some of these are jurisdictional wetlands. These mineral flats support corn cultivation. Soils in the Coastal Plain were developed from unconsolidated marine sediments. The texture of these soils is generally sandy silt from flood plain deposits, clayey silt on fluvial terraces, fine silty sand on higher marine terraces, and clayey silt from Coastal Plain peneplain. These soils are deep, but their drainage characteristics range from well-drained to poorly-drained. Wetness and poor drainage are prevalent in a number of locations in the region. Low-lying and upland soils are tidal marsh and manmade land (fill material).

The Geologic Map of the Virginia Beach quadrangle maps the beach segment of the project area as Holocene-age sand along the coast, with marshland and Pleistocene-age Kempsville Formation (Lynnhaven Member, near shore marine sand and clay) directly to the west of the project area (Oaks, 1974). Beaches consist mostly of sandy material deposited by wave action which is subjected to daily tidal flooding. Mean grain size at the placement site ranges between 0.25 mm and 0.35 mm. The average erosion rates for the Sandbridge shoreline range from 2 to10 feet per year.

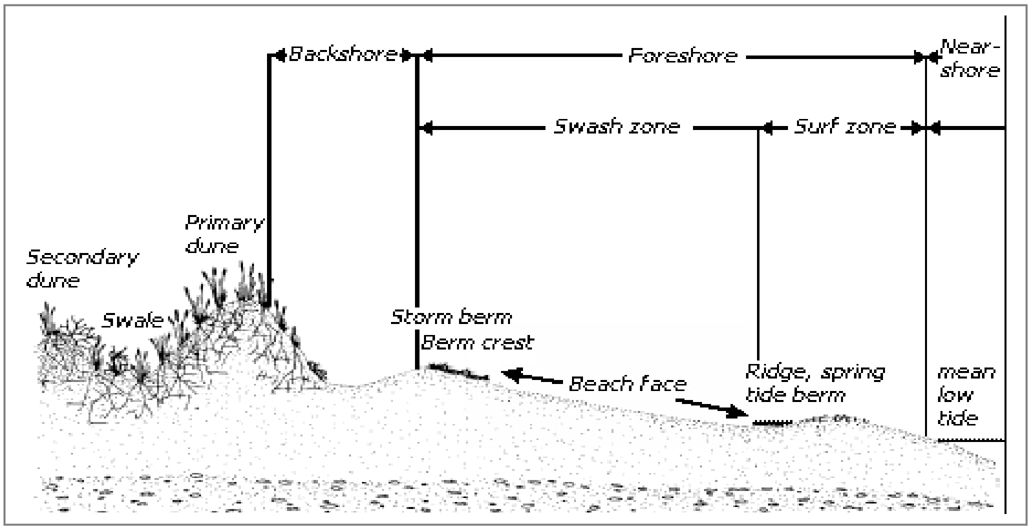
6.1.2.2 Borrow Area. Continental shelf topography offshore southeastern Virginia is dominated by ridge and swale features formed during the Holocene transgression. Many potential sand resource sites are associated with sand ridges and large shoal bodies approximately 20 km (approximately 12 miles) offshore Virginia Beach (known as the Virginia Beach Ridges) and seaward of False Cape (False Cape Ridges). Sandbridge Shoal has been identified as a high quality medium to coarse sand resource for beach nourishment along the southeastern Virginia coast, located 3 miles east of the north end of the project area (Figure 3). The horseshoe-shaped shoal is characterized as a northward and eastward thinning wedge of sand approximately 48 km^2 in area and up to 6 meters thick. Maximum relief over the ambient shelf surface is about 4 meters. The borrow area is estimated to be approximately 96 percent sand, 1.5 percent gravel, and about 2.5 percent fines (USACE, 1992). The grain size composition is compatible with the material on the existing beach and suitable as beach fill material.

6.1.3 Terrestrial Environment. Sandbridge is a barrier island separating the Atlantic Ocean from Back Bay, a shallow oligohaline bay. The bay-side is dominated by wetlands subject to irregular wind-tidal flooding along the shores that have been cut off from oceanic influences by the closure of inlets. The system is influenced by wind-driven currents and may produce as much as 1 m (3 ft) of variation in water levels and contribute to a salinity regime that fluctuates between completely fresh and salinity of about 5 ppt (VADCR, 2006). Vegetation consists of a mixture of freshwater species and few species more typical of mesohaline marshes. Patch-dominance of the tall marsh graminoids include big cordgrass (*Spartina cynosuroides*), bulrush (*Schoenoplectus tabernaemontani*), black needlerush (*Juncus roemerianus*), and cattails (*Typha angustifolia*). More locally distributed are patches of diverse short-statured marshes characterized by creeping spikerush (*Eleocharis fallax*), bull-tongue arrowhead (*Sagittaria lancifolia ssp. media*), pickerelweed (*Pontederia cordata*), and a large number of minor associates. Shallow, muck-filled pools within the marshes contain patches of American water-lily (*Nymphaea odorata ssp. odorata*). The marsh provides habitat for a diverse assortment of wildlife including snakes, otters, nutria, and waterfowl species such as geese, osprey, pelicans, herons, and swans.

Maritime forests occur on the leeward slope of bay-side dunes. This habitat is populated by a variety of plant species such as scrub pine (*Pinus virginiana*), live oak (*Quercus virginiana*), southern bayberry (*Morella cerifera*), greenbriers (*Smilax rotundifolia*), slash pine

(*Pinus elliottii*), and loblolly pine (*Pinus taeda*). Animals that inhabit the maritime forest include snakes, squirrels, opossums, skunk, rabbits, raccoon, and fox.

The dune and beach habitat is located ocean side of the barrier island and has distinct segments, as shown in the diagram below.



Typical Beach Profile (How Stuff Works, 2008)

The backshore is the region of a beach from the berm crest landward (to the foredune ridge, vegetation line, seawall etc.); it is typically beyond the reach of ordinary waves and tides but is influenced by wind. Common plant species include sea oat (*Uniola paniculata*), seaside goldenrod (*Solidago sempervirens*), and sea rocket (*Cakile edentula*). It is an area subject to harsh environmental and physical changes, including a wide temperature range, salinity fluctuations, and wave action that causes cycles of erosion and accretion. The beach surface presents a harsh environment as the temperature of the sand on a hot, sunny day may be extremely high, but less than an inch below the surface, the temperature is lower and more conducive to life. Thus, most permanent residents of the upper parts of the beach are burrowers and come out primarily at night (USACE, 1992). The upper beach, above mean high water, is generally dry except during storms. Storms can significantly modify the physical environment by eroding or accreting the upper beach and altering the beach animal communities. Resident species of the upper beach generally emerge from their burrows only at night; characteristic species are ghost crab (*Ocypode spp*.), sandfleas (*Talitridae*), hermit crab (*Pagurus sp.*), and sand fiddler crab (*Uca pugilator*). Many birds also use the beach for breeding, nesting, and feeding. Gulls (*Larus spp*.), sanderlings (*Crocethia alba*), fish crows (*Corvus ossifragus*), and grackles (*Quiscalus quiscula*) are the most noticeable bird species in this community.

The foreshore is the sloping portion of the beach between the limits of high tide and low tide swash which includes the entire intertidal (beach face and low tide terrace) area affected by swash and backwash. The beach face is commonly separated by a plunge step, a small trough filled with coarse sand or shells from by the breaking of small plunging waves at the base of the beach face. The foreshore is the zone that is submerged at high tide and exposed at low tide.

The nearshore is seaward of the foreshore and is submerged even at low tide. Residents of the lower beach, below mean high water, includes annelid worms, clams (*Donax spp*.), and mole crabs (*Emerita spp*.). These invertebrate species provide important ecological functions in coastal environments including cycling of organic matter and nutrition and transfer of both primary and secondary production to surf zone fishes and shore birds. As in most harsh environments, the fauna and flora are limited in number of species, often in number of individuals, and the inhabitants include many examples of extreme adaptation to a specialized way of life. Animals that live in shifting sands on marine beaches are well adapted and tolerate environmental extremes in order to feed, burrow, and reproduce.

6.1.4 Physical Oceanography. The currents of the Virginia shelf have been discussed in detail in Harrison et al. (1964), Ludwick (1978), Wright et al. (1987), Valle-Levinson and Lwiza (1998), Marmorino et al. (1999), and Lentz (2008). The driving forces include wind stress, pressure gradients, and tides (Valle-Levinson and Lwiza, 1998; Epifanio and Garvine, 2001). The relative importance of each varies by season, tidal cycle, and meteorological conditions, but mean flows over the shoreface and inner shelf are largely driven by north-northeast winds and are generally southward and along-isobath (Beardsley and Boicourt, 1981; Xu and Wright, 1998; Lentz, 2008). Mean cross-shore flows are generally onshore reflecting upwelling conditions (Byrnes et al., 2003). Northeasters and extratropical storms contribute to severe waves, strong wind-driven along-shelf flows, and enhanced, but comparatively small, across-shelf flows (Wright et al., 1991; Xu and Wright, 1998). Net and gross sediment transport is expected in the along-shelf direction. Strong wind/wave events may enhance near-bottom flows and promote offshore transport of entrained sediment. Waves, wave-induced currents, and tidal currents exert increasing influence in the surf zone and reverse the direction of net sediment transport.

The mean tidal range is approximately 1 m (3.3 ft), with a maximum spring range less than 1.5 m (5 ft). The semidiurnal tidal constituent dominates tidal forcing, and the tidal phase propagates northward along the Outer Banks, North Carolina. Off southeastern Virginia, semidiurnal tidal ellipses are strongly oriented northwest-southeast with velocities increasing shoreward, reflecting the funneling effect of the Chesapeake Bay mouth (Valle-Levinson and Lwiza, 1998). With increasing distance south of the tidally-influenced bay outflow, tidal forcing grows increasingly less important in along-shelf and cross-shelf processes (Byrnes et al., 2003). During storm conditions, coupling of wind-generated mean flows and wave orbital velocities overshadow tidal currents. Subtidal circulation responds to synoptic-scale winds, which last for 2 to 10 days and are typically associated with large-scale weather patterns. These events typically lead to strong downwelling, contributing to a southward subtidal flow (Kim et al., 1997; Marmorino et al., 1999). Surface circulation and water mass properties along southeast Virginia are dependent on outflow from the Chesapeake Bay (Beardsley and Boicourt, 1981; Lentz and Langier, 2006). Under the influence of downwelling winds or northeasterly winds blowing onshore, the buoyant discharge, dominated by tidal and wind forcing, from the Chesapeake Bay is generally restricted to a narrow band along the coast (Valle-Levinson and Lwiza, 1998). North-northeast winds enhance the buoyant plume flowing out of the Chesapeake Bay and favor seaward, cross-shore, near-bottom flow (Xu and Wright, 1998).

The mean annual significant wave height offshore Virginia Beach is approximately 1 m (Hobbs et al., 2006); winter significant wave heights average 1.2 m, whereas summer wave heights average 0.7 m. The most frequently-occurring waves propagate from the south-

southeast, but the largest waves are generally from the east-northeast (Dolan et al., 1988). Waves approaching during the fall and winter are primarily from the northeast, compared to east and southeast directions for spring and summer. Komar and Allan (2008) have recently reported a progressive increase in summer wave heights since the mid-1970s and attributed that change to intensification and increased frequency of hurricanes, which are most important to wave generation in summer months. In contrast, waves measured during the winter, generated largely by northeasters, have not experienced a statistically significant change.

Maa and Hobbs (1998) demonstrate strong wave convergence near Sandbridge Beach for all wave propagation directions because of refraction induced by the Sandbridge Shoal complex. A regional maximum in long-term shoreline erosion rates coincides with the zone of regionally high breaking-wave heights along Sandbridge Beach (Wright et al., 1987; Maa and Hobbs, 1998). Net annual sediment flux in the surf zone is northward, contrasting transport on the inner shelf (Wright et al., 1987; Kelley et al., 2001a). A nodal point, or zone of divergence in long-shore sediment transport, occurs immediately south of Sandbridge Beach (Hobbs et al., 1999). These phenomena contribute to long-term retreat rates of 3.5 m/yr at the southern end of Sandbridge, compared to 1.1 m/yr at the northern end (Hobbs et al., 1999; Kelley et al., 2001b).

6.1.5 Noise. Noise levels in the area are typical of recreational and beach activities. Noise levels fluctuate with the highest levels usually occurring during the spring and summer months due to increased tourism, boating, vessel traffic, military activity, fishing, and coastal activities. The project vicinity does not encompass any noise-sensitive institutions, structures, or facilities such as churches, parks, or hospitals. Noise from the dredge equipment and other job-related equipment would increase during the proposed operations in the project vicinity.

In recent years concerns have been raised regarding underwater noise of anthropogenic origin and potential impacts on aquatic organisms. Hypothetically, underwater sounds may interrupt or impair communication, foraging, migratory, and other behaviors of aquatic organisms. To obtain data to address this concern, field investigations were undertaken to characterize underwater sounds typical of bucket, hydraulic cutterhead, and hopper dredging operations (Dickerson, et al., 2001). Preliminary findings were that cutterhead dredging operations are relatively quiet as compared to other sound sources in aquatic environments. Hopper dredges produce somewhat more intense sounds similar to those generated by vessels of comparable size and bucket dredging sounds represent a more complex spectrum of sounds, very different than either cutterhead or hopper dredges. A trailing suction hopper dredge would most likely be utilized for this project. Hopper dredge noise consist of a combination of sounds emitted from two relatively continuous sources: engine and propeller noise similar to that of large commercial vessels, and sounds of dragheads moving in contact with the substrate. The intensity, periodicity, and spectra of emitted sounds differ greatly among dredge types. Components of underwater sounds produced by each type are influenced by a host of factors including substrate type, geomorphology of the waterway, site-specific hydrodynamic conditions, equipment maintenance status, and skill of the dredge plant operator (Dickerson, et al., 2001).

6.1.6 Hazardous Material. The VDEQ Waste Division has furnished the following inventories of generators and sites of Hazardous, Toxic, and Radioactive Wastes (HTRW) within the project area:

1) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Information System. This database lists potential hazardous release sites under the Superfund Program.
2) Resource Conservation and Recovery Information System (RCRIS). This is an inventory of hazardous waste handlers.
3) Toxics Release Inventory. This is an information system about toxic chemicals that are being used, manufactured, treated, transported, or released into the environment.
4) Solid Waste Facilities Inventory. This is an information system about large facilities for the storage and handling of solid waste, whether transported or left in place.

No CERCLA sites are located within 4 miles of the project area. One RCRIS generator at False Cape State Park is located within four miles of the project area. No generators or handlers of HTRW are located within the project area. A review of the listed solid waste management facilities indicated there are no facilities near the project area that would impact or be impacted by the project.

During an archaeological remote sensing survey conducted in 2007, it was determined the borrow area (Sandbridge Shoal) had high potential for other materials, such as ordnance, because the shoal was within an area designated as a range for coastal ordnance training and military weapons experiments (Watts, 2007). Historical records confirmed those activities associated with the operations at the Fleet Combat Training Center at Dam Neck, located just north of Sandbridge. Since small caliber unexploded ordnance (UXO) may be encountered in the borrow areas during dredging operations, 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 hopper and/or being subsequently placed on the beach.

6.1.7 Water Quality.

6.1.7.1 Placement Site. The state waters immediately seaward of the nourishment site extending offshore towards the 3-mile limit of the borrow site are considered Class I Special Standard a Open Ocean waters (9 VAC 25-260-520). This classification pertains to waters generally used for public or municipal water supplies, primary contact recreations, fishing, or other beneficial uses (MMS, 1997). Under this classification, the requirements for minimum dissolved oxygen are 5.0 mg/l, pH range of 6.0 to 9.0, and any rise above natural temperature shall not exceed 3 degrees Celsius. The special standard sets fecal coliform standards for shellfishing waters (9 VAC 25-260-310). The City of Virginia Beach monitors waters off Sandbridge Beach for bacteria during spring and summer months; no exceedances have been documented between 2004 and 2008. Turbidity is the main water quality parameter expected to be affected by placement operations. The Nephelometric Turbidity Unit (NTU) is the legal standard for measuring turbidity, which is defined as a decrease in water clarity due to fine silt and clay particles in suspension.

6.1.7.2 Borrow Area. The borrow area at Sandbridge Shoal is located 3 nautical miles from the shoreline, outside of Virginia's territorial sea, and is considered Class I Open Ocean. Substrate at the Sandbridge Shoal is "clean sand" characterized as medium grained (mean grain size of 0.2 mm) with little silt or clay content (MMS, 1997).

6.1.8 Air Quality. Concentrations of air pollutants in the Sandbridge Beach area, except ozone, are within the national ambient air quality standards (NAAQS). The Norfolk-Virginia Beach-Newport News-Hampton Roads area is classified marginal nonattainment with respect to the 8-hour ozone standard (April 30, 2004 Federal Register). The nonattainment designation was based on ozone data collected in the 2001-2003 monitoring period. On March 12, 2008 the EPA promulgated a more stringent standard for ozone. The new standard for the 8-hour average ozone concentration is 0.075 parts per million (ppm). The EPA is required to make a decision on classifications by March 2010. Based on the measurements collected for the years 2006 through 2008, ozone concentrations in the proposed project area exceed the revised standard (ambient air quality data for Virginia obtained from http://www.epa.gov/air/data/geosel.html). The Virginia Air Pollution Control Board general conformity regulations (9 VAC 5-160) require a Federal agency to prepare conformity determination if the total of direct and indirect emissions from a Federal action in an ozone nonattainment or maintenance area exceeds 100 tons per year of nitrogen oxides (NOx) or volatile organic compounds (VOC) (http://www.deq.virginia.gov/air/regulations/airregs.html).

Air emissions associated with the proposed action would result from operation of the dredge pumps and coupled pump-out equipment, the dredge propulsion engines, and the tugs and barges used in the placement and relocation of the mooring buoys. In addition, air emissions would result from bulldozers used on the beach in the construction of the berm and from trucks used in supporting operations.

6.2 Coastal and Aquatic Resources:

6.2.1 Benthos, Motile Invertebrates, and Fishes.

6.2.1.1 Placement Site. High-energy beaches along the U.S. Atlantic coast are dominated by two types of infaunal assemblages: small interstitial organisms and large mobile organisms. Interstitial organisms are usually more abundant while larger organisms constitute a greater proportion of the biomass. The distribution of beach infauna is dependent on several physical factors, including wave energy, tidal range, sediment texture, and morphological features of the beach, such as cusps and horns. Intertidal infauna are usually highest in both abundance and biomass in the summer, and lowest during mid-winter. Biological abundance is seasonal, with the maximum achieved in the summer and the minimum in the winter, throughout the surf zone in the southeast. Species composition varies within different areas of the beach, with less species diversity occurring in the upper beach zone. The following types of organisms are typically found along sandy beaches in their respective zones: 1) upper beach - burrowing organisms such as talitrid amphipods (sand fleas), ocypodid crabs, and isopods; and transient animals, such as scavenger beetles; 2) midlittoral zone - polychaetes, isopods, and haustoriid amphipods; and interstitial organisms that feed on bacteria and unicellular algae among the sand grains; 3) swash zone - polychaete worms, coquina clams, and mole crabs; and 4) surf zone -

shellfish, forage fish, and predatory birds; offshore migrating predators are most common in this zone. (ASMFC, 2002)

6.2.1.2 Borrow Area. In the spring and fall seasons of 1996 and 1997, Virginia Institute of Marine Science (VIMS) conducted benthic and biological resource sampling off the Virginia coast including the Sandbrige Shoal area (Cutter & Diaz, 1998). Sediment types in the study region were primarily sands from -1 to 4 mesh diameter (phi), though some fine sands of 2 to 3 (phi) were also common. Muds were prevalent in the northwestern part of the study area and in patches throughout the region. Muds were typically silt to clayey silt. The spring 1997 sampling grid did not encounter as many silty sediment patches as did the 1996 sampling. A total of 119 species were identified from 13 of the grab samples, and half of the top 14 species in terms of occurrence and abundance were polychaetes (i.e. bristle worms). The other half consisted of only one representative each from the amphipods (scud, shrimp-like species), bivalves (i.e. scallops & clams), nemerteans (i.e. ribbon worms), echinoderms (i.e. sea stars), chordates (i.e. fishes), decapods (larger crustaceans such as shrimp, lobster, & crab), and tanaids (tiny crustaceans). The fall 1997 sampling revealed a similar pattern of benthic composition. In fall, annelid biomass production fell off during both sampling years, likely due to post settlement seasonal growth and mortality of macrofauna. The size distribution of the benthos, both biomass and number of individuals, is a very important limiting factor in determining potential food resources available to bottom-feeding fish and crabs and are data used in calculating secondary production. Crustacean production was low throughout the study area for all seasons, though relatively higher in the northwest sample grid and at one site in the study area off Sandbridge. Overall, the community composition within the study area was typical for sandy shallow continental shelf habitats, with annelids being the dominant taxonomic group in numbers, biomass, and trophic distribution. Generally, benthos of the Mid-Atlantic continental shelf increase in species diversity and densities with increased depth along the shelf. A larger number of species and higher densities are typically found in the depressions between small sand waves and larger ridges and swales where finer sediments with high organic content deposit. The inner shelf undergoes wide yearly fluctuations in water temperature and is affected by wave action, which creates a more rigorous and stressful environment where fewer species live than the central or outer continental shelf.

From 2002 to 2005, VIMS implemented a rigorous field program that focused on possible biological impacts from ongoing dredging of Sandbridge Shoal (Diaz et al., 2006). Results from that field campaign were compared to earlier benthic assessments (Cutter and Diaz, 1998). During survey periods in 2002, 2004, and 2005, physical processes were predominant in structuring sediment surfaces for all sampling stations in all years. Observations in 1996 and 1997 showed more biologically dominated habitats with increasing distance off shoal. Diaz et al. (2006) have attributed some of the spatial and temporal heterogeneity to 1) energetic storms which expose and rework surface sediments, 2) infrequent, but significant benthic recruitment events, and 3) seasonal variability. The benthic community composition on Sandbridge Shoal for 1996-1997 and 2002-2005 periods was similar. Cutter and Diaz (1998) found polychaetes, amphipods, decapods, bivalves, sand dollars, and lancelets (primitive animals) to be the dominant groups. Diaz et al. (2006) found the most abundant benthic group during 2002-2005 monitoring was polychaetes. Other benthic species observed included amphiods, bivalves, lancelets, and to a lesser extent, decapods, nemerteans, echinoderms, anemonies (sea anemone), isopods (crustaceans related to shrimp and crabs), gastropods, phoronids (i.e. horseshoe worms), and tunicates (primitive animals). Diaz et al. (2006) and Cutter and Diaz (1998) observed that macrobenthic production was higher off shoal relative to on shoal. The average macrofaunal abundance in 1996 and 1997 was 1½ to 2½ times lower than 2002 to 2005 conditions.

In providing support data to the (Supplement) Final Environmental Impact Statement-Virginia Beach Erosion Control and Hurricane Protection Project, the U.S. Fish and Wildlife Service conducted a benthic sampling program for nearshore habitat of Virginia Beach (USACE, 1994). In total, 40 benthic samples were taken at eight stations. The most abundant forms (in descending order) were polychaete worms, bivalve mollusks and amphipod crustaceans. Densities of macrobenthic organisms generally ranged between 3,400 and 7,400 individuals per square meter. In a few stations, the polychates (*Cirratulidae spp.*) were particularly abundant, and densities were even greater, with a peak value of 19,800. Three trawl stations occupied during the course of this study showed the dominant epibenthos were blue mussel (*Mytilus edulis*), common squid (*Loligo pealei*), hermit crab (*Paragus longicarpus*), windowpane flounder (*Scopthalmus aquosus*) and spotted hake (*Urophycis regia*). The blue crab (*Callinectes sapidus*) was poorly represented in the trawl data.

Some common invertebrates found in Mid-Atlantic waters are brown shrimp (*Panaeus aztecus*), pink shrimp (*P. duorarum*), white shrimp (*P. setiferus*), horseshoe crab (*Limulus polyphemus*), sea nettle (*Chrysaora quinquecirrha*), and sea star (*Asterias forbesi*). Common vertebrate species include Atlantic bottlenose dolphins (*Tursiops truncates*), sandbar sharks (*Carcharhinus plumbeus*), Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*), and common fish species include the bluefish (*Pomatomus saltatrix*), windowpane flounder (*Scopthalmus aquosus*), summer flounder (*Paralicthys dentatus*), scup (*Stenotomus chrysops*), Atlantic sea herring (*Clupea harengus*), black sea bass (*Centropristus striata*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), cobia (*Rachycentron canadum*), red drum (*Sciaenops occelatus*), red hake (*Urophycis chuss*), yellowfin tuna (*Thunnus albacares*) sea robins (*Prionotus carolinus*), butterfish (*Peprilus triacanthus*), and pinfish (*Lagodon rhomboids*).

During the 2002-2005 monitoring, 1,600 fishes and skates, representing 12 taxa, and 1,000 invertebrates, representing 12 taxa, were collected on Sandbridge Shoal. The most common fishes were sea robins, accounting for 32% of all fishes. Spotted hake was the second most abundant and accounted for 26% of the fishes, even though it did not occur in any trawl in 2002. Butterfish were 16% of the fishes, even though it did not occur in 2002. Pinfish and smallmouth flounder were 16% and 6% of the fishes, respectively. The trawls also collected hermit crabs (*Pagurus* spp.), sand shrimp (*Crangon septemspinosa*), Atlantic brief squid (*Lolliguncula brevis*), and Atlantic bobtail squid (*Rossia* sp.). For the most abundant fishes, there were no differences in habitat utilization, but fishes generally showed broad preference for sandy habitat. The food web in the vicinity of Sandbridge Shoal was generally limited to two trophic levels beyond the primary producers; primary consumers, such as bivalves and amphipods, supported secondary consumers and demersal fish at the third trophic level. Top level species were spotted hake and weakfish.

6.2.2 Submerged Aquatic Vegetation. No submerged aquatic vegetation is present within or near any of the potential borrow areas or offshore of the proposed nourishment area. The proposed borrow areas are too deep and not within the photic zone. No submerged aquatic vegetation subsists in the beach sands of the proposed nourishment area due to the high energy of the waves and the extremes of temperature, availability of water, and fluctuations in salinity.

6.2.3 Essential Fish Habitat. Essential Fish Habitat (EFH) is defined in the Magnuson-Stevens Fishery Conservation and Management Act as…"those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity." The designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities. The 1996 amendments to the Magnuson-Stevens Fishery Management and Conservation Act require Federal agencies to consult with the National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH. The project area includes the waters of Sandbridge Shoal and ocean shore of Sandbridge Beach.

Under provisions of the reauthorized Magnuson-Stevens Fishery Conservation and Management Act of 1996, the following species were designated as having a Fishery Management Plan: windowpane flounder (*Scopthalmus aquosus*), bluefish (*Pomatomus saltatrix*), Atlantic butterfish (*Peprilus triacanthus*), summer flounder (*Paralicthys dentatus*), witch flounder (*Glyptocephalus cynoglossus*), scup (*Stenotomus chrysops*), Atlantic sea herring (*Clupea harengus*), surfclam (*Spisula solidissima*), black sea bass (*Centropristis striata*), monkfish (*Lophius americanus*), spiny dogfish (*Squalus acanthias*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), cobia (*Rachycentron canadum*), red drum (*Sciaenops occelatus*), red hake (*Urophycis chuss*), sand tiger shark (*Charcharias taurus*), Atlantic sharpnose shark (*Rhizoprinodon terraenovae*), dusky shark (*Charcharinus obscurus*), sandbar shark (*Charcharinus plumbeus*), scalloped hammerhead shark (*Spyrna lewini*), tiger shark (*Galeocerdo cuvieri*), clearnose skate (*Raja eglanteria*), little skate (*Raja erinacea*), and winter skate (*Raja ocellata*) (NMFS, 2006). Those bottom habitats with mud, gravel, and sand substrate that occur within the project area are designated as EFH for the clearnose skate. Those bottom habitats with soft bottom, rocky, or gravelly substrates that occur within the project area are designated as EFH for the little skate. For the winter skate, those bottom habitats with a substrate of sand and gravel or mud that occur within the project area are designated as EFH. The NMFS designated a "habitat area of particular concern" (HAPC) for the sandbar shark but not for any other Atlantic highly migratory species (HMS) due to a general lack of scientific information detailing HMS-habitat associations. There are no management or fisheries restrictions in place in or around the project area at this time. A detailed discussion and assessment of impacts to EFH for the above species are included in Appendix B of this document.

6.2.4 Threatened and Endangered Species. Preliminary review of this action identified species on the Department of Commerce, National Marine Fisheries Service (NMFS) and the Department of the Interior, U.S. Fish and Wildlife Service (USFWS) List of Threatened and Endangered Wildlife and Plants in Virginia. The following list identifies the Federally listed species that may occur along the Atlantic Coast of southern Virginia:

E - Listed Endangered T- Listed Threatened
(Last Updated: October 7, 2008 - U.S. Fish and Wildlife Service, Virginia Field Office)

<ins>Whales</ins>
E- Blue whale (*Balaenoptera musculus)*

E- Finback whale (*Balaenoptera physalus)*
E- Humpback whale (*Megaptera novaengliae)*
E- Right whale (*Eubalaena glacialis)*
E- Sei whale (*Balaenoptera boreal*is)
E- Sperm whale (*Physeter macrocephalus)*

Birds
T- Piping plover (*Charadrius melodus)*
E- Roseate tern (*Sterna dougallii dougallii)*

Fish
E- Shortnose sturgeon (*Acipenser brevirostrum)*

Turtles
T- Loggerhead sea turtle (*Caretta caretta)*
T- Green sea turtle (*Chelonia mydas)*
E- Leatherback sea turtle (*Dermochelys coriacea)*
E- Hawksbill sea turtle (*Eretmochelys imbricate*)
E- Kemp's ridley sea turtle (*Lepidochelys kempii)*

Plants
T- Seabeach amaranth (*Amaranthus pumilus)*

Insects
T- Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*)

Of the listed species, only the sea turtles, piping plover, roseate tern, right whale, humpback whale, and finback whale may be potentially affected by this action. The blue whale, sei whale, sperm whale, seabeach amaranth, and northeastern beach tiger beetle are highly unlikely to occur within the project area. A review of the listed shortnose sturgeon indicated a low likelihood of occurrence within the project area; however, since its habitat range (historically) is within a proximate distance, continued consideration by this document was warranted.

Blue whales are rare in the shelf waters of the eastern United States. Occasional sightings of individuals have been made off Cape Cod, Massachusetts, in summer and fall. Farther north in Canadian waters, a few sightings have been made on the Scotian Shelf, and two blue whales were sighted in August 1995 in the lower Bay of Fundy. A stranding at Ocean City, Maryland, in October 1891 is the southernmost confirmed record on the east coast (NMFS, 1998).

Sei whales prefer subtropical to subpolar waters on the continental shelf edge and slope worldwide; they are usually observed in deeper waters of oceanic areas far from the coastline (Waring, 2007). The entire distribution and movement patterns of this species is not well known. They are believed to undertake seasonal north/south migrations; spending the summer on feeding grounds in the higher latitudes and winter in lower latitudes where they most likely breed or calve.

Sperm whales tend to inhabit areas with a water depth of 1,968 feet (600 m) or more, and are uncommon in waters less than 984 feet (300 m) deep. Female sperm whales are generally found in deep waters (at least 3280 feet, or 1000 m) of low latitudes (less than 40°, except in the North Pacific where they are found as high as 50°). These conditions generally correspond to sea surface temperatures greater than 15°C, and while female sperm whales are sometimes seen near oceanic islands, they are typically far from land (NMFS, 2006).

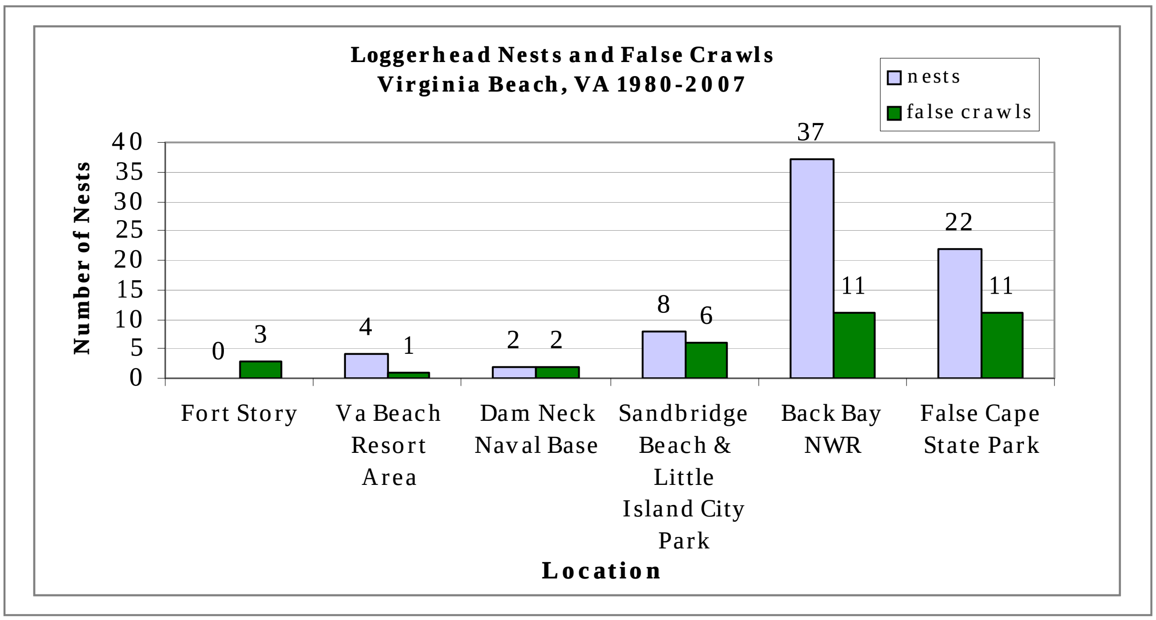
At one time, seabeach amaranth thrived in coastal environments from Massachusetts to South Carolina. A review of the species indicated it has been reduced to about one-third of historical distribution, found only on a few protected undeveloped beaches. It is thought to no longer occur, or very rarely to occur, on beaches in Massachusetts, Rhode Island, New Jersey, Delaware, most of Maryland, and Virginia. Therefore, seabeach amaranth was not assessed further by this document.

Historically, the northeastern beach tiger beetle was common on coastal beaches from Massachusetts to central New Jersey, and along the Chesapeake Bay in Maryland and Virginia. Currently, the only populations known to exist along the Atlantic Coast are in New Jersey and southeastern Massachusetts; the majority of populations occur along the Chesapeake Bay in Maryland and Virginia (USFWS, 1999). Virginia populations are distributed along the eastern and western shorelines of Chesapeake Bay (more than 60 miles from Sandbridge Beach).

Loggerhead sea turtle (*Caretta caretta).* Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Gulf of Mexico, Pacific, and Indian Oceans. This species may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, and the mouths of large rivers. As loggerheads mature, they travel and forage through near shore waters until their breeding season, when they return to the nesting beach areas. This species nests within the U.S. from Texas to Virginia, although the major nesting concentrations are found along the Atlantic coast of Florida, Georgia, South Carolina, and North Carolina. The loggerhead sea turtle nests in small numbers along Virginia's coast and is the only predominant species recurrently nesting along the Virginia Beach coastline (Dodd, 1998). The northern extent of its nesting range in the United States is along the Virginia/Maryland border. Loggerhead females generally nest every 2 to 4 years, and lay from 1 to 6 clutches of eggs a season. The re-nesting interval varies from 12 to 16 days, with an average of 14 days (NMFS, 1991). Sea turtles return to the same area to lay successive clutches of eggs that are usually within a 5 km radius of the first nest. Thus, the discovery of one nest may mean that others will soon follow. It is unlikely that loggerheads will be spotted until the ocean temperature reaches 74º F; they are usually found in Virginia's waters from May through November. Because of the movement of individual loggerhead sea turtles, it is difficult to estimate the population of this species in U.S. and territorial waters, although numbers of nesting females give a useful index of the species' population size and stability at this life state. Unfortunately, population trends analysis based upon this method may not reflect overall population growth rates, since a female may lay multiple nests in any one season.

Occasionally, a nesting turtle may emerge from the ocean but not lay eggs on the beach. This event, characterized by an abandoned nesting attempt or simply a U-shaped crawl from the ocean up the beach, then back to the water, is called a false crawl. A turtle may false crawl for a number of reasons, some of which include; being disturbed by lights or noise; encountering obstacles; encountering roots, debris, or rocks while digging her egg chamber; and sand not having the right consistency or moisture. A turtle may false crawl at any point in her nesting sequence up to the point where her eggs are laid. A turtle may even complete her egg chamber and for some reason not deposit her eggs. The key factor that indicates whether a turtle has laid her eggs or not is the presence or absence of a mound of sand and the escarpment created when the turtle flings the sand back over her nest site. A turtle will not obliterate her nest site if she has not deposited eggs (VIMS, 2008).

Since 1980, the USFWS, volunteers and staff at Back Bay National Wildlife Refuge have surveyed the Virginia Beach coastline throughout sea turtle nesting season; map of the areas patrolled daily is shown on Figure 5. The chart below represents nests and false crawls located at the sections of beach surveyed.



A total of 73 nests were recorded in Virginia Beach over the 27-year summary period. The overall hatch success rate was 76% (does not include 3 nests lost to Hurricane Isabel). Sandbridge Beaches accounted for 11% of the nesting sites, Virginia Beach Resort (and Croatan) beaches 5% of the nesting sites, Dam Neck Naval Base 3% of the nesting sites, and none were recorded at Fort Story. The majority (81%) of the nesting sites occurred at Back Bay and at False Cape State Park, the longest contiguous tract of undeveloped shoreline in the city. For various reasons, including water temperature, this area has been chosen by the loggerheads as the most suitable nesting site. Another of the likely reasons is the learned behavior of the turtles relocated to Back Bay from more northern nesting sites by USFWS Back Bay National Wildlife Refuge staff as part of the Loggerhead Egg Transplant Project. Back Bay and False Cape State Park have become the familiar land-based sites for these turtles to return to as adults.

Green sea turtle (*Chelonia mydas).* The green turtle was listed under the Endangered Species Act (ESA) on July 28, 1978. The breeding populations in Florida and the Pacific coast of Mexico are listed as endangered; elsewhere the species is listed as threatened. Green sea turtles are found worldwide, although this species is concentrated primarily between the 35° North and 35° South latitudes. In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from Texas to Massachusetts, the U.S. Virgin Islands, and Puerto Rico (NMFS, 1991). Green sea turtles tend to occur in waters that remain warmer than 68° F. Adult green turtles are unique among sea turtles in that they are herbivorous, feeding primarily on seagrasses and algae. This diet is thought to give them greenish colored fat, from which they take their name. A green turtle's carapace (top shell) is smooth and can be shades of black, gray, green, brown, and yellow. Their plastron (bottom shell) is yellowish white. This species migrates often over long distances between feeding and nesting areas. Mid-Atlantic Green turtle population estimates are derived from the major nesting beaches for this species along the Atlantic coast of Florida with some usage of the beaches of the panhandle. Until the nesting season of 2005, there had been no documented nest sites for this species north of North Carolina. The first documented green turtle nest site north of North Carolina was discovered on August 1, 2005, by a passer-by on the beach south of Sandbridge, several miles south from the project site. Biologists at Back Bay National Wildlife Refuge confirmed that 124 eggs were successfully laid by a green turtle as observers monitored the egg laying. The eggs were immediately transplanted to a secured site on the refuge (Glass, 2005).

Leatherback sea turtle (*Dermochelys coriacea).* The leatherback is the largest turtle and the largest living reptile in the world. Mature males and females can be as long as six and a half feet (2 m) and weigh almost 2,000 lbs. (900 kg). The leatherback is the only sea turtle that lacks a hard, bony shell. A leatherback's carapace is approximately 1.5 inches (4 cm) thick and consists of leathery, oil saturated connective tissue overlying loosely interlocking dermal bones (NMFS, 1992). Leatherbacks are the most migratory and wide ranging of sea turtle species. In the Atlantic, their range extends from Cape Sable, Nova Scotia, south to Puerto Rico and the U.S. Virgin Islands. Leatherbacks are found in temperate waters while migrating to tropical waters to nest. Distribution of this species has been linked to thermal preference and seasonal fluctuations in the Gulf Stream and other warm water features (Fritts, 1983). Nesting of Leatherback sea turtles is nocturnal with only a small number of nests occurring in the United States in the Gulf of Mexico (Florida) from April to late July. Leatherbacks prefer open access beaches possibly to avoid damage to their soft plastron and flippers. Unfortunately, such open beaches with little shoreline protection are vulnerable to beach erosion triggered by seasonal changes in wind and wave direction. Thus, eggs may be lost when open beaches undergo severe and dramatic erosion. The Pacific coast of Mexico supports the world’s largest known concentration of nesting Leatherbacks. There is very little nesting in the United States. Nest counts are the only reliable source of population data for leatherback turtles. The adults of the species are found in low numbers in the lower Chesapeake Bay during summer. Leatherbacks do not nest on any Virginia coast beaches.

Hawksbill sea turtle (*Eretmochelys imbricate).* Hawksbill turtle population estimates are derived from beach nest sites in the Virgin Islands and Puerto Rico. The hawksbill turtle's status in the United States has not changed since it was listed as endangered in 1970. It is small to medium-sized compared to other sea turtle species. Adults weigh 100-150 lbs (45 to 68 kg) on average, but can grow as large as 200 lbs (NMFS, 1993). It is a solitary nester, so population trends or estimates are difficult to determine. The most significant nesting within the U.S. occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and Buck Island, respectively. Each year, about 500-1000 hawksbill nests are laid on Mona Island, Puerto Rico, and another 100-150 nests on Buck Island Reef National Monument off St. Croix in the U.S. Virgin Islands. Within the continental U.S., nesting is restricted to the southeast coast of Florida and the Florida Keys, but nesting is rare in these areas. In addition to nesting beaches in the U.S. Caribbean, hawksbills nest at numerous other sites throughout the Caribbean, with the majority of nesting occurring in Mexico and Cuba. The largest nesting population of hawksbills appears to occur in Australia. Approximately 2,000 hawksbills nest on the northwest coast of Australia and about 6,000 to 8,000 off the Great Barrier Reef each year. Although the species is an occasional visitor to the Mid-Atlantic region, hawksbill sightings are very rare on Virginia beaches (Williams et al, 2000). The NMFS contractor observer program (50 CFR' 229.7(c)) has not recorded any takes in northeast or Mid-Atlantic fisheries.

Kemp's ridley sea turtle (*Lepidochelys kempii).* Adult Kemp's ridleys, considered the smallest marine turtle in the world, weigh on average around 100 pounds (45 kg) with a carapace (top shell) measuring between 24-28 inches (60-70 cm) in length. They are the most endangered of all sea turtles, listed in the United States as endangered throughout its range in 1970. Kemp’s ridley sea turtle population estimates are derived from the only major nesting site for the species, a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico. The number of nests observed here is increasing at a mean rate of 11.3 percent per year since 1966, allowing some optimism about the possible recovery of the most endangered sea turtle species. Similar to olive ridleys, Kemp's ridleys display one of the most unique synchronized nesting habits in the natural world. Large groups of Kemp's ridleys gather off a particular nesting beach near Rancho Nuevo, Mexico, in the state of Tamaulipas. Wave upon wave of females come ashore and nest in what is known as an "arribada," which means "arrival" in Spanish (NMFS, 1992). There are many theories on what triggers an arribada, including offshore winds, lunar cycles, and the release of pheromones by females. Scientists have yet to conclusively determine the cues for ridley arribadas. Arribada nesting is a behavior found only in the genus Lepidochelys. Female Kemp's ridleys nest from May to July, laying two to three clutches of approximately 100 eggs, which incubate for 50-60 days.

Piping plover (*Charadrius melodus).* The piping plover breeds on coastal beaches from Newfoundland and southeastern Quebec to North Carolina. Piping plovers favor open sand, gravel, or cobble beaches for breeding. Breeding sites are generally found on islands, lake shores, coastal shorelines, and river margins. These birds winter primarily on the Atlantic Coast from North Carolina to Florida, although some migrate to the Bahamas and West Indies (USFWS, 2007). The piping plover is an uncommon summer resident in the lower Chesapeake Bay. It breeds and forages in Virginia from March to October. All piping plovers are considered threatened species under the Endangered Species Act when on their wintering grounds. Critical habitat identifies specific areas that are essential to the conservation of a listed species, and that may require special management considerations or protection.

Roseate tern (*Sterna dougallii dougallii).* Currently about 6,000-6,500 roseate terns breed in an area from the south shore of Long Island, New York, north to Nova Scotia, Canada (Spendelow, 1995). Although its range in North America is often listed as extending from Nova Scotia to Virginia or North Carolina and the southern tip of Florida, the roseate tern is most common from Massachusetts to Long Island; they no longer breed south of Long Island, NY (USFWS, 1998). Almost all important colonies of roseate terns are and have been on small islands, often located at ends or breaks in barrier islands. Nesting habitat for the northeastern North American population has been greatly reduced by housing developments and other human activity on and near the coastal barrier islands. Some roseate terns have attempted to nest with common terns in the salt marshes but with almost no success. The decline of the northeastern population of roseate terns and its subsequent listing as endangered prompted an intensive study into the causes of its endangerment and possible strategies for its recovery. The two main factors identified as limiting to roseate terns in the Northeast were loss of nesting sites and predation. Many islands that traditionally were used as nesting sites by roseate terns have been taken over by herring gulls (*Larus argentatus*) and great black-backed gulls (*L. marinus*); other islands were lost to erosion. The loss of these islands to gulls or erosion forced roseate terns to nest at sites either on or close to the mainland, where they are more vulnerable to human disturbance and to predators. Historically, they nested on the Eastern Shore, but no known nests have been documented since 1927. The northeast population of the roseate tern nests on barrier islands and salt marshes, typically along with common terns, and forages over shallow coastal waters, inlets, and offshore seas. While competing with common terns for food and nesting sites, roseates benefit from the former's aggressive defense of colony sites against predators. While breeding, they primarily feed on American sand lance, a small marine fish. Their nesting success rates may be related to the abundance and proximity of sand lance.

Finback whale (*Balaenoptera physalus).* Fin whales are found in all the world's major oceans, from polar to tropical waters. It is the second largest whale and the second largest living animal after the blue whale (American Cetacean Society, 2004). Adult males measure up to 78 feet (24 m) in the northern hemisphere, and 88 feet (26.8 m) in the southern hemisphere. Females are slightly larger than males. Weight for both sexes is between 50-70 tons (45,360-63,500 kg). The highest population density occurs in temperate and cool waters. It is less densely populated in the hottest, equatorial regions; it prefers deep waters beyond the continental shelf. Fin whales are common in waters of the U. S. Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward but are mostly northern, with few sightings south of Cape Cod. Fin whales are migratory, moving seasonally in and out of high-latitude feeding areas; however, the overall migration patterns are complex and not well understood (NMFS, 2006). They feed mainly on small shrimp-like creatures called krill and schooling fish. In autumn, these whales migrate several thousand miles to equatorial waters to mate during the winter. They were hunted extensively between the 1930's and the 1960's, but now since they are protected worldwide, fin whales are estimated to number 40,000 - 60,000. Currently, the largest threat to fin whales is entanglement and habitat destruction.

Humpback whale (*Megaptera novaengliae).* The humpback whale is found in all the major oceans in a wide band running from the Antarctic ice edge to 65° N latitude. They are distinguished from other whales in the same Family (Balaenopteridae) by extraordinarily long flippers, a more robust body, fewer throat grooves, more variable dorsal fin, and utilization of very long (up to 30 min.) and complex, repetitive vocalization (songs) during courtship (NMFS, 1991). Like other whales, the humpback whale became endangered as a result of exploitation from commercial whaling (Marine Mammal Commission, 2002). The species first received protection in the North Atlantic in 1955 when the International Whaling Commission placed a prohibition on non-subsistence hunting by member nations. Protection was extended to the North Pacific and Southern Hemisphere populations after the 1965 hunting season. It was classified as an endangered species when the ESA was passed in 1973, and it remains so today. Currently, there are is estimated 30,000–40,000 humpback whales worldwide. An increased number of sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992. A reported 38 humpback whale strandings occurred during 1985-1992 in the

U.S. mid-Atlantic and southeastern states. The strandings increased, particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature; in addition, the small size of many of these whales strongly suggested that they had only recently separated from their mothers (NMFS, 2007).

Right whale (*Eubalaena glacialis).* Right whales are the rarest of all large whale species and are among the rarest of all marine mammal species. The North Atlantic right whale primarily occurs in coastal or shelf waters. Individuals in the western North Atlantic population range from winter calving and nursery areas in coastal waters off the southeastern United States to summer feeding grounds in New England waters and north to the Bay of Fundy and Scotian Shelf (NMFS, 2005). In spring, summer and autumn, they feed in areas in a range stretching from New York to Nova Scotia. In winter, they head south towards Georgia and Florida to give birth. Right whales were named because when whaling started they were considered the "right" whale to hunt because they are very slow and easy to approach. NMFS designated three areas in June 1994 as critical habitat for the western North Atlantic population including coastal Florida and Georgia (Sebastian Inlet, FL to the Altamaha River, GA), Great South Channel (east of Cape Cod), and Massachusetts Bay and Cape Cod Bay. The population is currently believed to contain only about 300 individuals and it remains unclear whether its abundance is static, undergoing modest growth or, as recent modeling exercises suggest, currently in decline. However, there has been no apparent sign of recovery in the last 15 years, and the species may be rarer and more endangered than previously thought (NMFS, 2005).

Shortnose sturgeon (*Acipenser brevirostrum).* The shortnose sturgeon is anadromous, which means that it lives in slow moving river waters or nearshore marine waters, but migrates periodically to fresher water to spawn. Spawning begins in freshwater from late winter/early spring (southern rivers) to mid to late-spring (northern rivers) when water temperatures increase to 8-9°C (46-48°F). Historically, shortnose sturgeon were found in large coastal rivers of eastern North America in the Mid-Atlantic region, and in the rivers of North Carolina and Chesapeake Bay system. Shortnose sturgeon inhabit the main stems of their natal rivers, migrating between freshwater and mesohaline river reaches. Spawning occurs in upper, freshwater areas, while feeding and overwintering activities may occur in both fresh and saline habitats (NMFS, 1998). Shortnose sturgeon prefer lower salinity than pure seawater, typically in the range of 30-31 ppt (ppt-parts per thousand). In areas where the shortnose sturgeon occurs with the Atlantic sturgeon, the two species apparently segregate the habitat according to salinity preferences, with Atlantic sturgeon preferring more saline areas. Gilbert (1990) suggested that though the shortnose sturgeon is capable of entering the open ocean, it is hesitant to do so. This factor may be the single largest consideration limiting extensive coastal migrations of this species (Hill, 2008).

Anthropogenic mortality sources for the shortnose sturgeon include entrainment in dredges, entanglement in commercial or recreational fishing gear, structures associated with dams, and power plant cooling water intakes. Sources also include waterfront construction in freshwater sections of large and deep rivers where the species spawn; these include the Chesapeake Bay and its tributaries, particularly the Susquehanna, Bohemia, Potomac, and Elk Rivers. A comprehensive analysis of entanglement patterns is not available due in part to frequent confusion with the similar Atlantic sturgeon. The distribution and movement of the species in the bay is poorly understood for the same reason. When not spawning, shortnose sturgeons favor the deep channel sections of the large rivers mentioned above. Annual egg production fluctuates in the species due to several factors; females do not spawn every year. Eggs may not be fertilized due to interrupted migrations or unsuitable environmental conditions at the time of spawning.

6.3 Socio and Economic Environment:

6.3.1 Socioeconomic Resources.

6.3.1.1 Population. Virginia Beach is part of the Norfolk-Virginia Beach-Newport News Metropolitan Statistical Area (MSA), a group of economically and socially integrated cities and counties in southeastern Virginia. This city is the largest one in the state with a 2000 population of 425,257, an 8.2 percent increase from 1990 (U.S. Census). This rate of growth is a significant decrease from the 50 percent growth that occurred in the city between 1980 and 1990. While Virginia Beach's earlier growth was fueled primarily by in-migration, the growth in the last decade has been the result of natural increase (more births than deaths). The most recent state figures show an estimated 2007 population of 433,033, a 1.8 percent increase since 2000 (Weldon Cooper Center for Public Service, 2008). Projections from the Hampton Roads Planning District Commission show Virginia Beach's population continuing to grow slowly through the year 2034, reaching a figure of 469,200. This figure represents an average annual growth rate of 0.3 percent.

6.3.1.2 Employment / Economy. From 1970 to 1990, employment in Virginia Beach grew at a 7.0 percent rate as the population grew rapidly. As of the year 2000, there were 236,744 people working in the city, which is about 25 percent of the region's total employment (Bureau of Economic Analysis, 2006). Between 1990 and 2000 employment grew at an average annual rate of 2.4 percent compared to 1.1 percent for the MSA and 1.7 percent for the state. Projections by the Hampton Roads Planning District Commission show Virginia Beach's employment increasing at an average annual rate of 0.5 percent through 2034. Virginia Beach's economy is highly dependent on the Federal Government, which is the largest single employer in the city as well as in the region. For Virginia Beach most of this employment is concentrated in the four Federal military bases located in the city: Little Creek Amphibious Base, Dam Neck, Oceana Naval Air Station, and Fort Story. As of 2000, there were 23,538 military jobs in the city, which is 10 percent of Virginia Beach's total employment (BEA). Thirty-three percent of the jobs are in the services sector, followed by the trade and government sectors with 22.3 percent and 20.7 percent, respectively (BEA).

6.3.1.3 Tourism / Fishing Industry. Over the course of the year, in 2007, 2.75 million overnight visitors arrived in Virginia Beach spending approximately $857 million for accommodations, meals & entertainment. The tourism industry has created more than 14,900 jobs in the city, and visitor expenditures have generated $73.2 million in direct city revenue (City of Virginia Beach, 2008). Many visitors to Sandbridge enjoy Back Bay National Wildlife Refuge and False Cape State Park for kayaking, biking and fishing. There are hundreds of cottage and condominium rentals available year-round. The sport fishing industry and charter fishing boat trips are also a major draw for tourists and visiting anglers to the area. The resort area of Virginia Beach offers several charter fishing boats, however there are no trips that depart from Sandbridge. The Sandbridge Fishing Pier, located at Little Island State Park, is one of coastal Virginia's most popular fishing piers. Species that are commonly caught from the pier include spot, croaker, pompano, flounder, whiting, bluefish, speckled trout, blacktip reef sharks, skate and stingrays. Surf fishing from the beach is also popular. Many homes in Sandbridge are located on canals that lead out to Back Bay where boat docks are available for fishing and crabbing. Fish caught by recreational anglers in the vicinity of Sandbridge Shoal include tautog, black sea bass, cobia, king mackerel, Spanish mackerel, bluefish, striped bass, spotted trout, and pigfish (MMS, 2001). Major commercial species found in the vicinity of the shoal include menhaden, summer flounder, croaker, striped bass, blueback herring, American shad, and scup.

6.3.2 Environmental Justice. The Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations* (February 11, 1994) requires that "Federal agencies conduct their programs, policies, and activities that substantially affect human health or the environment in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under such programs, policies, and activities because of their race, color, or national origin." An analysis of the U.S. Census data for 2000 shows that the census tract that encompasses the study area (tract 454.12), has a much smaller minority population than the city as a whole (see Figure 6). The non-white population for the tract was only 2.7 percent of its population, whereas the non-white population of Virginia Beach was 28.6 percent. Thus, the study area does not have a significant minority population that could be affected by project implementation. Income levels for the study area show that income levels for residents of the area are considerably higher than those for the city's residents as a whole. For example, only 34.0 percent of the households in the study area had incomes below $50,000, while 51.6 percent of the city's households had incomes below that level as of the year 2000 (U.S. Census, 2000). Only 2.9 percent of the study area individuals and no families in the study area reported incomes below the poverty level, compared to 6.5 percent and 5.1 percent for the city as a whole, respectively. These figures indicate that the study area is one of the higher income areas of the city.

6.3.3 Military Use / Navigation. Navy Fleet Combat Training Center (at Dam Neck) Firing Area (204.52) encompasses the Sandbridge Shoal borrow area. In the past, firing exercises have been conducted intermittently throughout the year. These are publicized weekly in the Coast Guard's Local Notice to Mariners, along with the presence of dredging operations. As per 33 CFR 334.380, vessels within the firing zone area shall proceed through the area with caution and shall remain therein no longer than necessary for purpose of transit. The dredging equipment and the pump-out buoys would be not operating within a navigational channel or within the firing area.

6.3.4 Cultural Resources. Although there were a few visits from Spanish explorers in the 16^{th} century, Virginia Beach's recorded history generally began in 1607 with the landing at Cape Henry of the English settlers who eventually established the first permanent colony at Jamestown. Although the first colonists settled inland away from the coast, by 1635 settlers had started to move into the Hampton Roads area, settling along the Elizabeth, Lynnhaven, and North Landing Rivers and the north-south ridges of arable land. Several villages developed in the next 250 years in Princess Anne County, the county which would eventually make up the majority of modern day Virginia Beach.

The original town of Virginia Beach began as a small settlement near the Seatack Life Station. Towards the end of the century the town began to grow quickly as hotels and vacation cottages were constructed. By 1906, Virginia Beach had become an incorporated town, and in 1923 it annexed a small part of the county. In 1963, Princess Anne County and the city of Virginia Beach merged to become the city of Virginia Beach with its current boundaries.

Within the study area, there are no known archaeological or historical sites eligible for or listed on the National Register of Historic Places. However, the Little Island Coast Guard Station, a structure of local interest, is located landward of the beach near the Little Island City Park, a city maintained beach facility. The original U.S. Life-Saving Station (Little Island Coast Guard Station 2001-2) was constructed on this site in 1878 to protect the shoreline between the stations at Dam Neck Mills and False Cape. In 1925, the current main building and boathouse were constructed as replacements for the earlier structures. The earlier life-saving buildings were destroyed in a hurricane in 1933, during which the current building served as a shelter. The site remained an active Coast Guard station until it was deactivated in 1964. Today the site serves the City of Virginia Beach's Department of Parks and Recreation at Little Island City Park (see photos below).

In the past 15 years various remote sensing surveys of the proposed borrow areas have been carried out to determine the presence of cultural resources in these and adjacent areas. In 1996, Christopher Goodwin and Associates carried out a literature search and remote sensing survey of portions of Areas A and B for the Navy’s beach nourishment project at Dam Neck, resulting in a recommendation of no further work for the six anomalies discovered in that survey. In 1998, Tidewater Atlantic Research (TAR) carried out a remote sensing survey of part of Area B, which resulted in the report, “ Phase I Remote Sensing Archaeological Survey of the Sandbridge Shoal Borrow Areas Near Virginia Beach, Virginia,” recommending no additional investigation.

In 2006, TAR carried out a remote sensing survey of Area A and the part of Area B that was not previously surveyed. This survey, entitled “Archaeological Remote Sensing Survey of Offshore Borrow Areas Near Sandbridge Beach, Virginia,” (2007) resulted in the identification of numerous magnetic anomalies. The remote sensing survey recorded 51 unidentified magnetic anomalies and one side-scan sonar target in proposed Borrow Area A, and 37 unidentified magnetic anomalies and one side-scan sonar target within proposed Borrow Area B (Figure 3). The side-scan sonar target recorded in Borrow Area A has been identified as a small barge. Five of the magnetic anomalies were associated with this feature. The side-scan sonar target and five associated magnetic anomalies recorded in Borrow Area B have been tentatively identified as a potentially significant historic shipwreck site. Of the remaining 46 unidentified magnetic anomalies in Area A, 29 are considered to be potentially representative of historic shipwreck sites, and of the remaining 32 unidentified magnetic anomalies in Area B, 17 are considered to be potentially representative of historic shipwreck sites. Analysis of the subbottom profiler data by Tidewater Atlantic Research indicated the presence of a paleochannel feature in the extreme southeastern corner of Borrow Area A. There is a low potential for the preservation of prehistoric resources associated with the paleochannel.

6.3.5 Aesthetics. Visual and aesthetic features include a wide beach with a dune system along much of the project length and beach cottages. Most of Sandbridge is residential and privately owned; however, a small percentage of the shoreline is held in public domain where there are several public beaches. Overall, the entire length of the project can be considered aesthetically pleasing to those who enjoy the view of a residential seashore. During the summer months, tourists arrive for ocean and bayfront activities such as swimming, surfing, dining and entertainment. The Back Bay Wildlife Refuge, located (directly) south of the project, contains approximately 4,600 acres of beach, dunes, marsh and woodlands making the area a popular destination for recreation.

6.4 Regulatory Requirements:

6.4.1 Coastal Barrier Resources Act. Coastal Barrier Resources Act (CBRA) was enacted October 18, 1982 by Public Law 97-348 (96 Stat. 1653; 16 U.S.C. 3501 et seq.). It designated various undeveloped coastal barrier islands, depicted by specific maps, for inclusion in the Coastal Barrier Resources System (CBRS). Areas designated were made ineligible for direct or indirect Federal financial assistance that might support development, including flood insurance, except for emergency life-saving activities. Federal expenditures are authorized for activities associated with energy resources; navigation channels; public roads; national security; Coast Guard facilities; wildlife enhancement, protection, and management; public health and safety; and restoration of natural shoreline stabilization systems. The Coastal Barrier Improvement Act (CBIA) of 1990 reauthorized the CBRA and expanded the CBRS by adding new units and enlarging some previously designated units along the Atlantic and Gulf coasts. The CBIA also designated a new category of lands called “otherwise protected areas” (OPA’s). OPA’s are public or private lands that are held for conservation purposes; these areas include national wildlife refuges, national parks and seashores, state parks, and lands owned by private organizations for conservation purposes.

6.4.2 Coastal Zone Management Act. The Virginia Coastal Zone Management Program (VA CZM Program) was established in 1986 to protect and manage Virginia's coastal zone. The Virginia CZM Program is part of a national coastal zone management program, a voluntary partnership between the National Oceanic and Atmospheric Administration (NOAA) and U.S. coastal states and territories authorized by the Coastal Zone Management Act (CZMA) of 1972, as amended. A Federally approved Coastal Program authorizes Virginia to require that Federal actions are consistent with the state's Coastal Program's laws and enforceable policies. The Virginia Department of Environmental Quality (VDEQ) serves as the lead agency for Virginia’s networked coastal management program.

6.4.3 Clean Water Act. Section 404 of the Clean Water Act (CWA) of 1972, as amended (33 U.S.C. s/s 1251 and following) (1977) is the primary law that governs disposal of dredged and fill material in waters of the United States. Waters of the United States include ocean areas, estuaries, streams, ponds, rivers, lakes, and wetlands. The CWA requires any applicant for a federal license or permit for any activity that may result in a discharge into navigable waters to obtain a certification that the discharge will not adversely affect water quality from the state in which the discharge will occur. VDEQ is responsible for 401 Certification, called the Virginia Water Protection permit (VWP). VWP permits issued by DEQ contain conditions to protect water quality in the area of the proposed project. Additionally, a permit must be obtained from the Virginia Marine Resources Commission (VMRC) to build, dump or otherwise trespass upon or over, encroach upon, take or use any material from the beds of the bays, ocean, rivers, streams or creeks within the jurisdiction of Virginia.

7.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

7.1 Environmental Setting:

7.1.1 Climate. No climatic changes will occur as a result of this localized project.

7.1.2 Geology and Soils. Many factors affect the shape, composition, and structure of beaches after they are renourished. The shape varies with sand supply, sea level change, and wave size. The project will provide for a wider beach offering significant benefits in the form of storm damage reduction. During storms with elevated water levels and high waves, a wide beach performs as an effective energy absorber with the wave energy dissipated across the surf zone and wide beach rather than impacting on the upland structures. The proposed action would remove approximately 1.5 to 2.0 million cy of sand from Sandbridge Shoal. The sediments in the shoal are approximately 96 percent sand, 1.5 percent gravel, and about 2.5 percent fines. Mean grain size at the placement site ranges between 0.25 mm and 0.35 mm, medium grained sand. There would be no significant impacts to sediment quality at the borrow area or at the placement site.

7.1.3 Terrestrial Environment. Some benthic organisms associated with nearshore areas that would be covered by the dredged material will be lost. Studies of sand grain by Ackerman (1996) show that nourished beaches are harder than non-nourished beaches; sand grains tend to be more cemented. This has not been demonstrated to retard or prevent the re-colonization of the beach by interstitial and burrowing fauna. Observations made by the USACE and others at previous beach nourishment projects in Hampton (Buckroe Beach and others) have shown that these species will re-colonize within a year of sand placement. No impacts to dune plants are anticipated, as none are located within the elevations selected for beach nourishment. Avian communities could be temporarily displaced by dredge pipelines, and construction equipment along the beach or may avoid foraging if they are aurally affected (Peterson et al., 2001). However, construction will be short-term and minor and is not expected to interfere with nesting, breeding, or migration of any avian species. Terrestrial reptiles, amphibians, and mammals may be temporarily disturbed but will not be adversely impacted by any aspect of the project. As a result of this evaluation, no significant impacts to the terrestrial environment are expected to occur.

7.1.4 Physical Oceanography. Potential impacts to the physical environment from offshore sand extraction include changes to hydrodynamic and sediment transport processes, as well as the formation of short-lived turbidity plumes. Although the potential impact on shoal currents from bathymetric modification has not been explicitly modeled, near-bed current measurements show large seasonal and event-scale variability, including flow reversals (Valle-Levinson and Lwiza, 1998). Numerical modeling of comparable dredging scenarios off Ocean City, Maryland (Maa et al., 2004) and Outer Banks, North Carolina (Byrnes et al., 2003) shows that increasing shoal depth generally leads to decreased current velocity, sediment convergence, and infilling. Although local velocities immediately downstream of dredged areas may temporarily increase (in the direction of strong along shelf flows), the magnitude of change and the size of the footprint are expected to be relatively small. Alterations of near-bed currents may result in local and short-lived changes in sediment transport pathways in the immediate vicinity of the borrow areas, but the pathways are expected to return to pre-dredging conditions following infilling (Byrnes et al., 2003). Infilling rates and sediment deposited in borrow depressions are expected to reflect natural variations, including storm characteristics and source material.

As waves move shoreward from deeper water and propagate over depth anomalies resulting from removal of material at the borrow site for nourishment, the height, direction, and other characteristics of the waves change. These transformations, called wave shoaling, refraction, reflection, and diffraction, can significantly increase or decrease the transport of sand along the shoreline, resulting in localized erosion and accretion. When evaluating offshore dredging, it is important to consider the possible effect on nearshore wave transformation and changes to wave-induced longshore sediment transport, which in turn may affect shoreline change. Using a range of monochromatic and spectral wave models, Maa and Hobbs (1998), Boon (1998), Basco (1999), and Kelly et al. (2001a) independently show significant wave convergence along Sandbridge Beach. Strong gradients in breaking wave height and angle occur along the entire length of Sandbridge with two pronounced peaks spaced approximately 5 km (Maa and Hobbs, 1998). Refraction of long period waves by Sandbridge Shoal and convergence has been reproduced in all of the independent model runs; however, wave interactions with intermediate scale, shore-oblique bars recently mapped on the lower shoreface off Sandbridge Beach (McNinch, 2004) have yet to be incorporated. Model output from a suite of dredge scenarios generally indicates a reduction in wave height within the borrow area, especially with larger, longer period waves (Kelley and Ramsey, 2001; Kelley et al., 2001b). Refraction contributes to an increase in wave height towards the boundaries of the borrow areas. Offshore wave transformation contributes to a shadow zone of reduced wave energy landward of borrow areas A and B, but also a zone of increased wave energy north and south of the shadow zone. The total length of potentially affected shoreline (~15 km) is approximately two times longer than the combined alongshore dimension of the borrow areas. However, due to the redistribution of breaking wave energy and relative changes in wave direction, relatively small changes in longshore transport potential are predicted; the direction and magnitude of transport potential vary with forcing conditions (Maa and Hobbs, 1998; Kelley et al., 2001a).

Given the predominantly southeast wave climate, an average net transport rate to the north of approximately 300,000 m^3/yr is predicted (Kelley et al., 2001). Kelley, (2001) reports a maximum change (decrease) in net longshore transport potential of about 8,000 m^3/yr for a $1.5x10^6$ m^3 hypothetical extraction, although relative alongshore transport gradients may be locally enhanced. The decrease in northerly-directed sediment transport predicted by the model suggests that more sand may actually accumulate (i.e., accretion) along Sandbridge Beach than prior to dredging, although more discrete locations along the reach of shoreline may experience increased transport divergence (i.e., erosion). Although this change in transport potential may appear significant, representing about 7.5% of the mean annual transport rate, the potential effect of the dredging scenario is an order of magnitude less than the uncertainty associated with the sediment transport calculations and well within the inter-annual transport potential variability which exceeds 100,000 m^3/yr (Kelley et al., 2001).

7.1.5 Noise. The beach re-nourishment, including mobilization, is anticipated to take approximately 3-5 months, depending on weather conditions and equipment breakdown. Operations are expected to continue 24 hours per day, 7 days per week. Bulldozers will be working on the beach continuously, which would impact the ambient noise level, although the impacts would be restricted to the immediate construction reach. Noise pollution and construction activities will be monitored to ensure minimum disturbance to the surrounding community. The offshore pumps are not expected to impact the ambient noise level as they will be far enough from the beach to be a nuisance.

Ambient underwater sound levels are an important consideration in assessing the probability of detrimental effects of dredging sounds. Much of the sound produced during filling of the hopper is associated with propeller and engine noise with additional sounds emitted by pumps and generators; these sounds are continuous in nature. Numerous factors contribute to ambient sounds at a given location, including tidal hydrodynamics, meteorological conditions and sea state, the presence or absence of ice, and sounds of biological origin. It should also be recognized that interpreting underwater sound data may be futile without fundamental studies on biological responses to characteristic dredging sounds (Dickerson, et al., 2001). There is few data exist that adequately characterize sounds emitted by dredge plants that would support objective decisions balancing the need to dredge against relative risk to a fishery resource (Dickerson, et al., 2001).

7.1.6 H**azardous Materials.** Borrow area and beach nourishment activities are not expected to result in the identification and/or disturbance of HTRW, as it has been found that coarse-grained material in a high-energy area is unlikely to be contaminated with HTRW (USACE, 1994). Since small caliber UXO may be encountered in the borrow areas during dredging operations, 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 hopper and/or being subsequently placed on the beach; the screen will be made of vertical metal bars with a gap of no more than 1.5 inches. This method has been employed successfully in previous sand borrow placement activities at Sandbridge. In addition, a qualitative (QA) reconnaissance munitions beach survey based on both visual observations and analog geophysics (magnetometer) will be periodically conducted during the Sandbridge Beach replenishment operations. The magnetometer survey conducted of the borrow area identified a number of items to avoid; the contractor will not be permitted to dredge within a 100-foot radius of these items. In the event that ordnance is encountered in the borrow area, the screening and/or magnetometer sweeping will all but eliminate the possibility of any ordnance remaining on the new beach after construction.

The contractor would be responsible for proper storage and disposal of any hazardous material such as oils and fuels used during the dredging and beach nourishment operations. 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. No accidental spills of diesel fuel from the dredge plant or tender vessels are expected.

7.1.7 Water Quality.

7.1.7.1 Placement Site. There will be increased, localized turbidity associated with the beach nourishment operations. Near shore turbidity impacts are directly related to the quantity of fines (silt and clay) in the nourishment material. The medium sized sand grains should allow for a short suspension time and containment of sediment during and after construction. Short-term impacts would involve increased, localized turbidity associated with dredging and disposal operations. However, these impacts are expected to be minimal. The beachfill consists of beach quality sand of similar grain size and composition of indigenous beach sands. Therefore, turbidity impacts will be short-term and spatially-limited to the vicinity of the dredge outfall pipe.

7.1.7.2 Borrow Area. Dredging in the borrow area would result in some short-term negative effects, including localized increases in turbidity and slight decreases in DO. Since the dominant substrate at the borrow area is medium-grain sand, it is expected to settle rapidly, causing less turbidity and less oxygen demand than finer-grained (organic) sediments. Studies (Priest, 1981; Barnard, 1978) have concluded that the turbidity created by a dredging operation is restricted to the vicinity of the operation and decreases significantly with increased distance from the dredge. 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. No appreciable effects on DO, pH, or temperature are anticipated due to the nature of the dredged material (sand), related low levels of organics and biological oxygen demand, and the hydrodynamic influences within the borrow area in the open ocean where the water column is subject to significant mixing and exchange with oxygen rich surface waters.

7.1.8 Air Quality. Criteria air pollutant emissions were estimated for the preferred action using estimates of power requirements, duration of operations, and emission factors for the various equipment types. Multiplying horsepower rating, activity rating factor (percent of total power), and operating time yields the energy used. The energy used multiplied by an emission factor yields the emission estimate. Fuel consumption and operational data from the 2007 nourishment cycle were used to estimate power requirements and duration for each phase of the proposed hopper dredging activity. The horsepower rating of the dredge plant was assumed for each activity as follows: propulsion (5000 hp), dredging (5000 hp), pumping (4000 hp), and auxiliary (2000 hp). Different rating factors were used for dredging, propulsion, and pumping. The duration of dredging was estimated at 130 days. The estimated time to each complete dredge cycle, including idle time, was approximately 3.2 hours per load. It was assumed that about 2,800 yd^3 of material would be moved in each cycle, requiring about 880 trips to excavate enough material to place 2.0 million yd^3 of sand on the beach. The placement and relocation of the nearshore mooring buoys used during pump-out would involve two tender tugboats, a derrick barge, two work barges, and pipeline hauler / crane. It was assumed that the buoy would need to be moved at most five times during the project, with each move taking approximately 12 hours. Emission factors for the diesel engines on the hopper dredge, barge, and tugboats were obtained from EPA's *Compilation of Air Pollutant Emissions Factors, AP-42, Volume 1* (2002). Emission factors for tiered equipment were derived from NONROAD model (5a) estimates. The beach fill related estimates assumed the use of up to four bulldozers and a flat bed truck/ATV, each operating continuously for the duration of the project.

All dredging was assumed to occur on the OCS, whereas 90% of hopper transport and all other emitting activities were assumed to occur over state waters or at the placement site. Total project emissions of nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOC), and particulate matter (PM) are presented in Table 1.

Table 1: Estimated emissions for the preferred alternative (tons per year)

Activity	Emissions (tons)					
	NOx	**SO2**	**CO**	**VOC**	**$PM_{2.5}$**	**PM_{10}**
Dredge Vessel (Hopper)						
Dredging	39.1	0.7	9.0	1.0	0.6	0.7
Transit	50.1	0.8	11.5	1.3	0.8	0.8
Pump-out	28.5	0.5	6.5	0.8	0.5	0.5
Idle	4.8	0.1	1.1	0.1	0.1	0.1
Relocation of Mooring Buoy	5.8	0.1	1.3	0.1	0.1	0.1
Beach Fill	12.0	2.2	5.4	0.8	0.9	0.9
Total Emissions	140.3	4.4	34.9	4.2	3.1	3.1
Total Emissions within State	95.7	3.6	24.6	3.0	2.3	2.4
Total Emissions within OCS	44.7	0.8	10.2	1.2	0.7	0.7
Nonpoint + Mobile Source Emissions (Point and Nonpoint + Mobile Emissions) (City of Virginia Beach 2002 from EPA National Emission Inventory)	11,736 12,464	3,008 3,597	86,990 87,570	14,151 14,301	1,314 1,385	5,215 5,334
Virginia Beach 2002 emissions from http://www.epa.gov/air/data/repsst.html?st~VA~Virginia						

The proposed action would result in small, localized, temporary increases in concentrations of nitrogen dioxide (NO_2), SO_2, CO, VOC, and PM. Emissions associated with the dredge plant would be the largest contribution to the inventory. However, the total increases are relatively minor in context of the existing nonpoint and mobile source emissions in the

Virginia Beach region (Table 1). Based on the preceding analysis, projected emissions from the Sandbridge Project would not adversely impact air quality given the relatively low level of emissions and the prevailing offshore winds. With the proposed action, the criteria pollutant levels would be well within the national ambient air quality standards. In order to determine if a conformity determination needed to be performed, estimates were made of the portion of total emissions that would occur within state limits. Since the Federal OCS waters attainment status is unclassified, there is no provision for any classification in the Clean Air Act for waters outside of the boundaries of state waters. Calculating the increase in emissions that may occur within the state limits was done by subtracting out the dredging-related and ten percent of transport emissions, since those activities would take place entirely over Federal waters. Projected emissions of NO_x and VOC within state boundaries are within the 100 tons/year threshold for a marginal ozone nonattainment area. Therefore, no conformity determination will be required under 40 CFR Part 93.

7.2 Coastal and Aquatic Resources:

7.2.1 Benthos, Motile Invertebrates, and Fishes.

7.2.1.2 Placement Site. Recovery time of the benthos within both the dredging area and the seaward surf zone is expected to be relatively rapid, although full recovery of both sites by benthos to a condition resembling pre-project conditions may take several years (Nelson, 1993; Newell et al., 1998). In general, the beach will repopulate relatively quickly. Several environmental studies of beach nourishment indicate that there are no detrimental long-term changes in the beach fauna as a result of beach nourishment (Burlas et al., 2001). In order to further determine the effects of beach nourishment activities upon key organisms, the Norfolk District conducted a study in 1987 along the nearby Virginia Beach shoreline (USACE, 1992). The findings of this study are based upon population changes of the mole crab (*Emerita talpoida*), ghost crab (*Ocypode albicans*), calico crab (*Ovalipes ocellatus*), amphipods (*Haustorius arenarius*), and sand worms (*Clymenella torquata*) in response to deposition of material dredged from offshore sources on the resort beach. This study supported the findings of other separate and independent studies, concluding that the greatest influencing factor on beach fauna populations appears to be not the introduction of additional material onto the beach, but rather the composition of the introduced material. The deposited sediments, when similar in composition (grain size and other physical characteristics) to existing beach material (whether indigenous or introduced by an earlier nourishment or construction event), do not appear to have the potential to reduce the numbers of species or individuals of beach infauna (USACE, 1994).

7.2.1.3 Borrow Area. The rate of benthic recovery and degree of diversity following a dredging event depend on a number of factors including: 1) duration and timing of dredging, 2) the type of dredging equipment used to extract the sediment, 3) sediment composition of the mine site, 4) amount of sand removed from the site, 5) the fauna present in the borrow area and surrounding area prior to dredging and their ability to adapt to change, 6) characteristics of the new sediment interface, 7) life history characteristics of fauna that re-colonize, 8) water quality at the site, 9) hydrodynamics of the mine pit and surrounding area, and 10) degree of sedimentation that occurs following dredging. Some of the motile benthic and pelagic fauna, such as crabs, shrimp, and fish, are able to avoid the dredging area and should return shortly after the activity is completed. Most motile epibenthic forms such as crustaceans and a few burrowing fishes such as flounder are rarely found in pumped sediments (USACE, 1992). Impacts to benthos are expected to be temporary in duration, as populations of green and blue algae, acorn worms, and other species tend to repopulate rapidly following dredging. Relatively non-motile benthos, such as worms and molluscs, will be destroyed over much of the area to be dredged. This may result in loss of prey items for finfish following dredging until benthic communities recover. Analysis of sediment core samples taken after dredging has demonstrated that the remaining epibenthic sediments are decimated (Parr, e al, 1978). However, studies have shown that re-colonization in sediments generally occurs rapidly. Organisms that feed by filtering suspended particles from the water are most likely to be negatively impacted by the abrasive action of clay and silt, or by exposure to toxins associated with suspended particles. Some of the specific physiological effects on filter feeding organisms include abrasion of gill filaments, impaired respiration, retarded egg development, survival of larvae, and clogging of gills (Gordon et al. 1972). A USACE study conducted in 2001 demonstrated no extensive beds of filter feeding mollusks at Sandbridge Shoal; the offshore site lies beyond any oyster beds. The coarse-grained sand of the borrow areas, far removed from potential contaminant sources, does not retain toxic sediment contaminants.

In June 1998 and May 1999, the Virginia Institute of Marine Science and the University of New Hampshire conducted a study of the effects of sand dredging on benthic populations forming the bulk of food sources for juvenile finfish in the shallow oceanic waters off the coast of Maryland and Delaware, specifically, Weaver Shoal and Fenwick Shoal. Video sleds, sediment coring, and metered beam trawling were utilized to focus upon areas which provide the most desired sand grain size for commercial sand mining operations. The most abundant species were spotted hake (*Urophycis regia*) and smallmouth flounder (*Etropus microstomus*). Re-colonization occurred naturally within approximately one year of sand mining. The study concluded that, in order to minimize impacts to finfish food supplies and to promote re-colonization of mined areas as rapidly and efficiently as possible, the total removal of a layer of substrate should be avoided and the tactic of leaving small un-dredged areas within an identified borrow area should be instituted. The purpose of this is to create refuge patches that will promote rapid re-colonization and serve as habitat for the mobile benthic species. Dredging activities ending in time for the spring and summer recruitment would favor crustaceans. Dredging operations that begin in the summer and end in time for the fall and winter recruitment season would favor annelids (Diaz, Cutter and Hobbs, 2004). Comparable monitoring between 2002 and 2005 at Sandbridge Shoal revealed no significant difference in macrofaunal abundance between dredged areas (Area B) and controls, suggesting that dredging within Area B has had little impact on habitat value (Diaz et al., 2006). Despite multiple dredging events, the shoal environment continues to host robust macrobenthic and fish communities. In the vicinity of historic dredging, no negative impacts for macrobenthos or demersal fishes have been documented. The overall impact to these organisms is expected to be temporary in nature and not significant.

7.2.2 Submerged Aquatic Vegetation. There would be no effect to submerged aquatic vegetation by the proposed project either offshore or within the area of beach nourishment.

7.2.3 Essential Fish Habitat. The 1996 amendments to the MSA require Federal agencies to consult with NMFS regarding the potential effects of the action on essential fish habitat (EFH), which is defined as those waters and substrates necessary to Federally-managed fish for spawning, breeding, feeding, or growth to maturity. In compliance with MSA, an EFH Assessment has been prepared and appears as Appendix B. The EFH Assessment includes: (1) a description of the proposed action; (2) an analysis of the effects of the action on EFH and associated species; (3) the Federal agency's views regarding the effects of the action on EFH; and (4) a discussion of proposed mitigation, if applicable. The following narrative is a brief synopsis of this assessment.

Fish occupation of waters within the project impact area is highly variable spatially and temporally. Some of the species are strictly offshore, while others may occupy both near shore and offshore waters. In addition, some species may be suited for open ocean or pelagic waters, while others may be more oriented to bottom or demersal waters. This can also vary between life stages of Federally-managed species. Additionally, seasonal abundance is highly variable, as many species are migratory.

Direct impacts to each finfish species are evaluated on their likelihood of being present, and therefore, potentially physically harmed at either the proposed borrow areas or beach fill placement areas during project construction. Finfish species could potentially be harmed at the borrow area entrainment in the dredge. Pelagic species, such as bluefish and Atlantic butterfish, should be able to avoid the entrainment into the dredge due to their high mobility. Demersal species such as the windowpane flounder and the summer flounder are mobile and should be able to avoid dredge entrainment as well. However, because of their demersal nature, individuals that may remain on the seafloor of the borrow area during dredging could be entrained and destroyed; demersal eggs may be entrained as well. Juveniles are likely more vulnerable than adults due to their slower swimming speed. Finfish species that have eggs and larvae in surface waters may be impacted by the hopper dredge making numerous transits through the borrow area; any eggs in the path of the dredge are likely to be destroyed by the ship's propeller. Because eggs and larvae are widely distributed over the continental shelf, egg destruction is not expected to cause significant impacts to fish populations. While some individual finfish will likely be entrained into the dredge and destroyed, no detrimental impacts to populations of any finfish are expected from the proposed project. Dredging may also result in physical alterations to the substrate of EFH which could cause changes to benthic community assemblages after re-colonization or in unsuitable substrate for spawning of some finfish species. However, significant changes in substrate are not expected because dredging depths would be based on vibracore data to minimize dissimilar substrates (MMS, 2006). Finfish species could also be harmed in the surfzone while sand is being pumped onto the beach however; the majority of fish living nearshore are motile and can easily escape from sand placement. The greatest impacts of sand placement are the initial decrease in fish abundance, potential for gill clogging caused by increased turbidity, and direct burial of demersal fish. These impacts would be short-term and would not cause significant impacts to populations of any finfish.

Indirect impacts to each finfish species could occur as a result of several aspects of the project. EFH species can be adversely impacted temporarily due to the formation of a turbidity plume, sedimentation, and decreased dissolved oxygen (DO) content during the dredging and placement. Potential impacts to juvenile and adult fish from turbidity include gill clogging or abrasion. These fish are motile and would most likely leave the area while dredging and sand placement occurs, significantly decreasing their abundance and diversity in the short-term. Sessile prey organisms that feed by filtering suspended particles from water are likely to be harmed by turbidity and sedimentation. Abrasion, impaired respiration, and reductions in larvae survival are some of the associated effects (MMS, 1997). Populations exposed to the increased turbidity and sedimentation are expected to have a drop in productivity. However, no large concentrations of filter feeding organisms are known to exist in the project area. These impacts would subside upon cessation of construction activities. There is only a minor portion of fine-grained sediment within the material to be dredged and placed, and turbidity can be pronounced locally at both sites naturally as a result of wave re-suspension of bottom sediments at any time of year. For these reasons it is assumed that impacts from turbidity will be very minor. In addition, because of the open nature of the sites, turbidity should decrease as the particles in the water column rapidly dissipate into the surrounding coastal ocean waters. Short-term beneficial impacts could result from the increase in suspended, nutritive material as a food source creating areas of feeding concentrations.

The sandbar shark (*Charcharinus plumbeus*) is designated as having a Habitat Area of Particular Concern (HAPC), which is described in regulations as a subset of EFH that is rare; particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally-stressed area. There will be short-term increases in turbidity and settlement associated with dredging and sand placement but they will be localized and temporary. Any minimal turbidity will be very short in duration (i.e., will settle rapidly) and will be generally limited to the vicinity of the dredging and sand placement. It is generally viewed that elevated levels of turbidity generated by trailing suction hopper dredge operations in open ocean waters do not represent a significant ecological impact. Fish can avoid plumes and other organisms can survive short-term elevated turbidity. The beach nourishment area (surf zone) and borrow area are not located within nursery or pupping grounds for the sandbar shark. Given that the shark can be found from the intertidal zone to waters more than 655 feet deep and is widely distributed along the East Coast, the borrow area represents a fraction of available forage habitat.

Adverse effects on EFH species, due to dredging and construction activities, will largely be temporary and minimal within the dredged footprints and beach nourishment areas in the surf zone. In conclusion, the project is not anticipated to significantly impact EFH species or habitat (including HAPC) that may be in the project area. As mentioned previously, a complete assessment of impacts to EFH is included in Appendix B.

7.2.4 Threatened and Endangered Species.

Sea Turtles. The listed sea turtles that could be potentially affected by the proposed action are the loggerhead, green, leatherback, hawksbill, and Kemp's ridley.

The loss of nesting beaches, hatchling disorientation from artificial light, drowning in fishing and shrimping trawls, marine pollution, and plastics and styrofoam have led to the decline of sea turtles. The major known sources of anthropogenic mortality for the leatherback, loggerhead, Kemps ridley, green, and hawksbill sea turtles at nest sites on beaches are coastal construction, motor vehicles, poaching, exotic species such as fire ants, as well as beach armoring and nourishment. In oceanic habitats these known sources of anthropogenic mortality are trawl, purse seins, hook and line, gill net, pound net, and longline and trap fisheries. They also include oil and gas exploration, marine pollution, underwater explosions, hopper dredging, offshore artificial lighting, power plant entrainment and/or impingement, debris entanglement and ingestion, marina and dock construction, poaching, and boat collisions.

Turtle issues associated with dredging are entrainment, which is defined as the direct uptake of aquatic organisms by the suction field generated at the draghead or cutterhead. Sea turtle mortalities due to entrainment during hopper dredging operations have been documented on the East Coast since 1980. The Endangered Species Observer Program, established in 1980, required observers to quantify entrainment of turtles by screening dredged material from hopper dredge intake structures or overflows. By species, loggerheads were the most frequently entrained during hopper dredging, accounting for 67.4 percent of the total entrainment (for turtles identified per species). Green sea turtles and Kemp's ridleys accounted for 11.1 and 2.5 percent of entrainment incidents, respectively. Nineteen percent were unidentified as to species, since only fragments were recovered (Reine and Clark 1998). Over the past 24 years, the USACE and dredging industry have worked to develop protocols, operational methods, and modified dredging equipment to reduce dredging impacts to sea turtles. If dredging occurs from May 1 to November 30, hopper dredges must be equipped with rigid turtle deflectors attached to the drag-head. The deflector is checked throughout every load to ensure that proper installation is maintained.

Turtle nesting issues associated with beach fill include grain size, color, radiance and compaction. In order to minimize impacts on nesting sea turtles, re-nourishment sand should complement natural sand as closely as possible. The principal sediment types associated with the shoal are generally in the category of medium-grained beach quality sand. Mean grain size at the placement site ranges between 0.23 mm on the berm and 0.26 mm on the foreshore. The mean grain size at Sandbridge Shoal is 0.25 mm. The dredged material closely matches the existing beach material, thus sea turtles should not be affected by the type of material used for beach placement.

On April 2, 1993, the NMFS issued a Biological Opinion (BO) for the borrow area dredging and transport to Sandbridge Beach. Due to funding delays, the project was not completed until 1998, at which time the reasonable and prudent measures, and terms, and conditions outlined in the 1993 BO were incorporated into the current project specifications. The Incidental Take Statement (ITS) was updated in 2001 following new information on sea turtles resuscitation, hopper dredge interactions, and reporting requirements. Recent coordination with the NMFS on December 2007, concluded that the current ITS and BO remain valid for the upcoming dredging and beach nourishment operations provided Norfolk District adheres to all reasonable and prudent measures and terms and conditions as outlined in the 2001 ITS and 1993 BO. The NMFS concluded that the proposed project was likely to adversely affect sea turtles, but not likely to jeopardize the continued existence of the species.

In April 2001, the USFWS issued a letter stating that the proposed project is not likely adversely affect sea turtles and in 2002, the USFWS agreed to the Corps' request to monitor for sea turtles only on the sections undergoing beach nourishment, rather than monitor the entire Virginia Beach shoreline. Additionally, the USFWS issued letter dated, October, 10, 2008 stating if the previously mentioned protective measures are followed, the proposed action is not likely to adversely affect Federally listed or proposed species or their critical habitat. The Corps will continue to adhere to conditions of the BO and ITS some of which include the following: if dredging occurs between May 1 and November 30, with the use of a hopper dredge, turtle deflectors will be outfitted on the draghead. Small caliber unexploded ordnance (UXO) may be encountered in the borrow areas during dredging operations. As a safety precaution, the Corps has required that a screen be placed over the drag head to effectively prevent any of the UXO from entering the hopper 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 ITS issued for this project requires that NMFS approved endangered species observers be on board the dredge during the period of April 1-November 30, or whenever-water temperatures are above 11°C to monitor the hopper spoil, overflow, screening and dragheads for sea turtles and their remains. Observer coverage is required to allow for the screening of 100% of dredged material. On January 31, 2007, the Corps requested that this requirement be waived for the 2007 dredging season as the installation of the screen on the draghead would preclude sea turtles from becoming entrained in the draghead and prevent any sea turtles or sea turtle parts from being observed. The NMFS responded by letter dated February 7, 2007, and agreed that the installation of the screening on the draghead would prevent sea turtles from becoming entrained in the draghead, as the screens prevent sea turtles from becoming entrained in the dredge. NMFS stated it was not necessary to have an observer onboard to inspect for sea turtle parts and agreed to the Corps request to remove the observer requirement for the previous 2007 dredging project. Furthermore, the NMFS stated that removal of the observer requirement did not alter the conclusions reached in the 1993 Opinion and 2001 revisions (See Appendix C for Agency Correspondence).

Additionally, during May 1 and November 30, sections of the beach undergoing beach re-nourishment will be monitored for sea turtles, their nests, and nesting activities. The Norfolk District will employ trained personnel to conduct the monitoring consistent to our agreement with the USFWS. The BO is included as Appendix A to this document.

The last beach nourishment project at Sandbridge was completed in September of 2007. Numerous sea turtle sightings were recorded during dredging operations, but there were no incidents involving sea turtles or whales. Additionally, there were no sea turtle incidents during the nighttime nesting surveys which were conducted nightly at two hour intervals. The area was physically surveyed for the presence of sea turtles, turtle trails, and nests along the high tide line in both directions and through visual inspection in the entire beach fill area for the duration of the project.

Whales. The listed whales that could be potentially affected by the proposed action are the finback, humpback, and right whales. Dredging impacts on marine mammals may result from underwater noise and vessel collisions. It appears that right whales may be somewhat tolerant of the noise, with closer whales exhibiting a more conspicuous avoidance than more distant whales (MMS, 2001). The major known sources of anthropogenic mortality for the right whale, humpback whale, and fin whale are entanglement in commercial fishing gear and ship strikes. Acoustic trauma and habitat degradation also constitute adverse effects. Collision with vessels is the leading human-caused source of mortality for whales; the most lethal and serious injuries are caused by large, fast-moving ships.

The NMFS has established regulations to implement speed restrictions of no more than 10 knots applying to all vessels 65 ft. or greater overall length in certain locations and at certain times of the year along the east coast of the U.S. Atlantic seaboard. The purpose of the regulations is to reduce the likelihood of deaths and serious injuries to endangered North Atlantic right whales that result from collisions with ships (50 CFR, part 224). Since these restrictions are not mandatory for vessels owned or operated by, or under contract to, U.S. Federal agencies, the NMFS has requested all Federal agencies to voluntarily observe the conditions of the proposed regulations when and where their missions are not compromised. Should whales happen to occur during dredging operations, USACE will adhere to NMFS' observer/monitoring program to insure that vessel collisions are avoided. The proposed action is not likely to adversely affect any of these whale species.

Birds. The listed birds that could be potentially affected by the proposed action are the piping plover and roseate tern. Neither species are known to nest on Sandbridge beaches nor is the project area wintering ground. The roseate tern is rare visitor to the mid-Atlantic and would only be in the coastal area of Virginia during the summer. The piping plover is also an uncommon summer resident in the lower Chesapeake Bay. It breeds and forages in Virginia, mostly on the Eastern Shore from March to October. The proposed action is not likely to affect the roseate tern or the piping plover.

Fish. The listed shortnose sturgeon population declines have been attributed to over-fishing, habitat losses, decreased water quality, siltation, and dams. The re-nourishment project will impact epibenthic crustaceans and infaunal polychaetes within the nearshore area that serve as potential prey items for the sturgeon. The majority of the impacts are primarily short-term in nature and consist of a temporary loss of benthic invertebrate populations. The project area constitutes a fraction of the total available forage habitat for the species. Shortnose sturgeons prefer lower salinity than pure seawater. They are capable of entering the open ocean, but hesitant to do so. Therefore, the proposed action is not likely to affect the shortnose sturgeon.

7.3 Socio and Economic Environment:

7.3.1 Socio Economic Resources.

7.3.1.1 Population. The project would have no impact to the population of Virginia Beach or the State of Virginia.

7.3.1.2 Employment / Economy. The project is not expected to impact employment or income in Virginia Beach or the State of Virginia.

7.3.1.3 Tourism / Fishing Industry. There would be short term impacts to seasonal home renters (within the project vicinity) due to the presence of construction equipment and general beach nourishment operations. However, the project will result in an enhanced beach providing visitors with continued beach related recreational activities. The numbers of renters and rental incomes have continually remained consistent in recent years (MMS, 2001). Surf fishing from the beach would be limited (within the project vicinity) during construction operations. Some fish may become entrained in the dredge at the borrow area however, the catch of these species in the dredged material is not significant to the local populations and is insignificant to the number harvested in commercial and recreational fisheries.

7.3.2 Environmental Justice. The proposed action will not result in any adverse effects on any identifiable minority or low-income communities in the city of Virginia Beach. Census data indicate that the study area itself does not contain any significant concentrations of either low-income or minority populations.

7.3.3 Military Use/Navigation. To prevent conflict between the firing exercises and dredging operations, the following coordination mechanism must be established between the contractor and the Training Center: *The contractor, when operating a dredge, barge, boat, or aircraft in Firing Area 204.52, shall enter into an agreement with the commander of the Fleet Combat Training Center prior to commencing such operations. Such an agreement would prevent undue disturbance to Training Center exercises and danger to dredging operations.* The dredging equipment and the pump-out buoys would be not located within a navigational channel. Since the submerged pipelines run along the ocean floor, boats navigating between the buoys and shoreline would not be affected by the associated disposal activities. While the presence of the pump-out buoys would be a slight inconvenience to mariners, no significant adverse impacts would occur to navigation.

7.3.4 Cultural Resources. The proposed action will have no effect on any known significant cultural resources in the subaerial project area. There are no known resources within the area along the shoreline where the sand will be placed. This is a highly erosive area that has been nourished several times previously. No effect on the Little Island Coast Guard Station is expected from the project because of the distance of the Coast Guard Station from the actual area where sand will be placed and the fact that the Station is located behind the existing dune line. All the construction activities will take place to the east of the existing dune line well beyond the building.

The offshore borrow areas have been surveyed for the presence of historical resources, and numerous anomalies were noted as a result of the 2006 survey. The unidentified magnetic anomalies listed as potentially significant in the 2007 TAR report will be avoided by all bottom-disturbing activites, including anchoring, for a minimum distance of 200 feet. Additionally, the location of the small barge in Area A and the side-scan sonar target in Area B will be avoided for a minimum distance of 500 feet. Avoidance of the two side-scan targets by 500 feet will result in the avoidance of all associated magnetic anomalies as well. Analysis of the subbottom profiler data by tidewater Atlantic Research indicated the presence of a paleochannel feature in the extreme southeastern corner of Borrow Area A. If proposed dredging operations in Borrow Area A will disturb the sediments to a depth that would intersect this feature, the dredging operations will avoid the outermost margins of the paleochannel feature by a minimum distance of 100 feet. However, with such borrow activities there is always the possibility for unexpected discoveries of historical resources. Proper procedures to address such a possibility will be included in the plans and specifications for the construction contract. This proposed action was coordinated with the Virginia Department of Historic Resources (DHR) by letter of May 12, 2008. DHR requested additional information on two aspects of the project: avoidance of the anomalies in the borrow areas and potential effects on the Little Island Coast Guard Station from project construction. After receipt of the additional information requested, DHR replied by letter dated, July 17, 2008, the project would not adversely affect historic properties.

7.3.5 Aesthetics. There will be a short term negative effect on the beach's appearance while the placement of the material on the beach takes place. The equipment used to pump the sand on the beach and contour it will present visual obstacles but they will be temporary, lasting only during the construction of the project. Slight increases in berm height will not reduce ocean views. Ultimately, the impact of the proposed project on the appearance of the beach will be positive because of the increased beach area.

7.4 Regulatory Requirements:

7.4.1 Coastal Barrier Resources Act. The project is not located within the CBRS, although Little Island City Park, considered an Otherwise Protected Areas (OPA), is within project limits. The beach park is located south of Sandbridge and north of the Back Bay Wildlife Refuge. This OPA is listed as part of Back Bay Unit VA 62-P, community number 515531. OPA designations add Federal protection to coastal barriers already held for conservation or recreation, such as national wildlife refuges, national parks and seashores, state and county parks, and land owned by private groups for conservation or recreational purposes. The only Federal funding prohibition within OPA's is Federal flood insurance. Therefore, the project is in compliance with the CBRA.

7.4.2 Coastal Zone Management Act. In accordance with the CZMA and the approved Coastal Zone Management Program of Virginia, the proposed project has been evaluated for consistency with the coastal development policies. A permit will be applied for and a consistency determination will be submitted VMRC and VDEQ. Receipt of all necessary permits will be acquired before the project begins. The permits must be approved prior to construction via Virginia's Joint permit application process.

7.4.3 Clean Water Act. Environmental concerns involving the proposed placement activities have been evaluated under the CWA and a Section 404(b)(1) evaluation report has been prepared to address impacts associated with the proposed action. Items discussed in the referenced report include temporary increases in turbidity, temporary loss of benthic communities, and temporary reduction in phytoplankton productivity. The Section 404(b)(1) evaluation is included as Enclosure 2 to this document. A public notice describing the proposed project and inviting public comment were published in the local newspaper on April 23, 2009 and a copy of the Draft EA was provided to a distribution list as part of the VMRC and VDEQ permitting requirements.

8.0 CUMULATIVE EFFECTS SUMMARY

Cumulative impacts are those impacts on the environment that result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions. This section analyzes the proposed action in context of similar and unrelated actions occurring in the vicinity of the action area. In considering potential cumulative impacts, time crowded perturbations, space crowded perturbations, indirect and synergistic impacts, and combinations thereof were evaluated. Other activities of importance occurring in the vicinity of the project area include beach recreation, coastal development, beach nourishment and navigation channel maintenance, commercial and recreational fishing, military exercises, and shipping traffic. Both beneficial and adverse cumulative impacts could occur when the impacts of the proposed action are considered in context, but the incremental contribution to impacts to air quality, avian communities, beach habitat, marine mammals and sea turtles, benthic communities, finfish and essential fish habitat, and physical processes from the proposed action are minor.

Maintenance nourishment of Sandbridge Beach is projected for approximately every 3-5 years for the next 40 years. Considered in context of past projects at Sandbridge Beach and the adjacent Dam Neck Naval Facility (7-10 year frequency), as well as past and future beach fill along the Virginia Resort Beach, almost the entire shoreline from Cape Henry south to the Back Bay National Wildlife Refuge will continue to be subject to the stresses of such activities. The impacted area would not increase, and the nature of impacts would not change. The intervening periods between nourishments generally allow for physical and biological recovery and equilibration of the subaerial beach and surf zone. Beach nourishment activities are generally considered beneficial to beach recreation, tourism, and property values, but may encourage disturbance or loss of beach, dune, and overwash habitat owing to human activities associated with coastal development. Trampling, artificial lighting, and beach erosion control (e.g., bulkheading) potentially degrade the full range of seabird and sea turtle nesting habitat and interfere with nesting, foraging, parental care, and hatchling behavior (Defeo et al., 2009). Off-road vehicle use is not common practice on Sandbridge Beach, except during construction periods. Beach fill should balance or counter those losses, replacing the dune and beach habitat that would otherwise be lost to erosion or compromised by more aggressive shoreline protection measures. With the respite between maintenance cycles, sensitive biological resources, including infaunal and epifaunal invertebrates, should substantially recover from disturbances, which include burial, reduced prey availability, and emigration (Burlas et al., 2001; Peterson and Bishop, 2005). Most sandy-beach species are adapted to severe physical disturbances, since storms are frequent along the mid-Atlantic coast. Seabirds, including protected species such as piping plovers, should benefit from the long-term nesting habitat that would certainly disappear with unmitigated coastal erosion. In general, behavior modifications and displacement from preferred nesting and foraging areas will be temporary.

Not all beach restoration projects along Virginia Beach use the same offshore borrow area, but both the Corps of Engineers and Navy use Sandbridge Shoal. The long-term use of Sandbridge Shoal requires careful resource management, as the shoal will not naturally recover the volume of sand that is dredged. The shoal's function as habitat may be adversely affected, but to date, there has been limited evidence of any sustained disturbance beyond transient and localized impacts to a wide range of benthic and pelagic biota (Diaz et al., 2006). Areas of the shoal where sediment grain-size is incompatible with nourishment grain size requirements, as well as other no-dredge areas such as the submarine cable zone, will remain undisturbed, serving as feeder zone for benthic recolonization and natural bottom habitat. Additionally, since borrow areas are not typically dredged perfectly flat relative to the adjacent seafloor, a portion of the dredge areas will remain morphologically intact.

Given the likelihood of future dredging at Sandbridge Shoal, it is important to fully consider the potential impacts of continued dredging. Incremental dredging is expected to result in decreasing wave convergence in the lee of the shoal and increasing reduction in annual net northerly sediment transport (Maa and Hobbs, 1998; Kelley and Ramsey, 2001a). To date, approximately ~6x106 m3 of OCS sand has been excavated from Sandbridge Shoal (resource evaluations suggest the Shoal may contain between 17-80x106 m3 of sand). The 2 million cubic yards of sand (~1.53x106 m3) potentially removed in this proposed action represents 9% of the most conservative volume estimate in the main shoal body (~17x106 m3), or 14% of the volume remaining in the main shoal body (~11x106 m3). Kelley and Ramsey (2001b) consider the potential wave transformation effect of dredging 3 m of sand for the equivalent extraction volume of 12.3 x106 m3 (5.3 x106 m3 at Area A and 6.9 x106 m3 at Area B). Kelley and Ramsey (2001b) estimate a maximum change (decrease) in longshore transport rates of approximately 25,000 m3/yr. The potential effect is minor in context of the inherent variability in transport potential owing to the incident wave climate, which amounts to 20 to 35% of the mean annual net transport potential (~100,000 m/yr).

Prominent shoals or broad sand bodies are often the primary target for dredging, but are also considered valuable benthic and fish habitat. The importance of sand shoal habitats to sea turtles and other sensitive biota is largely unknown. The areal extent of seafloor disturbance is governed by dredging cut depth and thickness of available sand deposits. The currently planned project is expected to impact approximately 150-300 acres of seafloor, but no more than 500 acres. These habitats are naturally dynamic and physically-dominated, making resident biota fairly resilient. The proposed action and foreseeable actions will not result in significant effects on sensitive biological resources. It is likely that recolonization of benthic fauna will occur rapidly by migration and larval recruitment (see EFH Assessment). Long-term impacts will be limited provided areas being dredged are rotated, which has been the case of the first five cycles. Cumulative impacts to EFH and finfish occur from a vast array of sources, including neighboring navigation channel dredging, and are discussed in the attached EFH Assessment (Appendix B).

The most influential of impacts on EFH, finfish, and shellfish are regulated recreational and commercial fishing activities that conduct unsustainable fishing practices and policies. Nearly one third of U.S. marine fisheries have been officially designated as overfished or nearly so; unsustainable harvesting practices reduce recruitment, decrease spawning stock, and decrease overall populations (Defeo et al., 2009). Gillnet fishing may be conducted for fish species such as the spiny dogfish and striped bass. Some bycatch is caught along with the targeted species, and this could potentially reduce the population numbers of non-targeted organisms, sublegal size fish and prey species. Many commercially-caught fish species, such as bluefish and Atlantic croaker, are caught by rod and reel or hand line. Impacts include mortality of catch released because of size limits or species prohibitions. If anchoring takes place, there may be some bottom disturbance as well. Trawl fisheries have targeted bottom fish such as grey seatrout and summer flounder or water column species such as bluefish. Traditional bottom trawls have been shown to remove bottom dwelling organisms such as brittle stars and urchins as well as polychaetes. Colonial epifauna have also been shown to be less abundant in areas disturbed by bottom trawling. This epifauna provides habitat for shrimp, polychaetes and small fish which are potential prey species for commercially desirable fish species. Seafloor areas that have been heavily trawled may bear tracks where trawl doors have gouged into the sediment, changing the sediment surface and in other areas the trawl has flattened the sediment surface reducing habitat for managed species and their prey. Traditional trawl techniques were known to be nonselective in their catch thus having the potential to reduce both prey species and year classes of managed species not yet mature. Longline fishing for species such as some coastal sharks is also expected to occur. Longlining may result in the death of some juvenile and non-target fish species. Recreational anglers have also caught designated EFH species within the vicinity of the borrow areas (i.e. bluefish, cobia, striped bas, king mackerel) via rod and reel, power trolling, and spear fishing. Mortality of some species is expected from the bycatch of non-target species and sub-legal catches. Additionally, disruption of bottom habitat can occur from the anchoring of recreational boats. Benthos and fish caught by the anchor may be destroyed. Repeated anchoring in same location can lead to patches void of benthic organisms. It can reasonably be assumed that Virginia will continue to license and permit recreational vessels and operations, which do not fall under the purview of a Federal agency. If recreational activity increases, the number moralities may continue to increase as well.

Vessel activity associated with dredging and fisheries would be added to the existing commercial shipping and naval vessel traffic using the Chesapeake Bay ports. Air emissions from the construction activities are extremely small in context of the existing point and non-point emissions that contribute to moderate air quality conditions. The impacts on water quality from beach nourishment and channel maintenance activities, including elevated turbidity and introduction of nutrients and contaminants, are short in duration and limited to the placement and dredging location. The impacts may be influenced by seasonal fluctuations in natural river and tidal inlet exchange. Routine discharges from dredge and service vessels are not expected to contribute appreciably to degraded water quality. Oil spills, although nonroutine from vessel activity, are potentially the most destructive pollution source impacting sand beaches and biological resources. Runoff from agriculture, stormwater, and other sources carry pathogens, contaminants, and excess nutrients into coastal waters (Defeo et al., 2009). These can lead to reproductive failure, deformations, mortality and contribute to locally anoxic habitats. Impacts from the nonpoint sources of pollution are expected to continue. Dredge plants and support vessels, like military, shipping, and fishing activities, may contribute to disrupted feeding, loss of prey, noise disruption, and possible collision and entrainment of finfish and sea turtles. Military activities, including ordnance testing, sonar testing, and operational exercises, may affect listed turtle and marine mammal species. Since sea turtles and pelagic fish are highly migratory, the disturbances discussed above can generally be avoided. The same species are likely to be affected by human activities throughout their geographic range. The mitigation measures considered integral to the project are adopted for the express purpose of reducing these risks.

9.0 CONCLUSION

The project will provide for a wider beach offering significant benefits in the form of storm damage reduction. Maintaining and restoring dimensions of the beach will aid in reducing shoreline erosion and provide greater storm protection, thus improving the size and quality of habitats for shoreline wildlife. Re-establishing beach habitat that supports a variety of associated flora and fauna contributes to the success and continual survival of several species such as sea turtles and shorebirds. The proposed action would have no significant environmental impacts on the existing environment. Mitigation measures, such as those specified in the referenced Biological Opinion, will be required. The implementation of the proposed action would not have a significant adverse impact on the quality of the environment, and an environmental impact statement is not required.

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12.0 REFERENCES

Ackermann, R. A. 1996. The nest environment and the embryonic development of sea turtles. In: P. L. Lutz and J. A. Musick (eds.). The Biology of Sea Turtles. CRC Press, Boca Raton, Florida. pp. 83–106.

American Cetacean Society. "Fin Whale *Balaenoptera physalus* Fact Sheet". Retrieved February 18, 2008, <http://www.acsonline.org/factpack/finwhl.htm>.

Barnard, W. D. 1978. Prediction and control of dredged material dispersion around dredging and open water pipeline disposal operations. Dredged Material Research Program Synthesis Report, TR DS-78-13, U.S. Army Engineers Waterways Experiment Station. Vicksburg, Mississippi, 114 p.

Basco, D.R., 1999. A methodology and criteria to assess the impacts of sand volume removed in federal waters on the nearshore wave climate. U.S. Department of the Interior, Minerals Management Service. OCS Report MMS 99-046, 81 pp.

Beardsley, R.C. and W.C. Boicourt, 1981. On estuarine and continental-shelf circulation in the Middle Atlantic Bight. In B.A. Warren and C. Wunch, ed. Evolution of Physical Oceanography. MIT Press, Cambridge, MA, 198–233.

Boon, J.D., 1998. Environmental studies relative to potential sand mining in the vicinity of Virginia Beach, Virginia: Part 3, nearshore waves and current observations and modeling. U.S. Department of the Interior, Minerals Management Service. OCS Report MMS 97-025, 250-293.

Buckley, P.A., & F.G. Buckley. 1981. The Endangered Status of North American Roseate Terns. Colonial Waterbirds. 4:166-173.

Buckley, P.A., & F.G. Buckley. 1984. Seabirds of the North and Middle Atlantic Coast of the United States. Pp. 101-117. In: Croxall, P.G.H. Evans, and R.W. Schreiber. Status and Conservation the World's Seabirds. International Council for Bird Preservation. Tech. Pub. No. 2. pp. 778.

Bureau of Economic Analysis, regional Economic Accounts, 2006. <http://www.bea.gov/bea/regional/reis/action.cfm>

Burlas, M., G. Ray, and D. Clarke, 2001. The New York District's Biological Monitoring Program for the Atlantic Coast of New Jersey, Asbury Park to Manasquan Section Beach

Erosion Control Project. Engineer Research and Development Center, U. S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Byrnes, M.R., R.M. Hammer, B.A. Vittor, S.W. Kelley, D.B. Snyder, J.M. Côté, J.S. Ramsey, T.D. Thibaut, N.W. Phillips, and J.D. Wood, 2003. Collection of environmental data within sand resource areas offshore North Carolina and the implications of sand removal for coastal and beach restoration. U.S. Department of the Interior, Minerals Management Service. OCS Report MMS 2000-056, Volume I: Main Text 257 pp. + Volume II: Appendices 70 pp.

City of Virginia Beach. 2002. Virginia Beach Beach Management Plan. Beaches and Waterways Advisory Commission. Retrieved March, 5 2008, <http://www.vbgov.com/file_source/dept/planning/beach_management_plan.pdf>.

City of Virginia Beach. 2007. 3rd Annual Report on the Tax Increment Financing Districts and Special Service Districts in Virginia Beach, Virginia.

City of Virginia Beach. 2008. Official Virginia Beach Economic Development Community Profile page. Retrieved January 14, 2009. <http://www.yesvirginiabeach.com>

Code of Federal Regulations. Title 50: Wildlife and Fisheries. Part 229- Authorization for Commercial Fisheries under the Marine Mammal Protection Act of 1972. Monitoring of incidental mortalities and serious injuries. 50 CFR 229.7(c).

Code of Federal Regulations. Title 50: Endangered Fish and Wildlife; Part 224- Final Rule to Implement Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales. NOAA. Final Rule Effective December 9, 2008 through December 9, 2013.

Cutter, G.R., and R.J. Diaz. 1998. Benthic Habitats and Biological Resources off the Virginia Coast, 1996 and 1997. Final Report to the U.S. Department of Interior, Minerals Management Service (MMS), under Cooperative Agreement #MMS 14-35-001-3087. Virginia Institute of Marine Sciences, College of William and Mary, Gloucester Point, Virginia.

Diaz, R. J., G. R. Cutter, Jr., and C. H. Hobbs, III, 2004. Potential impacts of sand mining offshore of Maryland and Delaware: Part 2 - biological considerations. Journal of Coastal Research, 20: 61-69.

Dickerson, C., Reine, K. J., and Clarke, D. G. 2001. Characterization of Underwater Sounds Produced by Bucket Dredging Operations. DOER Technical Notes Collection, TNDOER-E14, U. S. Army Engineer Research and Development Center, Vicksburg, MS. 17pp.

Dickerson, C., Reine, K. J., and Clarke, D. G. Dredging '02: Key Technologies for Global Prosperity. 3rd Specialty Conference on Dredging and Dredged Material Disposal Orlando, Florida, USA.

Dodd, C. K, Jr. 1988. Synopsis of biological data on the loggerhead sea turtle *Caretta caretta* (Lineaus 1758). U. S. Fish and Wildlife Service Biological Report 88: 1-110.

Dolan, R., H. Lins, and B. Hayden, 1988. Mid-Atlantic coastal storms. Journal of Coastal Research, 4, 417-433.

Epifanio, C.E. and R.W. Garvine, 2001. Larval transport on the Atlantic continental shelf of North America: a review. Estuarine, Coastal and Shelf Science, 52, 51-77.

Fritts, T.H., A.B. Irvine, R.D. Jennings, L.A. Callum, W. Hoffman, and M.S. McGehee. 1983. Turtles, Birds, and Mammals in the Nearby Atlantic Waters. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D.C. 455 pp.

Gilbert, C. R. 1990. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic Bight) -Atlantic and shortnose sturgeons. U.S. Fish and Wildlife Service Biol. Rep. 82(11.122). 28 pp.

Glass, Jon W. "Rare kind of sea turtle lays a one-of-a-kind nest." *The Virginian-Pilot*, August 5, 2005.

Gordon, R. B., D. C. Rhoads, and K. K. Turekian, 1972. The Environmental Consequence of Dredge Spoil Disposal in Central Long Island Sound: 1. the New Haven Spoil Ground and New Haven Harbor. Department of Geology and Geophysics, Yale University. 39 pp.

Greene, Karen. 2002. Beach nourishment: a review of the biological and physical impacts. Atlantic States Marine Fisheries Commission. Habitat Management Series #7, November 2002. 174 pp.

Hampton Roads Planning District Commission, 2007. <http://www.hrpdc.org/publications/techreports/Economics/2034Forecast.pdf>

Harrison,W, M.L. Brehmer, and R.B. Stone, 1964. Nearshore tidal and non-tidal currents, Virginia Beach, Virginia. U.S. Army Coastal Engineering Research Center, Technical Memorandum No. 4, 20 pp.

Hill, K. "Shortnose Sturgeon *Acipenser brevirostrum*." Smithsonian Marine Station at Fort Pierce. Retrieved April 15, 2008, <http://www.sms.si.edu/irlSpec/Acipes_brevir.htm>.

Hobbs, C.H., D.A. Milligan, and C.S. Hardaway, 1999. Long-term trends and short-term variability in shoreline change rates: Southeastern Virginia. In: Kraus, N.C. and W.G. McDougal, (eds.), Coastal Sediments 99, Proceedings of the 4th International Symposium on Coastal Engineering and Science of Coastal Sediment Processes, 1268-1283.

HowStuffWorks, Inc. "Barrier Island Habitats". Retrieved May 12, 2008. <http://www.howstuffworks.com/barrier-island2.htm>.

Kelley, S.W. and J.S. Ramsey, 2001. Cumulative impacts from dredging at Sandbridge Shoal, Virginia. Applied Coastal Research and Engineering, Contract report for the U.S. Department of the Interior, Minerals Management Service. 13 pp.

Kelley, S.W., J.S. Ramsey, and M.R. Byrnes, 2001a. Numerical wave model analysis, Sandbridge Shoal, proposed spring 2002 Sandbridge Beach, Virginia renourishment. Applied Coastal Research and Engineering, Contract report for the U.S. Department of the Interior, Minerals Management Service. 15 pp.

Kelley, S.W., J.S. Ramsey, and M.R. Byrnes, 2001b. Numerical modeling evaluation of the cumulative physical effects of offshore sand dredging for beach nourishment. U.S. Department of the Interior, Minerals Management Service. OCS Report MMS 2001-098, Volume I: Main Text 95 pp. + Volume II: Appendices 106 pp.

Kim, S.C., L.D. Wright, and B.O. Kim, 1997. The combined effects of synoptic-scale and local-scale meteorological events on the bed stress and sediment transport on the inner shelf of the Middle Atlantic Bight. Continental Shelf Research, 17(4), 407-433.

Kimball, S. and J. Dame, 1989. Geotechnical Evaluation of Sand Resources on the Inner Shelf of Southern Virginia, Virginia Institute of Marine Science.

Kimball, S., J. Dame, and C. Hobbs III, 1991. Investigation of Isolated Sand Shoals on the Inner Shelf of Southern Virginia, Virginia Institute of Marine Science.

Komar, P.D. and J.C. Allan, 2008. Increasing hurricane-generated wave heights along the U.S. East Coast and their climate controls. Journal of Coastal Research, 24(2), 479-488.

Lentz, S.J., 2008. Observations and a model of the mean circulation over the Middle Atlantic Bight Continental Shelf. Journal of Physical Oceanography, 38(6), 1203-1221.

Lentz, S.J. and J. Largier, 2006. The influence of wind forcing on the Chesapeake Bay buoyant coastal current. Journal of Physical Oceanography, 36(7), 1305-1316.

Ludwick, J.C., 1978. Coastal currents and an associated sand stream off Virginia Beach, Virginia. Journal of Geophysical Research, 83, 2365-2372.

Maa, J.P.-Y. and C.H. Hobbs, 1998. Physical impact of waves on adjacent coasts resulting from dredging at Sandbridge Shoal, Virginia. Journal of Coastal Research, 14(2), 525-536.

Maa, J.P.-Y., C.H. Hobbs, S.C. Kim, and E.Wei, 2004. Potential impacts of sand mining offshore of Maryland and Delaware: Part I- impacts on physical oceanographic processes. Journal of Coastal Research, 20(1), 44-60.

Marmorino, G.A., L.K. Shay, B.K. Haus, R.A. Handler, H.C. Graber, and M.P. Horne, 1999. An EOF analysis of HF Doppler radar current measurements of the Chesapeake Bay buoyant outflow. Continental Shelf Research, 19, 271-288.

Marine Mammal Commission. 2003. Annual Report to Congress 2002, Chapter III Species of Special Concern Humpback Whale. Bethesda, Maryland. 274 pp.

McNinch, J.E., 2004. Geologic control in the nearshore: shore-oblique sandbars and shoreline erosional hotspots, Mid-Atlantic Bight, USA. Marine Geology, 211, 121-141.

Minerals Management Service. 1997. Environmental Assessment: Issuance of a Noncompetitive Lease for Sandbridge Shoal Sand and Gravel Borrow Area (unit 1) - Sandbridge Beach Erosion and Hurricane Protection Project, Virginia Beach, VA.

Minerals Management Service. 1997. Environmental Assessment: Issuance of a Noncompetitive Lease for Sandbridge Shoal Sand Borrow Area B Sandbridge Beach Erosion and Hurricane Protection Project, Virginia Beach, VA.

Minerals Management Service. 2001. Environmental Assessment: Issuance of a Noncompetitive Lease for Sandbridge Shoal Sand Borrow Area B Sandbridge Beach Erosion and Hurricane Protection Project, Virginia Beach, VA.

Minerals Management Service. 2006. Environmental Assessment: Issuance of a Noncompetitive Lease for Sandbridge Shoal Sand (Borrow Areas A & B) Sandbridge Beach Erosion and Hurricane Protection Project, Virginia Beach, VA.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1991. Recovery Plan for U.S. population of loggerhead turtle (*Caretta caretta)*. NMFS, Washington, D.C. 64 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1991. Recovery Plan for U.S. Population of Atlantic green turtle *Chelonia mydas*. NMFS, Washington, D.C. 59 pp.

National Marine Fisheries Service. 1991. Recovery Plan for the Humpback Whale (*Megaptera novaengliae)*. Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service. Silver Spring, Maryland. 105 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service.1992. Recovery Plan for Leatherback Turtles (*Dermochelys coriacea)* in the U.S. Caribbean, Atlantic and Gulf of Mexico. NMFS, Washington, D.C. 69 pp.

National MarineFisheries Service and U.S. Fish and Wildlife Service. 1992. Recovery Plan for the Kemp's ridley sea turtle (*Lepidochelys kempii)*. NMFS, St. Petersburg, FL. 40 pp.

National Marine Fisheries Service and U.S. Fish and. Wildlife Service. 1993. Recovery Plan for Hawksbill Turtles (*Eretmochelys imbricate)* in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. NMFS, St. Petersburg, Florida. 59 pp.

National Marine Fisheries Service. 1998. Recovery plan for the blue whale (*Balaenoptera musculus*). Prepared by Reeves R.R., P.J. Clapham, R.L. Brownell, Jr., and G.K. Silber for the National Marine Fisheries Service, Silver Spring, MD. 42 pp.

National Marine Fisheries Service. 1998. Recovery Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 104 pages.

National Marine Fisheries Service. 2005. Recovery Plan for the North Atlantic Right Whale *(Eubalaena glacialis)*. NMFS, Silver Spring, MD. 137 pp.

National Marine Fisheries Service. 2006. Draft recovery plan for the fin whale (*Balaenoptera physalus*). National Marine Fisheries Service, Silver Spring, MD.

National Marine Fisheries Service. 2006. Draft recovery plan for the sperm whale (*Physeter Macrocephalus*). National Marine Fisheries Service, Silver Spring, MD.

National Marine Fisheries Service. 2007. Stock Assessments Humpback Whale (*Megaptera novaeangliae*) Gulf of Maine Stock. NOAA's Fisheries Office of Protected Resources National Marine Fisheries Service.

National Marine Fisheries Service. "Guide to Essential Fish Habitat Designations in the Northeastern United States." Retrieved April 16, 2008, <http://www.nero.noaa.gov/hcd/skateefhmaps.htm>.

Nelson, W.G. 1993. Beach Restoration in the Southeastern U.S: Environmental effects and biological monitoring. Ocean and Coastal Management, 19:157-182.

Newell, R.C., L.J. Seiderer, and D.R. Hitchcock. 1998. The impact of dredging works in coastal waters: A review of the sensitivity to disturbance and sunsequent recovery of biological resources on the sea bed. Oceanograpphy and Marine Biology: An Annual Review, 36: 127.

Oaks, R.Q., Jr., Coch, N.K., Sanders, J.E., and Flint, R.F., 1974a, Post-Miocene shorelines and sea levels, southeastern Virginia, Post-Miocene stratigraphy, central and southern Atlantic Coastal Plain. Logan, Utah State University Press.

Parr, T., D. Diner, and S. Lacy, 1978. Effects of Beach Replenishment on the Nearshore Sand Fauna at Imperial Beach, California. Miscellaneous Paper No. 78-4, U. S. Army Corps of Engineers, Coastal Engineering Research Center, Fort Belvoir,Virginia. 125 pp.

Peterson, C.H. and M. Bishop, 2005. Assessing the environmental impacts of beach nourishment. Bioscience, 55, 887-896.

Priest, W. I. 1981. The effects of dredging impacts on water quality and estuarine organisms: A literature review, Special Report in Applied Marine Science and Ocean Engineering, No. 247, Virginia Institute of Marine Science, Gloucester Point, Virginia.

Reine, K., and Clarke, D. 1998. Entrainment by hydraulic dredges - A review of potential impacts. Technical Note DOER-E1. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Spendelow, Jeffery A. "Roseate Tern Fact Sheet". U.S. National Biological Service. Retrieved April 30, 2008, <http://www.mbr-pwrc.usgs.gov/mbr/tern2.htm>.

U.S. Army Corps of Engineers.1992. Final Feasibility Report and Environmental Assessment Sandbridge, Virginia Beach, Virginia. USACE, Norfolk District.

U.S. Army Corps of Engineers, Norfolk District, 1994. General Reevaluation Report, Main Report, Environmental Assessment, and Appendixes, Beach Erosion Control and Hurricane Protection Study, Virginia Beach, Virginia.

U.S. Army Corps of Engineers. 2001. The New York Districts' Biological Monitoring Program for the Atlantic Coast of New Jersey, Asbury Park to Manasquan Section Beach Erosion Control Project. Final report. Waterways Experiment Station, Vicksburg, MS.

U.S. Fish and Wildlife Service. "Piping Plover Atlantic Coast Population". Retrieved April 30, 2008, <http://www.fws.gov/northeast/pipingplover/pdf/plover.pdf>.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1992. Recovery plan for the Kemp's ridley sea turtle (*Lepidochelys kempii*). National Marine Fisheries Service, St. Petersburg, FL. 40pp.

U.S. Fish and Wildlife Service. 1998. Roseate tern recovery plan, northeastern population, first update. Hadley, MA. 75 pp.

U.S. Fish and Wildlife Service. 1999. Fact Sheet Northeastern Beach Tiger Beetle *Cicindela dorsalis dorsalis.* Virginia Field Office, Gloucester, Virginia.

Valle-Levinson, A. and K.M.M. Lwiza, 1998. Observations on the influence of downwelling winds on the Chesapeake Bay outflow, in Physics of Estuaries and Coastal Seas, edited by J. Dronkers and M. Scheffers, A.A. Balkema, Rotterdam, 247-256.

Virginia Department of Environmental Quality. "Air Quality". Retrieved February 12, 2008, <http://www.deq.virginia.gov/air/planning/lpo.html>.

Virginia Department of Conservation and Recreation. "Natural Communities." Retrieved March, 10, 2009, http://www.dcr.virginia.gov/natural_heritage/ncEIc.shtml>.

Virginia Institute of Marine Science."Sea Turtle Nesting Behavior". Retrieved May 6, 2008, <http://www.fisheries.vims.edu/turtletracking/nestingbehavior.html>.

Waring GT, Josephson E, Fairfield-Walsh CP, Maze-Foley K, editors. 2007. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2007. NOAA Tech Memo NMFS NE 205; 415 p.

Watts, Gordon P. 2007. Archeological Remote Sensing Survey of Offshore Borrow Areas Near Sandbridge Beach, Virginia. Report to the USACE Wilmington District, under Contract No. W912HN-07-P-0034. Tidewater Atlantic Research. Washington, N. Carolina.

Weldon Cooper Center for Public Service, Demographics and Workforce Section, 2008. Population Estimates for Virginia, Localities, Planning Districts, & Metropolitan Areas: Final 2006 and Provisional 2007.

Williams, Sara, and John Gallegos, 2000. Nesting Loggerhead Sea Turtle Activity Report 2000 and 1980-2000 Nesting Summary. U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge. Prepared for the U.S. Army Corps of Engineers, Norfolk, Virginia. 26 pp.

Wright, L.D., J.D. Boon, S.C. Kim, and J.H. List, 1991. Modes of cross-shore sediment transport on the shoreface of the Middle Atlantic Bight. Marine Geology, 96, 19-51.

Wright, L.D., C.S. Kim, C.S. Hardaway, S.M. Kimball, and M.O. Green, 1987. Shoreface and beach dynamics of the coastal region from Cape Henry to False Cape, Virginia. Technical Report, Virginia Institute of Marine Science, Gloucester Point, VA, pp.116.

Wright, L.D., J.P. Xu, and O.S. Madsen, 1994. Across-shelf benthic transports on the inner shelf of the Middle Atlantic Bight during the Halloween Storm of 1991. Marine Geology, 188, 61-77.

Xu, J.P. and L.D. Wright, 1998. Observations of wind-generated shoreface currents off Duck, North Carolina. Journal of Coastal Research, 14(2), 610-619.

Figures

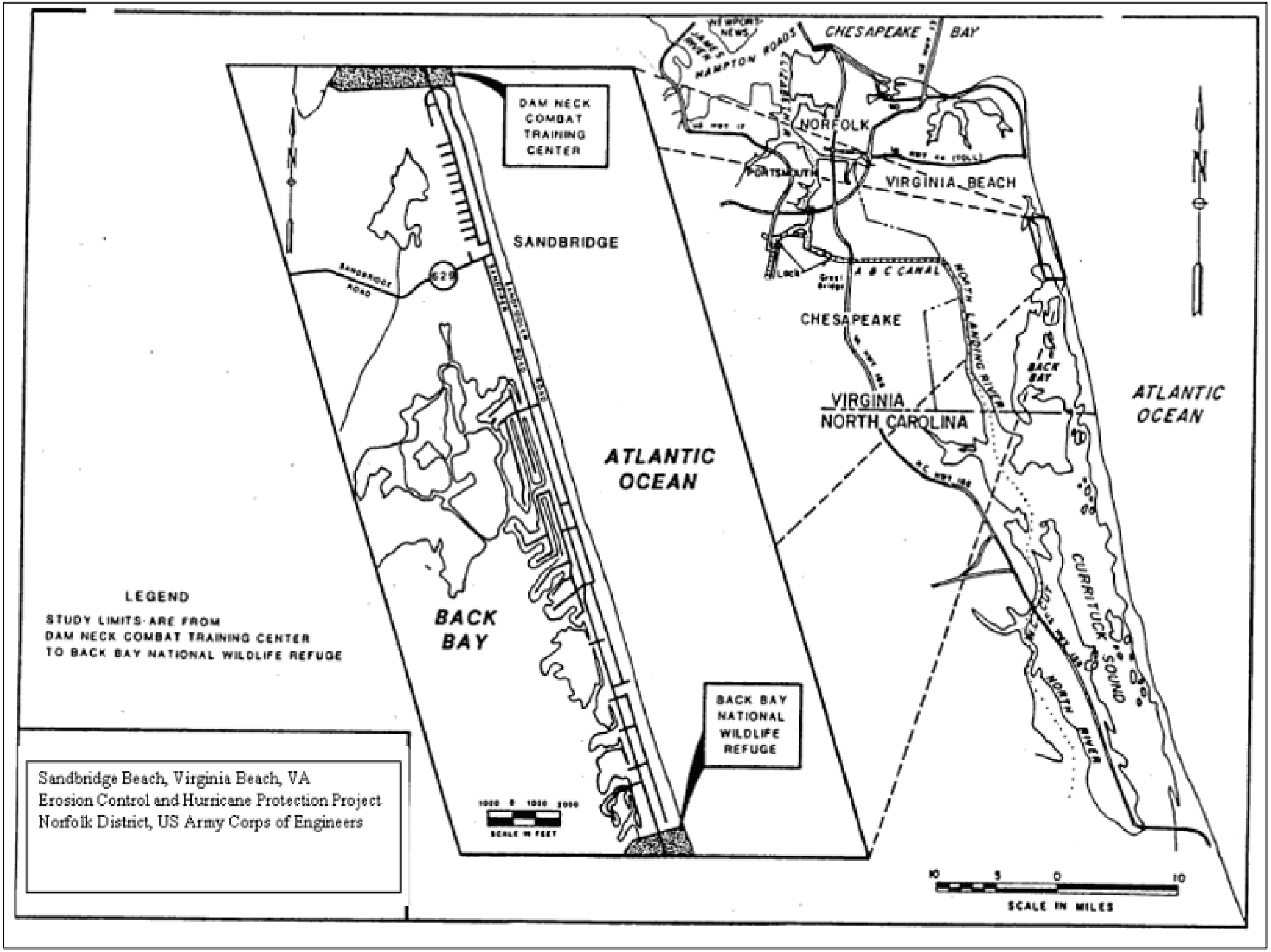

DAM NECK COMBAT TRAINING CENTER
SANDBRIDGE
ATLANTIC OCEAN
BACK BAY
BACK BAY NATIONAL WILDLIFE REFUGE
SCALE IN FEET
CHESAPEAKE BAY
HAMPTON ROADS
NORFOLK
PORTSMOUTH
VIRGINIA BEACH
A & C CANAL
CHESAPEAKE
VIRGINIA
NORTH CAROLINA
NORTH LANDING RIVER
CURRITUCK SOUND
NORTH RIVER
ATLANTIC OCEAN
SCALE IN MILES
LEGEND
STUDY LIMITS ARE FROM
DAM NECK COMBAT TRAINING CENTER
TO BACK BAY NATIONAL WILDLIFE REFUGE
Sandbridge Beach, Virginia Beach, VA
Erosion Control and Hurricane Protection Project
Norfolk District, US Army Corps of Engineers

Figure 1

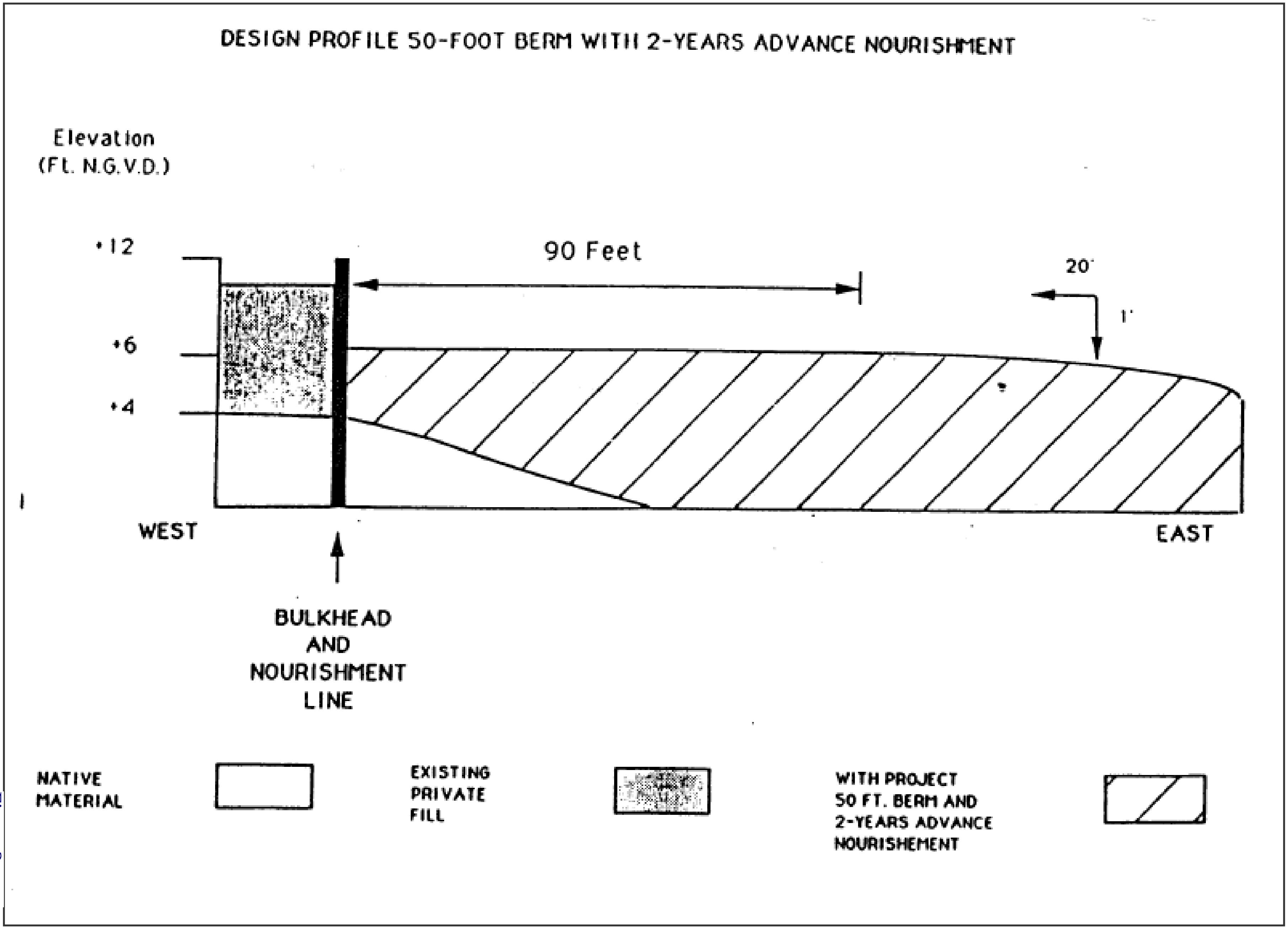

DESIGN PROFILE 50-FOOT BERM WITH 2-YEARS ADVANCE NOURISHMENT
Elevation
(Ft. N.G.V.D.)
+12
+6
+4
90 Feet
20'
1'
WEST
EAST
BULKHEAD
AND
NOURISHMENT
LINE
NATIVE
MATERIAL
EXISTING
PRIVATE
FILL
WITH PROJECT
50 FT. BERM AND
2-YEARS ADVANCE
NOURISHEMENT

Figure 2

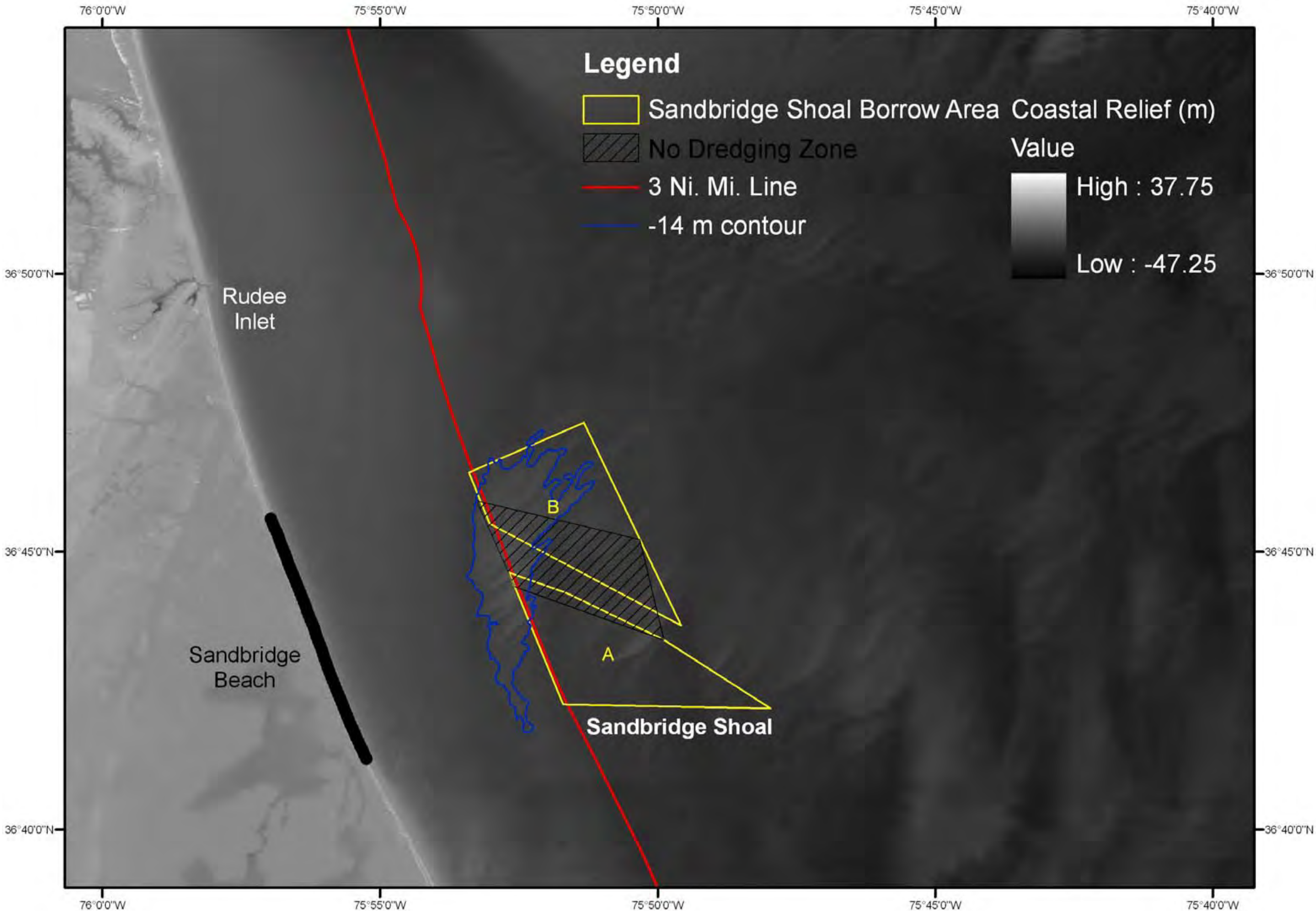

Legend
Sandbridge Shoal Borrow Area
No Dredging Zone
3 Ni. Mi. Line
-14 m contour
Coastal Relief (m)
Value
High : 37.75
Low : -47.25
Rudee Inlet
Sandbridge Beach
Sandbridge Shoal
A
B
76°0'0"W
75°55'0"W
75°50'0"W
75°45'0"W
75°40'0"W
36°50'0"N
36°45'0"N
36°40'0"N

Figure 3

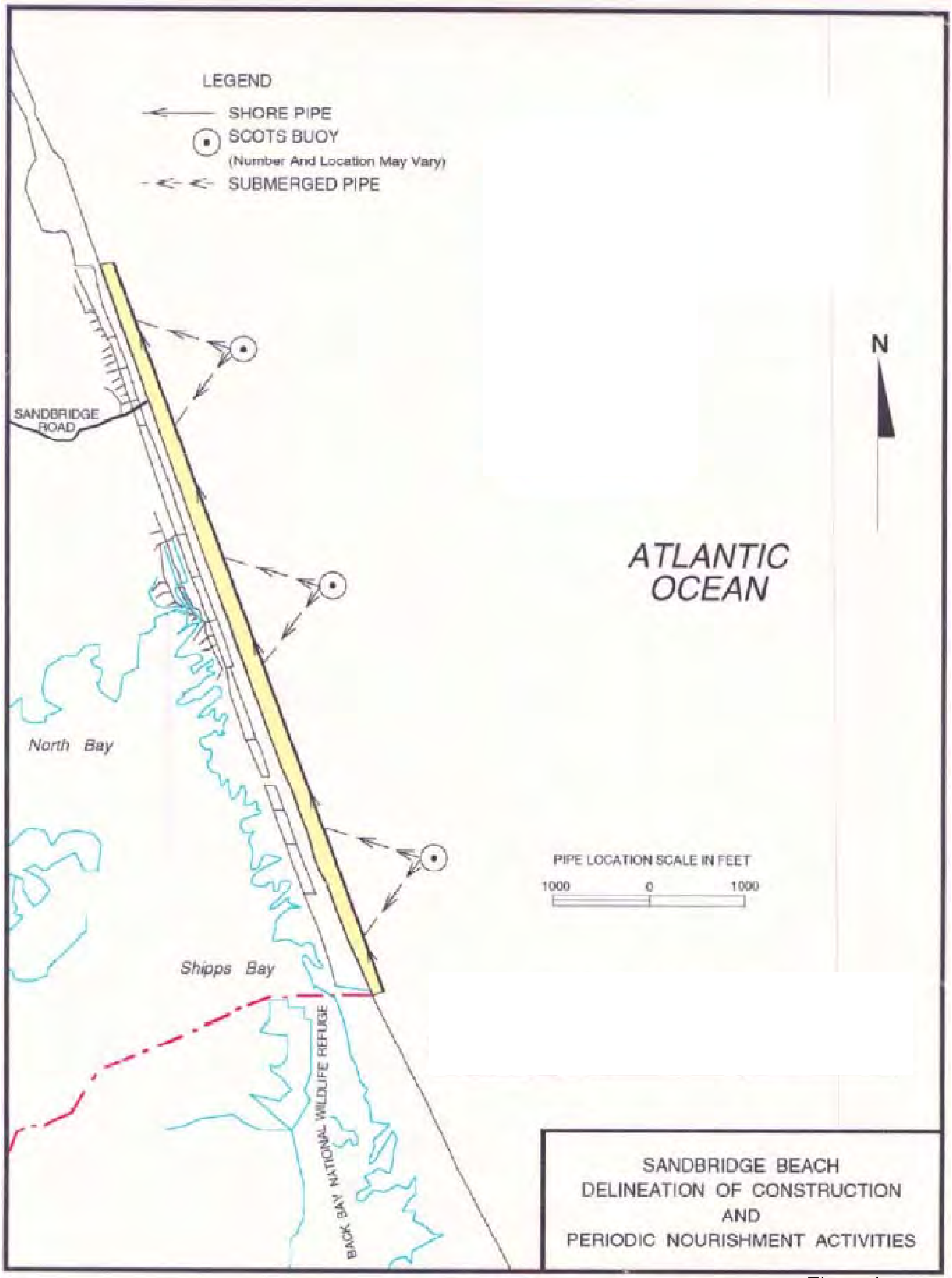

LEGEND
SHORE PIPE
SCOTS BUOY
(Number And Location May Vary)
SUBMERGED PIPE
SANDBRIDGE ROAD
N
ATLANTIC OCEAN
North Bay
Shipps Bay
PIPE LOCATION SCALE IN FEET
1000
0
1000
BACK BAY NATIONAL WILDLIFE REFUGE
SANDBRIDGE BEACH
DELINEATION OF CONSTRUCTION
AND
PERIODIC NOURISHMENT ACTIVITIES

Figure 4

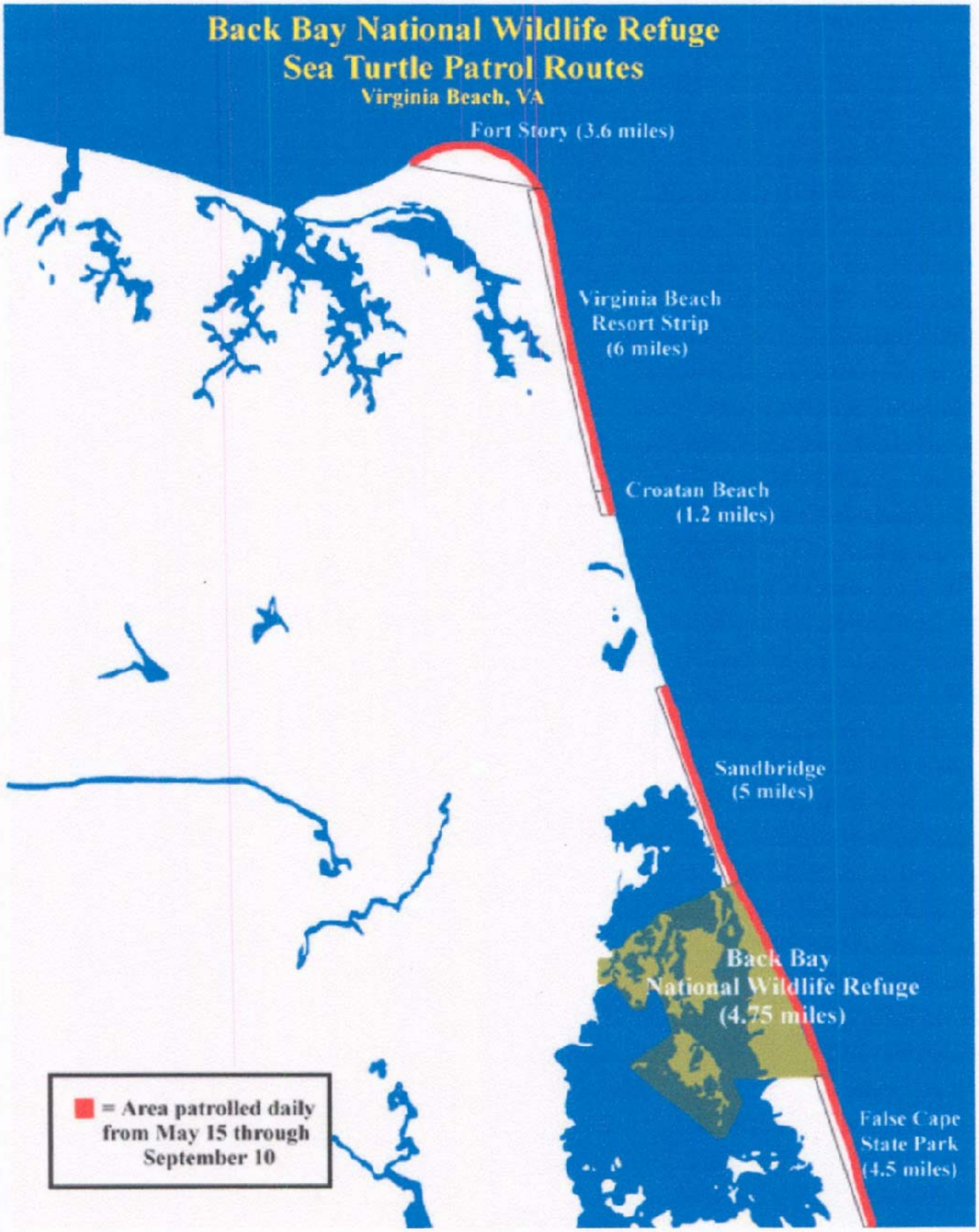
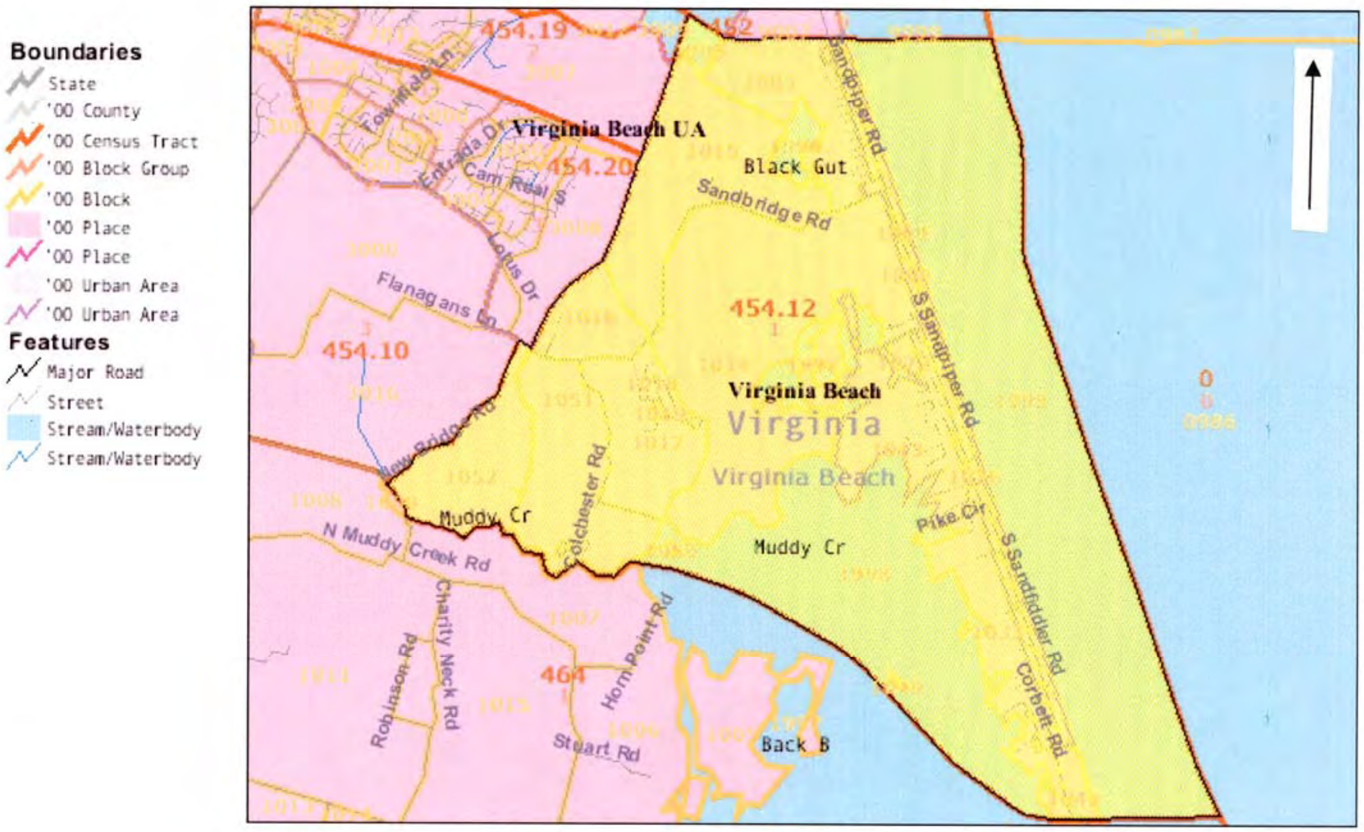

Back Bay National Wildlife Refuge
Sea Turtle Patrol Routes
Virginia Beach, VA
Fort Story (3.6 miles)
Virginia Beach
Resort Strip
(6 miles)
Croatan Beach
(1.2 miles)
Sandbridge
(5 miles)
Back Bay
National Wildlife Refuge
(4.75 miles)
False Cape
State Park
(4.5 miles)
= Area patrolled daily
from May 15 through
September 10

Figure 5

City of Virginia Beach Census Tract 454.12



7 miles across

Figure 6

Enclosures

ENCLOSURE 1
SANDBRIDGE BEACH EROSION CONTROL
AND HURRICANE PROTECTION PROJECT
VIRGINIA BEACH, VIRGINIA
SUMMARY CONSISTENCY DETERMINATION

CONSISTENCY REVIEW: Information presented in this summary consistency determination can be found in the accompanying Environmental Assessment, dated June, 2009.

PROJECT DESCRIPTION: This project will involve beach nourishment at the Sandbridge oceanfront, an area approximately 5 miles long and 125 feet wide. The specific beach area covered extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north to Back Bay National Wildlife Refuge to the south. The project dimensions include a 50-foot wide berm at an elevation of 6 feet North American Vertical Datum (NGVD) with a foreshore slope of approximately 1:20 (one vertical value to 20 horizontal) for a distance of approximately 5 miles. The designated borrow site is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea

PROPERTY CLASSIFICATION: The project would occur upon lands included in the Commonwealth of Virginia's coastal zone.

IMPACTS TO RESOURCES/USES OF THE COASTAL ZONE: See table.

DETERMINATION: Based upon evaluation of impacts analyzed in the Environmental Assessment, the Norfolk District Corps of Engineers has determined that the proposed project will be undertaken in a manner consistent to the maximum extent practicable with the Commonwealth of Virginia's Coastal Zone Management Program.

FEDERAL CONSISTENCY DETERMINATION
COASTAL ZONE MANAGEMENT ACT OF 1972, AS AMENDED
VIRGINIA COASTAL RESOURCES MANAGEMENT PROGRAM
SANDBRIDGE BEACH, VIRGINIA BEACH, VIRGINIA

Enforceable Program	Approval/Permit Obtained
1. Fisheries Management	Finfish and Shellfish: No significant impact as determined in EA. TBT Regulatory Program: No TBT possession, sale, or use related to project (N/A).
2. Subaqueous Lands Management	Encroachment upon state-owned bottom – will obtain VMRC Permit. Activity involves discharge of fill into waters of the United States – State Water Quality Certification will be obtained from DEQ. Previous VMRC Permit #01-0951 (exp. date 07/31/06) Previous DEQ Permit #90-0474 (exp. date 10/01/07)
3. Wetlands Management	No wetlands impacts (N/A)
4. Dunes Management, Coastal Primary Sand Dune Act and Coastal Primary Sand Dunes/Beaches Guidelines	No destruction or alteration of primary dunes related to this project (N/A).The site for the disposal of dredged material is determined to be suitable for beach nourishment.
5. Non-point Source Pollution Control	Implementation of BMP’s during construction.
6. Point Source Pollution Control	No VPDES impact. State Water Quality Certification under Section 401 of the Clean Water Act will be obtained. Involves discharges of fill material (sand) into waters of the United States.
7. Shoreline Sanitation	No activities related to installation of septic tanks (N/A).
8. Air Pollution Control	Although there will be minor air pollution increases from construction equipment, these increases will be short-term and below *de minimus levels*. Clean Air Act conformity determination completed in EA.

ENCLOSURE 2

SECTION 404 (b)(l) EVALUATION REPORT
SANDBRIDGE BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT
VIRGINIA BEACH, VIRGINIA

1. PROJECT DESCRIPTION.

a. **Location.** The project area is located within the city of Virginia Beach, VA. It is approximately 16 miles east of Norfolk, VA and just north of the Back Bay National Wildlife Refuge. Sandbridge Beach is located on a barrier island separating the Atlantic Ocean on the east, from Back Bay to the west. It is a residential community of mostly year round residents, rental properties and summer homes located approximately 5 miles south of Virginia Beach's "resort strip".

b. **Description of the Proposed Action.** The proposed action would involve beach nourishment at the Sandbridge oceanfront, an area approximately 5 miles long and 125 feet wide. The specific beach area covered extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north to Back Bay National Wildlife Refuge to the south. The project dimensions include a 50-foot wide berm at an elevation of 6 feet North American Vertical Datum (NGVD) with a foreshore slope of approximately 1:20 (one vertical value to 20 horizontal) for a distance of approximately 5 miles. The designated borrow site is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea. There are two designated borrow areas within Sandbridge Shoal, Area B to the north and Area A to the south; depths range from 30 to 65 feet. The area between the two borrow sites is off limits due to the presence of a buried Navy submarine communications cable. Beach quality sand would most likely be removed by trailing suction hopper dredge. The hydraulic dredge would pump the material ashore for dispersal as slurry, through a pipeline deployed on the seabed. The hopper dredge is equipped with drag heads and a hopper which collects sand. When the hopper is full, material is transported to a pump out buoy located offshore. The material would then be pumped through a discharge pipeline, which runs along the ocean floor, and up onto the beach where bulldozers and graders will distribute the material. Approximately 1.5 to 2.0 million cubic yards (cy) of beach quality sand would be placed on the beach approximately every 3 years depending upon weather conditions, availability of funding, and behavior of subsequently placed material at the project site. The cycle may occur less often, but probably no less than once every 5 years.

c. **Authority and Purpose.** Sandbridge Beach was authorized by Section 1(a) of the Water Resources Development Act of 1974 (Public Law 93-251, 93rd Congress, H.R. 10203, 7 March 1974). The purpose of the proposed action is to provide protection from erosion induced damages and also to provide limited protection to the beach and to residential structures from storm damage. The Sandbridge oceanfront is vulnerable to direct wave attack during storms when greater than normal tide levels overtop the backshore. Sandbridge Beach was last re-nourished in 2007.

d. **General Description of Dredged or Fill Material.**

(1) **General Characteristics of Material.** The borrow area is a source of high quality medium to coarse sand. It is comprised of a large, exposed deposit of sand that varies in thickness and is estimated to be approximately 96 percent sand, 1.5 percent gravel, and about 2.5 percent fines.

(2) **Quantity of Material.** Approximately 1.5 to 2.0 million cy of beach quality sand would be removed from the shoal and placed on Sandbridge Beach.

(3) **Source of Material.** The sand borrow source is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline.

e. **General Description of the Discharge Site.**

(1) **Location.** Sandbridge Beach. The specific beach area covered extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north and to Back Bay National Wildlife Refuge to the south.

(2) **Size.** The beach is approximately 125 feet wide and approximately 5 miles long. The project dimensions include a 50-foot wide berm at an elevation of 6 feet NGVD with a foreshore slope of approximately 1:20 (one vertical value to 20 horizontal).

(3) **Type of Discharge Site.** Oceanfront beach.

(4) **Types of Habitats.** The site is a barrier island separating the Atlantic Ocean from Back Bay, a shallow fresh-water sound. The sound-side is dominated by salt marsh wetland. The dune and beach habitat is located ocean side of the barrier island and has distinct segments including the backshore, foreshore, and nearshore.

(5) **Timing and Duration of Discharge.** Re-nourishment is expected to occur between 2010 and 2011 and would require several months to complete. Beach nourishment would probably occur no less than once every 5 years. Dredging for the project has historically occurred predominantly between the months of April and October to avoid winter sea conditions. Future dredging could potentially occur during any month of the year, but substantial winter dredging would be unlikely because of greater ocean wave energy and resultant higher risk to ships and crew as well as difficulty of operation. The beach re-nourishment, including mobilization, is anticipated to take approximately 3-5 months, depending on weather conditions and equipment breakdown.

(6) **Description of Disposal Methods.** Beach quality sand would be removed by either hydraulic cutterhead suction dredge or by trailing suction hopper dredge. The hydraulic dredge would pump the material ashore for dispersal as slurry, through a pipeline deployed on the seabed. The hopper dredge is equipped with drag heads and a hopper which collects sand. When the hopper is full, material is transported to a pump out buoy located offshore. The material would then be pumped through a discharge pipeline, which runs along the ocean floor, and up onto the beach where bulldozers and graders will distribute the material.

2. FACTUAL DETERMINATIONS.

a. Physical Substrate Determinations.

(1) **Substrate elevation and slope.** The horseshoe-shaped shoal is characterized as a northward and eastward thinning wedge of sand approximately 48 km^2 (157,480 ft^2) in area and up to 6 meters (20 ft) thick. Maximum relief over the ambient shelf surface is about 4 meters (13 ft).

(2) **Sediment type.** The principal sediment types associated with the Sandbridge Shoal are generally in the category of medium-grained sand. Substrate at the shoal is "clean sand" a mean grain size of 0.2 mm, with little silt or clay content. Mean grain size at the placement site ranges between 0.25 mm and 0.35 mm.

(2) **Dredged/fill material movement.** The average erosion rates for the Sandbridge shoreline range from 2 to10 feet per year. The net sediment transport is toward the north; the north literal transport is contributed by wave energy and northerly currents related to the circulation associated with the Chesapeake Bay entrance.

(4) **Physical effects on benthos.** There would be temporary disruption of the aquatic community. Non-motile benthic fauna within the project area will be lost due to proposed operations, but should repopulate within several months after dredging completion. Some of the motile benthic and pelagic fauna, such as crabs, shrimp, and fishes are able to avoid the disturbed area and should return shortly after the activity is completed. Larval and juvenile stages of these forms may not be able to avoid the activity due to limited mobility. Recovery time of the benthos within both the dredging area and the seaward surf zone is expected to be relatively rapid, although full recovery of both sites by benthos to a condition resembling pre-project conditions may take several years. Several environmental studies of beach nourishment indicate that there are no detrimental long-term changes in the beach fauna as a result of beach nourishment.

(5) **Other effects.** No other effects are anticipated.

(6) **Actions taken to minimize impacts.** The sand to be placed at the site are similar in granulometry to those that exist at the beach re-nourishment site, therefore, no further actions are deemed necessary. There will be increased, localized turbidity associated with the beach nourishment operations. Near shore turbidity impacts are directly related to the quantity of fines (silt and clay) in the nourishment material. The medium sized sand grains should allow for a short suspension time and containment of sediment during and after construction. Short-term impacts would involve increased, localized turbidity associated with dredging and disposal operations, however these impacts are expected to be minimal.

b. Water Circulation/Fluctuation, and Salinity Determination.

(1) **Water.** Dredging in the borrow site would result in some short-term negative effects, including localized increases in turbidity and slight decreases in dissolved oxygen (DO). Since the dominant substrate at the borrow site is medium-grain sand, it is expected to settle

rapidly, causing less turbidity and less oxygen demand than finer-grained (organic) sediments. Dredging within the shoal would have no significant impact on salinity, water chemistry, clarity, color, odor, taste, dissolved gas levels, nutrients, or eutrophication characteristics of the adjacent areas.

(2) **Current patterns and circulation.** Potential impacts to the physical environment from offshore sand extraction include changes to hydrodynamic and sediment transport processes, as well as the formation of short-lived turbidity plumes. Although the potential impact on shoal currents from bathymetric modification has not been explicitly modeled, near-bed current measurements show large seasonal and event-scale variability, including flow reversals. As waves move shoreward from deeper water and propagate over depth anomalies resulting from removal of material at the borrow site for nourishment, the height, direction, and other characteristics of the waves change. These transformations, called wave shoaling, refraction, reflection, and diffraction, can significantly increase or decrease the transport of sand along the shoreline, resulting in localized erosion and accretion. Although local velocities immediately downstream of dredged areas may temporarily increase (in the direction of strong along shelf flows), the magnitude of change and the size of the footprint is expected to be relatively small. Alterations of near-bed currents may result in local and short-lived changes in sediment transport pathways in the immediate vicinity of the borrow areas, but pathways are expected to return to pre-dredging conditions following infilling.

(3) **Normal water level fluctuations.** Tidal action would not be affected.

(4) **Salinity gradients.** The project would have no impact on salinity.

(5) **Actions that will be taken to minimize impacts.** No other actions that would minimize impacts on water circulation/fluctuation and salinity is deemed necessary.

c. **Suspended Particulate/Turbidity Determinations.**

(1) **Expected changes in suspended particulate and turbidity levels in the vicinity of the disposal site.** There will be increased, localized turbidity associated with the beach nourishment operations. The medium sized sand grains should allow for a short suspension time and containment of sediment during and after construction. The beachfill consists of beach quality sand of similar grain size and composition of indigenous beach sands therefore, turbidity impacts will be short-term and spatially-limited to the vicinity of the dredge outfall pipe.

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

(a) **Light penetration.** Possible short-term reduction resulting from temporary increase in turbidity.

(b) **Dissolved oxygen.** There may be slight reductions as compounds in dredged material are oxidized and nutrients are utilized by bacteria.

(c) **Toxic metals and organics.** None identified.

(d) **Pathogens.** No pathogens are expected to be released into the water column.

(e) **Esthetics.** No long-term esthetic changes will result from the proposed action.

(f) **Others as appropriate.** None identified.

(3) **Effects on biota.**

(a) **Primary production, photosynthesis.** Primary production and photosynthesis would not be significantly impacted.

(b) **Suspension/filter feeders.** No significant effects.

(c) **Sight feeders.** Shorebirds tend to be attracted to disposal sites and placement activities due to the presence of food items in the dredged material. The impact of these operations at the open-water on sight feeders is expected to be a beneficial, short-term impact.

(4) **Actions taken to minimize impacts.** No special activities are anticipated to be required to minimize impacts on biota. Material will be placed as a thin layer to promote quick recovery of benthic species.

(5) **Contaminant determination.** No significant effects. As indicated in section 2.c.(2)(c) of this evaluation concerning toxic metals and organics. The results indicated no significant contamination in the sediment or overlying water.

d. **Aquatic Ecosystem and Organism Determinations.**

(1) **Effects on plankton.** Impacts from entrainment into the dredge and because of potential turbidity during dredging are anticipated to be minor and temporary because plankton are widely dispersed throughout the area. No detrimental long-term impacts to populations are expected.

(2) **Effects on benthos.** There would be temporary disruption of the aquatic community. Non-motile benthic fauna within the project area will be lost due to the proposed operations, but should repopulate within several months after dredging completion. Some of the motile benthic and pelagic fauna, such as crabs, shrimp, and fishes are able to avoid the disturbed area and should return shortly after the activity is completed. Larval and juvenile stages of these forms may not be able to avoid the activity due to limited mobility. The overall impact to these organisms is expected to be temporary and insignificant.

(3) **Effects on nekton.** Any dredging conducted during cold weather months may entrain and destroy sluggish benthic nekton juveniles and adults. Although benthic nekton may be destroyed during cold weather months, no significant impacts to benthic nekton populations are expected because the areas proposed for dredging are not known to be exclusive areas of high

concentrations of individuals of any species. During warm weather months, juvenile and adult benthic nekton should readily be able to avoid entrainment and destruction. Nekton would be able to return to borrow areas immediately following dredging.

(4) **Effects on aquatic food web.** The aquatic food web is anticipated to be temporarily impacted to a minor degree by dredging activities. Destruction of benthos will temporarily detrimentally impact the aquatic food web for a period of months to years until benthos recolonize the borrow site. Following recovery of food resources, no long-term impact to the aquatic food web is expected. No significant effects.

(5) **Effects on special aquatic sites.** No seagrass or oyster reefs are found within the project area.

(a) **Sanctuaries and refuges.** Not applicable to this area.

(b) **Wetlands.** No wetlands would be impacted during the proposed activity.

(c) **Mud flats.** No significant effects.

(d) **Vegetated shallows.** No significant effects.

(e) **Coral reefs.** Not applicable to this area.

(f) **Riffle and pool complexes.** Not applicable to this area.

(6) **Threatened and Endangered Species.** Under Section 7 coordination of the Endangered Species Act and the Marine Mammal Protection Act, the U.S. Army Corps of Engineers (USACE), Norfolk District, requested concurrence from the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) on the proposed threatened and endangered species in the project vicinity. On April 2, 1993, the NMFS issued a Biological Opinion (BO) for the borrow area dredging and transport to Sandbridge Beach. Recent coordination with the NMFS on December 2007, concluded that the current ITS and BO remain valid for the upcoming dredging and beach nourishment operations provided Norfolk District adheres to all reasonable and prudent measures and terms and conditions as outlined in the 2001 ITS and 1993 BO. The NMFS concluded that the proposed project was likely to adversely affect sea turtles, but not likely to jeopardize the continued existence of the species.

In April 2001, the USFWS issued a letter stating that the proposed project is not likely adversely affect sea turtles and in 2002, the USFWS agreed to the Corps' request to monitor for sea turtles only on the sections undergoing beach nourishment, rather than monitor the entire Virginia Beach shoreline. Additionally, the USFWS issued letter dated, October, 10, 2008 stating if the previously mentioned protective measures are followed, the proposed action is not likely to adversely affect Federally listed or proposed species or their critical habitat.

(7) **Other wildlife.** No significant effects.

(8) **Actions to minimize impact.** To prevent entrainment of sea turtles in the dredge, each dredge will be equipped with a turtle excluder device operated in manner approved by NMFS the for this purpose.

e. **Proposed Disposal Site Determinations.**

(1) **Mixing zone determinations.** Coarse grained-sand will rapidly settle to the bottom both at the dredging site(s) and at the placement site. Depth considerations are minimal since the receiving area is a beach; current velocities will remain essentially unchanged.

(2) **Determination of compliance with applicable water quality standards.** Dredging activities will be conducted in accordance with practices utilized in adjacent state waters. Transport of dredged material will comply with state water quality standards. State water quality certification will be obtained and all conditions of that certification will be followed.

(3) **Potential effects on human use characteristics.**

(a) **Municipal and private water supply.** Not applicable.

(c) **Recreational and commercial fisheries.** Minor short-term negative impact to commercial and recreational fishery anticipated during dredging and following loss of benthos. Benthic fauna on shoals are expected to recover within several months to several years following dredging. No long-term impacts to fisheries are expected.

(c) **Water-related recreation.** No significant effects.

(d) **Aesthetics.** Aesthetics will be modified temporarily by the physical presence of the dredge during borrow activities and there will be a short term negative effect on the beach's appearance while the placement of the material on the beach takes place due to the presence of the pipe and related equipment. No significant long-term effects.

(e) **Parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves.** No effects.

f. **Determination of Cumulative Effects on the Aquatic Ecosystem.** All data and information presented suggests the dredged material placement area would have no significant cumulative adverse effects on the aquatic ecosystem.

g. **Determination of Secondary Effects on the Aquatic Ecosystem.** No significant secondary effects on the aquatic ecosystem are expected.

3. **FINDING OF COMPLIANCE:**

a. Adaptation of the Section 404(b)(1) Guidelines to This Evaluation - No significant adaptation to the guidelines was made relative to this evaluation.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem - Beach nourishment at Sandbridge was chosen as an alternative because of the demonstrated need to provide shoreline protection.

c. Compliance with Applicable State Water Quality Standards- The proposed action would not violate any applicable state water quality standards. Water quality certification will be received prior to construction. As required by the Coastal Zone Management Act, Coastal Zone Management Program of Virginia, the proposed project has been evaluated for consistency with the coastal development policies.

d. Compliance with Applicable Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act. - The proposed action would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

e. Compliance with Endangered Species Act of 1973 - The project will not significantly detrimentally impact any endangered species or its critical habitat, and is therefore in compliance with the Endangered Species Act of 1973. To avoid detrimental impacts the needs of endangered species, mitigation measures will be utilized dredging to minimize the risk of entraining and destroying sea turtles. These measures include outfitting dredges with sea-turtle deflectors, conducting dredging operations in a manner to minimize risk of sea turtle entrainment, crew training, and the use of NMFS-approved observers, when applicable.

f. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972 - No Marine Sanctuaries, as designated in the Marine Protection, Research, and Sanctuaries Act of 1972, are located within the study area.

g. Evaluation of Extent of Degradation of Waters of the United States - The proposed dredging will result in adverse impacts to benthic invertebrates at the site, although not to regional populations. The proposed project would not have significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish and shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and wildlife will not be significantly adversely affected. No significant adverse impacts on aquatic ecosystem diversity, productivity and stability, and recreation, aesthetics and economic values will occur as a result of the project.

h. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem - Appropriate steps will be taken to minimize potential adverse impacts of placing the fill material in the aquatic system. Proposed dredging guidelines and constraints were developed to minimize long-term adverse aquatic impacts, and best management practices will be utilized during dredging to minimize adverse environmental impacts.

i. On the basis of the guidelines, the proposed activities are specified as complying with the requirement of these guidelines with the inclusion of appropriate and practical conditions to minimize adverse effects to the aquatic ecosystem.

Appendix A - Biological Assessment and Biological Opinion

Supplemental Biological Assessment for the Potential Impacts to Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) Resulting from Beach Nourishment Activities at Sandbridge Beach Utilizing the Sandbridge Shoal Borrow Areas

Sandbridge Beach Nourishment and Hurricane Protection Project

FEBRUARY 2012

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1.0 Introduction

1.1 Endangered Species Act (ESA) Background

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) are ancient fish that once inhabited approximately 38 rivers along the Atlantic seaboard of the United States (ASSRT, 2007). They are generally a long lived, anadromous, estuarine dependent species that can grow up to 15 feet long (Dadswell, 2006). Atlantic sturgeon are differentiated into two sub-species: *Acipenser oxyrinchus oxyrinchus* and *Acipenser oxyrinchus desotoi*, which are commonly referred to as Atlantic and Gulf sturgeon respectively. For the purposes of this document, each sub-species will be referred to by their common name, Atlantic sturgeon (*A. oxyrinchus oxyrinchus*) or Gulf sturgeon (*A. oxyrinchus desotoi*). The northern sub-species of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) will be the focus of this document.

Over the past 30 years, several status reviews of the Atlantic sturgeon have been conducted by the National Marine Fisheries Service (NMFS). The initial status review was conducted in 1977 and the most recent status review occurred in 2007. The purpose of the status reviews was to allow the NMFS to determine the overall condition of a species and to evaluate whether the listing of a species is warranted. In 1991, the NMFS added the Atlantic sturgeon to the candidate species list (Colligan et al., 1998). Subsequently in 2004, the Atlantic sturgeon was also added to the species of concern list when clarifications were made to ESA designations (ASSRT, 2007). During the 2007 status review, the NMFS determined that the Atlantic sturgeon is comprised of five distinct population segments (DPS), and qualified as a species as defined by the ESA (ASSRT, 2007). The five Atlantic sturgeon DPS' from north to south are: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic.

In October of 2009, the NMFS received a petition to list the Atlantic sturgeon as endangered under the ESA. Another alternative mentioned in this petition was to list the Gulf of Maine and South Atlantic DPS' as threatened, with the Chesapeake Bay, New York Bight, and Carolina DPS' as endangered. The final part of this petition was to designate critical habitat for the species. The 90 day finding by NMFS in January 2010 (regarding the petition filed in late 2009) stated that the petition warranted listing action, given the information provided. This subsequently led to the proposed listing determination in October 2010 for the Gulf of Maine, New York Bight and Chesapeake Bay DPS'. A separate proposed listing determination was made simultaneously for the remaining two DPS' (Carolina and South Atlantic). The proposed listing determination in October 2010 called for endangered status for the New York Bight and Chesapeake Bay DPS' and threatened status for the Gulf of Maine DPS. This listing determination is consistent with the petition request made in October 2009.

NMFS published the final decision regarding the listing of all five DPS of Atlantic sturgeon on February 6, 2012. The NMFS declared the Chesapeake Bay DPS as endangered under ESA, the final ruling was published on February 6, 2012 in the Federal Register. The listing will officially go into effect on April 6, 2012.

The Chesapeake Bay DPS of the Atlantic sturgeon includes sturgeon spawned in rivers within the entire Chesapeake Bay and all its major tributaries from Fenwick Island (Maryland/Delaware border) to Cape Henry, Virginia (ASSRT, 2007), as well as, all marine waters including coastal bays and estuaries from the Bay of Fundy, Canada to the Saint Johns River, Florida.

1.2 Purpose

In order to comply with Section 7 of the Endangered Species Act of 1973 (as amended), all major Federal actions that may affect listed species or species proposed to be listed must consult with the NMFS. Formal consultation for the Norfolk District was initiated on May 18, 1993. A biological opinion (BO) was issued on October 6, 1993. Consultation was re-initiated on October 12, 2001 to account for greater dredging quantities, project durations, and associated impacts to listed sea turtles. A BO was issued on January 24, 2002. In letters dated January 15 and Feburary 6, 2003 the Corps requested reinitiation of consultation in recognition of the need to determine a different incidental take level. The NMFS issued its most recent Biological Opinion on July 24, 2003 and determined that the dredging activities may adversely affect but is not likely to jeopardize the continued existence of the listed species. The July 24, 2003 BO accounts for the potential impacts to loggerhead, leatherback, Kemp’s ridley, hawksbill, and green sea turtles; right, fin, and humpback whales; and shortnose sturgeon. A detailed chronology of the consultation history is documented in the July 24, 2003 biological opinion.

The purpose of this Biological Assessment (BA) is to evaluate potential impacts from borrow area dredging and transportation to the placement site on Sandbridge Beach, Virginia Beach, Virginia. This document will focus solely on the placement of dredge material at Sandbridge Beach utilizing the offshore Sandbridge Shoals borrow area as the beach material source and the Chesapeake Bay DPS of the Atlantic sturgeon. All five DPS areas overlap, Atlantic sturgeon that may originate from the any other DPS could be considered in a potential effect.

2.0 Project Description

The proposed action would involve beach nourishment at the Sandbridge oceanfront, an area approximately 5 miles long and 125 feet wide (Appendix A). The specific beach area covered extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north to Back Bay National Wildlife Refuge (NWR) to the south. The project dimensions include a 50-foot wide berm at an elevation of 6 feet North American Vertical Datum (NGVD) with a foreshore slope of approximately 1:20 (one vertical value to 20 horizontal) for a distance of approximately 5 miles. The designated borrow area is Sandbridge Shoal (Appendix A), located approximately 3 nautical miles from the shoreline, outside of Virginia’s territorial sea. There are two selected borrow areas within Sandbridge Shoal, Area B to the north and Area A to the south; depths range from 30 to 65 feet. The area between the two borrow areas is off limits due to the presence of a buried Navy submarine communications cable. Beach quality sand would most likely be removed by trailing suction hopper dredge with the possibility of using a hydraulic pipeline dredge (i.e. cutterhead) to avoid and lessen potential impacts to threatened and endangered species.

The hopper dredge is a self propelled vessel equipped with trailing suction dragheads and a hopper which collects sand. When the hopper is full, material is transported to a pump out buoy located offshore. The material would then be pumped through a pipeline, which runs along the ocean floor, and up onto the beach where bulldozers and graders will distribute the sand. There are known ordinance isues located within the Sandbridge Shoals area, UXO screening will be required for this action. This is due to training operations at the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck. Ordinances have been found in earlier dredging actions for this on-going project, see Section 5.6 and Appendix B for further information.

A hydraulic pipeline dredge uses a cutterhead to loosen or dislodge sediments to hydraulically capture the material. The slurried sediment is transported through a pipeline to the placement site. Because pipeline dredges pump directly to the placement site, they can operate continuously and can be very productive, and cost efficient and may avoid or lessen impacts to federally listed species. Once the material is placed on the beach similar construction methods are used to distribute the material properly.

The purpose of the proposed action is to provide protection from erosion induced damages including limited protection to the beach and to residential structures from storm damage. Several alternatives were considered in the feasibility phase of the project including structural, non-structural and a no action alternative. Neither one nor a combination of the other alternatives discussed provided an acceptable solution in terms of feasibility and/or economics, environmental, and technical concerns, to the existing beach erosion and hurricane protection needs, thus, eliminated from further consideration as a viable solution to coastal erosion and storm problems at Sandbridge Beach.

2.1 Authorization

The Advanced Engineering and Design Study for Beach Erosion and Hurricane Protection at Virginia Beach, Virginia, including Sandbridge Beach, was authorized by Section 1(a) of the Water Resources Development Act of 1974 (Public Law 93-251, 93rd Congress, H.R. 10203, 7 March 1974). The applicable portion of the authorizing act is as follows:

"Sec. 1(a) The Secretary of the Army, acting through the Chief of Engineers, is hereby authorized to undertake the Phase I Design Memorandum stage of advanced engineering and design of the following multi-purpose water resources development projects, substantially in accordance with, and subject to the conditions recommended by the Chief of Engineers in the reports hereinafter designated."

Middle Atlantic Coastal Area

"The project for hurricane-flood protection at Virginia Beach, Virginia: House Document Numbered 92-365, at an estimated cost of $954,000 (1974 dollars)."

The Bureau of Ocean Energy Management (BOEM) will authorize the use of sand from an OCS sand borrow area for the project under the OCS Lands Act, 43 U.S.C. § 1337(k). In 1994, OCSLA was amended to allow BOEM to convey, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for use in a program for shore protection, beach restoration, or coastal wetlands restoration undertaken by a Federal, State, or local government agency (43

U.S.C. 1337(k)(2)(A)(i)). An agreement will be negotiated between BOEM, the USACE Norfolk District, and City of Virignia Beach.

The Corps was designated the lead agency for purposes of complying with ESA requirements per 50 C.F.R §402.07 and served as the lead agency for biological consultation. The Corps notified NMFS of BOEM's involvement pursuant to 50 C.F.R §402.07.

2.2 Location

Sandbridge Beach Nourishment and Hurricane Protection Project
The beach nourishment will occur along a five mile stretch of the Sandbridge Beach between Back Bay NWR at the southern most extent (36.698017 N, -75.924196 W-WSG84 datum) and the U.S. Naval Fleet Anti-Air Warfare Training Center at the northern most extent (36.760823 N, - 75.948829 W) along the beach. The borrow areas (A and B) are located about three miles offshore at Sandbridge Shoal perpendicular to the beach nourishment reach (Appendix A). A no dredging zone separates the two borrow areas to protect underground cable lines. The coordinates for these borrow areas start at the three miles state waters boundary from east to west and are approximate as follows:

Area A: 36.7396 N, - 75.8762 W
36.7235 N, - 75.8315 W
Area B: 36.7638 N, - 75.8860 W
36.7537 N, - 75.8387 W

3.0 Proposed Action

As previously mentioned, the proposed action will utilize either a hopper style dredge or a hydraulic pipeline dredge to borrow beach quality sand from authorized sites along Sandbridge Shoals to renourish the beach at Sandbridge Beach via the placement of dredged material onto the beach. The placement will occur along a five mile stretch of beach at Sandbridge Beach essentially covering from just North of the Back Bay NWRD entrance north along the beach to the south side of the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck. Approximately 1.5 to 2.0 million cubic yards will be placed on this section of the beach for erosion control and to provide hurricane relief as requested by the non-federal sponsor, the City of Virginia Beach. The action is planned to occur from December 1, 2012 to April 30, 2013 but dependent upon timing and duration of the action dredging could possibly occur outside of this optimal window to avoid take of turtles and whales. The duration of dredging the amount of material removed from Sandbridge Shoals is dependent on several factors that include: environmental conditions, type of dredge plant utlilized, presence/absence of threatened and endangered species, funding, time of year restrictions, emergencies, and others.

4.0 Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

4.1 Description and Biology

The Atlantic sturgeon is an anadromous species that can live up to 60 years, with a maximum length of 14-18 feet (ASMFC, 1998). Atlantic sturgeon are large, subcylindrical fish with a heterocercal tail and a ventral, protrusible mouth (Gilbert, 1989). As adults, they are covered in bony plates around the head and a series of bony scutes running along the length of the body. The large size as adults and bony plates that armor the body, protect the Atlantic sturgeon from predation by most fish after about two years of age (Van Den Avyle, 1984; Colligan et al., 1998). Other than sharks and humans, the Atlantic sturgeon has few predators. Although limited information is available, Sea lampreys (*Petromyzon marinus*) and gars (*Lepisosteus* sp.) are thought to be predators of Atlantic sturgeon (Scott and Crossman, 1973; Smith, 1985). Specific information concerning competition between Atlantic sturgeon and other species over habitat and food resources is scarce. There are no known exotic or non-native species that compete directly with Atlantic sturgeon. There is a chance that some bottom forage fish may compete with Atlantic sturgeon, but these interactions have not been fully studied (ASSRT, 2007).

Both adult and juvenile Atlantic sturgeons are opportunistic benthic feeders that eat a variety of invertebrates (aquatic insects, worms, gastropods, shrimp, isopods, and amphipods), small fish, and mollusks (Van Den Avyle, 1984). Sturgeon feed by using their barbels as sensory organs and their protractile mouth to burrow around in the bottom sediments, ingesting organisms found within (Smith, 1985). The sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. As juveniles, they spend an average of 1-6 years in natal rivers before migrating out to the ocean where they remain until they mature (Smith, 1985). During this time, juveniles will forage in a wide variety of depths and locations within the estuary or natal river. Larval Atlantic sturgeons rely predominantly on zooplankton as their primary food source (Van Eenennaam et al., 1996).

Maturation and growth rates show geographic variation, with individuals in more southern systems reaching maturity and faster growth than the more northern systems (Colligan et al., 1998; Gilbert, 1989; Smith, 1985). Maturation occurs between ages 7-27 for females, and 7-24 years for males, depending on latitude (Smith, 1985; Dadswell, 2006). In general, individuals from more northerly habitats matured more slowly than those found in more southern latitudes (Gilbert 1989). Males are typically smaller in size than females at maturation. Adults can reach lengths of up to 14 feet and weigh over 800 pounds (ASSRT, 2007). Hatin et al. (2007*b*) demonstrated that as the overall length of the fish increases, so does the swimming endurance.

4.2 Population Decline

Dating back more than 120 million years to the Cretaceous period, the Atlantic sturgeon is one of 24 species in the family Acipenseridae (Bushnoe et al., 2005). Atlantic sturgeon were once abundant in every major coastal river and estuary along the Atlantic coast of North America. This abundance combined with developments in caviar preparation, fishing gear and transportation improvements created large fishing industries throughout the Atlantic coast. Sturgeon fisheries emerged from Maine to Florida, producing caviar and smoked flesh. At their peak, the combined harvest of the United States measured approximately 3,200 metric tons in 1888 (Secor, 2002). However, over harvesting, by-catch of juveniles, and lack of restocking efforts led to population crashes around the year 1900. The over harvesting by the sturgeon industry was one of the primary causes of the reduction in genetic diversity and extirpation in some areas of the Atlantic coast.

After decades of population decline, Virginia implemented a state-wide harvesting moratorium in 1974, with the Atlantic States Marine Fisheries Commission following suit with a coast-wide moratorium in 1998 (ASMFC). Despite the implementation of moratoriums at both levels, Atlantic sturgeon populations have not shown positive signs of recovery. Fisheries managers have shifted their attention to other possible reasons impacting the species.

There are a number of other factors that have led to continued declines in Atlantic sturgeon populations which includes the following: the construction of dams on spawning rivers, slow maturation, mortality due to by-catch from other fisheries, and the degradation of habitat and water quality (Van Den Avyle, 1984; Wilson and McKinley, 2004; Birstein et al., 1997). The construction of dams on spawning rivers blocked the passage for mature adults to spawning grounds (Smith, 1985; Secor, 2002). This has prevented the migration of reproducing adults to historic spawning grounds in the upper portions of the watersheds. Vessel strikes have also been known to occur, resulting in injury or death of individuals.

Another limiting habitat requirement for Chesapeake Bay DPS sturgeons may be the availability of clean, hard substrate for attachment of demersal, adhesive eggs. Rubble, cobble, and gravel size rock, as well as shell, forest litter, and submerged vegetation provide substrate for egg attachment. In the Chesapeake Bay's watershed, 18th and 19th century agricultural clear cutting contributed large sediment loads that presumably have buried or reduced most sturgeon spawning habitats. The most significant impacts to Atlantic sturgeon spawning habitat likely occurred in 1843 and 1854 when the James River, which likely supported the largest subpopulation in the Chesapeake Bay based on commercial landings, had granite outcroppings consisting of large and small boulders removed and dredged to improve ship navigation. Existing spawning habitat in the Potomac River seems to be intact, although water quality is a major concern in this system. No dredging is currently conducted within potential Atlantic sturgeon spawning areas in the Rappahannock, Potomac, York, or Nanticoke rivers. (ASSRT, 2007)

Increasing pressures from pollution, land development, and deforestation have also contributed to the decline of water quality. While sturgeon can tolerate some degradation in habitat and water quality parameters, these parameters are essential to development and spawning success. Salinity, dissolved oxygen, hydrodynamic complexity, and clean spawning gravel are most critical to spawning success (Bilkovic et al., 2009). Juvenile Atlantic sturgeon are particularly sensitive to hypoxic conditions from high nutrient loading in estuarine habitats (Secor and Gunderson, 1998). The high nutrient loading and subsequent algal blooms increase the spatial and temporal frequency of hypoxic conditions (Colligan et al., 1998). The period of Atlantic sturgeon population decline and low abundance in the Chesapeake Bay corresponds to a period of poor water quality caused by increased nutrient loading and increased frequency of hypoxia (ASSRT, 2007).

Another contributing factor involved in the population decline is the slow maturation of the species, with some females not reaching first maturity for 10 years or more (Waldman and Wirgin, 1998). Slow maturation combined with non-annual reproduction, means that the population will not rebound very quickly after a crash. Biologic and anthropogenically associated impacts over the last century have led to a substantial decline in Atlantic sturgeon populations.

There is evidence, however, that environmental conditions within the entire Chesapeake Bay ecosystem have not degraded to the point at which they can no longer support sturgeon. Water quality and habitat degradation are threats to the viability and recovery of Atlantic sturgeon and that mitigation of these stressors would likely improve or accelerate the recovery of this species within the Bay (ASSRT, 2007).

4.3 Distribution

The current range of the Atlantic sturgeon is from Labrador, Canada to Florida, United States along the Atlantic coast. It is currently estimated that there are Atlantic sturgeon populations in 36 rivers, with 18 of those having documented spawning along the Atlantic seaboard (ASSRT, 2007). Although the historic range is similar, the number of rivers and estuaries that support Atlantic sturgeon populations has declined significantly. Decades of over-harvesting, blockages of spawning rivers by dams, and other anthropogenic causes, have lead to significant population declines throughout their range (Waldman and Wirgin, 1998; Wilson and McKinley, 2004).

The Chesapeake Bay DPS of the Atlantic sturgeon includes Atlantic sturgeon originating from the entire Chesapeake Bay and all its major tributaries from Fenwick Island (Maryland/Delaware border) to Cape Henry, Virginia (ASSRT, 2007), as well as, all marine waters including coastal bays and estuaries from the Bay of Fundy, Canada to the Saint Johns River, Florida. Within this range, Atlantic sturgeon have been documented from the James, York, Potomac, Rappahannock, Pocomoke, Choptank, Little Choptank, Patapsco, Nanticoke, Honga, and South rivers as well as the Susquehanna Flats. Historical evidence suggests that several of these, including the James, York, Potomac, Susquehanna, and Rappahannock Rivers, were Atlantic sturgeon spawning rivers. However, the James River is currently the only known spawning river for the Chesapeake Bay DPS. Evidence of spawning in other rivers of the Chesapeake Bay DPS is not available, although spawning is suspected to occur in the York River based on genetics data and anecdotal reports.

The Norfolk District has documented the presence of the Atlantic Sturgeon within the lower Chesapeake Bay. During sea turtle relocation trawling conducted in fall of 2003 in conjunction with the maintenance dredging of the Thimble Shoal Channel, fourteen (14) Atlantic Sturgeon were captured and released live in and around the channel. Additionally, the incidental take of one Atlantic sturgeon on two separate dates were documented in York Spit Channel on May 25, 2005 and April 10/11 of 2011 while conducting maintenance dredging operations with a hopper dredge. See Appendix D for more information.

4.4 Habitat and Life History

Detailed information regarding adult Atlantic sturgeon habitat (including spawning habitat) preferences specific to the southern Chesapeake Bay area has not been well documented. Atlantic sturgeon basic habitat needs include a river that has connectivity to the ocean, with some deep channels, with an estuarine component and an off shore coastal shelf (Dadswell, 2006). The river/estuary system needs to provide adequate habitat, substrate, and food for the development of sturgeon through all life stages, including spawning habitat. All life stages of Atlantic sturgeon require different habitat characteristics, which also govern the distribution of the species (Wilson and McKinley, 2004).

The specific habitat areas being utilized by Atlantic sturgeon are generally small in proportion to the overall size of the river or estuary that they inhabit (Hatin et al., 2007*b*). Variations in water quality in different areas of the river or estuary can influence habitat preference, growth, feeding, and spawning activities. However habitat for non-spawning adult Atlantic sturgeon consists of specific ranges of temperatures, substrates, and depths. Non-spawning adults can be found in depths between 10-40 meters, with depths of 11-13 meters utilized for spawning (Wilson and McKinley, 2004). Most captures in marine waters occur in depths less than 50 meters.

Water temperature plays a significant role in movement, spawning, and habitat use. In several studies temperature was the most important factor in determining overall habitat selection and growth and production of juveniles (Niklitschek and Secor, 2005; Coutant, 1987). During warmer months, Atlantic sturgeon movement is slow and minimal, generally traveling less than one kilometer per day (Moser and Moss, 1995). Adults congregate in deep thermal refuges and will tend to only move upriver when the tidal salinity is higher (Kieffer and Kynard, 1993; Moser and Moss, 1995). During the cooler months, in-stream movement is more rapid and of longer duration than summer months. Juveniles will tend to move down-estuary during the warmer months and up-river during the winter (Secor et al., 2000).

In the southern Chesapeake Bay region, the beginning of spawning migrations occurs in April-May, with adults spawning approximately every 2-5 years (Smith, 1985; Van Den Avyle, 1984). The trigger to begin the spawning migration appears to be related to water temperature, with temperatures between 13.3-17.8 degrees Celsius (C) in Delaware and 21-23 degrees C in South Carolina (Smith, 1985). Spawning temperatures for the James River range between 13-26 degrees C, with spawning occurring from May to July (Bushnoe et al., 2005). For optimal spawning conditions, water temperatures should be between 13-18 degrees C (Wilson and McKinley, 2004). However, on average July water temperatures on the James River are in excess of 26 degrees C, and are too warm for successful spawning. Spawning males typically migrate up river to spawning grounds earlier and will remain in the river longer than females (ASSRT, 2007; Van Eenennaam et al., 1996). This is thought to provide males with an opportunity to fertilize multiple females.

Atlantic sturgeon spawn over hard river bottoms, utilizing gravel, rock, rubble or the solid clay surface for the adhesion of eggs (Dadswell, 2006). Spawning occurs between the salt front and the fall line, in narrow reaches of the James River. Atlantic sturgeon prefer spawning sites immediately downstream of areas with hydrodynamic complexity (Bushnoe et al. 2005). These sites are typically areas 10-12 meters deep, with fast flowing water (Smith, 1985; Scott and Crossman, 1973). Spawning locations are in areas of the river with strong currents to keep the eggs well oxygenated and free from siltation. These spawning sites are often associated with eddies or other current breaks that promote gamete fertilization, egg dispersal, and predator exclusion (Sulak et al., 2000; Bushnoe et al., 2005).

Juvenile Atlantic sturgeon are divided into early and late development classes, correlating roughly to age and size of the individual. Juveniles range from 1-6 years in age, with early juveniles having a fork length of ≤ 600 mm, and larger individuals considered older juveniles (Hatin et al., 2007*b*). Juveniles will utilize a wide variety of areas within the river/estuary system, but will migrate up or down stream dependent on the water temperature. Juveniles tend to congregate in deep holes of the lower estuary during the winter months and will migrate upriver during the warm summer months (Bushnoe et al., 2005). The preferred habitat of juvenile Atlantic sturgeon varies with age in development. The early juveniles preferred more sandy bottoms, while the older juveniles preferred a silt-clay bottom (Hatin et al., 2007*b*). Older juveniles tend to remain in freshwater conditions close to the salt wedge boundary, in areas with lower bottom current velocities and depths 6-10 meters (Hatin et al., 2007*b*). Juvenile sturgeons are thought to gradually move downstream into brackish waters, and remain resident in estuarine waters for months or years. Upon reaching a size of approximately 67-92 cm, the subadults may move to coastal waters, where they undertake long migrations (ASSRT, 2007).

4.5 Critical Habitat

Under Section 7 of the ESA, proposed critical habitat areas consist of: (1) specific areas within the geographic range of the species that contain physical or biological features (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographic range occupied by the species that are essential for the conservation of the species [ESA §3 (5)(a) and (CFR §17 and 226)].

Critical habitat designations have not been determined for this species as of the writing of this document. Although no formal critical habitat designations have been made for the southern portion of the Chesapeake Bay, it is anticipated that some portions of the Bay will be designated as critical habitat. Portions of the Chesapeake Bay may meet the definition and criteria for critical habitat as discussed in the previous paragraph. However, to date no critical habitat designations have been made and it is unlikely there would be a final rule at the time dredging occurs in Sandbridge Shoal.

5.0 Summary of the Effects of Dredging on Atlantic Sturgeon

5.1 Dredging and Placement of Dredged Material

The Sandbridge Beach Nourishment Project is typically dredged by a hopper dredge, however USACE is evaluating the use of a hydraulic pipeline dredge during this current cycle. USACE requests consultation on either dredge plant type to allow for flexibility in completing the job safely and efficiently but also to avoid potential impacts to threatened and endangered species if the dredging activity occurs outside the time restrictions provided to avoid and minimize impacts to federally listed species. Hydraulic pipeline dredges are not known to pose a significant entrainment risks to sea turtles and likely presents a minimal risks of entrainment to adult Atlantic sturgeon . Entrainment of Atlantic sturgeon during hopper dredging operations in Federal navigation channels appears to be relatively rare. More so rare for cutterhead type dredges. The USACE has documented a total of thirty-five (35) incidental takes of sturgeon species (all sturgeon species) on monitored projects for all types of dredge plant (mechanical, hydraulic pipeline, and hopper dredge). Twenty (20) of the thirty-five documented observed takes were Atlantic sturgeon incidentally taken with hopper dredge plants. Please refer to table presenting the observed sturgeon incidental takes on monitored USACE projects between 1990 and March 2012 is presented in Appendix C. USACE-Norfolk District and Baltimore District hopper dredging projects have been monitored in the Chesapeake Bay since 1994 to present. During this period approximately 17 million cubic yards of dredged material have been removed from Federal navigation channels in the lower Chesapeake Bay including the larger Thimble Shoals Channel and Atlantic Ocean Channel with only two documented Atlantic sturgeon incidental takes. Appendix C shows that there are three takes of Atlantic surgeon by cutterhead pipeline hydraulic dredgesTwo occurred in Wilmington Harbor and one occurred in the Kennebec River, the Norfolk District has not observed a take of Atlantic sturgeon during cutterhead operation. Additionally, many of these projects were conducted during the period of year when NMFS approved observers were required. Hydraulic pipeline dredges tend to be more efficient than the hopper style dredges because the pipeline conveys sand directly to the placement site. However, hydraulic pipeline dredges are not well-adapted to work in environments with high wave energy.

Hopper dredges are self-propelled seagoing vessels that are equipped with propulsion machinery, sediment containers (hoppers), dredge pumps, and other specialized equipment required to perform their essential function of excavating sediments from the channel bottom. Hopper dredges have propulsion power adequate for required free-running speed and dredge against strong currents. They also have excellent maneuverability. This allows hopper dredges to provide a safe working environment for crew and equipment dredging bar channels or other areas subject to rough seas. Hopper dredges also are more practicable when interference with vessel traffic must be minimized.

A hopper dredge removes material from the bottom of the shoal in relatively thin layers, usually 2-12 inches, depending upon the density and cohesiveness of the dredged material. Pumps located within the hull, but sometimes mounted on the drag arm, create a region of low pressure around the drag heads and forces water and sediment up the drag arm and into the hopper. The more closely the drag head is maintained in contact with the sediment, the more efficient the dredging (i.e. the greater the concentration of sediment pumped into the hopper). Hopper dredges can efficiently dredge non-cohesive sands and more cohesive silts and low density clay. The sediments routinely dredged from Sandbridge Shoal Consist mostly of variable grades of beach quality sand.

Hopper dredging is typically run along parallel transit lines along a predetermined distance along the shoal until it meets a specified stopping point. The dredge will then turn around and operate adjacent and parallel to previous transit line and continue this method until an economic load is achieved. In the hopper, the slurry mixture of the sediment and water is managed to settle out the dredged material solids and overflow the supernatant water. When an economic load is achieved, the vessel suspends dredging, the drag arms are raised, and the dredge travels to the designated placement site. Because dredging stops during the trip to the placement site, the overall efficiency of the hopper dredge is dependent on the distance between the dredging and placement sites; the more distant the placement site, the less efficient the hopper dredge.

Hopper dredging of Sandbridge Shoal has the potential to impact the Atlantic sturgeon in several ways. These impacts include the following:

1) burial, removal, and/or alteration of benthic habitat at the dredging and placement site;
2) rare potential for vessel strike while hopper dredge is moving back to borrow area
3) physical injury or death of juveniles or adults due to entrainment by the dredge;
4) physical or biological impacts to water quality via:
   - decreased dissolved oxygen levels
   - predator/prey interactions
   - primary productivity and respiration
   - loss of benthic prey species
   - noise and presence of the dredge and related equipment

Most pipeline dredges have a cutterhead on the suction end. A cutterhead is a mechanical device that has rotating blades or teeth to break up or loosen the bottom material so that it can be sucked through the dredge. Some cutterheads are rugged enough to break up rock for removal. Pipeline dredges are mounted (fastened) to barges and are not usually self-powered, but are towed to the dredging site and secured in place by special anchor piling, called spuds. To move the dredge, the operator's raises and lowers opposite spuds to crab crawl the dredge along at a much slower pace than hopper style dredges and are subsequently less maneuverable.

A hydraulic pipeline dredge removes material by controlling the dragline on which the suction cutterhead is attached. This style of dredge works more efficiently when it can move slowly and remove deeper materials as it moves along using the spuds. Material is directly mixed with water as it is sucked into the pipeline and hydraulically pumped and sent directly to the spoil disposal site. This makes this style dredge more efficient that a hopper style dredge that is required to move to a pump-out site to dispose of material. The suction is created by hydraulic pumps either located on board or in route along the pipeline acting as a booster and creates the same low pressure around the drag heads as similar to a hopper dredge to force the material along the pipeline. As with the hopper style dredge, the more closely the drag head is maintained in contact with the sediment, the more efficient the dredging.

Hydraulic pipeline dredging of Sandbridge Shoal also has the potential to impact the Atlantic sturgeon in several ways but may provide less impacts and lower incidents of take than hopper dredge. These impacts include the following:

1) burial, removal, and/or alteration of benthic habitat at the dredging and placement site;
2) rare potential for vessel strike while dredge is being moved via tug assist to and from borrow area
3) physical injury or death of juveniles and possibly adults due to entrainment by the dredge;
4) physical or biological impacts to water quality via:

- decreased dissolved oxygen levels
- predator/prey interactions
- primary productivity and respiration
- loss of benthic prey species
- noise and presence of the dredge and related equipment

5.2 Transit Area

The transit area is the area that the dredge will use when transporting material from the dredging site to the designated placement site, and then returning to the dredging area. It is important to note that the number of trips to and from the placement site will vary with each dredging event depending on the quantity and characteristic of material to be dredged and the hopper capacity of the dredge plant. This only occurs with the hopper style dredge, a pipeline will directly connect from where the hydraulic pipeline dredge is active to the placement area via the pipeline.

5.3 Benthic Impacts

Both types of dredging and dredged material placement operations have the potential to cause some alteration of benthic habitat by direct removal of the substrate through dredging or the placement of dredged material onto the tidally influenced benthic habitat of a pipeline placement area. Placing material via pipeline has the tendency to alter the substrate composition by making the benthic habitat temporarily unsuitable for certain organisms and disrupting the ecological processes. There may be direct and indirect effects on Atlantic sturgeon from these dredging operations for species that use the existing substrate and benthic habitat within the dredging and placement areas. Direct placement on the beach via pipeline is the least detrimental to the tidal benthic community. Beach placement will consist of pumping sand from Sandbridge Shoal along an approximate width of 150 to 200ft within the design parameters for an extent of just under 5 miles (27,500 feet) from Little Island north to Dam Neck, covering existing beach in mounds of sand that are spread out via bulldozer. Approximately 30% of the beach width will be tidally influenced and may be submerged during dredging.

The alteration of benthic substrate, by either direct burial or removal, can impact Atlantic sturgeon in several ways. Dredging may temporarily remove important food species inhabiting the sediments being removed. Re-colonization of the newly exposed substrate after dredging is not only a function of site-specific characteristics (i.e. bathymetry, tidal energy), but also of substrate requirements of the larvae of re-colonizing species (Rhoads and Germano, 1982). Any deviation from the existing benthic floor changes the complexion for smaller species that utilize the area for foraging, living space and as a place to take refuge from predators. Dredging will cause the short term loss of some benthic food sources, but the overall long term impact will be minor in comparison to the surrounding remaining available food sources (Van Dolah et al., 1984).

Impacts to the benthic substrate are anticipated at the dredging site but much less likely to occur in tidal waters just off the beach where placement may occur. While some negative effects are anticipated from the dredging activity, some positive impacts can also be expected. By bringing organic deposits to the benthic surface, some fish and crustacea have been shown to benefit and increase in numbers at the placement area (Johnston, 1981; Sherk, 1971). This is likely due to the introduction of nutrient rich sediment and additional food sources.

Previous studies in the upper Chesapeake Bay have demonstrated rapid recovery and resettlement by benthic biota and similar biomass and species diversity to pre-dredging conditions (Johnston, 1981; Diaz, 1994). Similar studies in the lower portions of the Chesapeake Bay produced rapid resettlement of dredging and placement areas by infauna (Sherk, 1972). McCauley et al. (1977) observed that while infauna populations declined significantly after dredging, infauna at dredging and placement areas recovered to pre-dredging conditions within 28 and 14 days, respectively. Therefore, the direct and indirect impacts to benthic communities are anticipated to be minimal. Rapid recovery and resettlement of benthic species is expected. Furthermore, since the majority of the dredging may be occurring in the winter and early spring months (December through April), whenever feasible, feeding habitats of the Atlantic sturgeon or along the shoal are expected to be light due to existing cooler water temperatures. Sturgeon generally feed when the water temperature is greater than 10°C (50°F) (Dadswell 1979 and Marchette and Smiley, 1982) and in general, feeding is heavy immediately after spawning in the spring and during the summer and fall, and lighter in the winter. The NOAA National Oceanographic Data Center (NODC) indicates that the average water temperature at the Kiptopeke, Virginia data center (approximately 27 miles north of Sandbridge Shoal) is 4.0°C (39.2°F) for the months of December through April, (http://www.nodc.noaa.gov/dsdt/cwtg/catl.html).

5.4 Entrainment

During dredging operations possible impacts to Atlantic sturgeon is the entrainment of juveniles and adults. Entrainment is defined as the direct uptake of aquatic organisms by the suction field generated at the drag head. The size and suction power of the dredge, the condition of the substrate being dredged, and the method of operation of the dredge and drag head all relate to the potential of the dredge to entrain Atlantic sturgeon (Reine and Clarke, 1998) . These parameters also govern the ability of the dredge to entrain other species of fish, sea turtles, and shellfish.

Entrainment is the most imminent danger for the sturgeon during dredge operations. Hydraulic dredges operate for prolonged periods underwater, with minimal disturbance, but generate continuous flow fields of suction forces while dredging. Entrainment is believed to occur primarily when the drag head is not in firm contact with the channel bottom, so the potential exists that sturgeon feeding or resting on or near the bottom may be vulnerable to entrainment.

Hopper type dredges may have more potential to impact Atlantic sturgeon than cutterhead pipeline hydraulic dredges because hopper dredges cover significantly more area during operation. However, the drag head for a hopper dredge is aft of the dredge. The movement of the dredge itself ahead of the drag head will allow time for finfish to disperse before the suction flow field reaches the individual(s). A hopper dredge may move up to 1 to 2 miles an hour whereas a hydraulic pipeline dredge may only move 300 feet allowing the drag head to pick up material that is falling off the sandbank as the drag head moves side to side. Atlantic sturgeon would have to move toward a hydraulic pipeline dredge whereas a hopper dredge may move into areas where Atlantic sturgeon individuals are present. Also, for maximum efficiency it is advantageous to operate the hydraulic pipeline dredges to maintain close contact with the channel bottom. This type of dredge, depending on the type of material, may bury the drag head up to 4 times the diameter of the cutterhead opening to obtain best results. The cutterhead will usually be operated to sit in one location longer and excevate deeper into the borrow site bank. Finfish can avoid entrainment by a slower moving suction pipe as it is dragged back and forth in front of the dredge while removing material.

Another factor influencing potential entrainment is based upon the swimming stamina and size of the individual fish at risk (Boysen and Hoover, 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger sturgeon is less likely due to the increased swimming performance and the relatively small size of the drag head opening. Industry and government hopper dredges are equipped with various power and pump configurations and may differ in hopper capacity with different dredging capabilities. An engineering analysis of the known hydraulic characteristics of the pump and pipeline system on the USACE hopper dredge “Essayons” (i.e. a 6,423 cy hopper dredge) indicates an operational flow rate of forty cubic feet per second with a flow velocity of eleven feet per second at the draghead port openings. The estimated force exerted on a one-foot diameter turtle (i.e. one foot diameter disc shaped object) at the pump operational point in this system was estimated to be twenty-eight pounds of suction or drag force on the object at the port opening of the draghead. A cutterhead hydraulic pipeline dredge typically have outlet pipe diameters ranging from 12 inches up to 36 inches abd usually the size of the dredge dictates this diameter as well as the diameter of the draghead. Draghead sizes are usually smaller than the outlet pipe to provide more suction and varies dependent on the size of the dredge plant. Cutterhead hydraulic pipeline dredges normally operate at a suction of 15 feet per second, dependent upon the outlet pipe diameter the cubic feet per second rate ranges from 5 to 100 cubic feet per second.

Juvenile entrainment is possible depending on the location of the dredging operations and the time of year in which the dredging occurs. Typically major concerns of juvenile entrainment relate to fish below 200 mm (Hoover et al., 2005; Boysen and Hoover, 2009). Juvenile sturgeon are not powerful swimmers and they are prone to bottom-holding behaviors, which make them vulnerable to entrainment when in close proximity to drag heads (Hoover et al., 2011).

On a hopper dredge, it is possible to monitor entrainment because the dredged material is retained on the vessels as opposed to the direct placement of dredged material by a hydraulic pipeline dredge. A hopper dredge contains screened inflow cages from which an observer can inspect recently dredged contents.

Although the possibility of entrainment exists, the Sandbridge Shoal offshore feature is large, approximately 10,948 acres in size. A cutterhead hydraulic pipeline dredge normally moves slowly and covers a smaller area than a hopper dredge but cuts deeper into the substrate. Based on conversations with Great Lakes Dredging Co. they state that they would typically take 10 feet of bank at the 35 to 45 foot contours when working offshore at shoaling areas. The Norfolk District has yet to determine the amount of area impacted but will be significantly less than if a hopper dredge were to perform the work. Atlantic sturgeon will have the ability to leave the dredging area once dredging operations commence. A 4-year fish entrainment study at the mouth of the Columbia River in Oregon concluded that it is unlikely that anadromous fishes are entrained in significant numbers by dredges, at least outside of constricted river areas (Larson and Moehl, 1990). Therefore, entrainment is more likely to occur in constricted waterways where the distribution of fish is in closer proximity to the dredge. The Sandbridge Shoal is located just offshore in the Atlantic Ocean with considerable deep open-water areas surrounding it. Two large designated borrow areas (A and B) are approximately 3,846 and 3,432 acres in size, respectively. Also, portions of the shoal are restricted from dredging, a no-dredging corridor

(3,670 acres) splits the two proposed dredging sites and can provide additional undisturbed habitat during dredging operations that would occur in either Area or B but not concurrently.

The National Marine Fisheries Service's (NMFS) biological opinion (BO) for impacts of the Army Corps of Engineers Norfolk District's dredging in Sandbridge Shoal dated April 2, 1993 and supplemented in 2001, established incidental take levels and reasonable and prudent measures necessary to minimize the incidental take of the sea turtles. Since both the sea turtle and the Atlantic sturgeon spend a significant amount of the time on or near the bottom, it is assumed that the existing required measures will also minimize the incidental take of sturgeon that may be traversing the shoal. For mostly sea turtles and the right whale, the Corps must take the following actions in addition to some other reasonable and prudent measures as stated in the BO:

If dredging occurs between May 1 and November 30, hopper dredges must be equipped with the rigid deflector draghead as designed by the ACOE Waterways Experiment Station (WES), or if that is unavailable, a rigid sea turtle deflector attached to the draghead. Deflectors should be checked and/or adjusted by a designated expert prior to a dredge operation to ensure proper installment and operation during dredging. The deflector should be checked after every load throughout the dredge operation to ensure the proper installation is maintained. Since operator skill is important to the effectiveness of the WES-developed draghead, operators must be properly instructed in its use. Sea turtle deflectors are only utilized on hopper dredges and are rigid V-shaped attachments on the front of the dragheads and are designed and intended to plow the sediment in front of the draghead. The plowing action creates a sand wave that rolls in front of the deflector. The propagated sand wave is intended to shed the turtle away from the deflector and out of the path of the draghead. The effectiveness of the rigid deflector design and its ability to reduce entrainment was studied by the USACE through model and field testing during the 1980s and early 1990s. The deflectors are most effective when operating on a uniform or flat bottom. However, the deflector effectiveness may be diminished when significant ridges and troughs are present that prevent the deflector from plowing and maintaining the sand wave and the dragheads from maintaining firm contact with the channel bottom. Deflectors used to minimize entrainment of sea turtles likely provide equal or greater protection to Atlantic sturgeon. Atlantic sturgeon in the Chesapeake Bay and Atlantic Ocean environment may be more capable and powerful swimmers than sea turtle species and may be more likely to avoid physical interactions with the deflectors and dragheads and subsequent entrainment.

Cutterhead hydraulic dredges are not know to impact sea turtles to the degree that hopper dredges do and haven't merited the amount of investigation, design, and approval of a deflector. Currently cutterhead hydraulic dredges contain screening attached to the draghead which prevent entrainment of sea turtles. Adult Atlantic sturgeon swimming performance is to a higher degree than sea turtles and should be provided ample time to avoid the screen, especially with a lower suction force of 15 feet per second.

1. If dredging occurs during the period of May 1 through November 30, the ACOE must adhere to the attached "Monitoring Specifications for Hopper Dredges" with trained NMFS-approved sea turtle observers, in accordance with the :Observer Protocol" and "Observer Requirements" (BO Appendix A). NMFS-approved observers will be required on hopper dredges during the period of May 1 through November 30 of any year

to monitor hopper spoil, overflow, screening and dragheads for sea turtles and their remains.

2. The Norfolk District ACOE shall ensure that all contracted personnel involved in operating hopper dredges receive thorough training on measures of dredge operation that will minimize takes of sea turtles. Training shall include measures discussed in Apendix A of BO. It shall be the goal of each hopper dredging operation to establish operating procedures that are consistent with those that have been used during hopper dredging in other regions of the coastal United States, and which have proven effective in reducing turtle/dredge interactions. It is unlikely that sea turtles will survive entrainment in a hopper dredge, as the turtles found in the dragheads are almost always dead, dying, or dismantled. However, a few have escaped hopper dredges without apparent injuries. A sub-adult loggerhead was removed from dredge gear unharmed in Savannah, Georgia and an occasional small green turtle has been known to survive (Slay 1995, Magnuson et al. 1990). The procedures for handling live sea turtles are outlined in case the unlikely event should occur. All permit holders must follow the sea turtle handling techniques specified in BO Appendix A-II-E and Appendix B.
3. A final report summarizing the results of the dredging and any takes of listed species must be submitted to NMFS (at the address specified in BO Appendix A) within 30 working days of completion of each cycle of the project.
4. Vessels must comply with the ESA 500-yard approach regulations for right whales. To minimize risks from vessel operations around other listed, the dredge vessel should not intentionally approach listed species closer than 100 yards when in transit. When species are present, vessels should, except when precluded by safety requirements, follow the advice of the onboard NMFS-approved observer to avoid collisions.
5. If listed species are present during dredging or material transport, vessels transiting the area should post watch, avoid intentional approaches closer than 100 yards (or 500 yards in the case of right whales) when in transit, and reduce speeds to below 4 knots.
6. If the take of loggerhead sea turtles approaches 2/3 of the permitted incidental take level (i.e. 3 turtles) during any project cycle, the ACOE should immediately contact NMFS at (978) 281-9388 to review the situation and determine whether any new management measures should be implemented to prevent the total incidental take level from being reached.

In April 2011, there were four documented takes of Atlantic sturgeon during the maintenance dredging of York Spit Federal Navigation Channel. However, two of the takes were believed to be portions from one individual Atlantic sturgeon, and the other two takes were portions from another individual sturgeon. Therefore, it appears from the observer documentation there were only two takes of Atlantic sturgeon during this dredging operation. These takes were the first documented incidental takes through entrainment of Atlantic sturgeon in the Chesapeake Bay. It can only be speculated why these takes occurred, but as with sea turtles, utilizing hopper dredges has the potential to impact the Atlantic sturgeon during the actual dredging activity through entrainment or other physical interactions with drag heads when sturgeon are present and on the shoal bottom. However, the use of the required measures of the above mentioned biological opinion should aid in the minimization of entrainment of the Atlantic sturgeon during dredging operations.

In the case that a hydraulic pipeline dredge is utilized it is noted in the Thimble Shoals Channel and Atlantic Ocean Biological Opinion, issued 4/25/02, page 5 (8 of 86) under "Description of the Proposed Action":

"The NMFS has previously determined that the use of mechanical and hydraulic dredging equipment other than hopper dredges is not expected to result in direct or indirect effects to sea turtles or marine mammals. " It would be difficult to monitor for entrainment of Atlantic sturgeon using a cutterhead hydraulic pipeline dredge. Observers could be placed at the outlet pipe to inspect for evidence of Atlantic sturgeon if any individual sturgeons are entrained. NMFS has previously suggested a cage or screen at the outlet pipe, this could further assist a biological monitor to ascertain take.

5.5 Dredging Impacts Related to Water Quality

Short term impacts to Atlantic sturgeon from dredging are primarily related to the impacts to water quality from increased turbidity. Since dredging agitates and resuspends bottom sediments, it is anticipated that impacts to the benthos would involve displacement of non-motile benthic organisms to the placement area either in the tidal waters along shore (hopper dredge) or actually on shore (hydraulic pipeline dredge).

The increased turbidity and suspended sediments related to the dredging and placement activities are anticipated to have short term, temporary impacts to water quality. Placement of sand at the designated beach nourishment site will be via hydraulic pipeline. Sand will be deposited directly on the beach and graded to profile. Fine particles that may be present in the sand borrow area will be transported along with the carrier water back and dispersed in the swash zone. The hydraulic pipeline placement occurs on the beach and would provide less direct impacts to water quality and levels will be attenuated through current and tidal fluctuations.

Some of the more common impacts to fish and their habitats include destruction of benthic communities, loss of prey species, and temporary impacts to water quality. As referenced in the Essential Fish Habitat Assessment for Gloucester Harbor, Massachusetts (Maguire Group Inc. 2001), the extent of the impact depends on hydrologic processes, sediment texture and composition, chemical content of the sediment and pore water matrices, and the behavior or life stages of the species. The dredging activities at Sandbridge Shoal and Sandbridge Beach may affect the sturgeon through temporary impacts to water quality, including potential decreases in dissolved oxygen concentrations and increases in turbidity and sediment loads.

A typical dredging cycle for beach renourshment usually lasts about 3 to 4 months depending upon the required type of dredging activities and condition of the borrow area and placement areas. The temporary increase in sediment loading within the water column at the dredging and placement areas has the potential to directly impact demersal species, such as the Atlantic sturgeon. Deposition of suspended sediments may induce impacts to demersal eggs and larvae through deposition and or smothering, especially in the dredging and placement areas (Johnston, 1981). There are no anticipated impacts to Atlantic sturgeon eggs and/or larvae because the designated borrow area and placement site are not located within known spawning grounds of the sturgeon. Although other demersal species may be impacted initially, long-term impacts are not anticipated after dredging operations cease. The high flushing rate, small area of impact, and implementation of certain operational controls on the dredge will minimize impacts to non-motile demersal organisms.

Physical and biological impairments to the water column can occur from increases in turbidity which can alter light penetration. The proposed dredging project will cause temporary increases in turbidity and suspension of sediments during dredging operations. As a result, the increase in turbidity can impact primary productivity and respiration of organisms within the project area. The re-suspension of sediments from dredging and dredged material placement can prevent or reduce gas-water exchanges in the gills of fish (Germano and Cary, 2005; Clarke and Wilber, 2000). The amount of impact that this can have on a species is dependent on the sensitivity of that species. This increase in turbidity can also impact prey species' predator avoidance response ability due to the decreased clarity in the water column.

Another component of water quality that may be affected by dredging is the reduction in dissolved oxygen. Low dissolved oxygen conditions can be generated by the dredging operations from the resuspension of sediments and the biochemical oxygen demand of the surrounding water (Johnston, 1981). This can be particularly important during the summer months when water temperatures are warmer and less capable of holding dissolved oxygen. Dredging during the warmer months can exacerbate low dissolved oxygen conditions (Hatin et al., 2007*a*). The intended timing of the dredging period will be mostly restricted to the winter months where average water temperatures are between 40 and 50 degrees Fahrenheit (4.4 to 10 degrees Celcius).

Overall, water quality impacts are anticipated to be minor and temporary in nature. Once dredging operations are complete the project area will soon return to ambient conditions due to the dilution or re-deposition of suspended sediments along with the strong littoral currents of the Chesapeake Bay and Atlantic Ocean.

5.6 Unexploded Ordnance

The United States Army Environmental Command (USAEC) defines unexploded ordnance (UXO) as military munitions that have been (1) primed, fused, armed or otherwise prepared for action; (2) fired, dropped, launched, projected, or placed in such a manner to constitute a hazard to operations, installations, personnel, or material, and (3) remain unexploded either by malfunction, design, or any other case. UXO comes in many shapes and sizes, may be completely visible or partially or completely buried, and may be easy or virtually impossible to recognize as a military munitions. UXO can be found on top of the ground, or partially or completely buried in the ground or by vegetation, sand or snow, in or under high grass or bushes; under water, in lakes or streams or, even, the ocean. UXO may look like a bullet or bomb, or be in many pieces, but even small pieces of UXO can be dangerous.   If disturbed, (touched, picked up, played with, kicked, thrown, etc) UXO may explode without warning, resulting in serious injury or even death.

The Sandbridge Shoal occurs in known locations associated with past and current military activities and has produced UXO during dredging operations. The presence of ordnance in dredged material presents two unique challenges. First, it poses a potential explosive safety hazard to dredging or observer personnel and potential damage to equipment and vessel. Second, any subsequent beneficial use of sand must also address the possibility of the presence of ordnance presence and/or its removal. The presence of UXO was documented during the previous Sandbridge Hurricane Protection Projects constructed in 2002 and 2007. Over one-hundred UXO were recovered during dredging operations and were transported to and properly disposed of at an undisclosed naval installation. A picture of a portion of the recovered UXO from the 2002-2003 operation is attached in Appendix B.

On April 1, 2006, the Dredge Padre Island operated by the Great Lakes Dredge & Dock Company was conducting maintenance dredging activities in the Atlantic Ocean Channel when it suffered a ruptured dredge clean out section and severed drag head as a result of an explosion presumed to be from ordnance device that was pumped into the drag head and associated lines. Unexploded ordnance had been previously retrieved from the drag head on three different occasions in February 2006. During the last dredging cycle of the AOC in February 2011, it was documented that UXO was encountered four times, mostly 5-inch shells, two of which were determined to be live ordnance. A UXO device was also presumed to be the cause of an explosion on a hydraulic cutter-head dredge conducting maintenance dredging in Norfolk Harbor in April 2005 rupturing the primary pump casing on the dredge. The Coast Guard rendered assistance to the dredge plant to provide additional pump-out capacity for the incoming water and stabilize the plant. Recent dredging of the Cape Henry Channel, which is located approximately 3 or less miles north of the Thimble Shoal Channel, documented UXO in the observer cages on April 15, 2011. Fortunately, in most incidents ordnance has not detonated and has been safely removed or jettisoned from the vessel.

As a result of the damage sustained on the Dredge Padre Island by the exploded ordnance in April 2006, the Corps had to require the installation of screens on the dragheads to prevent any further entrainment of UXO. On January 31, 2007, the Corps requested that the requirement for observers to be onboard be waived for the 2007 maintenance dredging for the Sandbridge Beach Nourishment Project which had previously documented and retrieved UXO from sand borrow areas. The waiver was requested because the installation of special screening on the drag head would preclude sea turtles from becoming entrained in the drag head and prevent any sea turtles or sea turtle parts from being observed on inflow cage screening. The NMFS responded by letter dated February 7, 2007, and agreed that the installation of the screening on the drag head would prevent sea turtles from becoming entrained in the drag head. NMFS stated it was not necessary to have an observer onboard to inspect for sea turtle parts and agreed to the Corps request to remove the observer requirement for the previous 2007 dredging project. Furthermore, the NMFS stated that removal of the observer requirement did not alter the conclusions reached in the 1993 Opinion and 2001 revisions.

As a safety precaution, since large and small caliber UXO may be encountered in Sandbridge Shoal during dredging operations, the Corps will install the special intake screening to be permanently placed over the drag head to effectively prevent any UXO from entering the hopper and/or being subsequently placed within the associated placement site as done in previous cycles.

Use of UXO/MEC screening is not expected to result in impacts to sea turtles species or Atlantic sturgeon beyond those already considered and accounted for in the existing biological opinion. The screening may prevent lethal entrainment or injury in some instances. However, the Norfolk District cannot conclusively determine or state that an incidental take of a sea turtle or sturgeon species will not occur. Physical interactions with the draghead combined with suction forces (i.e. mass flow of water and sediment) could result in the impingement of a sea turtle species or Atlantic sturgeon on the UXO/MEC screening and result in injury or lethal take of a sea turtle or sturgeon species. This type of potential interaction cannot be ruled out; but there are no known instances of impingement or entrainment with UXO/MEC screening. Suction flow rates and flow velocities are not significantly impacted or reduced by UXO/MEC screening devices. Use of this special UXO/MEC screening is not common and is normally limited to projects with known ordnance issues.

Special intake screening for UXO is typically specified and installed to prevent entrainment of any material greater than 1-1/4 inches in diameter. Typical allowable openings are 1-1/4 inches x 6 inches. The use of special UXO/MEC screening may require coordination with NMFS during each dredging cycle. The installation of the special intake screen on the drag head would likely preclude Atlantic sturgeon from becoming entrained in the drag head, and it will also prevent any sturgeon or sturgeon parts from being observed. However, it should be noted while the special screening prevents entrainment it may not prevent the incidental take of a sea turtle or sturgeon. The suction forces exerted by larger class hopper dredges are not diminished while using the special intake screens and may result in injury or death to individuals that cannot avoid the zone of influence of the suction. Since the safety of personnel aboard the dredge and the vessel itself is the highest priority, the UXO screens may be necessary at all times while dredging in Sandbridge Shoal, but the Corps recognizes that this will preclude any observation of potential incidental takes.

If a hydraulic pipeline dredge is utilized, special intake screening may also be installed on the cutterhead in the borrow area as well as special outfall screening installed in the pipe at the placement area. Screening devices are available from companies like Dredging Supply Company Inc. (DSC). DSC has developed a sizing screen that attaches inside the cutter basket near the suction mouth. This device effectively screens out the oversized material while greatly reducing the wear caused. As the suction screen passes by the suction mouth, oversized material is held against the screen by vacuum created by the dredge pump. As the rotation of the suction screen moves the oversized particle away and to the side off the suction mouth, the loss of vacuum allows the particle to fall away and subsequently behind the cutter head. The screen can be custom tailored to any dredge pump or plant requirement. See Appendix C for pictures of this device.

5.7 Presence and Noise from Dredging Operations

The impact to Atlantic sturgeon from dredging equipment and the associated noise has not been well documented. However, at the time of the writing of this document, available studies demonstrate no impact to behavior, spawning, feeding, or movement of any Atlantic sturgeon within the vicinity of active dredging operations (Moser and Ross, 1995). Moser and Ross

(1995) concluded that Atlantic sturgeon showed no difference in habitat preference or behavior between the dredged and undisturbed areas during dredging operations. The conclusions are consistent with USACE studies conducted on the James River with active dredging operations. The findings of this study showed no change in behavior or movement as a result of an active dredge operating within close proximity to radio-tracked Atlantic sturgeon (unpublished USACE, 2009).

5.8 Dredge Vessel Collisions

The Atlantic sturgeon juveniles tend to congregate in deep holes of the lower estuary during the winter months and will migrate upriver during the warm summer months (Bushnoe et al., 2005). Older juveniles tend to remain in freshwater conditions close to the salt wedge boundary, in areas with lower bottom current velocities and depths 6-10 meters (Hatin et al., 2007*b*). Juvenile sturgeons are thought to gradually move downstream into brackish waters, and remain resident in estuarine waters for months or years. Upon reaching a size of approximately 67-92 cm, the subadults may move to coastal waters, where they undertake long migrations (ASSRT, 2007). The preference of lower estuary and coastal waters of older juvenile and adult Atlantic sturgeon increases the potential for dredge interactions. Contact injuries are more likely to occur when the hopper dredge is moving within the transit area since the dredge will be moving at faster speeds than during dredging operations, particularly when empty while returning to the borrow area. The transit area is the area that the dredge will use when transporting material from the dredging site to an established pump-out location and then returning to the dredging area. The dredge speed can reach approximately 10-12 knots during transits to and from the borrow site.

Hydraulic pipeline dredges are usually mobilized under tug assistance to and from the project area. However once a hydraulic pipeline dredge is set up at a project area it moves very slowly, advancing on a system of spuds and anchor wires and may advance only a few hundred feet per day depending on the depth of the dredge-cut (i.e. borrow).

Due to the vast width of Chesapeake Bay and the Atlantic Ocean, the likelihood of vessel strikes is anticipated to be minimal. It is unlikely that anadromous fishes are entrained in significant numbers by dredges, at least outside of constricted river areas (Larson and Moehl, 1990). Therefore, it stands to reason that vessel strikes are more likely to occur in more constricted waterways where the distribution of fish is in closer proximity to the dredge. Daily contact with other commercial, military, or recreational vessels in these channels is more likely to occur than with the dredging vessel due to their limited operation schedules; however the possibility of vessel strikes cannot be disregarded.

5.9 Environmental Consequences of the Proposed Action

Beach nourishment activities have occurred in the Mid Atlantic for decades, authorization for these projects began as early as the 1970s nationwide. Some dredging methodologies may impact the benthic communities and/or fish species more than others, hopper dredges have more potential to impact than a hydraulic pipeline dredge but that doesn’t preclude the latter from causing impacts. With any method of dredging and placement some disturbances to the benthos will occur. However, depending on the method of dredging, some measures can be implemented to minimize disturbances to the environment. Offshore dredging is typically conducted via hopper dredge due to its ability to operate in strong currents and maneuver in rough seas and the distance to authorized placement areas. Impacts to the environment are minimized via the implementation of the best management practices and adherence to existing biological opinion protocol.

5.10 Cumulative Effects Analysis

The Sandbridge Beach Nourishment project is one of many beach nourishment projects ongoing along the Mid Atlantic Coast. The U.S. Army Corps of Engineers is responsible for administering these projects to provide hurricane and other related storm protection. In order to provide sand quantities needed for adequate storm protection, dredging and beach placement must occur in preparation for large storm events that regularly visit the Mid Atlantic.

Dredging of Sandbridge Shoal will be carried out in the same designated borrow areas, with approximately the same volumes of material being dredged and placed in the previously utilized reaches of Sandbridge Beach. The average amount of material removed from the shoal is approximately .5 to 2.0 million cubic yards. This dredging activity at Sandbridge will be conducted in a manner which will minimize impacts to Atlantic sturgeon.

6.0 Reasonable and Prudent Measures to Minimize Impacts

In order to minimize impacts to the Atlantic sturgeon during dredging operations at the Sandbridge Shoal, the Corps will take every reasonable and prudent measure to minimize impacts to this species and any other species traversing the shoal. During the sea turtle migration window from May 1 to November 30 of any given year, all dredge drag heads will be equipped with a Corps approved sea turtle deflector which is designed to minimize entrainment of turtles, with the assumption that this mechanism will push any Atlantic sturgeon out the path of the drag head, as well. In the past, the Norfolk District has been successful in scheduling the hopper dredging of these channels during low risk periods when the sea turtle numbers are presumed to be low or absent from the project area. It is assumed that the presence of Atlantic sturgeon in the project area during the winter months will be low due to migrating adults and decreased foraging activity. Anadromous fish migrations upriver typically occur from February to June of any given year. Therefore, every effort will be made to conduct hopper dredging activities during winter months. However, it is important to note that the dredging of Sandbridge Shoal for beach nourishment is dependent upon funding and dredge availability. Therefore, scheduling or limiting dredging to only winter months is not always feasible.

Furthermore, due to the high probability that UXO is present at Sandbridge Shoal, the drag heads may have to be equipped with special intake screens to prevent any entrainment of UXO into the dredge, thus preventing the observation of an incidental take. Other methods to minimize potential of entrainment to sturgeon and sea turtles may be utilized, as approved by NMFS, such as closed and open trawling relocation. Open trawling or non-capture trawling may be studied in the near future to evaluate equipment designs and protocols to ensure the effectiveness of its use on the species. Trawling can be an alternative for observing take for a cutterhead pipeline hydraulic dredge, unfortunately this is very expensive. The screening developed by DSC may totally eliminate the need for observers because of the way it completely prevents entrainment of anything larger than a few inches in length and also how it is able to reduce the suction force as described in the last paragraph of Section 5.6. Any proposed use of new methods will be coordinated and approved by appropriate environmental agencies as their development evolves.

Dredging and placement activities will be conducted in a manner to minimize impacts to water quality to the maximum extent practicable. Temporary impacts to water quality can be expected during dredging operations. However, once complete, the project area will soon return to ambient conditions of the Atlantic Ocean. Other measures to minimize impacts involve implementation of best management practices.

7.0 Conclusions

During a given year, adult and juvenile Atlantic sturgeon are likely to be present at Sandbridge Shoal. While juveniles will use portions of the Chesapeake Bay and Atlantic Ocean, there will be locations more frequently used depending on their habitat needs during that stage in development. Adults may utilize this area as well, but would more commonly be found in the upper reaches of tributary rivers during spawning months or out in the ocean. Eggs and young juvenile fish are not likely to inhabit the open ocean environment including Sandbridge Shoal. As a result, the likelihood of early life stages being present at Sandbridge Shoal during dredging activities is minimal. There is a greater likelihood of adult sturgeon being present. Their potential presence will depend mostly on the time of year and associated water temperatures.

This dredging operation will have some minor impacts on water quality and benthic organisms inhabiting the dredging and/or placement areas. These dredging related impacts are not anticipated to affect the short or long term survival of the Atlantic sturgeon. The dredging activity may affect the species' ability to visually avoid predators and experience a temporary loss of prey organisms at the dredging site. Other water quality impacts may include lower dissolved oxygen levels at the dredging site and placement area, and minor impacts to respiration and primary productivity due to elevated turbidity at the dredging and placement area. Water quality impacts to sturgeon present in the dredging and/or placement area will be temporary and minor due to the mobility of the species to avoid impacted areas of the shoal and the natural variation in ambient conditions in the bay and ocean. The loss of benthic organisms inhabiting the dredging and/or placement areas will be temporary due to the rapid recolonization upon completion of the project.

In summary, the information contained in this BA is based on currently available historical information, a review of current literature and studies. The Norfolk District believes that by utilizing existing reasonable and prudent measures for minimizing dredge takes of sea turtles and employing other best management practices, the dredging and related placement activities associated with the Sandbridge Nourishment project may adversely affect the Atlantic sturgeon, but is not likely to jeopardize the existence of this species. The Norfolk District seeks your concurrence in the finding of our agency.

8.0 References

ASMFC (Atlantic States Marine Fisheries Commission). 1998. Amendment 1 to the Interstate Fishery Management Plan for the Atlantic sturgeon. Fishery Management Report No. 31. 42 pp.

ASSRT (Atlantic Sturgeon Status Review Team). 2007. Status Review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). Report to National Marine Fisheries Service, Northeast Regional Office. February 23, 2007. 174 pp.

Bain, M., N. Haley, D. Peterson, J.R. Waldman, and K. Arend. 2000. Harvest and habits of Atlantic sturgeon *Acipenser oxyrinchus* Mitchill, 1815 in the Hudson River estuary: lessons for sturgeon conservation. Boletín Instituto Español de Oceanografía 16:43-53.

Bilkovic, D.M, Angstadt, K. and D. Stanhope. 2009. Atlantic Sturgeon Spawning Habitat on the James River, Virginia: Final Report to NOAA/NMFS Chesapeake Bay Office. Virginia Institute of Marine Science, Gloucester Point, Virginia.

Birstein, V.J., Bemis, W.E. and J.R. Waldman. 1997. The threatened status of acipenseriform species: a summary. Environmental Biology of Fishes 48: 427-435.

Bushnoe, T. M., Musick, J.A. and D.S. Ha. 2005. Essential spawning and nursery habitat of Atlantic sturgeon (*Acipenser oxyrinchus*) in Virginia. Provided by Jack Musick, Virginia Institute of Marine Science, Gloucester Point, Virginia.

Clarke, D. G., and Wilber, D. H. 2000. Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Colligan, M., Collins, M., Hecht, A., Hendrix, M., Kahnle, A., Laney, W., St. Pierre, R., Santos, R., and Squiers, T. 1998. Status Review of Atlantic sturgeon *(Acipenser oxyrinchus oxyrinchus).* U.S. Department of the Interior and U.S. Department of Commerce.

Coutant, C.C., 1987. Thermal preference: when does an asset become a liability? Environmental Biology of Fishes 18:161-172.

Dadswell, M.J. 1979. Biology and population characteristics of the shortnose sturgeon, *Acipenser brevirostrum* LeSueur, 1818 *(Osteichthyes: Acipenseridae),* in the Saint John River estuary, New Brunswick, Canada. Canadian Journal of Zoology 57:2186-2210.

Dadswell, M.J. 2006. A Review of the Status of Atlantic Sturgeon in Canada, with comparisons to populations in the United States and Europe. Fisheries 31(5) 218-228 pp.

Diaz, R.J. 1994. Response of tidal freshwater macrobenthos to sediment disturbance. Hydrobiologia 278: 201-212.

Dovel, W.L. and T.J. Berggren. 1983. Atlantic sturgeon of the Hudson estuary, New York. New York Fish and Game Journal 30(2): 140-172.

Germano, J. D., and Cary, D. (2005). "Rates and effects of sedimentation in the context of dredging and dredged material placement," *DOER Technical Notes Collection* (ERDC TN-DOER-E19), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Grogan, C.S. and J. Boreman. 1998. Estimating the Probability that Historical Populations of Fish Species are Extirpated. North American Journal of Fisheries Management 18(3): 522-529.

Hatin, D., Lachance, S., D. Fournier. 2007*a*. Effect of Dredged Sediment Deposition on use by Atlantic Sturgeon and Lake Sturgeon at an Open-water Disposal Site in the St. Lawrence Estuarine Transition Zone. American Fisheries Society Symposium 56:235-255.

Hatin, D., Munro, J., Caron, F., and R. Simons. 2007*b*. Movements, home range size, and habitat use and selection of early juvenile Atlantic sturgeon in the St. Lawrence estuarine transition zone. American Fisheries Society Symposium 56:129-155.

Hoover, J.J., Boysen, K.A., Beard, J.A., and H. Smith. 2011. Assessing the risk of entrainment by cutterhead pipeline hydraulic dredges to juvenile lake sturgeon (*Acipenser fulvescens*) and juvenile pallid sturgeon (*Scaphirhynchus albus*). Journal of Applied Ichthyology 27:369-375.

Hoover, J.J., Killgore, K.J., Clarke, D.G., Smith, H., Turnage, A., and Beard, J. 2005. Paddlefish and sturgeon entrainment by dredges: Swimming performance as an indicator of risk. DOER Technical Notes Collection (ERDC-TN-DOER-E22), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Johnston Jr., S.A. 1981. Estuarine Dredge and Fill Activities: A Review of Impacts. Environmental Management 5(5): 427-440.

Kieffer M.C. and B. Kynard. 1993. Annual Movements of Shortnose and Atlantic Sturgeons in the Merrimack River, Massachusetts. Transactions of the American Fisheries Society 122:1088-1103.

Larson, K. and Moehl, C. 1990. "Fish entrainment by dredges in Grays Harbor, Washington". Effects of dredging on anadromous Pacific Coast fishes. C.A. Simenstad ed., Washington Sea Grant Program, University of Washington, Seattle. 102-12 pp.

LaSalle, M.W. 1990. Physical and chemical alterations associated with dredging. C.A. Simenstad editor. Proceedings of the workshop on the effects of dredging on anadromous Pacific coast fishes. Washington Sea Grant Program, Seattle. 1-12 pp.

Magnuson, J.J., J. A. Bjorndal, W.D. DuPaul, G.L. Graham, D.W. Owens, C.H. Peterson, P.C.H. Prichard, J.I. Richardson, G.E. Saul, and C.W. West. 1990. Decline of Sea Turtles: Causes and Prevention. Committee on Sea Turtle Conservation, Board of Environmental Studies and

Toxicology, Board on Biology, Commission of Life Sciences, National Research Council, National Academy Press, Washington, D.C. 259 pp.

Maguire Group, Inc. 2001. Essential Fish Habitat (EFH) Assessment. Gloucester Harbor, Massachusetts. Prepared for: Massachusetts Coastal Zone Management by: Maguire Group, Inc. December.

Marchette, D.E. and R. Smiley. 1982. Biology and life history of incidentally captured shortnose sturgeon, *Acipenser brevirostrum*, in South Carolina. South Carolina Wild. Mar. Res. Inst. 57 pp.

McCauley, J.E., Parr, R.A. and D. R. Hancock. 1977. Benthic Infauna and Maintenance Dredging: A Case Study. Water Research 11: 233-242.

Moser, M.L. and S.W. Ross. 1995. Habitat use and Movements of Shortnose and Atlantic Sturgeons in the Lower Cape Fear River, North Carolina. Transactions of the American Fisheries Society 124:225-234.

Murdy, Edward O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of the Chesapeake Bay. Smithsonian Institution Press, Washington, D.C. USA.

National Marine Fisheries Service. 1993/2001. Biological Opinion and Supplemental Incidental Take Statement for the USACE Norfolk District's Sandbridge Beach Nourishment and Hurricane Protection Project . U.S. Department of Commerce, National Oceanic and Atmospheric Administration. 36pp.

National Marine Fisheries Service. 2002. Biological Opinion for the USACE Norfolk District's Maintenance Dredging of the Thimble Shoal and Atlantic Ocean Channels. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. 83pp.

Niklitschek, E.J. and D.H. Secor. 2005. Modeling spatial and temporal variation of suitable nursery habitats for Atlantic sturgeon in the Chesapeake Bay. Estuarine, Coastal and Shelf Science 64:135-148.

Reine, K., and Clarke, D. 1998. Entrainment by hydraulic dredges–A review of potential impacts. Technical Note DOER-E1. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Rhoads, D.C. and J.D. Germano. 1982. Characterization of Benthic Processes Using Sediment Profile Imaging: an Efficient Method of Remote Ecological Monitoring on the Seafloor (REMOTS System). Marine Ecology Process Series 8:115-128

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada Bulletin 184:966 pp.

Secor, D.H. 2002. Atlantic Sturgeon Fisheries and Stock Abundances during the late Nineteenth Century. American Fisheries Society Symposium 28:89-98.

Secor, D.H., E. Niklitschek, J.T. Stevenson, T.E. Gunderson, S. Minkkinen, B. Florence, M. Mangold, J. Skjeveland and A. Henderson-Arzapalo. 2000. Dispersal and growth of yearling Atlantic sturgeon *Acipenser oxyrinchus* released into the Chesapeake Bay. Fish. Bull. 98: 800-810.

Secor, D.H. and T.E. Gunderson. 1998. Effects of hypoxia and temperature on survival, growth, and respiration of juvenile Atlantic sturgeon, *Acipenser oxyrinchus*. Fishery Bulletin 96 (3) 603-613.

Sherk, J.A. 1972. Current Status of the Knowledge of the Biological Effects of Suspended and Deposited Sediments in Chesapeake Bay. Chesapeake Science, vol. 13, Supplement: Biota of the Chesapeake Bay pp. S137-S144.

Sherk, J.A. 1971. Effects of suspended and deposited sediments on estuarine organisms. Chesapeake Biological Laboratory, University of Maryland. Contribution No. 443.

Slay, C.K. 1995. Sea turtle mortality related to dredging activities in the southeastern U.S.: 1991. Richardson, J.I. and T.H. Richardson (compilers). Proceedings of the Twelth Annual Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-361, pp. 132-133.

Smith, T.I.J. 1985. The fishery, biology, and management of Atlantic sturgeon, *Acipenser oxyrhynchus*, in North America. Environmental Biology of Fishes 14(1) 61-72.

Sulak, K.J., M. Randall, J.P. Clugston, and W.H. Clark. 2000. Critical Spawning Habitat, Early Life History Requirements, and Other Life History and Population Aspects of the Gulf Sturgeon in the Suwannee River. Gainesville, Florida. 106 pp.

Van Den Avyle, M.J. 1984. Species profiles: life histories and environmental requirements (South Atlantic) – Atlantic sturgeon. U.S. Fish Wildl. Ser. FWS/OBS-82/11.25. U.S. Army Corps Engineers, TR EL-82-4 17 pp.

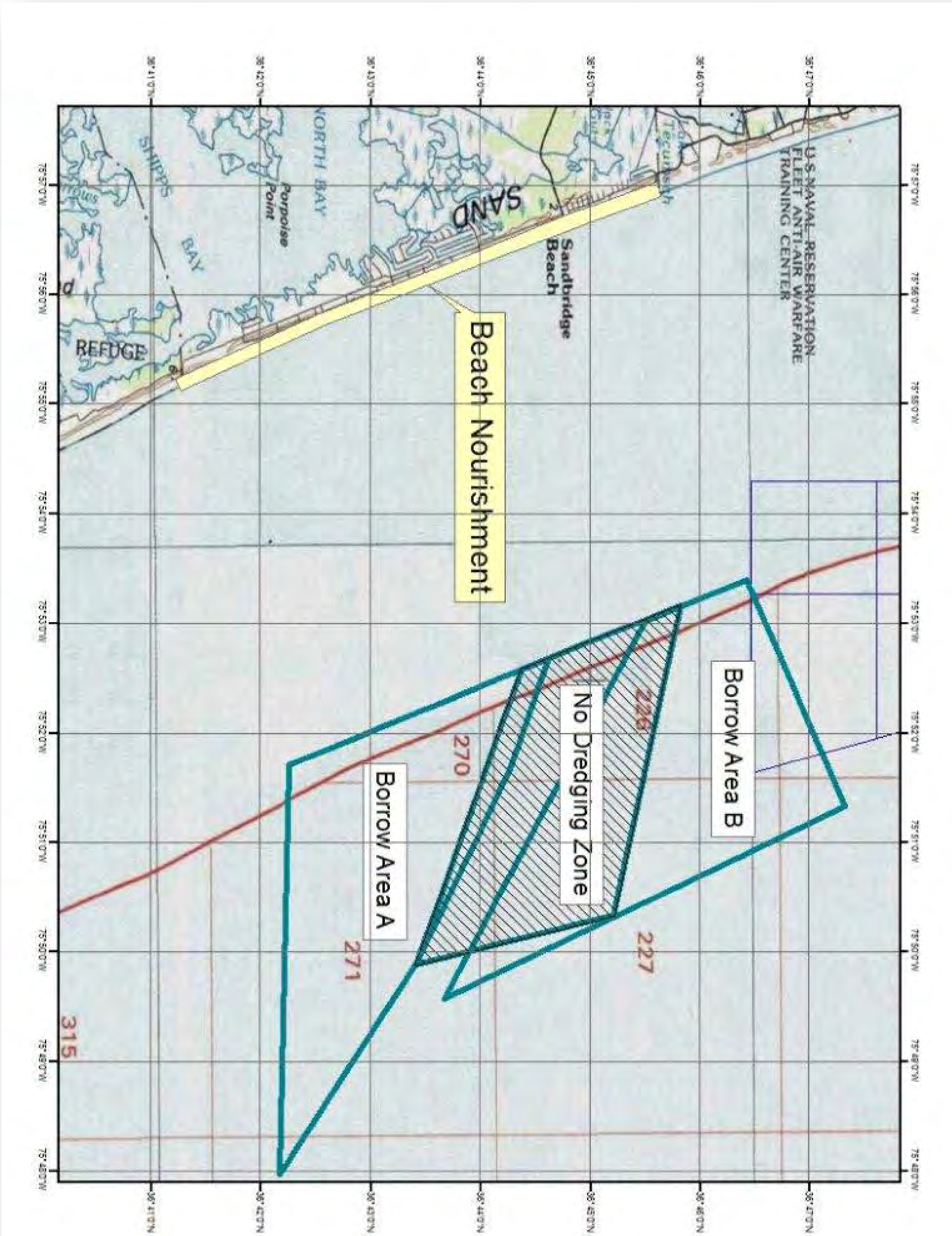
Van Dolah, R.F. D.R. Calder, D.M. Knott. 1984. Effects of Dredging and Open-Water Disposal on Benthic Macroinvertebrates in a South Carolina Estuary. Estuaries 7(1): 28-37.

Van Eenennaam, J.P., S.I. Doroshov, G.P. Moberg, J.G. Watson, D.S. Moore, and J. Linares. 1996. Reproductive Conditions of the Atlantic Sturgeon (*Acipenser oxyrinchus*) in the Hudson River. Estuaries 19(4): 769-777.

Waldman, J.R. and I. I. Wirgin. 1998. Status and Restoration Options for Atlantic Sturgeon in North America. Conservation Biology 12(3) June 631-638.

Wilson, J.A. and R.S. McKinley. 2004. Distribution, habitat, and movements. In G.T.O. LeBreton, F.W.H. Beamish and R.S. McKinley (Eds.). Sturgeons and Paddlefish of North America (pp. 40-72). Netherlands: Kluwer Academic Publishers.

Appendix A


Beach Nourishment
Borrow Area A
Borrow Area B
No Dredging Zone
Sandbridge Beach
U.S. NAVAL RESERVATION
FLEET ANTI-AIR WARFARE
TRAINING CENTER
REFUGE
Porpoise Point
SAND
BAY
270
271
227
315

Appendix B

Appendix C

Appendix D

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
1	30 Oct 90	SAC	Winyah Bay Georgetown	A	H *Ouchita*	Dead	~69cm, rear half	Overflow Screening	N	Chris Slay pers com Observer report DACW 60-90-C-0067
2	15 Jan 94	SAS	Savannah Harbor	A	H *RN Weeks*	NA	NA	Found by Turtle observer	No	Steve Calver pers com 14 Jun 05 Observer load sheet and final rpt #DACW21-93-C-0072
3	07 Dec 94	SAS	Savannah Harbor	A	H *Dodge Island*	Live released	71cm, whole fish	Starboard Skimmer Screening	Yes We have efile	Chris Slay pers com Observer report
4	07 Dec 94 Different Load	SAS	Savannah Harbor	A	H *Dodge Island*	Dead	77.5cm, whole fish	Starboard Skimmer Screening	Yes We have efile	Chris Slay pers com Observer report
5	Feb 96	NAP	Delaware River Newbold Island	S	P *Ozark*	Dead	83cm, female w/eggs	In DMA Money Island		NMFS memo for record From Laurie Silva 19 Apr 96
6	Feb 96	NAP	Delaware River Newbold Island	S	P *Ozark*	Dead	63cm, mature male	In DMA Money Island		NMFS memo for record From Laurie Silva 19 Apr 96
7	06 Jan 98	NAP	Delaware River Kinkora Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
8	12 Jan 98	NAP	Delaware River Florence Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
9	13 Jan 98	NAP	Delaware River Florence Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
10	7 Sep 98	SAW	Wilmington Har Cape Fear River	A	H *McFarland*	Dead	Head only (1 ft long)	In turtle Inflow screen		Observer incident report Pers com Bill Adams- SAW 26 Jul 04
11	01 Mar 00	SAC	Charleston Harbor	A	H *Stuyvesant*	Dead	Missing head and tail	Main Overflow Screening	No	Chris Slay pers com Observer reporting forms
12	12 Apr 00	SAC	Charleston Harbor	A	H *Stuyvesant*	Dead	71.6cm, whole fish	Starboard Overflow screening	No	Chris Slay pers com Observer reporting forms
13	03 Dec 00	SAW	Wilmington Har MOTSU	A	C *New York*	Dead	82.5cm, whole fish decomposing	In bucket	Y Not e-file Payonk? ?	Chris Slay pers com Phil Payonk pers com 30 Jul 04 Bill Adams pers com 28 Jul 04 #DACW54-00-C-0013

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
14	24 Feb 01	SAS	Brunswick Harbor	A	H *RN Weeks*	Dead	Head only	Just mentions take on all forms, no other info.	No	Daily and Weekly Reports, Load sheet.
15	19 Jun 01	NAE	Kennebec River Bath Iron Works	A	C *??*	Live released		Put in scow, released unharmed		Julie Crocker NMFS pers com 19 Jul 04 2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001
16	30 Apr 03	NAE	Kennebec River Bath Iron Works	S	C Reed and Reed dredge company	Dead	Fish nearly cut in half		Y We have e-file	Julie Crocker NMFS pers com 19 Jul 04 2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001
17	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	38.1inches	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
18	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	37.0 inches	In hopper Did not dive Probably died	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
19	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Live	Swam away	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
20	06 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	Found alive	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
21	08 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Live	Good condition	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
22	07 Jan 04	SAC	Charleston Harbor	A	H *Manhattan Island*	Live	Whole fish 49 inches total length May have died later when released	Found by Coastwise turtle observers	Yes (We Have e-file)	Robert Chappell pers com 28 Jun 04 Observer daily report 7 Jan 04
23	13 Dec 04	SAM	Gulfport Harbor Channel	G	H *Bayport*	Dead	Trunk of fish 59.5cm	Found by turtle observers		Observer incident report Susan Rees pers com 7 Jan 05
24a	28 Dec 04	SAM	Mobile Bar Channel	G	H *Padre Island*	Dead	Trunk of fish 2 ft, 1inch	Found by Turtle observers	Yes (We Have e-file)	Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049
24b	01 Jan 05	SAM	Mobile Bar Channel	G	H *Padre Island*	Dead	Head only of fish 22.5cm	2nd part of take on 28 Dec 04	Yes taken But we Have not received	Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049
25	2 Mar 05	SAS	Brunswick Harbor	A	H *RN Weeks*	Dead	Posterior section only 60 cm section w/tail	Found by turtle observer	Yes (We Have e-file)	Chris Slay pers com 7 Jun 05 Steve Calver pers com 14 Jun 05
26	26 Dec 06	SAS	Brunswick	A	H *Newport*	Dead	Head only	Caught in port screen and	Black and	Incident and load report

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
								turtle part caught in starboard screen	White	
27	17 Jan 07	SAS	Savannah Entrance Channel	A	H *Glenn Edwards*	Dead	Whole fish, FL 104 cm	Fresh Dead, 60 Horseshoe crab in with load	Coastwise took photo	Incident and Load report
28	2 Mar 09	SAS	Savannah Entrance Channel	A	H *Dodge Island*	Dead	Total Length 111 cm	Fresh Dead, found in starboard aft inflow box, load #42		Incident, Load and Daily report
29	6 Feb 10	SAS	Brunswick Entrance Channel	A	H *Glenn Edwards*	Dead	No measurements	Fore screen contents, Load #19 with 12 Horseshoe crab		No incident report, just listed on load sheet and daily summary
30	7 Feb 10	SAS	Brunswick Entrance Channel	A	H *Glenn Edwards*	Dead	No measurements	Fore screen contents, Load #25 with 20 Horseshoe crab		No incident report, just listed on load sheet and daily summary
31	2 Feb 10	SAS	Brunswick Entrance Channel	A	H *Bayport*	Dead	No measurements, head to mid body in load #193 and mid body to tail recovered in load #194.	Stbd screen contents, load #193 and overflow screen in #194,		No incident report, just listed on load sheet and daily summary
32	7 Dec 10	SAW	Wilmington Harbor	A	H Terrapin Island	Dead	Whole fish, FL 61 cm	Fresh Dead, water temp 12 C, air 2 C, load 6	Coastwise took photo	Incident and Load report
33	10 Apr 11	NAO	York Spit Channel	A	H Terrapin Island	Dead	Total Length 24.5" in, Fork Length 13.5", Middle of anus to Anal Fin 3.8"	During Clean up. Torn in half, only posterior from pectoral region to tail, no head. Fins and tail torn but complete		Hopper daily report from, QCR, e-mail, incident report, daily report, load sheets

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
34	11Apr 11	NAO	York Spit Channel	A	H Liberty Island	Dead		During cleanup. Another piece taken on 4/13/11 matches perfectly.	Y	E-mail
35	14 Mar 12	SAC	Charleston Harbor Channel	A	H Glenn Edwards	Dead	Fresh dead, body part 26”-30” long X 13” width, no head or tail	Load 129 (0024-0345) found in starboard draghead, during cleanup mode. Given to South Carolina DNR	Yes	E-mail, load sheet, incident report
NT	25 May 05	NAO	York Spit Channel	?	H *McFarland*	Dead	Approx. 2 ft estimate from photos	Too decomposed to identify	Yes (We Have e-file)	Observer final report, REMSA 2004
NDNEF	26 Jun 96	NAN	East Rock Away Long Island	?	H Dodge Island	Dead	(~3'), couldn't identify and doesn't mention condition (fresh or dead already)? Chris Starbird.	Load sheet states Carp or sturgeon	No	Load sheet, Daily and Weekly Summary mentions. No way to confirm.
NDNEF	About 98	SAW	Wilmington Har Cape Fear River	A	P *??*	Dead				NMFS 1998 Shortnose Recovery Plan p. 53
NDNEF	About 98	SAW	Wilmington Har Cape Fear River	A	C	Dead				NMFS 1998 Shortnose Recovery Plan p. 53
NDNEF	About 98	SAJ or SAS	Kings Bay	A	H *??*	Dead				NMFS 1998 Shortnose Recovery Plan p. 52 Chris Slay pers com

Sp=sturgeon species
A=Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*)
S=Shortnose sturgeon (*Acipenser brevirostrum*)
G=Gulf sturgeon (*Acipenser oxyrhynchus desotoi*)
NT = Non-take incident by dredge
SAC=Charleston

SAW=Wilmington
SAS=Savannah
SAJ=Jacksonville
SAM=Mobile
NAE=New England
NAO=Norfolk
NAN=New York
NAP=Philadelphia
H=Hopper
P=Hydraulic Cutterhead pipeline
C=Mechanical clamshell or bucket, bucket and barge
DMA=Dredged material disposal area
NDNEF=No documentation, no evidence found to confirm citation

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: Army Corps of Engineers (USACE), Norfolk District (lead)
Bureau of Ocean Energy Management

Activity Considered: **Use of Sandbridge Shoals Borrow Area for Sandbridge Shoals Hurricane Protection Project, 2012-2013**
F/NER/2012/01586

Conducted by: National Marine Fisheries Service
Northeast Region

Date Issued: SEP - 7 2012

Approved by: George H. Darcy for John K. Bullard

Table of Contents

1.0 INTRODUCTION

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) issued pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, on the effects of the Army Corps of Engineers, Norfolk District (USACE) proposal to dredge in Sanbridge Shoal borrow area in 2012-2013 for purposes of obtaining sand to be placed on Sandbridge Beach. Because Sandbridge Shoal is located on the Outer Continental Shelf, authorization is also required from the Bureau of Ocean Energy Management (BOEM).

This Opinion is based on information provided in the Biological Assessment (BA) dated April 5, 2012, past consultations with the USACE Norfolk and Baltimore Districts and scientific papers and other sources of information as cited in this Opinion. We will keep a complete administrative record of this consultation at our Northeast Regional Office. By issuing this Opinion we withdraw the Opinion issued by us regarding the Sandbridge Beach Hurricane Protection Project on April 2, 1993, and amended on August 20, 2001.

2.0 CONSULTATION HISTORY

Consultation between USACE and NMFS on effects of dredging in the Chesapeake Bay navigation channels and borrow areas has been ongoing since the 1980s. Formal consultation for the use of the Sandbridge Shoal borrow area was initiated in May 1992. A Biological Opinion was issued by us on April 2, 1993. This Opinion was amended by letter issued August 20, 2001 to account for greater dredging quantities, project durations, and associated impacts to listed sea turtles. In 2007, USACE requested that we waive the requirement for 100% endangered species observer coverage for dredging planned for 2007. This request was due to the presence of unexploded ordinance (UXO) in the area to be dredged and the placement of screening on the dragheads. We granted that request by letter and determined that the use of UXO screening did not require reinitiation of the consultation. The 1993 Opinion, as amended in 2001, concluded that dredging in Sandbridge Shoal was not likely to jeopardize the continued existence of any species of whale or sea turtle. An Incidental Take Statement (ITS) was included with the Opinion, exempting the lethal take of six loggerhead sea turtles and one Kemp's ridley or green sea turtle for each biennial dredge event. Use of the Sandbridge Shoal borrow areas requires coordination with the Bureau of Ocean Energy Management (BOEM); the USACE was designated the lead agency for purposes of complying with ESA requirements per 50 C.F.R 5402.07 and serves as the lead agency for ESA consultation.

On February 6, 2012, we published two final rules listing five Distinct Population Segments (DPS) of Atlantic sturgeon. The New York Bight, Chesapeake Bay, South Atlantic and Carolina DPSs are listed as endangered and the Gulf of Maine DPS is listed as threatened. Reinitiation of consultation is required if: "(a) the amount or extent of taking specified in the ITS is exceeded; (b) new information reveals effects of these actions that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) any of the identified actions are subsequently modified in a manner that causes an effect to the listed species that was not considered in the Opinion; or (d) a new species is listed or critical habitat designated that may be affected by the identified actions" (50 CFR § 402.16).

In a letter dated April 5, 2012, USACE requested reinitiation of the 1993 consultation. USACE submitted a Biological Assessment with this letter. Discussions between USACE and NMFS staff through the spring and summer of 2012 sought to clarify the extent of the proposed action, the relationship between multiple dredge actions proposed for the Chesapeake Bay and the duration of these activities. Consultation was initiated on April 5, 2012. A draft of the Biological Opinion was provided to USACE on August 2, 2012; comments were received on August 13, 2012 and incorporated as appropriate.

3.0 DESCRIPTION OF THE PROPOSED ACTION

This Opinion considers the effects of work proposed for 2012-2013 in Sandbridge Shoals. This work will be carried out by the USACE and their contractors. Additionally, authorization from BOEM, in the form of a lease, is required for use of the Sandbridge Shoal borrow area.

The Advanced Engineering and Design Study for Beach Erosion and Hurricane Protection at Virginia Beach, Virginia, including Sandbridge Beach, was authorized by Section 1(a) of the Water Resources Development Act of 1974 (Public Law 93-251, 93'd Congress, H.R. 10203.7 March 1974). The applicable portion of the authorizing act is as follows:

> "Sec. I (a) The Secretary of the Army, acting through the Chief of Engineers, is hereby authorized to undertake the Phase I Design Memorandum stage of advanced engineering and design of the following multi-purpose water resources development projects, substantially in accordance with, and subject to the conditions recommended by the Chief of Engineers in the reports here in after designated."
>
> Middle Atlantic Coastal Area
>
> "The project for hurricane-flood protection at Virginia Beach, Virginia: House Document Numbered 92-365, at an estimated cost of 8954,000 (1974 dollars)."

BOEM will authorize the use of sand from an OCS sand borrow area for the project under the OCS Lands Act, 43 U.S.C. §1337(k). In 1994, OCSLA was amended to allow BOEM to convey, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for use in a program for shore protection, beach restoration, or coastal wetlands restoration undertaken by a Federal, State, or local government agency (43 U.S.C. 1337(k)(2)(A)(i)). An agreement will be negotiated between BOEM, the USACE Norfolk District, and City of Virginia Beach for the dredging and relocation of the sand.

The proposed action would involve beach nourishment at the Sandbridge oceanfront, an area approximately 5 miles long and 725 feet wide (as illustrated in Appendix A). The specific beach area covered extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north to Back Bay National Wildlife Refuge (NWR) to the south. The project dimensions include a 50-foot wide berm at an elevation of 6 feet North American Vertical Datum (NGVD) with a foreshore slope of approximately 1:20 (one vertical value to 20 horizontal) for a distance of approximately 5 miles. The designated borrow area is Sandbridge Shoal (Appendix A), located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea. There are two selected borrow areas within Sandbridge Shoal, Area B to the north and Area A to the south; depths range from 30 to 65 feet. The area between the two borrow areas is restricted due to the presence of a buried Navy submarine communications cable. Beach quality sand would most likely be removed by trailing suction hopper dredge with the possibility of using a hydraulic pipeline dredge (i.e. cutterhead).

The hopper dredge is a self-propelled vessel equipped with trailing suction dragheads and a hopper that collects sand. When the hopper is full, material is transported to a pump out buoy located offshore. The material would then be pumped through a pipeline, which runs along the ocean floor, and up onto the beach where bulldozers and graders will distribute the sand. There are known ordinance issues located within the Sandbridge Shoals area, UXO screening will be required for this action. This is due to training operations at the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck. Ordinances have been found in earlier dredging actions for this on-going project.

A hydraulic pipeline dredge uses a cutterhead to loosen or dislodge sediments to hydraulically capture the material. The sluried sediment is transported through a pipeline to the placement site. Because pipeline dredges pump directly to the placement site, they can operate continuously and can be very productive and cost efficient. Once the material is placed on the beach similar construction methods are used to distribute the material properly.

The purpose of the proposed action is to provide protection from erosion induced damages including limited protection to the beach and to residential structures from storm damage. Several alternatives were considered in the feasibility phase of the project including structural, non-structural and a no action alternative. Neither one nor a combination of the other alternatives discussed provided an acceptable solution in terms of feasibility and/or economics, environmental, and technical concerns, to the existing beach erosion and hurricane protection needs; and, thus were eliminated from further consideration as viable solutions to coastal erosion and storm problems at Sandbridge Beach.

As previously mentioned, the proposed action will utilize either a hopper style dredge or a hydraulic pipeline dredge to borrow beach quality sand from authorized sites along Sandbridge Shoals to renourish the beach at Sandbridge Beach via the placement of dredged material onto the beach. Approximately 1.5 to 2.0 million cubic yards will be placed on this section of the beach for erosion control and to provide hurricane relief as requested by the non-federal sponsor, the City of Virginia Beach. The action is planned to occur from December 1, 2012 to May 15, 2013 but could occur outside of this period.

3.1 Information on Dredges that may be used

In the past, a hopper dredge has been used at Sandbridge Shoals. However, USACE has indicated that a hydraulic cutterhead dredge may be used at Sandbridge Shoal for the dredging contemplated in this action. The type of dredge to be used will be determined during the contract review process.

3.1.1 Self-Propelled Hopper Dredges

Hopper dredges are typically self-propelled seagoing vessels. They are equipped with propulsion machinery, sediment containers (i.e., hoppers), dredge pumps, and other specialized equipment required to excavate sediments from the channel bottom. Hopper dredges have propulsion power adequate for required free-running speed and dredging against strong currents.

A hopper dredge removes material from the bottom of the channel in thin layers, usually 2-12 inches, depending on the density and cohesiveness of the dredged material (Taylor, 1990). Pumps within the hull, but sometimes mounted on the dragarm, create a region of low pressure around the dragheads; this forces water and sediment up the dragarm and into the hopper. The more closely the draghead is maintained in contact with the sediment, the more efficient the dredging (i.e., the greater the concentration of sediment pumped into the hopper). In the hopper, the slurry mixture of sediment and water is managed to settle out the dredged material solids and overflow the supernatant water. When a full load is achieved, the vessel suspends dredging, the dragarms are heaved aboard, and the dredge travels to the placement site where dredged material is disposed of.

3.1.2 Hydraulic Cutterhead Pipeline Dredges

The cutterhead dredge is essentially a barge hull with a moveable rotating cutter apparatus surrounding the intake of a suction pipe (Taylor, 1990). By combining the mechanical cutting action with the hydraulic suction, the hydraulic cutterhead has the capability of efficiently dredging a wide range of material, including clay, silt, sand, and gravel.

The largest hydraulic cutterhead dredges have 30 to 42 inch diameter pumps with 15,000 to 20,000 horsepower. The dredge used for this project is expected to have a pump and pipeline with approximately 30” diameter. These dredges are capable of pumping certain types of material through as much as 5-6 miles of pipeline, though up to 3 miles is more typical. The cutterhead pipeline plant employs spuds and anchors in a manner similar to floating mechanical dredges.

3.2 Bed Leveling Devices

USACE has indicated that in certain circumstances, a dredge contractor may employ a bed-leveler device to smooth the channel bottom or to reduce the heights of disposal mounds created during hydraulic placement operations. The USACE has reported that they are not aware of any instances where bed-leveling has been utilized in Sandbridge Shoals. However, bed-leveling may be a preferred alternative during certain phases of the dredging operations (i.e. clean-up phase) and it is possible that a bed leveler will be used during this dredge cycle.

Bed leveling techniques have been documented as far back as 1565 (USACE, 2006). However, the use of bed-levelers in U.S. waters is not well documented. The devices are typically used during final clean-up operations when localized mounds or ridges exist shallower than required dredging depths. Passage of a draghead can create ridges up to two feet high and can require multiple passes to reduce the height during clean-up operations. Often these areas cannot be efficiently or economically dredged to specified depths and make it difficult to maintain hard contact between the draghead and channel bottom. Bed-leveler devices may consist of a large customized plow or a box beam suspended from a work-barge that can be pushed or towed by a tug. The bed-leveler may be towed by a short or long towing line depending on the sea-state. Bed-leveler size and geometry can vary but are typically thirty and fifty feet in width and may weigh from twenty-five to fifty tons. Bed-levelers are generally towed at speeds ranging from 1-2 knots. Bed-leveler operation can be affected by sea state conditions and generally require longer towing line in rougher waters.

The USACE-ERDC has performed an engineering evaluation on various configurations of bed-leveler prototypes to determine their performance aspects for production rates (i.e. ability to remove target material), ability to deflect model turtles, and bed-leveler construction and operation in the field. Model studies were performed at Texas A&M. The study tested conceptual designs using a conventional straight square tube box-beam, a 90-degree raked plow (i.e. inclined), a 90-degree square tube box beam plow, a 130- degree box square tube box beam plow. Model study results indicated that the straight square tube box beam design provided the highest production rate moving sediment in the direction of the bed leveler device but provided the least turtle shedding capability. The 90-degree raked (inclined) plow produced an increased vertical downward force on the towing cables resulting in some operational difficulty. In general, the increase in the sweep angle increased the side-spilling or side-casting of sediment which also accounted for the designs ability to shed model turtles from in front of the bed-leveler device. The 130-degree box beam plow likely provides the optimal mix of production, turtle shedding capability, and operational deployment. The conceptual bed-leveling designs tested in the model study are presented in Appendix F of USACE's BA (Appendix B of this Opinion).

3.3 Interrelated or Interdependent Actions

Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR § 402.02; see also 1998 FWS-NMFS Joint Consultation Handbook, pp. 4-26 to 4-28). We have not identified any interrelated or interdependent actions.

3.4 Action Area

The action area is defined in 50 CFR § 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation includes the area affected by dredging and disposal activities as well as the area transited by dredges and dredged material disposal vessels. The action area, therefore, includes the entirety of the navigation channels, borrow areas and disposal areas noted above. The action area will also encompass the underwater area where dredging will result in increased suspended sediment. The size of the sediment plume will vary depending on the type of dredge used and is detailed below.

4.0 SPECIES THAT ARE NOT LIKELY TO BE ADVERSELY AFFECTED BY THE PROPOSED ACTION

4.1 Shortnose Sturgeon

Shortnose sturgeon are benthic fish that occur in large coastal rivers of eastern North America. They range from as far south as the St. Johns River, Florida (possibly extirpated from this system) to as far north as the Saint John River in New Brunswick, Canada. Shortnose sturgeon occur in 19 rivers along the U.S. Atlantic coast. Shortnose sturgeon historically occurred in the Chesapeake Bay, but prior to 1996, the best available information suggested that the species was either extirpated from the area or present in extremely low numbers. Before 1996, there were only 15 published historic records of shortnose sturgeon in the Chesapeake Bay, and most of these were based on personal observations from the upper Chesapeake Bay during the 1970s and 1980s (Dadswell et al. 1984). From February through November 1997, a Fish and Wildlife Service reward program was in effect for Atlantic sturgeon in Virginia's major tributaries (James, York, and Rappahannock Rivers). A sturgeon captured from the Rappahannock River in May 1997 was confirmed as a shortnose sturgeon (Spells 1998). This capture represents the only recent capture of a shortnose sturgeon in Virginia. On October 22, 2003, an endangered species observer initially reported the capture of one shortnose sturgeon in a sea turtle relocation trawling operation in

Thimble Shoals Channel. Several Atlantic sturgeon were captured during the relocation trawl and due to the difficulty in distinguishing these species, the fish was initially reported as a shortnose sturgeon. The captured fish was reported as 123 cm fork length (FL), which is close to the maximum length of shortnose sturgeon in northern river systems reported in the literature (130 cm FL) and far greater than the maximum length of shortnose sturgeon in southern river systems (97 cm FL). Further analysis resulted in the observer correcting the report and stating that the fish was actually an Atlantic sturgeon.

Despite numerous studies that have occurred to document the presence of Atlantic sturgeon in Virginia waters, only one shortnose sturgeon has been captured. Because we anticipate that shortnose sturgeon would have been captured in sampling gear if present, and that these captures would be reported to NMFS, we believe this lack of captures is indicative of the rarity of shortnose sturgeon in Virginia waters of the Chesapeake Bay. We do not anticipate that shortnose sturgeon would be present in the action area and therefore, any effects to shortnose sturgeon are extremely unlikely to occur. The lack of any interactions with shortnose sturgeon during dredging or relocation trawling associated with any of the channels or borrow areas in the lower Chesapeake Bay to date, supports this determination. Because any effects to shortnose sturgeon are extremely unlikely to occur, all effects to shortnose sturgeon are discountable. As such, we have determined that the proposed action is not likely to adversely affect this species and it is not considered further in this Opinion.

4.2 Hawksbill sea turtle

The hawksbill sea turtle is listed as endangered. This species is uncommon in the waters of the continental U.S. Hawksbills prefer coral reef habitats, such as those found in the Caribbean and Central America. Mona Island (Puerto Rico) and Buck Island (St. Croix, U.S. Virgin Islands) contain especially important foraging and nesting habitat for hawksbills. Within the continental U.S., nesting is restricted to the southeast coast of Florida and the Florida Keys, but nesting is rare in these areas. Hawksbills have been recorded from all the Gulf States and along the east coast of the U.S. as far north as Massachusetts, but sightings north of Florida are rare. Many of these strandings in the North Atlantic were observed after hurricanes or offshore storms. Aside from Florida, Texas is the only other U.S. state where hawksbills are sighted with any regularity.

Only two hawksbill sea turtles have been documented in Virginia waters since 1979 (Mansfield 2006) and no hawksbill sea turtles have ever been documented in the Chesapeake Bay. The occurrence of Hawksbill sea turtles in the Chesapeake Bay would be an extremely rare occurrence. Because Hawksbill sea turtles are so unlikely to occur in the action area, impacts to this species are considered extremely unlikely. The lack of any interactions with hawksbills during dredging or relocation trawling associated with any of the channels or borrow areas in the Chesapeake Bay to date, supports this determination. Because any effects to hawksbills are extremely unlikely to occur, all effects to hawksbill sea turtles are discountable. As such, we have has determined that the proposed action is not likely to adversely affect this species and it is not considered further in this Opinion.

4.3 Sperm, Blue, Right, Humpback and Fin whales

Sperm whales and blue whales are listed as endangered. During surveys for the Cetacean and Turtle Assessment Program (CeTAP), sperm whales were observed along the shelf edge, centered around the 1,000 m depth contour but extending seaward out to the 2,000 m depth contour (CeTAP

1982). Although blue whales are occasionally seen in U.S. waters, they are more commonly found in Canadian waters and are rare in continental shelf waters of the eastern U.S. (Waring *et al.* 2000). Given the predominantly offshore distribution of these two cetacean species, both are highly unlikely to occur in the action area or to be affected by the actions considered in this Opinion.

The Chesapeake Bay is not a high use area for whales. Transient individual right, humpback and fin whales may occasionally be present in the lower Bay for brief periods during annual migrations or during the summer months, but no whales are known to be resident in this area and even transient whales are considered rare in the action area. Because any effects to whales are extremely unlikely to occur, all effects to whales are discountable. As such, we have determined that the proposed action is not likely to adversely affect right, humpback or fin whales. These species will not be considered further in this Opinion.

5.0 STATUS OF LISTED SPECIES IN THE ACTION AREA THAT MAY BE AFFECTED BY THE PROPOSED ACTION

Several species listed under NMFS' jurisdiction occur in the action area for this consultation. NMFS has determined that the action being considered in this biological opinion may affect the following endangered or threatened species under NMFS' jurisdiction:

Sea Turtles

Northwest Atlantic DPS of Loggerhead sea turtle (*Caretta caretta*)	Threatened
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered
Kemp's ridley sea turtle (*Lepidochelys kempi*)	Endangered
Green sea turtle (*Chelonia mydas*)	Endangered/Threatened[1]

Fish

Gulf of Maine DPS of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)	Threatened
New York Bight DPS of Atlantic sturgeon	Endangered
Chesapeake Bay DPS of Atlantic sturgeon	Endangered
South Atlantic DPS of Atlantic sturgeon	Endangered
Carolina DPS of Atlantic sturgeon	Endangered

This section will focus on the status of the various species within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action.

5.1 Overview of Status of Sea Turtles

With the exception of loggerheads, sea turtles are listed under the ESA at the species level rather than as subspecies or distinct population segments (DPS). Therefore, information on the range-wide status of leatherback, Kemp's ridley and green sea turtles is included to provide the status of each species overall. Information on the status of loggerheads will only be presented for the DPS affected by this action. Additional background information on the range-wide status of these

1 Pursuant to NMFS regulations at 50 CFR 223.205, the prohibitions of Section 9 of the Endangered Species Act apply to all green turtles, whether endangered or threatened.

species can be found in a number of published documents, including sea turtle status reviews and biological reports (NMFS and USFWS 1995; Hirth 1997; Marine Turtle Expert Working Group [TEWG] 1998, 2000, 2007, 2009; NMFS and USFWS 2007a, 2007b, 2007c, 2007d; Conant *et al.* 2009), and recovery plans for the loggerhead sea turtle (NMFS and USFWS 2008), Kemp's ridley sea turtle (NMFS *et al.* 2011), leatherback sea turtle (NMFS and USFWS 1992, 1998a), Kemp's ridley sea turtle (NMFS *et al.* 2011)and green sea turtle (NMFS and USFWS 1991, 1998b).

2010 BP Deepwater Horizon Oil Spill
The April 20, 2010, explosion of the Deepwater Horizon oil rig affected sea turtles in the Gulf of Mexico. There is an on-going assessment of the long-term effects of the spill on Gulf of Mexico marine life, including sea turtle populations. Following the spill, juvenile Kemp's ridley, green, and loggerhead sea turtles were found in *Sargassum* algae mats in the convergence zones, where currents meet and oil collected. Sea turtles found in these areas were often coated in oil and/or had ingested oil. Approximately 536 live adult and juvenile sea turtles were recovered from the Gulf and brought into rehabilitation centers; of these, 456 were visibly oiled (these and the following numbers were obtained from http://www.nmfs.noaa.gov/pr/health/oilspill/). To date, 469 of the live recovered sea turtles have been successfully returned to the wild, 25 died during rehabilitation, and 42 are still in care but are expected to be returned to the wild eventually. During the clean-up period, 613 dead sea turtles were recovered in coastal waters or on beaches in Mississippi, Alabama, Louisiana, and the Florida Panhandle. As of February 2011, 478 of these dead turtles had been examined. Many of the examined sea turtles showed indications that they had died as a result of interactions with trawl gear, most likely used in the shrimp fishery, and not as a result of exposure to or ingestion of oil.

During the spring and summer of 2010, nearly 300 sea turtle nests were relocated from the northern Gulf to the east coast of Florida with the goal of preventing hatchlings from entering the oiled waters of the northern Gulf. From these relocated nests, 14,676 sea turtles, including 14,235 loggerheads, 125 Kemp's ridleys, and 316 greens, were ultimately released from Florida beaches.

A thorough assessment of the long-term effects of the spill on sea turtles has not yet been completed. The spill resulted in the direct mortality of many sea turtles and may have had sublethal effects or caused environmental damage that will impact sea turtles into the future. The population level effects of the spill and associated response activity are likely to remain unknown for some period into the future.

5.2 Northwest Atlantic DPS of loggerhead sea turtle

The loggerhead is the most abundant species of sea turtle in U.S. waters. Loggerhead sea turtles are found in temperate and subtropical waters and occupy a range of habitats including offshore waters, continental shelves, bays, estuaries, and lagoons. They are also exposed to a variety of natural and anthropogenic threats in the terrestrial and marine environment.

Listing History
Loggerhead sea turtles were listed as threatened throughout their global range on July 28, 1978. Since that time, several status reviews have been conducted to review the status of the species and make recommendations regarding its ESA listing status. Based on a 2007 5-year status review of the species, which discussed a variety of threats to loggerheads including climate change, NMFS

and FWS determined that loggerhead sea turtles should not be delisted or reclassified as endangered. However, we also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified for the loggerhead (NMFS and USFWS 2007a). Genetic differences exist between loggerhead sea turtles that nest and forage in the different ocean basins (Bowen 2003; Bowen and Karl 2007). Differences in the maternally inherited mitochondrial DNA also exist between loggerhead nesting groups that occur within the same ocean basin (TEWG 2000; Pearce 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007; TEWG 2009; NMFS and USFWS 2008). Site fidelity of females to one or more nesting beaches in an area is believed to account for these genetic differences (TEWG 2000; Bowen 2003).

In part to evaluate those genetic differences, in 2008, NMFS and FWS established a Loggerhead Biological Review Team (BRT) to assess the global loggerhead population structure to determine whether DPSs exist and, if so, the status of each DPS. The BRT evaluated genetic data, tagging and telemetry data, demographic information, oceanographic features, and geographic barriers to determine whether population segments exist. The BRT report was completed in August 2009 (Conant *et al.* 2009). In this report, the BRT identified the following nine DPSs as being discrete from other conspecific population segments and significant to the species: (1) North Pacific Ocean, (2) South Pacific Ocean, (3) North Indian Ocean, (4) Southeast Indo-Pacific Ocean, (5) Southwest Indian Ocean, (6) Northwest Atlantic Ocean, (7) Northeast Atlantic Ocean, (8) Mediterranean Sea, and (9) South Atlantic Ocean.

The BRT concluded that although some DPSs are indicating increasing trends at nesting beaches (Southwest Indian Ocean and South Atlantic Ocean), available information about anthropogenic threats to juveniles and adults in neritic and oceanic environments indicate possible unsustainable additional mortalities. According to an analysis using expert opinion in a matrix model framework, the BRT report stated that all loggerhead DPSs have the potential to decline in the foreseeable future. Based on the threat matrix analysis, the potential for future decline was reported as greatest for the North Indian Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, Mediterranean Sea, and South Atlantic Ocean DPSs (Conant *et al.* 2009). The BRT concluded that the North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Southeast Indo-Pacific Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, and Mediterranean Sea DPSs were at risk of extinction. The BRT concluded that although the Southwest Indian Ocean and South Atlantic Ocean DPSs were likely not currently at immediate risk of extinction, the extinction risk was likely to increase in the foreseeable future.

On March 16, 2010, NMFS and USFWS published a proposed rule (75 FR 12598) to divide the worldwide population of loggerhead sea turtles into nine DPSs, as described in the 2009 Status Review. Two of the DPSs were proposed to be listed as threatened and seven of the DPSs, including the Northwest Atlantic Ocean DPS, were proposed to be listed as endangered. NMFS and the USFWS accepted comments on the proposed rule through September 13, 2010 (75 FR 30769, June 2, 2010). On March 22, 2011 (76 FR 15932), NMFS and USFWS extended the date by which a final determination on the listing action will be made to no later than September 16, 2011. This action was taken to address the interpretation of the existing data on status and trends and its relevance to the assessment of risk of extinction for the Northwest Atlantic Ocean DPS, as well as the magnitude and immediacy of the fisheries bycatch threat and measures to reduce this threat. New information or analyses to help clarify these issues were requested by April 11, 2011.

On September 22, 2011, NMFS and USFWS issued a final rule (76 FR 58868), determining that the loggerhead sea turtle is composed of nine DPSs (as defined in Conant *et al*., 2009) that constitute species that may be listed as threatened or endangered under the ESA. Five DPSs were listed as endangered (North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Northeast Atlantic Ocean, and Mediterranean Sea), and four DPSs were listed as threatened (Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean). Note that the Northwest Atlantic Ocean (NWA) DPS and the Southeast Indo-Pacific Ocean DPS were originally proposed as endangered. The NWA DPS was determined to be threatened based on review of nesting data available after the proposed rule was published, information provided in public comments on the proposed rule, and further discussions within the agencies. The two primary factors considered were population abundance and population trend. NMFS and USFWS found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats. This final listing rule became effective on October 24, 2011.

The September 2011 final rule also noted that critical habitat for the two DPSs occurring within the U.S. (NWA DPS and North Pacific DPS) will be designated in a future rulemaking. Information from the public related to the identification of critical habitat, essential physical or biological features for this species, and other relevant impacts of a critical habitat designation was solicited. Currently, no critical habitat is designated for any DPS of loggerhead sea turtles, and therefore, no critical habitat for any DPS occurs in the action area.

Presence of Loggerhead Sea Turtles in the Action Area
The effects of this proposed action are only experienced within the Atlantic Ocean. NMFS has considered the available information on the distribution of the 9 DPSs to determine the origin of any loggerhead sea turtles that may occur in the action area. As noted in Conant *et al.* (2009), the range of the four DPSs occurring in the Atlantic Ocean are as follows: NWA DPS – north of the equator, south of 60° N latitude, and west of 40° W longitude; Northeast Atlantic Ocean (NEA) DPS – north of the equator, south of 60° N latitude, east of 40° W longitude, and west of 5° 36' W longitude; South Atlantic DPS – south of the equator, north of 60° S latitude, west of 20° E longitude, and east of 60° W longitude; Mediterranean DPS – the Mediterranean Sea east of 5° 36' W longitude. These boundaries were determined based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. While adults are highly structured with no overlap, there may be some degree of overlap by juveniles of the NWA, NEA, and Mediterranean DPSs on oceanic foraging grounds (Laurent *et al.* 1993, 1998; Bolten *et al.* 1998; LaCasella *et al.* 2005; Carreras *et al.* 2006, Monzón-Argüello *et al.* 2006; Revelles *et al.* 2007). Previous literature (Bowen *et al.* 2004) has suggested that there is the potential, albeit small, for some juveniles from the Mediterranean DPS to be present in U.S. Atlantic coastal foraging grounds. These conclusions must be interpreted with caution however, as they may reflect a shared common haplotype and lack of representative sampling at Eastern Atlantic rookeries rather than an actual presence of Mediterranean DPS turtles in US Atlantic coastal waters. A re-analysis of the data by the Atlantic loggerhead Turtle Expert Working Group has found that that it is unlikely that U.S. fishing fleets are interacting with either the Northeast Atlantic loggerhead DPS or the Mediterranean loggerhead DPS (Peter Dutton, NMFS,

Marine Turtle Genetics Program, Program Leader, personal communication, September 10, 2011). Given that the action area is a subset of the area fished by US fleets, it is reasonable to assume that based on this new analysis, no individuals from the Mediterranean DPS or Northeast Atlantic DPS would be present in the action area. Sea turtles of the South Atlantic DPS do not inhabit the action area of this consultation (Conant *et al.* 2009). As such, the remainder of this consultation will only focus on the NWA DPS, listed as threatened.

Distribution and Life History
Ehrhart *et al.* (2003) provided a summary of the literature identifying known nesting habitats and foraging areas for loggerheads within the Atlantic Ocean. Detailed information is also provided in the 5-year status review for loggerheads (NMFS and USFWS 2007a), the TEWG report (2009), and the final revised recovery plan for loggerheads in the Northwest Atlantic Ocean (NMFS and USFWS 2008), which is a second revision to the original recovery plan that was approved in 1984 and subsequently revised in 1991.

In the western Atlantic, waters as far north as 41° N to 42° N latitude are used for foraging by juveniles, as well as adults (Shoop 1987; Shoop and Kenney 1992; Ehrhart *et al.* 2003; Mitchell *et al.* 2003). In U.S. Atlantic waters, loggerheads commonly occur throughout the inner continental shelf from Florida to Cape Cod, Massachusetts and in the Gulf of Mexico from Florida to Texas, although their presence varies with the seasons due to changes in water temperature (Shoop and Kenney 1992; Epperly *et al.* 1995a, 1995b; Braun and Epperly 1996; Braun-McNeill *et al.* 2008; Mitchell *et al.* 2003). Loggerheads have been observed in waters with surface temperatures of 7°C to 30°C, but water temperatures ≥11°C are most favorable (Shoop and Kenney 1992; Epperly *et al.* 1995b). The presence of loggerhead sea turtles in U.S. Atlantic waters is also influenced by water depth. Aerial surveys of continental shelf waters north of Cape Hatteras, North Carolina indicated that loggerhead sea turtles were most commonly sighted in waters with bottom depths ranging from 22 m to 49 m deep (Shoop and Kenney 1992). However, more recent survey and satellite tracking data support that they occur in waters from the beach to beyond the continental shelf (Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; Mansfield 2006; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007; Mansfield *et al.* 2009).

Loggerhead sea turtles occur year round in ocean waters off North Carolina, South Carolina, Georgia, and Florida. In these areas of the South Atlantic Bight, water temperature is influenced by the proximity of the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to migrate to inshore waters of the Southeast United States (*e.g.*, Pamlico and Core Sounds) and also move up the U.S. Atlantic coast (Epperly *et al.* 1995a, 1995b, 1995c; Braun-McNeill and Epperly 2004), occurring in Virginia foraging areas as early as April/May and on the most northern foraging grounds in the Gulf of Maine in June (Shoop and Kenney 1992). The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some turtles may remain in Mid-Atlantic and Northeast areas until late fall. By December, loggerheads have migrated from inshore and more northern coastal waters to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Shoop and Kenney 1992; Epperly *et al.* 1995b).

Recent studies have established that the loggerhead's life history is more complex than previously believed. Rather than making discrete developmental shifts from oceanic to neritic environments, research is showing that both adults and (presumed) neritic stage juveniles continue to use the oceanic environment and will move back and forth between the two habitats (Witzell 2002; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007; Mansfield *et al.* 2009). One of the studies tracked the movements of adult post-nesting females and found that differences in habitat use were related to body size with larger adults staying in coastal waters and smaller adults traveling to oceanic waters (Hawkes *et al.* 2006). A tracking study of large juveniles found that the habitat preferences of this life stage were also diverse with some remaining in neritic waters and others moving off into oceanic waters (McClellan and Read 2007). However, unlike the Hawkes *et al.* (2006) study, there was no significant difference in the body size of turtles that remained in neritic waters versus oceanic waters (McClellan and Read 2007).

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988; NMFS and USFWS 2008). Sub-adult and adult loggerheads are primarily coastal dwelling and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats (NMFS and USFWS 2008).

As presented below, Table 3 from the 2008 loggerhead recovery plan (Table 1 in this Opinion) highlights the key life history parameters for loggerheads nesting in the United States.

Table 3. Typical values of life history parameters for loggerheads nesting in the U.S.

Life History Parameter	Data
Clutch size	100-126 eggs[1]
Egg incubation duration (varies depending on time of year and latitude)	42-75 days[2,3]
Pivotal temperature (incubation temperature that produces an equal number of males and females)	29.0°C[5]
Nest productivity (emerged hatchlings/total eggs) x 100 (varies depending on site specific factors)	45-70%[2,6]
Clutch frequency (number of nests/female/season)	3-5.5 nests[7]
Internesting interval (number of days between successive nests within a season)	12-15 days[8]
Juvenile (<87 cm CCL) sex ratio	65-70% female[4]
Remigration interval (number of years between successive nesting migrations)	2.5-3.7 years[9]
Nesting season	late April-early September
Hatching season	late June-early November
Age at sexual maturity	32-35 years[10]
Life span	>57 years[11]

1 Dodd 1988.
2 Dodd and Mackinnon (1999, 2000, 2001, 2002, 2003, 2004).
3 Blair Witherington, FFWCC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=865).
4 National Marine Fisheries Service (2001); Allen Foley, FFWCC, personal communication, 2005.
5 Mrosovsky (1988).
6 Blair Witherington, FFWCC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=1,680).
7 Murphy and Hopkins (1984); Frazer and Richardson (1985); Ehrhart, unpublished data; Hawkes *et al*. 2005; Scott 2006; Tony Tucker, Mote Marine Laboratory, personal communication, 2008.
8 Caldwell (1962), Dodd (1988).
9 Richardson *et al*. (1978); Bjorndal *et al*. (1983); Ehrhart, unpublished data.
10 Melissa Snover, NMFS, personal communication, 2005; see Table A1-6.
11 Dahlen *et al*. (2000).

Population Dynamics and Status

By far, the majority of Atlantic nesting occurs on beaches of the southeastern United States (NMFS and USFWS 2007a). For the past decade or so, the scientific literature has recognized five distinct nesting groups, or subpopulations, of loggerhead sea turtles in the Northwest Atlantic, divided geographically as follows: (1) a northern group of nesting females that nest from North Carolina to northeast Florida at about 29° N latitude; (2) a south Florida group of nesting females that nest from 29° N latitude on the east coast to Sarasota on the west coast; (3) a Florida Panhandle group of nesting females that nest around Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán group of nesting females that nest on beaches of the eastern Yucatán Peninsula, Mexico; and (5) a Dry Tortugas group that nests on beaches of the islands of the Dry Tortugas, near Key West, Florida and on Cal Sal Bank (TEWG 2009). Genetic analyses of mitochondrial DNA, which a sea turtle inherits from its mother, indicate that there are genetic differences between loggerheads that nest at and originate from the beaches used by each of the five identified nesting groups of females (TEWG 2009). However, analyses of microsatellite loci from nuclear DNA, which represents the genetic contribution from both parents, indicates little to no genetic differences between loggerheads originating from nesting beaches of the five Northwest Atlantic nesting groups (Pearce and Bowen 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007). These results suggest that female loggerheads have site fidelity to nesting beaches within a particular area, while males provide an avenue of gene flow between nesting groups by mating with females that originate from different nesting groups (Bowen 2003; Bowen *et al.* 2005). The extent of such gene flow, however, is unclear (Shamblin 2007).

The lack of genetic structure makes it difficult to designate specific boundaries for the nesting subpopulations based on genetic differences alone. Therefore, the Loggerhead Recovery Team recently used a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to reassess the designation of these subpopulations to identify recovery units in the 2008 recovery plan.

In the 2008 recovery plan, the Loggerhead Recovery Team designated five recovery units for the Northwest Atlantic population of loggerhead sea turtles based on the aforementioned nesting groups and inclusive of a few other nesting areas not mentioned above. The first four of these recovery units represent nesting assemblages located in the Southeast United States. The fifth recovery unit is composed of all other nesting assemblages of loggerheads within the Greater Caribbean, outside the United States, but which occur within U.S. waters during some portion of their lives. The five recovery units representing nesting assemblages are: (1) the Northern Recovery Unit (NRU: Florida/Georgia border through southern Virginia), (2) the Peninsular Florida Recovery Unit (PFRU: Florida/Georgia border through Pinellas County, Florida), (3) the Dry Tortugas Recovery Unit (DTRU: islands located west of Key West, Florida), (4) the Northern Gulf of Mexico Recovery Unit (NGMRU: Franklin County, Florida through Texas), and (5) the Greater Caribbean Recovery Unit (GCRU: Mexico through French Guiana, Bahamas, Lesser Antilles, and Greater Antilles).

The Recovery Team evaluated the status and trends of the Northwest Atlantic loggerhead population for each of the five recovery units, using nesting data available as of October 2008 (NMFS and USFWS 2008). The level and consistency of nesting coverage varies among recovery units, with coverage in Florida generally being the most consistent and thorough over time. Since 1989, nest count surveys in Florida have occurred in the form of statewide surveys (a near complete census of entire Florida nesting) and index beach surveys (Witherington *et al.* 2009). Index beaches were established to standardize data collection methods and maintain a constant level of effort on key nesting beaches over time.

Note that NMFS and USFWS (2008), Witherington *et al.* (2009), and TEWG (2009) analyzed the status of the nesting assemblages within the NWA DPS using standardized data collected over periods ranging from 10-23 years. These analyses used different analytical approaches, but found the same finding that there had been a significant, overall nesting decline within the NWA DPS. However, with the addition of nesting data from 2008-2010, the trend line changes showing a very slight negative trend, but the rate of decline is not statistically different from zero (76 FR 58868, September 22, 2011). The nesting data presented in the Recovery Plan (through 2008) is described below, with updated trend information through 2010 for two recovery units.

From the beginning of standardized index surveys in 1989 until 1998, the PFRU, the largest nesting assemblage in the Northwest Atlantic by an order of magnitude, had a significant increase in the number of nests. However, from 1998 through 2008, there was a 41% decrease in annual nest counts from index beaches, which represent an average of 70% of the statewide nesting activity (NMFS and USFWS 2008). From 1989-2008, the PFRU had an overall declining nesting trend of 26% (95% CI: -42% to -5%; NMFS and USFWS 2008). With the addition of nesting data through 2010, the nesting trend for the PFRU does not show a nesting decline statistically different from zero (76 FR 58868, September 22, 2011). The NRU, the second largest nesting assemblage of loggerheads in the United States, has been declining at a rate of 1.3% annually since 1983 (NMFS and USFWS 2008). The NRU dataset included 11 beaches with an uninterrupted time series of coverage of at least 20 years; these beaches represent approximately 27% of NRU nesting (in 2008). Through 2008, there was strong statistical data to suggest the NRU has experienced a long-term decline, but with the inclusion of nesting data through 2010, nesting for the NRU is showing possible signs of stabilizing (76 FR 58868, September 22, 2011). Evaluation of long-term nesting trends for the NGMRU is difficult because of changed and expanded beach coverage. However, the NGMRU has shown a significant declining trend of 4.7% annually since index nesting beach surveys were initiated in 1997 (NMFS and USFWS 2008). No statistical trends in nesting abundance can be determined for the DTRU because of the lack of long-term data. Similarly, statistically valid analyses of long-term nesting trends for the entire GCRU are not available because there are few long-term standardized nesting surveys representative of the region. Additionally, changing survey effort at monitored beaches and scattered and low-level nesting by loggerheads at many locations currently precludes comprehensive analyses (NMFS and USFWS 2008).

Sea turtle census nesting surveys are important in that they provide information on the relative abundance of nesting each year, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The 2008 recovery plan compiled information on mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (*i.e.*, nesting groups). They are: (1) for the NRU, a mean of 5,215 loggerhead nests per year (from 1989-2008) with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year (from 1989-2007) with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year (from 1995-2004, excluding 2002) with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year (from 1995-2007) with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit. Note that the above values for average nesting females per year were based upon 4.1 nests per female per Murphy and Hopkins (1984).

Genetic studies of juvenile and a few adult loggerhead sea turtles collected from Northwest Atlantic foraging areas (beach strandings, a power plant in Florida, and North Carolina fisheries) show that the loggerheads that occupy East Coast U.S. waters originate from these Northwest Atlantic nesting groups; primarily from the nearby nesting beaches of southern Florida, as well as the northern Florida to North Carolina beaches, and finally from the beaches of the Yucatán Peninsula, Mexico (Rankin-Baransky *et al.* 2001; Witzell *et al.* 2002; Bass *et al.* 2004; Bowen *et al.* 2004). The contribution of these three nesting assemblages varies somewhat among the foraging habitats and age classes surveyed along the east coast. The distribution is not random and bears a significant relationship to the proximity and size of adjacent nesting colonies (Bowen *et al.* 2004). Bass *et al.* (2004) attribute the variety in the proportions of sea turtles from loggerhead turtle nesting assemblages documented in different east coast foraging habitats to a complex interplay of currents and the relative size and proximity of nesting beaches.

Unlike nesting surveys, in-water studies of sea turtles typically sample both sexes and multiple age classes. In-water studies have been conducted in some areas of the Northwest Atlantic and provide data by which to assess the relative abundance of loggerhead sea turtles and changes in abundance over time (Maier *et al.* 2004; Morreale *et al.* 2005; Mansfield 2006; Ehrhart *et al.* 2007; Epperly *et al.* 2007). The TEWG (2009) used raw data from six in-water study sites to conduct trend analyses. They identified an increasing trend in the abundance of loggerheads from three of the four sites located in the Southeast United States, one site showed no discernible trend, and the two sites located in the northeast United States showed a decreasing trend in abundance of loggerheads. The 2008 loggerhead recovery plan also includes a full discussion of in-water population studies for which trend data have been reported, and a brief summary will be provided here.

Maier *et al.* (2004) used fishery-independent trawl data to establish a regional index of loggerhead abundance for the southeast coast of the United States (Winyah Bay, South Carolina to St. Augustine, Florida) during the period 2000-2003. A comparison of loggerhead catch data from this study with historical values suggested that in-water populations of loggerhead sea turtles along the southeast U.S. coast appear to be larger, possibly an order of magnitude higher than they were 25 years ago, but the authors caution a direct comparison between the two studies given differences in sampling methodology (Maier *et al.* 2004). A comparison of catch rates for sea turtles in pound net gear fished in the Pamlico-Albemarle Estuarine Complex of North Carolina between the years 1995-1997 and 2001-2003 found a significant increase in catch rates for loggerhead sea turtles for the latter period (Epperly *et al.* 2007). A long-term, on-going study of loggerhead abundance in the Indian River Lagoon System of Florida found a significant increase in the relative abundance of loggerheads over the last 4 years of the study (Ehrhart *et al.* 2007). However, there was no discernible trend in loggerhead abundance during the 24-year time period of the study (1982-2006) (Ehrhart *et al.* 2007). At St. Lucie Power Plant, data collected from 1977-2004 show an increasing trend of loggerheads at the power plant intake structures (FPL and Quantum Resources 2005).

In contrast to these studies, Morreale *et al.* (2005) observed a decline in the percentage and relative numbers of loggerhead sea turtles incidentally captured in pound net gear fished around Long Island, New York during the period 2002-2004 in comparison to the period 1987-1992, with only two loggerheads (of a total 54 turtles) observed captured in pound net gear during the period 2002-

2004. This is in contrast to the previous decade's study where numbers of individual loggerheads ranged from 11 to 28 per year (Morreale *et al.* 2005). No additional loggerheads were reported captured in pound net gear in New York through 2007, although two were found cold-stunned on Long Island bay beaches in the fall of 2007 (Memo to the File, L. Lankshear, December 2007). Potential explanations for this decline include major shifts in loggerhead foraging areas and/or increased mortality in pelagic or early benthic stage/age classes (Morreale *et al.* 2005). Using aerial surveys, Mansfield (2006) also found a decline in the densities of loggerhead sea turtles in Chesapeake Bay over the period 2001-2004 compared to aerial survey data collected in the 1980s. Significantly fewer loggerheads (p<0.05) were observed in both the spring (May-June) and the summer (July-August) of 2001-2004 compared to those observed during aerial surveys in the 1980s (Mansfield 2006). A comparison of median densities from the 1980s to the 2000s suggested that there had been a 63.2% reduction in densities during the spring residency period and a 74.9% reduction in densities during the summer residency period (Mansfield 2006). The decline in observed loggerhead populations in Chesapeake Bay may be related to a significant decline in prey, namely horseshoe crabs and blue crabs, with loggerheads redistributing outside of Bay waters (NMFS and USFWS 2008).

As with other turtle species, population estimates for loggerhead sea turtles are difficult to determine, largely given their life history characteristics. However, a recent loggerhead assessment using a demographic matrix model estimated that the loggerhead adult female population in the western North Atlantic ranges from 16,847 to 89,649, with a median size of 30,050 (NMFS SEFSC 2009). The model results for population trajectory suggest that the population is most likely declining, but this result was very sensitive to the choice of the position of the parameters within their range and hypothesized distributions. The pelagic stage survival parameter had the largest effect on the model results. As a result of the large uncertainty in our knowledge of loggerhead life history, at this point predicting the future populations or population trajectories of loggerhead sea turtles with precision is very uncertain. It should also be noted that additional analyses are underway which will incorporate any newly available information.

As part of the Atlantic Marine Assessment Program for Protected Species (AMAPPS), line transect aerial abundance surveys and turtle telemetry studies were conducted along the Atlantic coast in the summer of 2010. AMAPPS is a multi-agency initiative to assess marine mammal, sea turtle, and seabird abundance and distribution in the Atlantic. Aerial surveys were conducted from Cape Canaveral, Florida to the Gulf of St. Lawrence, Canada. Satellite tags on juvenile loggerheads were deployed in two locations – off the coasts of northern Florida to South Carolina (n=30) and off the New Jersey and Delaware coasts (n=14). As presented in NMFS NEFSC (2011), the 2010 survey found a preliminary total surface abundance estimate within the entire study area of about 60,000 loggerheads (CV=0.13) or 85,000 if a portion of unidentified hard-shelled sea turtles were included (CV=0.10). Surfacing times were generated from the satellite tag data collected during the aerial survey period, resulting in a 7% (5%-11% inter-quartile range) median surface time in the South Atlantic area and a 67% (57%-77% inter-quartile range) median surface time to the north. The calculated preliminary regional abundance estimate is about 588,000 loggerheads along the U.S. Atlantic coast, with an inter-quartile range of 382,000-817,000 (NMFS NEFSC 2011). The estimate increases to approximately 801,000 (inter-quartile range of 521,000-1,111,000) when based on known loggerheads and a portion of unidentified turtle sightings. The density of loggerheads was generally lower in the north than the south; based on number of turtle groups detected, 64%

were seen south of Cape Hatteras, North Carolina, 30% in the southern Mid-Atlantic Bight, and 6% in the northern Mid-Atlantic Bight. Although they have been seen farther north in previous studies (*e.g.*, Shoop and Kenney 1992), no loggerheads were observed during the aerial surveys conducted in the summer of 2010 in the more northern zone encompassing Georges Bank, Cape Cod Bay, and the Gulf of Maine. These estimates of loggerhead abundance over the U.S. Atlantic continental shelf are considered very preliminary. A more thorough analysis will be completed pending the results of further studies related to improving estimates of regional and seasonal variation in loggerhead surface time (by increasing the sample size and geographical area of tagging) and other information needed to improve the biases inherent in aerial surveys of sea turtles (*e.g.*, research on depth of detection and species misidentification rate). This survey effort represents the most comprehensive assessment of sea turtle abundance and distribution in many years. Additional aerial surveys and research to improve the abundance estimates are anticipated in 2011-2014, depending on available funds.

Threats

The diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the neritic environment, and in the oceanic environment. The 5-year status review and 2008 recovery plan provide a summary of natural as well as anthropogenic threats to loggerhead sea turtles (NMFS and USFWS 2007a, 2008). Amongst those of natural origin, hurricanes are known to be destructive to sea turtle nests. Sand accretion, rainfall, and wave action that result from these storms can appreciably reduce hatchling success. Other sources of natural mortality include cold-stunning, biotoxin exposure, and native species predation.

Anthropogenic factors that impact hatchlings and adult females on land, or the success of nesting and hatching include: beach erosion, beach armoring, and nourishment; artificial lighting; beach cleaning; beach pollution; increased human presence; recreational beach equipment; vehicular and pedestrian traffic; coastal development/construction; exotic dune and beach vegetation; removal of native vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (*e.g.*, raccoons, armadillos, and opossums), which raid nests and feed on turtle eggs (NMFS and USFWS 2007a, 2008). Although sea turtle nesting beaches are protected along large expanses of the Northwest Atlantic coast (in areas like Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected high density East Florida nesting beaches from Indian River to Broward County are affected by all of the above threats.

Loggerheads are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, and transportation; marine pollution; underwater explosions; hopper dredging; offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching; and fishery interactions.

A 1990 National Research Council (NRC) report concluded that for juveniles, subadults, and breeding adults in coastal waters, the most important source of human caused mortality in U.S.

Atlantic waters was fishery interactions. The sizes and reproductive values of sea turtles taken by fisheries vary significantly, depending on the location and season of the fishery, and size-selectivity resulting from gear characteristics. Therefore, it is possible for fisheries that interact with fewer, more reproductively valuable turtles to have a greater detrimental effect on the population than one that takes greater numbers of less reproductively valuable turtles (Wallace *et al.* 2008). The Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant *et al.* 2009). Attaining a more thorough understanding of the characteristics, as well as the quantity of sea turtle bycatch across all fisheries is of great importance.

Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Biological Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations.

Of the many fisheries known to adversely affect loggerheads, the U.S. South Atlantic and Gulf of Mexico shrimp fisheries were considered to pose the greatest threat of mortality to neritic juvenile and adult age classes of loggerheads (NRC 1990, Finkbeiner *et al.* 2011). Significant changes to the South Atlantic and Gulf of Mexico shrimp fisheries have occurred since 1990, and the effects of these shrimp fisheries on ESA-listed species, including loggerhead sea turtles, have been assessed several times through section 7 consultation. There is also a lengthy regulatory history with regard to the use of Turtle Excluder Devices (TEDs) in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (Epperly and Teas 2002; NMFS 2002a; Lewison *et al.* 2003). The current section 7 consultation on the U.S. South Atlantic and Gulf of Mexico shrimp fisheries was completed in 2002 and estimated the total annual level of take for loggerhead sea turtles to be 163,160 interactions (the total number of turtles that enter a shrimp trawl, which may then escape through the TED or fail to escape and be captured) with 3,948 of those takes being lethal (NMFS 2002a).

In addition to improvements in TED designs and TED enforcement, interactions between loggerheads and the shrimp fishery have also been declining because of reductions in fishing effort unrelated to fisheries management actions. The 2002 Opinion take estimates are based in part on fishery effort levels. In recent years, low shrimp prices, rising fuel costs, competition with imported products, and the impacts of recent hurricanes in the Gulf of Mexico have all impacted the shrimp fleets; in some cases reducing fishing effort by as much as 50% for offshore waters of the Gulf of Mexico (GMFMC 2007). As a result, loggerhead interactions and mortalities in the Gulf of Mexico have been substantially less than projected in the 2002 Opinion. In 2008, the estimated annual number of interactions between loggerheads and shrimp trawls in the Gulf of Mexico shrimp fishery was 23,336, with 647 (2.8%) of those interactions resulting in mortality (Memo from Dr. B. Ponwith, Southeast Fisheries Science Center to Dr. R. Crabtree, Southeast Region, PRD, December

2008). A new Biological Opinion on the Shrimp FMP was completed in May 2012; this Opinion does not contain a quantitative estimate of the number of interactions between loggerheads and the shrimp fishery.

Loggerhead sea turtles are also known to interact with non-shrimp trawl, gillnet, longline, dredge, pound net, pot/trap, and hook and line fisheries. The NRC (1990) report stated that other U.S. Atlantic fisheries collectively accounted for 500 to 5,000 loggerhead deaths each year, but recognized that there was considerable uncertainty in the estimate. The reduction of sea turtle captures in fishing operations is identified in recovery plans and 5-year status reviews as a priority for the recovery of all sea turtle species. In the threats analysis of the loggerhead recovery plan, trawl bycatch is identified as the greatest source of mortality. While loggerhead bycatch in U.S. Mid-Atlantic bottom otter trawl gear was previously estimated for the period 1996-2004 (Murray 2006, 2008), a recent bycatch analysis estimated the number of loggerhead sea turtle interactions with U.S. Mid-Atlantic bottom trawl gear from 2005-2008 (Warden 2011a). Northeast Fisheries Observer Program data from 1994-2008 were used to develop a model of interaction rates and those predicted rates were applied to 2005-2008 commercial fishing data to estimate the number of interactions for the trawl fleet. The number of predicted average annual loggerhead interactions for 2005-2008 was 292 (CV=0.13, 95% CI=221-369), with an additional 61 loggerheads (CV=0.17, 95% CI=41-83) interacting with trawls but being released through a TED. Of the 292 average annual observable loggerhead interactions, approximately 44 of those were adult equivalents. Warden (2011b) found that latitude, depth and SST were associated with the interaction rate, with the rates being highest south of 37°N latitude in waters < 50 m deep and SST > 15°C. This estimate is a decrease from the average annual loggerhead bycatch in bottom otter trawls during 1996-2004, estimated to be 616 sea turtles (CV=0.23, 95% CI over the 9-year period: 367-890) (Murray 2006, 2008).

There have been several published estimates of the number of loggerheads taken annually as a result of the dredge fishery for Atlantic sea scallops, ranging from a low of zero in 2005 (Murray 2007) to a high of 749 in 2003 (Murray 2004). Murray (2011) recently re-evaluated loggerhead sea turtle interactions in scallop dredge gear from 2001-2008. In that paper, the average number of annual observable interactions of hard-shelled sea turtles in the Mid-Atlantic scallop dredge fishery prior to the implementation of chain mats (January 1, 2001 through September 25, 2006) was estimated to be 288 turtles (CV = 0.14, 95% CI: 209-363) [equivalent to 49 adults], 218 of which were loggerheads [equivalent to 37 adults]. After the implementation of chain mats, the average annual number of observable interactions was estimated to be 20 hard-shelled sea turtles (CV = 0.48, 95% CI: 3-42), 19 of which were loggerheads. If the rate of observable interactions from dredges without chain mats had been applied to trips with chain mats, the estimated number of observable and inferred interactions of hard-shelled sea turtles after chain mats were implemented would have been 125 turtles per year (CV = 0.15, 95% CI: 88-163) [equivalent to 22 adults], 95 of which were loggerheads [equivalent to 16 adults]. Interaction rates of hard-shelled turtles were correlated with sea surface temperature, depth, and use of a chain mat. Results from this recent analysis suggest that chain mats and fishing effort reductions have contributed to the decline in estimated loggerhead sea turtle interactions with scallop dredge gear after 2006 (Murray 2011).

An estimate of the number of loggerheads taken annually in U.S. Mid-Atlantic gillnet fisheries has also recently been published (Murray 2009a, b). From 1995-2006, the annual bycatch of loggerheads in U.S. Mid-Atlantic gillnet gear was estimated to average 350 turtles (CV=0.20, 95% CI over the 12-year period: 234 to 504). Bycatch rates were correlated with latitude, sea surface temperature, and mesh size. The highest predicted bycatch rates occurred in warm waters of the southern Mid-Atlantic in large-mesh gillnets (Murray 2009a).

The U.S. tuna and swordfish longline fisheries that are managed under the Highly Migratory Species (HMS) FMP are estimated to capture 1,905 loggerheads (no more than 339 mortalities) for each 3-year period starting in 2007 (NMFS 2004a). NMFS has mandated gear changes for the HMS fishery to reduce sea turtle bycatch and the likelihood of death from those incidental takes that would still occur (Garrison and Stokes 2010). In 2010, there were 40 observed interactions between loggerhead sea turtles and longline gear used in the HMS fishery (Garrison and Stokes 2011a, 2011b). All of the loggerheads were released alive, with the vast majority released with all gear removed. While 2010 total estimates are not yet available, in 2009, 242.9 (95% CI: 167.9-351.2) loggerhead sea turtles are estimated to have been taken in the longline fisheries managed under the HMS FMP based on the observed takes (Garrison and Stokes 2010). The 2009 estimate is considerably lower than those in 2006 and 2007 and is consistent with historical averages since 2001 (Garrison and Stokes 2010). This fishery represents just one of several longline fisheries operating in the Atlantic Ocean. Lewison *et al.* (2004) estimated that 150,000-200,000 loggerheads were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries as well as others).

Documented takes also occur in other fishery gear types and by non-fishery mortality sources (*e.g.*, hopper dredges, power plants, vessel collisions), but quantitative estimates are unavailable. Past and future impacts of global climate change are considered in Section 6.0 below.

Summary of Status for Loggerhead Sea Turtles

Loggerheads are a long-lived species and reach sexual maturity relatively late at around 32-35 years in the Northwest Atlantic (NMFS and USFWS 2008). The species continues to be affected by many factors occurring on nesting beaches and in the water. These include poaching, habitat loss, and nesting predation that affects eggs, hatchlings, and nesting females on land, as well as fishery interactions, vessel interactions, marine pollution, and non-fishery (*e.g.*, dredging) operations affecting all sexes and age classes in the water (NRC 1990; NMFS and USFWS 2007a, 2008). As a result, loggerheads still face many of the original threats that were the cause of their listing under the ESA.

As mentioned previously, a final revised recovery plan for loggerhead sea turtles in the Northwest Atlantic was recently published by NMFS and FWS in December 2008. The revised recovery plan is significant in that it identifies five unique recovery units, which comprise the population of loggerheads in the Northwest Atlantic, and describes specific recovery criteria for each recovery unit. The recovery plan noted a decline in annual nest counts for three of the five recovery units for loggerheads in the Northwest Atlantic, including the PFRU, which is the largest (in terms of number of nests laid) in the Atlantic Ocean. The nesting trends for the other two recovery units could not be determined due to an absence of long term data.

NMFS convened a new Loggerhead Turtle Expert Working Group (TEWG) to review all available information on Atlantic loggerheads in order to evaluate the status of this species in the Atlantic. A final report from the Loggerhead TEWG was published in July 2009. In this report, the TEWG indicated that it could not determine whether the decreasing annual numbers of nests among the Northwest Atlantic loggerhead subpopulations were due to stochastic processes resulting in fewer nests, a decreasing average reproductive output of adult females, decreasing numbers of adult females, or a combination of these factors. Many factors are responsible for past or present loggerhead mortality that could impact current nest numbers; however, no single mortality factor stands out as a likely primary factor. It is likely that several factors compound to create the current decline, including incidental capture (in fisheries, power plant intakes, and dredging operations), lower adult female survival rates, increases in the proportion of first-time nesters, continued directed harvest, and increases in mortality due to disease. Regardless, the TEWG stated that "it is clear that the current levels of hatchling output will result in depressed recruitment to subsequent life stages over the coming decades" (TEWG 2009). However, the report does not provide information on the rate or amount of expected decrease in recruitment but goes on to state that the ability to assess the current status of loggerhead subpopulations is limited due to a lack of fundamental life history information and specific census and mortality data.

While several documents reported the decline in nesting numbers in the NWA DPS (NMFS and USFWS 2008, TEWG 2009), when nest counts through 2010 are analyzed, the nesting trends from 1989-2010 are not significantly different than zero for all recovery units within the NWA DPS for which there are enough data to analyze (76 FR 58868, September 22, 2011). The SEFSC (2009) estimated the number of adult females in the NWA DPS at 30,000, and if a 1:1 adult sex ratio is assumed, the result is 60,000 adults in this DPS. Based on the reviews of nesting data, as well as information on population abundance and trends, NMFS and USFWS determined in the September 2011 listing rule that the NWA DPS should be listed as threatened. They found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats.

5.3 Status of Kemp's Ridley Sea Turtles

Distribution and Life History

The Kemp's ridley is one of the least abundant of the world's sea turtle species. In contrast to loggerhead, leatherback, and green sea turtles, which are found in multiple oceans of the world, Kemp's ridleys typically occur only in the Gulf of Mexico and the northwestern Atlantic Ocean (NMFS *et al.* 2011).

Kemp's ridleys mature at 10-17 years (Caillouet *et al.* 1995; Schmid and Witzell 1997; Snover *et al.* 2007; NMFS and USFWS 2007c). Nesting occurs from April through July each year with hatchlings emerging after 45-58 days (NMFS *et al.* 2011). Females lay an average of 2.5 clutches within a season (TEWG 1998, 2000) and the mean remigration interval for adult females is 2 years (Marquez *et al.* 1982; TEWG 1998, 2000).

Once they leave the nesting beach, hatchlings presumably enter the Gulf of Mexico where they feed on available S*argassum* and associated infauna or other epipelagic species (NMFS *et al.* 2011). The presence of juvenile turtles along both the U.S. Atlantic and Gulf of Mexico coasts, where they are recruited to the coastal benthic environment, indicates that post-hatchlings are distributed in both the Gulf of Mexico and Atlantic Ocean (TEWG 2000).

The location and size classes of dead turtles recovered by the STSSN suggests that benthic immature developmental areas occur along the U.S. coast and that these areas may change given resource quality and quantity (TEWG 2000). Developmental habitats are defined by several characteristics, including coastal areas sheltered from high winds and waves such as embayments and estuaries, and nearshore temperate waters shallower than 50 m (NMFS and USFWS 2007c). The suitability of these habitats depends on resource availability, with optimal environments providing rich sources of crabs and other invertebrates. Kemp's ridleys consume a variety of crab species, including *Callinectes*, *Ovalipes*, *Libinia*, and *Cancer* species. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). A wide variety of substrates have been documented to provide good foraging habitat, including seagrass beds, oyster reefs, sandy and mud bottoms, and rock outcroppings (NMFS and USFWS 2007c).

Foraging areas documented along the U.S. Atlantic coast include Charleston Harbor, Pamlico Sound (Epperly *et al.* 1995c), Chesapeake Bay (Musick and Limpus 1997), Delaware Bay (Stetzar 2002), and Long Island Sound (Morreale and Standora 1993; Morreale *et al.* 2005). For instance, in the Chesapeake Bay, Kemp's ridleys frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997).

Upon leaving Chesapeake Bay in autumn, juvenile Kemp's ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Epperly *et al.* 1995a, 1995b; Musick and Limpus 1997).

Adult Kemp's ridleys are found in the coastal regions of the Gulf of Mexico and southeastern United States, but are typically rare in the northeastern U.S. waters of the Atlantic (TEWG 2000). Adults are primarily found in nearshore waters of 37 m or less that are rich in crabs and have a sandy or muddy bottom (NMFS and USFWS 2007c).

Population Dynamics and Status

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; NMFS and USFWS 2007c; NMFS *et al.* 2011). There is a limited amount of scattered nesting to the north and south of the primary nesting beach (NMFS and USFWS 2007c). Nesting often occurs in synchronized emergences termed *arribadas*. The number of recorded nests reached an estimated low of 702 nests in 1985, corresponding to fewer than 300 adult females nesting in that season (TEWG 2000; NMFS and USFWS 2007c; NMFS *et al.* 2011). Conservation efforts by Mexican and U.S. agencies have aided this species by eliminating egg harvest, protecting eggs and hatchlings, and reducing at-sea mortality through fishing regulations (TEWG 2000). Since the mid-1980s, the number of nests observed at Rancho Nuevo and nearby beaches has increased 14-16% per year (Heppell *et al.* 2005), allowing cautious optimism that the population is on its way to recovery. An estimated 5,500 females nested in the State of Tamaulipas over a 3-day period in May 2007 and over 4,000 of those nested at Rancho Nuevo (NMFS and USFWS 2007c). In 2008, 17,882 nests were documented on Mexican nesting beaches (NMFS

2011). There is limited nesting in the United States, most of which is located in South Texas. While six nests were documented in 1996, a record 195 nests were found in 2008 (NMFS 2011).

Threats
Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, predators, and oceanographic-related events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. In the last five years (2006-2010), the number of cold-stunned turtles on Cape Cod beaches averaged 115 Kemp's ridleys, 7 loggerheads, and 7 greens (NMFS unpublished data). The numbers ranged from a low in 2007 of 27 Kemp's ridleys, 5 loggerheads, and 5 greens to a high in 2010 of 213 Kemp's ridleys, 4 loggerheads, and 14 greens. Annual cold stun events vary in magnitude; the extent of episodic major cold stun events may be associated with numbers of turtles utilizing Northeast U.S. waters in a given year, oceanographic conditions, and/or the occurrence of storm events in the late fall. Although many cold-stunned turtles can survive if they are found early enough, these events represent a significant source of natural mortality for Kemp's ridleys.

Like other sea turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940s through the early 1960s, nests from Ranch Nuevo were heavily exploited, but beach protection in 1967 helped to curtail this activity (NMFS *et al.* 2011). Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where adult Kemp's ridley sea turtles occur. Information from fisheries observers helped to demonstrate the high number of turtles taken in these shrimp trawls (USFWS and NMFS 1992). Subsequently, NMFS has worked with the industry to reduce sea turtle takes in shrimp trawls and other trawl fisheries, including the development and use of turtle excluder devices (TEDs). As described above, there is lengthy regulatory history with regard to the use of TEDs in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (NMFS 2002a; Epperly 2003; Lewison *et al.* 2003). The 2002 Biological Opinion on shrimp trawling in the southeastern United States concluded that 155,503 Kemp's ridley sea turtles would be taken annually in the fishery with 4,208 of the takes resulting in mortality (NMFS 2002a).

Although modifications to shrimp trawls have helped to reduce mortality of Kemp's ridleys, a recent assessment found that the Southeast/Gulf of Mexico shrimp trawl fishery remained responsible for the vast majority of U.S. fishery interactions (up to 98%) and mortalities (more than 80%). Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Biological Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations.

This species is also affected by other sources of anthropogenic impact (fishery and non-fishery related), similar to those discussed above. Three Kemp's ridley captures in Mid-Atlantic trawl fisheries were documented by NMFS observers between 1994 and 2008 (Warden and Bisack 2010), and eight Kemp's ridleys were documented by NMFS observers in mid-Atlantic sink gillnet fisheries between 1995 and 2006 (Murray 2009a). Additionally, in the spring of 2000, a total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. The cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected by NMFS to have been from a large-mesh gillnet fishery for monkfish and dogfish operating offshore in the preceding weeks (67 FR 71895, December 3, 2002). The five Kemp's ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction, since it is unlikely that all of the carcasses washed ashore. The NMFS Northeast Fisheries Science Center also documented 14 Kemp's ridleys entangled in or impinged on Virginia pound net leaders from 2002-2005. Note that bycatch estimates for Kemp's ridleys in various fishing gear types (*e.g.*, trawl, gillnet, dredge) are not available at this time, largely due to the low number of observed interactions precluding a robust estimate. Kemp's ridley interactions in non-fisheries have also been observed; for example, the Oyster Creek Nuclear Generating Station in Barnegat Bay, New Jersey, recorded a total of 27 Kemp's ridleys (15 of which were found alive) impinged or captured on their intake screens from 1992-2006 (NMFS 2006).

Summary of Status for Kemp's Ridley Sea Turtles

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; NMFS and USFWS 2007c; NMFS *et al.* 2011). The number of nesting females in the Kemp's ridley population declined dramatically from the late 1940s through the mid-1980s, with an estimated 40,000 nesting females in a single *arribada* in 1947 and fewer than 300 nesting females in the entire 1985 nesting season (TEWG 2000; NMFS *et al.* 2011). However, the total annual number of nests at Rancho Nuevo gradually began to increase in the 1990s (NMFS and USFWS 2007c). Based on the number of nests laid in 2006 and the remigration interval for Kemp's ridley sea turtles (1.8-2 years), there were an estimated 7,000-8,000 adult female Kemp's ridley sea turtles in 2006 (NMFS and USFWS 2007c). The number of adult males in the population is unknown, but sex ratios of hatchlings and immature Kemp's ridleys suggest that the population is female-biased, suggesting that the number of adult males is less than the number of adult females (NMFS and USFWS 2007c). While there is cautious optimism for recovery, events such as the Deepwater Horizon oil release, and stranding events associated increased skimmer trawl use and poor TED compliance in the northern Gulf of Mexico may dampen recent population growth.

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality. Based on their 5-year status review of the species, NMFS and USFWS (2007c) determined that Kemp's ridley sea turtles should not be reclassified as threatened under the ESA. A revised bi-national recovery plan was published for public comment in 2010, and in September 2011, NMFS, USFWS, and the Services and the Secretary of Environment and Natural Resources, Mexico (SEMARNAT) released the second revision to the Kemp's ridley recovery plan.

5.4 Status of Green Sea Turtles

Green sea turtles are distributed circumglobally, and can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea (NMFS and USFWS 1991, 2007d; Seminoff 2004). In 1978, the Atlantic population of the green sea turtle was listed as threatened under the ESA, except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered. As it is difficult to differentiate between breeding populations away from the nesting beaches, all green sea turtles in the water are considered endangered.

Pacific Ocean

Green sea turtles occur in the western, central, and eastern Pacific. Foraging areas are also found throughout the Pacific and along the southwestern U.S. coast (NMFS and USFWS 1998b). In the western Pacific, major nesting rookeries at four sites including Heron Island (Australia), Raine Island (Australia), Guam, and Japan were evaluated and determined to be increasing in abundance, with the exception of Guam which appears stable (NMFS and USFWS 2007d). In the central Pacific, nesting occurs on French Frigate Shoals, Hawaii, which has also been reported as increasing with a mean of 400 nesting females annually from 2002-2006 (NMFS and USFWS 2007d). The main nesting sites for the green sea turtle in the eastern Pacific are located in Michoacan, Mexico and in the Galapagos Islands, Ecuador (NMFS and USFWS 2007d). The number of nesting females per year exceeds 1,000 females at each site (NMFS and USFWS 2007d). However, historically, greater than 20,000 females per year are believed to have nested in Michoacan alone (Cliffton *et al.* 1982; NMFS and USFWS 2007d). The Pacific Mexico green turtle nesting population (also called the black turtle) is considered endangered.

Historically, green sea turtles were used in many areas of the Pacific for food. They were also commercially exploited, which, coupled with habitat degradation, led to their decline in the Pacific (NMFS and USFWS 1998b). Green sea turtles in the Pacific continue to be affected by poaching, habitat loss or degradation, fishing gear interactions, and fibropapillomatosis, which is a viral disease that causes tumors in affected turtles (NMFS and USFWS 1998b; NMFS 2004b).

Indian Ocean

There are numerous nesting sites for green sea turtles in the Indian Ocean. One of the largest nesting sites for green sea turtles worldwide occurs on the beaches of Oman where an estimated 20,000 green sea turtles nest annually (Hirth 1997; Ferreira *et al.* 2003). Based on a review of the 32 Index Sites used to monitor green sea turtle nesting worldwide, Seminoff (2004) concluded that declines in green sea turtle nesting were evident for many of the Indian Ocean Index Sites. While several of these had not demonstrated further declines in the more recent past, only the Comoros Island Index Site in the western Indian Ocean showed evidence of increased nesting (Seminoff 2004).

Mediterranean Sea

There are four nesting concentrations of green sea turtles in the Mediterranean from which data are available – Turkey, Cyprus, Israel, and Syria. Currently, approximately 300-400 females nest each year, about two-thirds of which nest in Turkey and one-third in Cyprus. Although green sea turtles are depleted from historic levels in the Mediterranean Sea (Kasparek *et al.* 2001), nesting data gathered since the early 1990s in Turkey, Cyprus, and Israel show no apparent trend in any direction. However, a declining trend is apparent along the coast of Palestine/Israel, where 300-350 nests were deposited each year in the 1950s (Sella 1982) compared to a mean of 6 nests per year from 1993-2004 (Kuller 1999; Y. Levy, Israeli Sea Turtle Rescue Center, unpublished data). A recent discovery of green sea turtle nesting in Syria adds roughly 100 nests per year to green sea turtle nesting activity in the Mediterranean (Rees *et al.* 2005). That such a major nesting concentration could have gone unnoticed until recently (the Syria coast was surveyed in 1991, but nesting activity was attributed to loggerheads) bodes well for the ongoing speculation that the unsurveyed coast of Libya may also host substantial nesting.

Atlantic Ocean
Distribution and Life History
As has occurred in other oceans of its range, green sea turtles were once the target of directed fisheries in the United States and throughout the Caribbean. In 1890, over one million pounds of green sea turtles were taken in a directed fishery in the Gulf of Mexico (Doughty 1984). However, declines in the turtle fishery throughout the Gulf of Mexico were evident by 1902 (Doughty 1984).

In the western Atlantic, large juvenile and adult green sea turtles are largely herbivorous, occurring in habitats containing benthic algae and seagrasses from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999). Green sea turtles occur seasonally in Mid-Atlantic and Northeast waters such as Chesapeake Bay and Long Island Sound (Musick and Limpus 1997; Morreale and Standora 1998; Morreale *et al.* 2005), which serve as foraging and developmental habitats.

Some of the principal feeding areas in the western Atlantic Ocean include the upper west coast of Florida, the Florida Keys, and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). The waters surrounding the island of Culebra, Puerto Rico, and its outlying keys are designated critical habitat for the green sea turtle.

Age at maturity for green sea turtles is estimated to be 20-50 years (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004). As is the case with the other sea turtle species described above, adult females may nest multiple times in a season (average 3 nests/season with approximately 100 eggs/nest) and typically do not nest in successive years (NMFS and USFWS 1991; Hirth 1997).

Population Dynamics and Status
Like other sea turtle species, nest count information for green sea turtles provides information on the relative abundance of nesting, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The 5-year status review for the species identified eight geographic areas considered to be primary sites for threatened green sea turtle nesting in the Atlantic/Caribbean, and reviewed the trend in nest count data for each (NMFS and USFWS 2007d). These include: (1) Yucatán Peninsula, Mexico, (2) Tortuguero, Costa Rica, (3) Aves Island, Venezuela, (4) Galibi Reserve, Suriname, (5) Isla Trindade, Brazil, (6) Ascension Island, United Kingdom, (7) Bioko Island, Equatorial Guinea, and (8) Bijagos Achipelago, Guinea-Bissau (NMFS and USFWS 2007d).

Nesting at all of these sites is considered to be stable or increasing with the exception of Bioko Island, which may be declining. However, the lack of sufficient data precludes a meaningful trend assessment for this site (NMFS and USFWS 2007d).

Seminoff (2004) reviewed green sea turtle nesting data for eight sites in the western, eastern, and central Atlantic, including all of the above threatened nesting sites with the exception that nesting in Florida was reviewed in place of Isla Trindade, Brazil. He concluded that all sites in the central and western Atlantic showed increased nesting with the exception of nesting at Aves Island, Venezuela, while both sites in the eastern Atlantic demonstrated decreased nesting. These sites are not inclusive of all green sea turtle nesting in the Atlantic Ocean. However, other sites are not believed to support nesting levels high enough that would change the overall status of the species in the Atlantic (NMFS and USFWS 2007d).

By far, the most important nesting concentration for green sea turtles in the western Atlantic is in Tortuguero, Costa Rica (NMFS and USFWS 2007d). Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007d). The number of females nesting per year on beaches in the Yucatán, at Aves Island, Galibi Reserve, and Isla Trindade number in the hundreds to low thousands, depending on the site (NMFS and USFWS 2007d).

The status of the endangered Florida breeding population was also evaluated in the 5-year review (NMFS and USFWS 2007d). The pattern of green sea turtle nesting shows biennial peaks in abundance, with a generally positive trend since establishment of the Florida index beach surveys in 1989. This trend is perhaps due to increased protective legislation throughout the Caribbean (Meylan *et al.* 1995), as well as protections in Florida and throughout the United States (NMFS and USFWS 2007d).

The statewide Florida surveys (2000-2006) have shown that a mean of approximately 5,600 nests are laid annually in Florida, with a low of 581 in 2001 to a high of 9,644 in 2005 (NMFS and USFWS 2007d). Most nesting occurs along the east coast of Florida, but occasional nesting has been documented along the Gulf coast of Florida, at Southwest Florida beaches, as well as the beaches in the Florida Panhandle (Meylan *et al.* 1995). More recently, green sea turtle nesting occurred on Bald Head Island, North Carolina (just east of the mouth of the Cape Fear River), Onslow Island, and Cape Hatteras National Seashore. One green sea turtle nested on a beach in Delaware in 2011, although its occurrence was considered very rare.

Threats

Green sea turtles face many of the same natural threats as loggerhead and Kemp's ridley sea turtles. In addition, green sea turtles appear to be particularly susceptible to fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body. Juveniles appear to be most affected in that they have the highest incidence of disease and the most extensive lesions, whereas lesions in nesting adults are rare. Also, green sea turtles frequenting nearshore waters, areas adjacent to large human populations, and areas with low water turnover, such as lagoons, have a higher incidence of the disease than individuals in deeper, more remote waters. The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability, leading potentially to death (George 1997).

As with the other sea turtle species, incidental fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches. Witherington *et al.* (2009) observes that because green sea turtles spend a shorter time in oceanic waters and as older juveniles occur on shallow seagrass pastures (where benthic trawling is unlikely), they avoid high mortalities in pelagic longline and benthic trawl fisheries. Although the relatively low number of observed green sea turtle captures makes it difficult to estimate bycatch rates and annual take levels, green sea turtles have been observed captured in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and mid-Atlantic trawl and gillnet fisheries. Murray (2009a) also lists five observed captures of green turtle in Mid-Atlantic sink gillnet gear between 1995 and 2006.

Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Biological Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations.

Other activities like channel dredging, marine debris, pollution, vessel strikes, power plant impingement, and habitat destruction account for an unquantifiable level of other mortality. Stranding reports indicate that between 200-400 green sea turtles strand annually along the eastern U.S. coast from a variety of causes most of which are unknown (STSSN database).

Summary of Status of Green Sea Turtles
A review of 32 Index Sites[2] distributed globally revealed a 48-67% decline in the number of mature females nesting annually over the last three generations[3] (Seminoff 2004). An evaluation of green sea turtle nesting sites was also conducted as part of the 5-year status review of the species (NMFS and USFWS 2007d). Of the 23 threatened nesting groups assessed in that report for which nesting abundance trends could be determined, ten were considered to be increasing, nine were considered stable, and four were considered to be decreasing (NMFS and USFWS 2007d). Nesting groups were considered to be doing relatively well (the number of sites with increasing nesting were greater than the number of sites with decreasing nesting) in the Pacific, western Atlantic, and central Atlantic (NMFS and USFWS 2007d). However, nesting populations were determined to be doing relatively poorly in Southeast Asia, eastern Indian Ocean, and perhaps the Mediterranean. Overall, based on mean annual reproductive effort, the report estimated that 108,761 to 150,521 females nest each year among the 46 threatened and endangered nesting sites included in the evaluation (NMFS

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2 The 32 Index Sites include all of the major known nesting areas as well as many of the lesser nesting areas for which quantitative data are available.

3 Generation times ranged from 35.5 years to 49.5 years for the assessment depending on the Index Beach site

and USFWS 2007d). However, given the late age to maturity for green sea turtles, caution is urged regarding the status for any of the nesting groups since no area has a dataset spanning a full green sea turtle generation (NMFS and USFWS 2007d).

Seminoff (2004) and NMFS and USFWS (2007d) made comparable conclusions with regard to nesting for four nesting sites in the western Atlantic that indicate sea turtle abundance is increasing in the Atlantic Ocean. Each also concluded that nesting at Tortuguero, Costa Rica represented the most important nesting area for green sea turtles in the western Atlantic and that nesting had increased markedly since the 1970s (Seminoff 2004; NMFS and USFWS 2007d).

However, the 5-year review also noted that the Tortuguero nesting stock continued to be affected by ongoing directed take at their primary foraging area in Nicaragua (NMFS and USFWS 2007d). The endangered breeding population in Florida appears to be increasing based upon index nesting data from 1989-2010 (NMFS 2011).

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like hopper dredging, pollution, and habitat destruction account for an unknown level of other mortality. Based on its 5-year status review of the species, NMFS and USFWS (2007d) determined that the listing classification for green sea turtles should not be changed. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified (NMFS and USFWS 2007d).

5.5 Status of Leatherback Sea Turtles

Leatherback sea turtles are widely distributed throughout the oceans of the world, including the Atlantic, Pacific, and Indian Oceans, and the Mediterranean Sea (Ernst and Barbour 1972). Leatherbacks are the largest living turtles and range farther than any other sea turtle species. Their large size and tolerance of relatively low water temperatures allows them to occur in boreal waters such as those off Labrador and in the Barents Sea (NMFS and USFWS 1995).

In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982). By 1995, this global population of adult females was estimated to have declined to 34,500 (Spotila *et al.* 1996). The most recent population size estimate for the North Atlantic alone is a range of 34,000-94,000 adult leatherbacks (TEWG 2007). Thus, there is substantial uncertainty with respect to global population estimates of leatherback sea turtles.

Pacific Ocean

Leatherback nesting has been declining at all major Pacific basin nesting beaches for the last two decades (Spotila *et al.* 1996, 2000; NMFS and USFWS 1998a, 2007b; Sarti *et al.* 2000). In the western Pacific, major nesting beaches occur in Papua New Guinea, Indonesia, Solomon Islands, and Vanuatu, with an approximate 2,700-4,500 total breeding females, estimated from nest counts (Dutton *et al.* 2007). While there appears to be overall long term population decline, the Indonesian nesting aggregation at Jamursba-Medi is currently stable (since 1999), although there is evidence to suggest a significant and continued decline in leatherback nesting in Papua New Guinea and Solomon Islands over the past 30 years (NMFS 2011). Leatherback sea turtles disappeared from India before 1930, have been virtually extinct in Sri Lanka since 1994, and appear to be approaching extinction in Malaysia (Spotila *et al.* 2000). In Fiji, Thailand, and Australia, leatherback sea turtles have only been known to nest in low densities and scattered sites.

The largest, extant leatherback nesting group in the Indo-Pacific lies on the North Vogelkop coast of West Papua, Indonesia, with 3,000-5,000 nests reported annually in the 1990s (Suárez *et al.* 2000). However, in 1999, local villagers started reporting dramatic declines in sea turtles near their villages (Suárez 1999). Declines in nesting groups have been reported throughout the western Pacific region where observers report that nesting groups are well below abundance levels that were observed several decades ago (*e.g.*, Suárez 1999).

Leatherback sea turtles in the western Pacific are threatened by poaching of eggs, killing of nesting females, human encroachment on nesting beaches, incidental capture in fishing gear, beach erosion, and egg predation by animals.

In the eastern Pacific Ocean, major leatherback nesting beaches are located in Mexico and Costa Rica, where nest numbers have been declining. According to reports from the late 1970s and early 1980s, beaches located on the Mexican Pacific coasts of Michoacán, Guerrero, and Oaxaca sustained a large portion, perhaps 50%, of all global nesting by leatherbacks (Sarti *et al.* 1996). A dramatic decline has been seen on nesting beaches in Pacific Mexico, where aerial survey data was used to estimate that tens of thousands of leatherback nests were laid on the beaches in the 1980s (Pritchard 1982), but a total of only 120 nests on the four primary index beaches (combined) were counted in the 2003-2004 season (Sarti Martinez *et al.* 2007). Since the early 1980s, the Mexican Pacific population of adult female leatherback turtles has declined to slightly more than 200 during 1998-1999 and 1999-2000 (Sarti *et al.* 2000). Spotila *et al.* (2000) reported the decline of the leatherback nesting at Playa Grande, Costa Rica, which had been the fourth largest nesting group in the world and the most important nesting beach in the Pacific. Between 1988 and 1999, the nesting group declined from 1,367 to 117 female leatherback sea turtles. Based on their models, Spotila *et al.* (2000) estimated that the group could fall to less than 50 females by 2003-2004. Another, more recent, analysis of the Costa Rican nesting beaches indicates a decline in nesting during 15 years of monitoring (1989-2004) with approximately 1,504 females nesting in 1988-1989 to an average of 188 females nesting in 2000-2001 and 2003-2004 (NMFS and USFWS 2007b), indicating that the reductions in nesting females were not as extreme as the reductions predicted by Spotila *et al.* (2000).

On September 26, 2007, NMFS received a petition to revise the critical habitat designation for leatherback sea turtles to include waters along the U.S. West Coast. On December 28, 2007, NMFS published a positive 90-day finding on the petition and convened a critical habitat review team. On January 26, 2012, NMFS published a final rule to revise the critical habitat designation to include three particular areas of marine habitat. The designation includes approximately 16,910 square miles along the California coast from Point Arena to Point Arguello east of the 3,000 meter depth contour, and 25,004 square miles from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meter depth contour. The areas comprise approximately 41,914 square miles of marine habitat and include waters from the ocean surface down to a maximum depth of 262 feet. The designated critical habitat areas contain the physical or biological feature essential to the conservation of the species that may require special management conservation or protection. In particular, the team identified one Primary Constituent Element: the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae, of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

Leatherbacks in the eastern Pacific face a number of threats to their survival. For example, commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru; purse seine fisheries for tuna in the eastern tropical Pacific Ocean; and California/Oregon drift gillnet fisheries are known to capture, injure, or kill leatherbacks in the eastern Pacific Ocean. Given the declines in leatherback nesting in the Pacific, some researchers have concluded that the leatherback is on the verge of extinction in the Pacific Ocean (*e.g.,* Spotila *et al.* 1996, 2000).

Indian Ocean

Leatherbacks nest in several areas around the Indian Ocean. These sites include Tongaland, South Africa (Pritchard 2002) and the Andaman and Nicobar Islands (Andrews *et al.* 2002). Intensive survey and tagging work in 2001 provided new information on the level of nesting in the Andaman and Nicobar Islands (Andrews *et al.* 2002). Based on the survey and tagging work, it was estimated that 400-500 female leatherbacks nest annually on Great Nicobar Island (Andrews *et al.* 2002). The number of nesting females using the Andaman and Nicobar Islands combined was estimated around 1,000 (Andrews and Shanker 2002). Some nesting also occurs along the coast of Sri Lanka, although in much smaller numbers than in the past (Pritchard 2002).

Mediterranean Sea

Casale *et al.* (2003) reviewed the distribution of leatherback sea turtles in the Mediterranean. Among the 411 individual records of leatherback sightings in the Mediterranean, there were no nesting records. Nesting in the Mediterranean is believed to be extremely rare if it occurs at all. Leatherbacks found in Mediterranean waters originate from the Atlantic Ocean (P. Dutton, NMFS, unpublished data).

Atlantic Ocean

Distribution and Life History

Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between northern temperate and tropical waters (NMFS and USFWS 1992). Leatherbacks are frequently thought of as a pelagic species that feed on jellyfish (*e.g.*, *Stomolophus, Chryaora*, and *Aurelia* species) and tunicates (*e.g.*, salps, pyrosomas) (Rebel 1974; Davenport and Balazs 1991). However, leatherbacks are also known to use coastal waters of the U.S. continental shelf (James *et al.* 2005a; Eckert *et al.* 2006; Murphy *et al.* 2006), as well as the European continental shelf on a seasonal basis (Witt *et al.* 2007).

Tagging and satellite telemetry data indicate that leatherbacks from the western North Atlantic nesting beaches use the entire North Atlantic Ocean (TEWG 2007). For example, leatherbacks tagged at nesting beaches in Costa Rica have been found in Texas, Florida, South Carolina, Delaware, and New York (STSSN database). Leatherback sea turtles tagged in Puerto Rico, Trinidad, and the Virgin Islands have also been subsequently found on U.S. beaches of southern, Mid-Atlantic, and northern states (STSSN database). Leatherbacks from the South Atlantic nesting assemblages (West Africa, South Africa, and Brazil) have not been re-sighted in the western North Atlantic (TEWG 2007).

The CETAP aerial survey of the outer Continental Shelf from Cape Hatteras, North Carolina to Cape Sable, Nova Scotia conducted between 1978 and 1982 showed leatherbacks to be present throughout the area with the most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in water depths ranging from 1 to 4,151 m, but 84.4% of sightings were in waters less than 180 m (Shoop and Kenney 1992). Leatherbacks were sighted in waters within a sea surface temperature range similar to that observed for loggerheads; from 7°-27.2°C (Shoop and Kenney 1992). However, leatherbacks appear to have a greater tolerance for colder waters in comparison to loggerhead sea turtles since more leatherbacks were found at the lower temperatures (Shoop and Kenney 1992). Studies of satellite tagged leatherbacks suggest that they spend 10%-41% of their time at the surface, depending on the phase of their migratory cycle (James *et al.* 2005b). The greatest amount of surface time (up to 41%) was recorded when leatherbacks occurred in continental shelf and slope waters north of 38°N (James *et al.* 2005b).

In 1979, the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands were designated as critical habitat for the leatherback sea turtle. On February 2, 2010, NMFS received a petition to revise the critical habitat designation for leatherback sea turtles to include waters adjacent to a major nesting beach in Puerto Rico. NMFS published a 90-day finding on the petition on July 16, 2010, which found that the petition did not present substantial scientific information indicating that the petitioned revision was warranted. The original petitioners submitted a second petition on November 2, 2010 to revise the critical habitat designation to again include waters adjacent to a major nesting beach in Puerto Rico, including additional information on the usage of the waters. NMFS determined on May 5, 2011, that a revision to critical habitat off Puerto Rico may be warranted, and an analysis is underway. Note that on August 4, 2011, FWS issued a determination that revision to critical habitat along Puerto Rico should be made and will be addressed during the future planned status review.

Leatherbacks are a long lived species (>30 years). They were originally believed to mature at a younger age than loggerhead sea turtles, with a previous estimated age at sexual maturity of about 13-14 years for females with 9 years reported as a likely minimum (Zug and Parham 1996) and 19 years as a likely maximum (NMFS SEFSC 2001). However, new sophisticated analyses suggest that leatherbacks in the Northwest Atlantic may reach maturity at 24.5-29 years of age (Avens *et al.* 2009). In the United States and Caribbean, female leatherbacks nest from March through July. In the Atlantic, most nesting females average between 150-160 cm curved carapace length (CCL), although smaller (<145 cm CCL) and larger nesters are observed (Stewart *et al.* 2007, TEWG 2007). They nest frequently (up to seven nests per year) during a nesting season and nest about every 2-3 years. They produce 100 eggs or more in each clutch and can produce 700 eggs or more per nesting season (Schultz 1975). However, a significant portion (up to approximately 30%) of the eggs can be infertile. Therefore, the actual proportion of eggs that can result in hatchlings is less than the total number of eggs produced per season. As is the case with other sea turtle species, leatherback hatchlings enter the water soon after hatching. Based on a review of all sightings of leatherback sea turtles of <145 cm CCL, Eckert (1999) found that leatherback juveniles remain in waters warmer than 26°C until they exceed 100 cm CCL.

Population Dynamics and Status

As described earlier, sea turtle nesting survey data is important in that it provides information on the relative abundance of nesting, and the contribution of each population/subpopulation to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually, and as an indicator of the trend in the number of nesting females in the nesting group. The 5-year review for leatherback sea turtles (NMFS and USFWS 2007b) compiled the most recent information on mean number of leatherback nests per year for each of the seven leatherback populations or groups of populations that were identified by the Leatherback TEWG as occurring within the Atlantic. These are: Florida, North Caribbean, Western Caribbean, Southern Caribbean, West Africa, South Africa, and Brazil (TEWG 2007).

In the United States, the Florida Statewide Nesting Beach Survey program has documented an increase in leatherback nesting numbers from 98 nests in 1988 to between 800 and 900 nests in the early 2000s (NMFS and USFWS 2007b). Stewart *et al.* (2011) evaluated nest counts from 68 Florida beaches over 30 years (1979-2008) and found that nesting increased at all beaches with trends ranging from 3.1%-16.3% per year, with an overall increase of 10.2% per year. An analysis of Florida's index nesting beach sites from 1989-2006 shows a substantial increase in leatherback nesting in Florida during this time, with an annual growth rate of approximately 1.17 (TEWG 2007). The TEWG reports an increasing or stable nesting trend for all of the seven populations or groups of populations with the exception of the Western Caribbean and West Africa. The leatherback rookery along the northern coast of South America in French Guiana and Suriname supports the majority of leatherback nesting in the western Atlantic (TEWG 2007), and represents more than half of total nesting by leatherback sea turtles worldwide (Hilterman and Goverse 2004). Nest numbers in Suriname have shown an increase and the long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). The TEWG (2007) report indicates that using nest numbers from 1967-2005, a positive population growth rate was found over the 39-year period for French Guinea and Suriname, with a 95% probability that the population was growing. Given the magnitude of leatherback nesting in this area compared to other nest sites, negative impacts in leatherback sea turtles in this area could have profound impacts on the entire species.

The CETAP aerial survey conducted from 1978-1982 estimated the summer leatherback population for the northeastern United States at approximately 300-600 animals (from near Nova Scotia, Canada to Cape Hatteras, North Carolina) (Shoop and Kenney 1992). However, the estimate was based on turtles visible at the surface and does not include those that were below the surface out of view. Therefore, it likely underestimated the leatherback population for the northeastern United States at the time of the survey. Estimates of leatherback abundance of 1,052 turtles (C.V. = 0.38) and 1,174 turtles (C.V. = 0.52) were obtained from surveys conducted from Virginia to the Gulf of St. Lawrence in 1995 and 1998, respectively (Palka 2000). However, since these estimates were also based on sightings of leatherbacks at the surface, the author considered the estimates to be negatively biased and the true abundance of leatherbacks may be 4.27 times higher (Palka 2000).

Threats

The 5-year status review (NMFS and USFWS 2007b) and TEWG (2007) report provide summaries of natural as well as anthropogenic threats to leatherback sea turtles. Of the Atlantic sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear, trap/pot gear in particular. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their diving and foraging behavior, their distributional overlap with the gear, their possible attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, and perhaps to the lightsticks used to attract target species in longline fisheries. Leatherbacks entangled in fishing gear generally have a reduced ability to feed, dive, surface to breathe, or perform any other behavior essential to survival (Balazs 1985). In addition to drowning from forced submergence, they may be more susceptible to boat strikes if forced to remain at the surface, and entangling lines can constrict blood flow resulting in tissue necrosis. The long-term impacts of entanglement on leatherback health remain unclear. Innis *et al.* (2010) conducted a health evaluation of leatherback sea turtles during direct capture (n=12) and disentanglement (n=7). They found no significant difference in many of the measured health parameters between entangled and directly captured turtles. However, blood parameters, including but not limited to sodium, chloride, and blood urea nitrogen, for entangled turtles showed several key differences that were most likely due to reduced foraging and associated seawater ingestion, as well as a general stress response.

Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Biological Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations.

Leatherbacks have been documented interacting with longline, trap/pot, trawl, and gillnet fishing gear. For instance, an estimated 6,363 leatherback sea turtles were documented as caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992-1999 (NMFS SEFSC 2001). Currently, the U.S. tuna and swordfish longline fisheries managed under the HMS FMP are estimated to capture 1,764 leatherbacks (no more than 252 mortalities) for each 3-year period starting in 2007 (NMFS 2004a). In 2010, there were 26 observed interactions between leatherback sea turtles and longline gear used in the HMS fishery (Garrison and Stokes 2011a, 2011b). All leatherbacks were released alive, with all gear removed for the majority of captures. While 2010 total estimates are not yet available, in 2009, 285.8 (95% CI: 209.6-389.7) leatherback sea turtles are estimated to have been taken in the longline fisheries managed under the HMS FMP based on the observed takes (Garrison and Stokes 2010). The 2009 estimate continues a downward trend since 2007 and remains well below the average prior to implementation of gear regulations (Garrison and Stokes 2010). Since the U.S. fleet accounts for only 5%-8% of the longline hooks fished in the Atlantic Ocean, adding up the under-represented observed takes of the other 23 countries actively fishing in the area would likely result in annual take estimates of thousands of leatherbacks over different life stages (NMFS SEFSC 2001). Lewison *et al.* (2004) estimated that

30,000-60,000 leatherbacks were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries, as well as others).

Leatherbacks are susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer *et al.* 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer *et al.* 2002). More recently, from 2002 to 2010, NMFS received 137 reports of sea turtles entangled in vertical lines from Maine to Virginia, with 128 events confirmed (verified by photo documentation or response by a trained responder; NMFS 2008a). Of the 128 confirmed events during this period, 117 events involved leatherbacks. NMFS identified the gear type and fishery for 72 of the 117 confirmed events, which included lobster (42[4]), whelk/conch (15), black sea bass (10), crab (2), and research pot gear (1). A review of leatherback mortality documented by the STSSN in Massachusetts suggests that vessel strikes and entanglement in fixed gear (primarily lobster pots and whelk pots) are the principal sources of this mortality (Dwyer *et al.* 2002).

Leatherback interactions with the U.S. South Atlantic and Gulf of Mexico shrimp fisheries are also known to occur (NMFS 2002). Leatherbacks are likely to encounter shrimp trawls working in the coastal waters off the U.S. Atlantic coast (from Cape Canaveral, Florida through North Carolina) as they make their annual spring migration north. For many years, TEDs that were required for use in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries were less effective for leatherbacks as compared to the smaller, hard-shelled turtle species, because the TED openings were too small to allow leatherbacks to escape. To address this problem, NMFS issued a final rule on February 21, 2003, to amend the TED regulations (68 FR 8456, February 21, 2003). Modifications to the design of TEDs are now required in order to exclude leatherbacks as well as large benthic immature and sexually mature loggerhead and green sea turtles. Given those modifications, Epperly *et al.* (2002) anticipated an average of 80 leatherback mortalities a year in shrimp gear interactions, dropping to an estimate of 26 leatherback mortalities in 2009 due to effort reduction in the Southeast shrimp fishery (Memo from Dr. B. Ponwith, SEFSC, to Dr. R. Crabtree, SERO, January 5, 2011).

Other trawl fisheries are also known to interact with leatherback sea turtles although on a much smaller scale. In October 2001, for example, a NMFS fisheries observer documented the take of a leatherback in a bottom otter trawl fishing for *Loligo* squid off of Delaware. TEDs are not currently required in this fishery. In November 2007, fisheries observers reported the capture of a leatherback sea turtle in bottom otter trawl gear fishing for summer flounder.

Gillnet fisheries operating in the waters of the Mid-Atlantic states are also known to capture, injure, and/or kill leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the NEFSC Fisheries Observer Program from 1994-1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54%-92%. In North Carolina, six additional leatherbacks were reported captured in gillnet sets in the spring (NMFS SEFSC 2001). In addition to these, in September 1995, two dead leatherbacks were removed from an 11-inch (28.2-cm) monofilament shark gillnet set in the nearshore waters off of Cape Hatteras (STSSN unpublished data reported in NMFS SEFSC 2001). Lastly, Murray (2009a)

4 One case involved both lobster and whelk/conch gear.

reports five observed leatherback captures in Mid-Atlantic sink gillnet fisheries between 1994 and 2008.

Fishing gear interactions can occur throughout the range of leatherbacks. Entanglements occur in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line, and crab pot line. Leatherbacks are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Castroviejo *et al.* 1994; Graff 1995). Gillnets are one of the suspected causes for the decline in the leatherback sea turtle population in French Guiana (Chevalier *et al.* 1999), and gillnets targeting green and hawksbill sea turtles in the waters of coastal Nicaragua also incidentally catch leatherback sea turtles (Lagueux *et al.*1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alio-M. 2000). An estimated 1,000 mature female leatherback sea turtles are caught annually in fishing nets off of Trinidad and Tobago with mortality estimated to be between 50%-95% (Eckert and Lien 1999). Many of the sea turtles do not die as a result of drowning, but rather because the fishermen cut them out of their nets (NMFS SEFSC 2001).

Leatherbacks may be more susceptible to marine debris ingestion than other sea turtle species due to the tendency of floating debris to concentrate in convergence zones that juveniles and adults use for feeding (Shoop and Kenney 1992; Lutcavage *et al.* 1997). Investigations of the necropsy results of leatherback sea turtles revealed that a substantial percentage (34% of the 408 leatherback necropsies' recorded between 1885 and 2007) reported plastic within the turtles' stomach contents, and in some cases (8.7% of those cases in which plastic was reported), blockage of the gut was found in a manner that may have caused the mortality (Mrosovsky *et al.* 2009). An increase in reports of plastic ingestion was evident in leatherback necropsies conducted after the late 1960s (Mrosovsky *et al.* 2009). Along the coast of Peru, intestinal contents of 19 of 140 (13%) leatherback carcasses were found to contain plastic bags and film (Fritts 1982). The presence of plastic debris in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items (*e.g*., jellyfish) and plastic debris (Mrosovsky 1981). Balazs (1985) speculated that plastic objects may resemble food items by their shape, color, size, or even movements as they drift about, and induce a feeding response in leatherbacks.

Summary of Status for Leatherback Sea Turtles

In the Pacific Ocean, the abundance of leatherback sea turtles on nesting beaches has declined dramatically over the past 10 to 20 years. Nesting groups throughout the eastern and western Pacific Ocean have been reduced to a fraction of their former abundance by the combined effects of human activities that have reduced the number of nesting females and reduced the reproductive success of females that manage to nest (for example, egg poaching) (NMFS and USFWS 2007b). No reliable long term trend data for the Indian Ocean populations are currently available. While leatherbacks are known to occur in the Mediterranean Sea, nesting in this region is not known to occur (NMFS and USFWS 2007b).

Nest counts in many areas of the Atlantic Ocean show increasing trends, including for beaches in Suriname and French Guiana which support the majority of leatherback nesting (NMFS and USFWS 2007b). The species as a whole continues to face numerous threats in nesting and marine habitats. As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like pollution and habitat destruction account for an unknown level of other mortality. The long term recovery potential of this species may be further threatened by observed low genetic diversity, even in the largest nesting groups like French Guiana and Suriname (NMFS and USFWS 2007b).

Based on its 5-year status review of the species, NMFS and USFWS (2007b) determined that endangered leatherback sea turtles should not be delisted or reclassified. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified (NMFS and USFWS 2007b).

5.6 Status of Atlantic sturgeon

The section below describes the Atlantic sturgeon listing, provides life history information that is relevant to all DPSs of Atlantic sturgeon and then provides information specific to the status of each DPS of Atlantic sturgeon. Below, we also provide a description of which Atlantic sturgeon DPSs likely occur in the action area and provide information on the use of the action area by Atlantic sturgeon.

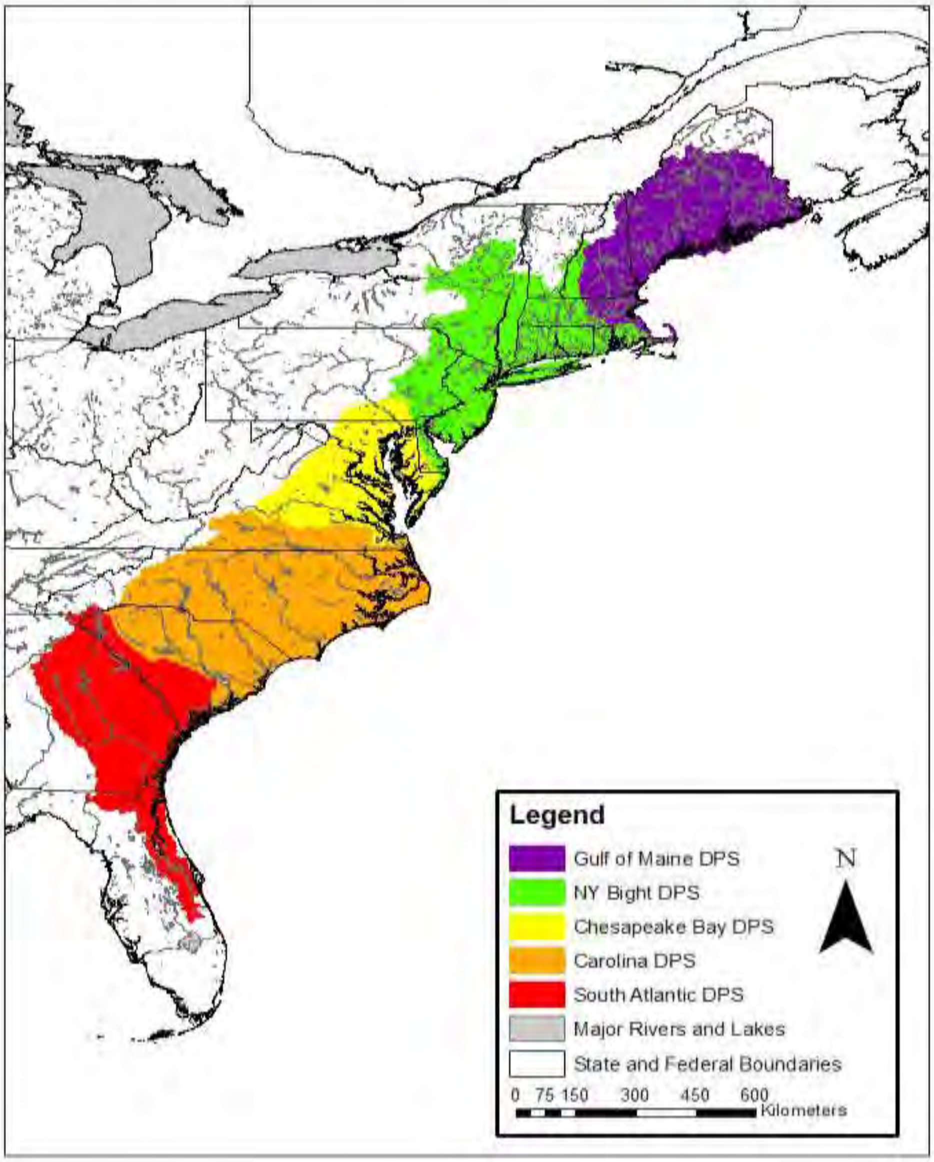
The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a subspecies of sturgeon distributed along the eastern coast of North America from Hamilton Inlet, Labrador, Canada to Cape Canaveral, Florida, USA (Scott and Scott, 1988; ASSRT, 2007; T. Savoy, CT DEP, pers. comm.). NMFS has delineated U.S. populations of Atlantic sturgeon into five DPSs[5] (77 FR 5880 and 77 FR 5914). These are: the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs (see Figure 1). The results of genetic studies suggest that natal origin influences the distribution of Atlantic sturgeon in the marine environment (Wirgin and King, 2011). However, genetic data as well as tracking and tagging data demonstrate sturgeon from each DPS and Canada occur throughout the full range of the subspecies. Therefore, sturgeon originating from any of the 5 DPSs can be affected by threats in the marine, estuarine and riverine environment that occur far from natal spawning rivers.

On February 6, 2012, we published notice in the *Federal Register* that we were listing the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs as "endangered," and the Gulf of Maine DPS as "threatened" (77 FR 5880 and 77 FR 5914). The effective date of the listings was April 6, 2012. The DPSs do not include Atlantic sturgeon that are spawned in Canadian rivers. Therefore, Canadian spawned fish are not included in the listings.

As described below, individuals originating from the five listed DPSs may occur in the action area. Information general to all Atlantic sturgeon as well as information specific to each of the relevant DPSs, is provided below.

5 To be considered for listing under the ESA, a group of organisms must constitute a "species." A "species" is defined in section 3 of the ESA to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature."

Figure 1. Map Depicting the Boundaries of the five Atlantic sturgeon DPSs



5.6.1 Atlantic sturgeon life history

Atlantic sturgeon are long lived (approximately 60 years), late maturing, estuarine dependent, anadromous[6] fish (Bigelow and Schroeder, 1953; Vladykov and Greeley 1963; Mangin, 1964; Pikitch *et al.*, 2005; Dadswell, 2006; ASSRT, 2007).

The life history of Atlantic sturgeon can be divided up into five general categories as described in

6 Anadromous refers to a fish that is born in freshwater, spends most of its life in the sea, and returns to freshwater to spawn (NEFSC FAQ's, available at http://www.nefsc.noaa.gov/faq/fishfaq1a.html, modified June 16, 2011)

the table below (adapted from ASSRT 2012).

Age Class	Size	Description
Egg		Fertilized or unfertilized
Larvae		Negative photo-taxic, nourished by yolk sac
Young of Year (YOY)	**0.3 grams <41 cm TL**	Fish that are > 3 months and < one year; capable of capturing and consuming live food
Sub-adults	**>41 cm and <150 cm TL**	Fish that are at least age 1 and are not sexually mature
Adults	**>150 cm TL**	Sexually mature fish

Table 2. Descriptions of Atlantic sturgeon life history stages.

They are a relatively large fish, even amongst sturgeon species (Pikitch *et al.*, 2005). Atlantic sturgeons are bottom feeders that suck food into a ventrally-located protruding mouth (Bigelow and Schroeder, 1953). Four barbels in front of the mouth assist the sturgeon in locating prey (Bigelow and Schroeder, 1953). Diets of adult and migrant subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder, 1953; ASSRT, 2007; Guilbard *et al.*, 2007; Savoy, 2007). While in the river, Atlantic sturgeon feed on aquatic insects, insect larvae, and other invertebrates (Bigelow and Schroeder, 1953; ASSRT, 2007; Guilbard *et al.*, 2007).

Rate of maturation is affected by water temperature and gender. In general: (1) Atlantic sturgeon that originate from southern systems grow faster and mature sooner than Atlantic sturgeon that originate from more northern systems; (2) males grow faster than females; (3) fully mature females attain a larger size (i.e. length) than fully mature males; and (4) the length of Atlantic sturgeon caught since the mid-late 20^{th} century have typically been less than 3 meters (m) (Smith *et al.*, 1982; Smith *et al.*, 1984; Smith, 1985; Scott and Scott, 1988; Young *et al.*, 1998; Collins *et al.*, 2000; Caron *et al.*, 2002; Dadswell, 2006; ASSRT, 2007; Kahnle *et al.*, 2007; DFO, 2011). The largest recorded Atlantic sturgeon was a female captured in 1924 that measured approximately 4.26 m (Vladykov and Greeley, 1963). Dadswell (2006) reported seeing seven fish of comparable size in the St. John River estuary from 1973 to 1995. Observations of large-sized sturgeon are particularly important given that egg production is correlated with age and body size (Smith *et al.*, 1982; Van

Eenennaam *et al.*, 1996; Van Eenennaam and Doroshov, 1998; Dadswell, 2006). However, while females are prolific with egg production ranging from 400,000 to 4 million eggs per spawning year, females spawn at intervals of 2-5 years (Vladykov and Greeley, 1963; Smith *et al.*, 1982; Van Eenennaam *et al.*, 1996; Van Eenennaam and Doroshov, 1998; Stevenson and Secor, 1999; Dadswell, 2006). Given spawning periodicity and a female's relatively late age to maturity, the age at which 50 percent of the maximum lifetime egg production is achieved is estimated to be 29 years (Boreman, 1997). Males exhibit spawning periodicity of 1-5 years (Smith, 1985; Collins *et al.*, 2000; Caron *et al.*, 2002). While long-lived, Atlantic sturgeon are exposed to a multitude of threats prior to achieving maturation and have a limited number of spawning opportunities once mature.

Water temperature plays a primary role in triggering the timing of spawning migrations (ASMFC, 2009). Spawning migrations generally occur during February-March in southern systems, April-May in Mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco, 1977; Smith, 1985; Bain, 1997; Smith and Clugston, 1997; Caron *et al.*, 2002). Male sturgeon begin upstream spawning migrations when waters reach approximately 6° C (43° F) (Smith *et al.*, 1982; Dovel and Berggren, 1983; Smith, 1985; ASMFC, 2009), and remain on the spawning grounds throughout the spawning season (Bain, 1997). Females begin spawning migrations when temperatures are closer to 12° C to 13° C (54° to 55° F) (Dovel and Berggren, 1983; Smith, 1985; Collins *et al.*, 2000), make rapid spawning migrations upstream, and quickly depart following spawning (Bain, 1997).

The spawning areas in most U.S. rivers have not been well defined. However, the habitat characteristics of spawning areas have been identified based on historical accounts of where fisheries occurred, tracking and tagging studies of spawning sturgeon, and physiological needs of early life stages. Spawning is believed to occur in flowing water between the salt front of estuaries and the fall line of large rivers, when and where optimal flows are 46-76 cm/s and depths are 3-27 m (Borodin, 1925; Dees, 1961; Leland, 1968; Scott and Crossman, 1973; Crance, 1987; Shirey *et al.* 1999; Bain *et al.*, 2000; Collins *et al.*, 2000; Caron *et al.* 2002; Hatin *et al.* 2002; ASMFC, 2009). Sturgeon eggs are deposited on hard bottom substrate such as cobble, coarse sand, and bedrock (Dees, 1961; Scott and Crossman, 1973; Gilbert, 1989; Smith and Clugston, 1997; Bain *et al.* 2000; Collins *et al.*, 2000; Caron *et al.*, 2002; Hatin *et al.*, 2002; Mohler, 2003; ASMFC, 2009), and become adhesive shortly after fertilization (Murawski and Pacheco, 1977; Van den Avyle, 1983; Mohler, 2003). Incubation time for the eggs increases as water temperature decreases (Mohler, 2003). At temperatures of 20° and 18° C, hatching occurs approximately 94 and 140 hours, respectively, after egg deposition (ASSRT, 2007).

Larval Atlantic sturgeon (i.e. less than 4 weeks old, with total lengths (TL) less than 30 mm; Van Eenennaam *et al.* 1996) are assumed to undertake a demersal existence and inhabit the same riverine or estuarine areas where they were spawned (Smith *et al.*, 1980; Bain *et al.*, 2000; Kynard and Horgan, 2002; ASMFC, 2009). Studies suggest that age-0 (i.e., young-of-year), age-1, and age-2 Atlantic sturgeon occur in low salinity waters of the natal estuary (Haley, 1999; Hatin *et al.*, 2007; McCord *et al.*, 2007; Munro *et al.*, 2007) while older fish are more salt tolerant and occur in higher salinity waters as well as low salinity waters (Collins *et al.*, 2000). Atlantic sturgeon remain in the natal estuary for months to years before emigrating to open ocean as subadults (Holland and Yelverton, 1973; Dovel and Berggen, 1983; Waldman *et al.*, 1996; Dadswell, 2006; ASSRT, 2007).

After emigration from the natal estuary, subadults and adults travel within the marine environment, typically in waters less than 50 m in depth, using coastal bays, sounds, and ocean waters (Vladykov and Greeley, 1963; Murawski and Pacheco, 1977; Dovel and Berggren, 1983; Smith, 1985; Collins and Smith, 1997; Welsh *et al.*, 2002; Savoy and Pacileo, 2003; Stein *et al.*, 2004; USFWS, 2004; Laney *et al.*, 2007; Dunton *et al.*, 2010; Erickson *et al.*, 2011; Wirgin and King, 2011). Tracking and tagging studies reveal seasonal movements of Atlantic sturgeon along the coast. Satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight at depths greater than 20 m during winter and spring, and in the northern portion of the Mid-Atlantic Bight at depths less than 20 m in summer and fall (Erickson *et al.*, 2011). Shirey (Delaware Department of Fish and Wildlife, unpublished data reviewed in ASMFC, 2009) found a similar movement pattern for juvenile Atlantic sturgeon based on recaptures of fish originally tagged in the Delaware River. After leaving the Delaware River estuary during the fall, juvenile Atlantic sturgeon were recaptured by commercial fishermen in nearshore waters along the Atlantic coast as far south as Cape Hatteras, North Carolina from November through early March. In the spring, a portion of the tagged fish re-entered the Delaware River estuary. However, many fish continued a northerly coastal migration through the Mid-Atlantic as well as into southern New England waters where they were recovered throughout the summer months. Movements as far north as Maine were documented. A southerly coastal migration was apparent from tag returns reported in the fall. The majority of these tag returns were reported from relatively shallow near shore fisheries with few fish reported from waters in excess of 25 m (C. Shirey, Delaware Department of Fish and Wildlife, unpublished data reviewed in ASMFC, 2009). Areas where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy (e.g., Minas and Cumberland Basins), Massachusetts Bay, Connecticut River estuary, Long Island Sound, New York Bight, Delaware Bay, Chesapeake Bay, and waters off of North Carolina from the Virginia/North Carolina border to Cape Hatteras at depths up to 24 m (Dovel and Berggren, 1983; Dadswell *et al.*, 1984; Johnson *et al.*, 1997; Rochard *et al.*, 1997; Kynard *et al.*, 2000; Eyler *et al.*, 2004; Stein *et al.*, 2004; Wehrell, 2005; Dadswell, 2006; ASSRT, 2007; Laney *et al.*, 2007). These sites may be used as foraging sites and/or thermal refuge.

5.6.2 Determination of DPS Composition in the Action Area

As explained above, the range of all five DPSs overlaps and extends from Canada through Cape Canaveral, Florida. The Chesapeake Bay is known to be used by Atlantic sturgeon originating from all five DPSs. We have considered the best available information to determine from which DPSs individuals in the action area are likely to have originated. We have mixed-stock analyses from samples taken in a variety of coastal sampling programs; however, to date, we have no mixed-stock or individual assignment data for Atlantic sturgeon captured in the Chesapeake Bay. We have mixed-stock analysis of Atlantic sturgeon captured in waters off the coast of southern Virginia and North Carolina during the winter months. This area is a known overwintering aggregation; accordingly, we do not expect that the composition of individuals in this area during the winter months is representative of the composition of individuals in the action area year round. Genetic analysis has been completed on 173 samples obtained through NMFS NEFOP program. These fish have been captured in commercial fishing gear from Maine to North Carolina. Because this sampling overlaps with the action area, we consider it to be the best available information from which to determine the DPS composition in the action area. Based on the mixed-stock analysis resulting from genetic assignments of the NEFOP samples, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB

49%; South Atlantic 20%; Chesapeake Bay 14%; Gulf of Maine 11%; and Carolina 4%. Two percent of Atlantic sturgeon in the action area may originate from the St. John's River in Canada; these fish are not included in the 2012 ESA listing. The genetic assignments have a plus/minus 5% confidence interval; however, for purposes of section 7 consultation we have selected the reported values above, which approximate the mid-point of the range, as a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area. These assignments and the data from which they are derived are described in detail in Damon-Randall *et al.* (2012a).

5.6.3 Distribution and Abundance

Atlantic sturgeon underwent significant range-wide declines from historical abundance levels due to overfishing in the mid to late 19th century when a caviar market was established (Scott and Crossman, 1973; Taub, 1990; Kennebec River Resource Management Plan, 1993; Smith and Clugston, 1997; Dadswell, 2006; ASSRT, 2007). Abundance of spawning-aged females prior to this period of exploitation was predicted to be greater than 100,000 for the Delaware, and at least 10,000 females for other spawning stocks (Secor and Waldman, 1999; Secor, 2002). Historical records suggest that Atlantic sturgeon spawned in at least 35 rivers prior to this period. Currently, only 16 U.S. rivers are known to support spawning based on available evidence (i.e., presence of young-of-year or gravid Atlantic sturgeon documented within the past 15 years) (ASSRT, 2007). While there may be other rivers supporting spawning for which definitive evidence has not been obtained (e.g., in the Penobscot and York Rivers), the number of rivers supporting spawning of Atlantic sturgeon are approximately half of what they were historically. In addition, only four rivers (Kennebec, Hudson, Delaware, James) are known to currently support spawning from Maine through Virginia where historical records support there used to be fifteen spawning rivers (ASSRT, 2007). Thus, there are substantial gaps in the range between Atlantic sturgeon spawning rivers amongst northern and mid-Atlantic states which could make recolonization of extirpated populations more difficult.

There are no current, published population abundance estimates for any of the currently known spawning stocks. Therefore, there are no published abundance estimates for any of the five DPSs of Atlantic sturgeon. An annual mean estimate of 863 mature adults (596 males and 267 females) was calculated for the Hudson River based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). An estimate of 343 spawning adults per year is available for the Altamaha River, GA, based on fishery-independent data collected in 2004 and 2005 (Schueller and Peterson, 2006). Using the data collected from the Hudson River and Altamaha River to estimate the total number of Atlantic sturgeon in either subpopulation is not possible, since mature Atlantic sturgeon may not spawn every year (Vladykov and Greeley, 1963; Smith, 1985; Van Eenennaam *et al.*, 1996; Stevenson and Secor, 1999; Collins *et al.* 2000; Caron *et al.*, 2002), the age structure of these populations is not well understood, and stage to stage survival is unknown. In other words, the information that would allow us to take an estimate of annual spawning adults and expand that estimate to an estimate of the total number of individuals (e.g., yearlings, subadults, and adults) in a population is lacking. The ASSRT presumed that the Hudson and Altamaha rivers had the most robust of the remaining U.S. Atlantic sturgeon spawning populations and concluded that the other U.S. spawning populations were likely less than 300 spawning adults per year (ASSRT, 2007).

Kahnle *et al.* (2007) estimated the number of total mature adults per year in the Hudson River using data from surveys in the 1980s to mid-1990s and based on mean harvest by sex divided by sex specific exploitation rate. While this data is over 20 years old, it is currently the best available data on the abundance of Hudson River origin Atlantic sturgeon. The sex ratio of spawners is estimated to be approximately 70% males and 30% females. As noted above, Kahnle *et al.* (2007) estimated a mean annual number of mature adults at 596 males and 267 females. It is important to note that the authors of this paper have stated that this is an estimate of the annual mean number of Hudson River mature adults during the 1985-1995 period, not an estimate of the number of spawners per year.

5.6.4 Threats faced by Atlantic sturgeon throughout their range

Atlantic sturgeon are susceptible to over exploitation given their life history characteristics (e.g., late maturity, dependence on a wide-variety of habitats). Similar to other sturgeon species (Vladykov and Greeley, 1963; Pikitch *et al.*, 2005), Atlantic sturgeon experienced range-wide declines from historical abundance levels due to overfishing (for caviar and meat) and impacts to habitat in the 19th and 20th centuries (Taub, 1990; Smith and Clugston, 1997; Secor and Waldman, 1999).

Based on the best available information, NMFS has concluded that unintended catch of Atlantic sturgeon in fisheries, vessel strikes, poor water quality, water availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon (77 FR 5880 and 77 FR 5914; February 6, 2012). While all of the threats are not necessarily present in the same area at the same time, given that Atlantic sturgeon subadults and adults use ocean waters from the Labrador, Canada to Cape Canaveral, FL, as well as estuaries of large rivers along the U.S. East Coast, activities affecting these water bodies are likely to impact more than one Atlantic sturgeon DPS. In addition, given that Atlantic sturgeon depend on a variety of habitats, every life stage is likely affected by one or more of the identified threats.

An ASMFC interstate fishery management plan for sturgeon (Sturgeon FMP) was developed and implemented in 1990 (Taub, 1990). In 1998, the remaining Atlantic sturgeon fisheries in U.S. state waters were closed per Amendment 1 to the Sturgeon FMP. Complementary regulations were implemented by NMFS in 1999 that prohibit fishing for, harvesting, possessing or retaining Atlantic sturgeon or its parts in or from the Exclusive Economic Zone in the course of a commercial fishing activity.

Commercial fisheries for Atlantic sturgeon still exist in Canadian waters (DFO, 2011). Sturgeon belonging to one or more of the DPSs may be harvested in the Canadian fisheries. In particular, the Bay of Fundy fishery in the Saint John estuary may capture sturgeon of U.S. origin given that sturgeon from the Gulf of Maine and the New York Bight DPSs have been incidentally captured in other Bay of Fundy fisheries (DFO, 2010; Wirgin and King, 2011). Because Atlantic sturgeon are listed under Appendix II of the Convention on International Trade in Endangered Species (CITES), the U.S. and Canada are currently working on a conservation strategy to address the potential for captures of U.S. fish in Canadian directed Atlantic sturgeon fisheries and of Canadian fish incidentally in U.S. commercial fisheries. At this time, there are no estimates of the number of individuals from any of the DPSs that are captured or killed in Canadian fisheries each year.

Based on geographic distribution, most U.S. Atlantic sturgeon that are intercepted in Canadian fisheries are likely to originate from the Gulf of Maine DPS, with a smaller percentage from the

New York Bight DPS.

Fisheries bycatch in U.S. waters is the primary threat faced by all 5 DPSs. At this time, we have an estimate of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by Federal FMPs (NMFS NEFSC 2011) in the Northeast Region but do not have a similar estimate for Southeast fisheries. We also do not have an estimate of the number of Atlantic sturgeon captured or killed in state fisheries. At this time, we are not able to quantify the effects of other significant threats (e.g., vessel strikes, poor water quality, water availability, dams, and dredging) in terms of habitat impacts or loss of individuals. While we have some information on the number of mortalities that have occurred in the past in association with certain activities (e.g., mortalities in the Delaware and James rivers that are thought to be due to vessel strikes), we are not able to use those numbers to extrapolate effects throughout one or more DPS. This is because of (1) the small number of data points and, (2) lack of information on the percent of incidences that the observed mortalities represent.

As noted above, the NEFSC prepared an estimate of the number of encounters of Atlantic sturgeon in fisheries authorized by Northeast FMPs (NEFSC 2011). The analysis prepared by the NEFSC estimates that from 2006 through 2010 there were 2,250 to 3,862 encounters per year in observed gillnet and trawl fisheries, with an average of 3,118 encounters. Mortality rates in gillnet gear are approximately 20%. Mortality rates in otter trawl gear are believed to be lower at approximately 5%.

5.7 Gulf of Maine DPS of Atlantic sturgeon

The Gulf of Maine DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, MA. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT, 2007). Spawning still occurs in the Kennebec and Androscoggin Rivers, and it is possible that it still occurs in the Penobscot River as well. Spawning in the Androscoggin River was just recently confirmed by the Maine Department of Marine Resources when they captured a larval Atlantic sturgeon during the 2011 spawning season below the Brunswick Dam. There is no evidence of recent spawning in the remaining rivers. In the 1800s, construction of the Essex Dam on the Merrimack River at river kilometer (rkm) 49 blocked access to 58 percent of Atlantic sturgeon habitat in the river (Oakley, 2003; ASSRT, 2007). However, the accessible portions of the Merrimack seem to be suitable habitat for Atlantic sturgeon spawning and rearing (i.e., nursery habitat) (Keiffer and Kynard, 1993). Therefore, the availability of spawning habitat does not appear to be the reason for the lack of observed spawning in the Merrimack River. Studies are on-going to determine whether Atlantic sturgeon are spawning in these rivers. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT, 2007). The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS as well as likely throughout the entire range (ASSRT, 2007; Fernandes, *et al.*, 2010).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June-July (Squiers *et al.*, 1981;

ASMFC, 1998; NMFS and USFWS, 1998). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (i.e., expressing milt) in July 1994 below the (former) Edwards Dam; (2) capture of 31 adult Atlantic sturgeon from June 15,1980, through July 26,1980, in a small commercial fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least 4 ripe males and 1 ripe female captured on July 26,1980; and, (3) capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, ME (NMFS and USFWS, 1998; ASMFC 2007). The low salinity values for waters above Merrymeeting Bay are consistent with values found in other rivers where successful Atlantic sturgeon spawning is known to occur.

Several threats play a role in shaping the current status of Gulf of Maine DPS Atlantic sturgeon. Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17th century (Squiers *et al.*, 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers *et al.*, 1979). Following the 1880's, the sturgeon fishery was almost non-existent due to a collapse of the sturgeon stocks. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon by catch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries occurring in state and federal waters still occurs. In the marine range, Gulf of Maine DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast FMPs. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the Gulf of Maine DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the Gulf of Maine DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region; however, as noted above, not all projects are monitored for interactions with fish. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects are also not able to quantify any effects to habitat.

Connectivity is disrupted by the presence of dams on several rivers in the Gulf of Maine region, including the Penobscot and Merrimack Rivers. While there are also dams on the Kennebec, Androscoggin and Saco Rivers, these dams are near the site of natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon are known to occur upstream of any hydroelectric projects in the Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. While not expected to be killed or injured during passage at a dam, the extent that Atlantic sturgeon are affected by the existence of dams and their operations in the Gulf of Maine region is currently unknown. The extent that Atlantic sturgeon are affected by operations of dams in the Gulf of Maine region is currently unknown; however, the documentation of an Atlantic sturgeon larvae downstream of the Brunswick Dam in the Androscoggin River suggests that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. The range of Atlantic sturgeon in the Penobscot River is limited by the presence of the Veazie and Great Works Dams. Together these dams prevent Atlantic sturgeon from accessing approximately 29 km of habitat, including the presumed historical spawning habitat located downstream of Milford Falls, the site of the Milford Dam. While removal of the Veazie and Great Works Dams is anticipated to occur in the near future, the presence of these dams is currently preventing access to significant habitats within the Penobscot River. While Atlantic sturgeon are known to occur in the Penobscot River, it is unknown if spawning is currently occurring or whether the presence of the Veazie and Great Works Dams affects the likelihood of spawning occurring in this river. The Essex Dam on the Merrimack River blocks access to approximately 58% of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. Like the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning occurring in this river.

Gulf of Maine DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Gulf of Maine over the past decades (Lichter *et al.* 2006; EPA, 2008). Many rivers in Maine, including the Androscoggin River, were heavily polluted in the past from industrial discharges from pulp and paper mills. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

There are no empirical abundance estimates for the Gulf of Maine DPS. The Atlantic sturgeon SRT (2007) presumed that the Gulf of Maine DPS was comprised of less than 300 spawning adults per year, based on abundance estimates for the Hudson and Altamaha River riverine populations of Atlantic sturgeon. Surveys of the Kennebec River over two time periods, 1977-1981 and 1998-2000, resulted in the capture of nine adult Atlantic sturgeon (Squiers, 2004). However, since the surveys were primarily directed at capture of shortnose sturgeon, the capture gear used may not have been selective for the larger-sized, adult Atlantic sturgeon; several hundred subadult Atlantic sturgeon were caught in the Kennebec River during these studies.

Summary of the Gulf of Maine DPS

Spawning for the Gulf of Maine DPS is known to occur in two rivers (Kennebec and Androscoggin) and possibly in a third. Spawning may be occurring in other rivers, such as the Sheepscot or Penobscot, but has not been confirmed. There are indications of increasing abundance of Atlantic sturgeon belonging to the Gulf of Maine DPS. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River, and are observed in rivers where they were unknown to occur or had not been observed to occur for many years (e.g., the Saco, Presumpscot, and Charles rivers). These observations suggest that abundance of the Gulf of Maine DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. However, despite some positive signs, there is not enough information to establish a trend for this DPS.

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC, 2007). Atlantic sturgeon from the GOM DPS are not commonly taken as bycatch in areas south of Chatham, MA, with only 8 percent (e.g., 7 of the 84 fish) of interactions observed in the Mid Atlantic/Carolina region being assigned to the Gulf of Maine DPS (Wirgin and King, 2011). Tagging results also indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south. However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy.(Canada) indicate that approximately 35 percent originated from the Gulf of Maine DPS (Wirgin *et al.*, in draft).

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). NMFS has determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

5.8 New York Bight DPS of Atlantic sturgeon

The New York Bight DPS includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters from Chatham, MA to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco, 1977; Secor, 2002; ASSRT, 2007). Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence (within the last 15 years) of spawning in the Connecticut and Taunton Rivers (ASSRT, 2007). Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT, 2007; Savoy, 2007; Wirgin and King, 2011).

The abundance of the Hudson River Atlantic sturgeon riverine population prior to the onset of expanded exploitation in the 1800's is unknown but, has been conservatively estimated at 10,000 adult females (Secor, 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (Secor, 2002; ASSRT, 2007; Kahnle *et al.*, 2007). As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). Kahnle *et al.* (1998; 2007) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. All available data on abundance of juvenile Atlantic sturgeon in the Hudson

River Estuary indicate a substantial drop in production of young since the mid 1970's (Kahnle *et al.*, 1998). A decline appeared to occur in the mid to late 1970's followed by a secondary drop in the late 1980's (Kahnle *et al.*, 1998; Sweka *et al.*, 2007; ASMFC, 2010). Catch-per-unit-effort data suggests that recruitment has remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980's (Sweka *et al.*, 2007; ASMFC, 2010). In examining the CPUE data from 1985-2007, there are significant fluctuations during this time. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s and while the CPUE is generally higher in the 2000s as compared to the 1990s, given the significant annual fluctuation it is difficult to discern any trend. Despite the CPUEs from 2000-2007 being generally higher than those from 1990-1999, they are low compared to the late 1980s. There is currently not enough information regarding any life stage to establish a trend for the Hudson River population.

There is no abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800's indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman, 1999; Secor, 2002). Sampling in 2009 to target young-of- the year (YOY) Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 mm TL (Fisher, 2009) and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron in Calvo *et al.*, 2010). Genetics information collected from 33 of the 2009 year class YOY indicates that at least 3 females successfully contributed to the 2009 year class (Fisher, 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning is still occurring in the Delaware River, the relatively low numbers suggest the existing riverine population is limited in size.

Several threats play a role in shaping the current status and trends observed in the Delaware River and Estuary. In-river threats include habitat disturbance from dredging, and impacts from historical pollution and impaired water quality. A dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron, 2009), and the river receives significant shipping traffic. Vessel strikes have been identified as a threat in the Delaware River; however, at this time we do not have information to quantify this threat or its impact to the population or the New York Bight DPS. Similar to the Hudson River, there is currently not enough information to determine a trend for the Delaware River population.

Summary of the New York Bight DPS

Atlantic sturgeon originating from the New York Bight DPS spawn in the Hudson and Delaware rivers. While genetic testing can differentiate between individuals originating from the Hudson or Delaware river the available information suggests that the straying rate is high between these rivers. There are no indications of increasing abundance for the New York Bight DPS (ASSRT, 2009; 2010). Some of the impact from the threats that contributed to the decline of the New York Bight DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally-managed fisheries, and vessel strikes remain significant threats to the New York Bight DPS.

In the marine range, New York Bight DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, currently available estimates indicate that at least 4% of adults may be killed as a result of bycatch in fisheries authorized under Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent of the Atlantic sturgeon bycatch interactions in the Mid Atlantic Bight region were sturgeon from the New York Bight DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1-2% were from the New York Bight DPS. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects operate with observers present to document fish mortalities many do not. We have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects are also not able to quantify any effects to habitat.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke Dam on the Connecticut River blocks further upstream passage; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. Connectivity may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. The extent that Atlantic sturgeon are affected by operations of dams in the New York Bight region is currently unknown.

New York Bight DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Hudson and Delaware over the past decades (Lichter *et al.* 2006; EPA, 2008). Both the Hudson and Delaware rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sanitary sewer discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes occur in the Delaware River. Twenty-nine mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2004 to 2008, and at least 13 of these fish were large adults. Given the time of year in which the fish were observed (predominantly May through July, with two in August), it is likely that many of the adults were migrating through the river to the spawning grounds. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the New York Bight DPS.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. As described in the final listing rule, NMFS has determined that the New York Bight DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

5.9 Chesapeake Bay DPS of Atlantic sturgeon

The Chesapeake Bay DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, VA. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT, 2007). Based on the review by Oakley (2003), 100 percent of Atlantic sturgeon habitat is currently accessible in these rivers since most of the barriers to passage (i.e. dams) are located upriver of where spawning is expected to have historically occurred (ASSRT, 2007). Spawning still occurs in the James River, and the presence of juvenile and adult sturgeon in the York River suggests that spawning may occur there as well (Musick *et al.*, 1994; ASSRT, 2007; Greene, 2009). However, conclusive evidence of current spawning is only available for the James River. Atlantic sturgeon that are spawned elsewhere are known to use the Chesapeake Bay for other life functions, such as foraging and as juvenile nursery habitat prior to entering the marine system as subadults (Vladykov and Greeley, 1963; ASSRT, 2007; Wirgin *et al.*, 2007; Grunwald *et al.*, 2008).

Age to maturity for Chesapeake Bay DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). Age at maturity is 5 to 19 years for Atlantic sturgeon originating from South Carolina rivers (Smith *et al.*, 1982) and 11 to 21 years for Atlantic sturgeon originating from the Hudson River (Young *et al.*, 1998). Therefore, age at maturity for Atlantic sturgeon of the Chesapeake Bay DPS likely falls within these values.

Several threats play a role in shaping the current status of Chesapeake Bay DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of Atlantic sturgeon from the James River and Chesapeake Bay in the 19th century (Hildebrand and Schroeder, 1928; Vladykov and Greeley, 1963; ASMFC, 1998; Secor, 2002; Bushnoe *et al.*, 2005; ASSRT, 2007) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (Secor, 2002; Bushnoe *et al.*, 2005; ASSRT, 2007; Balazik *et al.*, 2010). Habitat disturbance caused by in-river work such as dredging for navigational purposes is thought to have reduced available spawning habitat in the James River (Holton and Walsh, 1995; Bushnoe *et al.*, 2005; ASSRT, 2007). At this time, we do not have information to quantify this loss of spawning habitat.

Decreased water quality also threatens Atlantic sturgeon of the Chesapeake Bay DPS, especially since the Chesapeake Bay system is vulnerable to the effects of nutrient enrichment due to a relatively low tidal exchange and flushing rate, large surface to volume ratio, and strong stratification during the spring and summer months (Pyzik *et al.*, 2004; ASMFC, 1998; ASSRT, 2007; EPA, 2008). These conditions contribute to reductions in dissolved oxygen levels throughout the Bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low dissolved oxygen) conditions within the Bay (Niklitschek and Secor, 2005; 2010). At this time we do not have sufficient information to quantify the extent that degraded water quality effects habitat or individuals in the James River or throughout the Chesapeake Bay.

Vessel strikes have been observed in the James River (ASSRT, 2007). Eleven Atlantic sturgeon were reported to have been struck by vessels from 2005 through 2007. Several of these were mature individuals. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the New York Bight DPS.

In the marine and coastal range of the Chesapeake Bay DPS from Canada to Florida, fisheries bycatch in federally and state managed fisheries poses a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population (Stein *et al.*, 2004; ASMFC, 2007; ASSRT, 2007).

Summary of the Chesapeake Bay DPS

Spawning for the Chesapeake Bay DPS is known to occur in only the James River. Spawning may be occurring in other rivers, such as the York, but has not been confirmed. There are anecdotal reports of increased sightings and captures of Atlantic sturgeon in the James River. However, this information has not been comprehensive enough to develop a population estimate for the James River or to provide sufficient evidence to confirm increased abundance. Some of the impact from the threats that facilitated the decline of the Chesapeake Bay DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). We do not currently have enough information about any life stage to establish a trend for this DPS.

Areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in U.S. state and federally-managed fisheries, Canadian fisheries and vessel strikes remain significant threats to the Chesapeake Bay DPS of Atlantic sturgeon. Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007). The Chesapeake Bay DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for population recovery.

5.10 Carolina DPS of Atlantic sturgeon

The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) from Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. Sturgeon are commonly captured 40 miles offshore (D. Fox, DSU, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters deep (Stein et al. 2004, ASMFC 2007), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms.

Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers. We determined spawning was occurring if young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system (Table 3). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. There may also be spawning populations in the Neuse, Santee and Cooper Rivers, though it is uncertain. Historically, both the Sampit and Ashley Rivers were documented to have spawning populations at one time. However, the spawning population in the Sampit River is believed to be extirpated and the current status of the spawning population in the Ashley River is unknown. Both rivers may be used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. This represents our current knowledge of the river systems utilized by the Carolina DPS for specific life functions, such as spawning, nursery habitat, and foraging. However, fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

River/Estuary	**Spawning Population**	**Data**
Roanoke River, VA/NC; Albemarle Sound, NC	Yes	collection of 15 YOY (1997-1998); single YOY (2005)
Tar-Pamlico River, NC; Pamlico Sound	Yes	one YOY (2005)
Neuse River, NC; Pamlico Sound	Unknown	
Cape Fear River, NC	Yes	upstream migration of adults in the fall, carcass of a ripe female upstream in mid-September (2006)
Waccamaw River, SC; Winyah Bay	Yes	age-1, potentially YOY (1980s)
Pee Dee River, SC; Winyah Bay	Yes	running ripe male in Great Pee Dee River (2003)
Sampit, SC; Winyah Bay	Extirpated	
Santee River, SC	Unknown	
Cooper River, SC	Unknown	
Ashley River, SC	Unknown	

Table 3. Major rivers, tributaries, and sounds within the range of the Carolina DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

The riverine spawning habitat of the Carolina DPS occurs within the Mid-Atlantic Coastal Plain ecoregion (TNC 2002a), which includes bottomland hardwood forests, swamps, and some of the world's most active coastal dunes, sounds, and estuaries. Natural fires, floods, and storms are so dominant in this region that the landscape changes very quickly. Rivers routinely change their courses and emerge from their banks. The primary threats to biological diversity in the Mid-Atlantic Coastal Plain, as listed by TNC are: global climate change and rising sea level; altered surface hydrology and landform alteration (e.g., flood-control and hydroelectric dams, inter-basin transfers of water, drainage ditches, breached levees, artificial levees, dredged inlets and river channels, beach renourishment, and spoil deposition banks and piles); a regionally receding water table, probably resulting from both over-use and inadequate recharge; fire suppression; land fragmentation, mainly by highway development; land-use conversion (e.g., from forests to timber plantations, farms, golf courses, housing developments, and resorts); the invasion of exotic plants and animals; air and water pollution, mainly from agricultural activities including concentrated animal feed operations; and over-harvesting and poaching of species. Many of the Carolina DPS' spawning rivers, located in the Mid-Coastal Plain, originate in areas of marl. Waters draining calcareous, impervious surface materials such as marl are: (1) likely to be alkaline; (2) dominated by surface run-off; (3) have little groundwater connection; and, (4) are seasonally ephemeral.

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002, Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same time-frame. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the Carolina DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the Carolina DPS has been extirpated, with a potential extirpation in an additional system. The abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, is estimated to be less than 3 percent of what they were historically (ASSRT 2007).

Threats

The Carolina DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e, being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dams, dredging, and degraded water quality is contributing to the status of the Carolina DPS. Dams have curtailed Atlantic sturgeon spawning and juvenile developmental habitat by blocking over 60 percent of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and dissolved oxygen (DO)) downstream of these dams, as well as on the Roanoke River, has been reduced, which modifies and curtails the extent of spawning and nursery habitat for the Carolina DPS. Dredging in spawning and nursery grounds modifies the quality of the habitat and is further curtailing the extent of available habitat in the Cape Fear and Cooper Rivers, where Atlantic sturgeon habitat has already been modified and curtailed by the presence of dams. Reductions in water quality from terrestrial activities have modified habitat utilized by the Carolina DPS. In the Pamlico and Neuse systems, nutrient-loading and seasonal anoxia are occurring, associated in part with concentrated animal feeding operations (CAFOs). Heavy industrial development and CAFOs have degraded water quality in the Cape Fear River. Water quality in the Waccamaw and Pee Dee rivers have been affected by industrialization and riverine sediment samples contain high levels of various toxins, including dioxins. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the Carolina DPS. Twenty interbasin water transfers in existence prior to 1993, averaging 66.5 million gallons per day (mgd), were authorized at their maximum levels without being subjected to an evaluation for certification by

North Carolina Department of Environmental and Natural Resources or other resource agencies. Since the 1993 legislation requiring certificates for transfers, almost 170 mgd of interbasin water withdrawals have been authorized, with an additional 60 mgd pending certification. The removal of large amounts of water from the system will alter flows, temperature, and DO. Existing water allocation issues will likely be compounded by population growth and potentially climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the Carolina DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the Carolina DPS. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Further, a total population abundance for the DPS is not available, and it is therefore not possible to calculate the percentage of the DPS subject to bycatch mortality based on the available bycatch mortality rates for individual fisheries. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Carolina DPS Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution, etc.)

The recovery of Atlantic sturgeon along the Atlantic Coast, especially in areas where habitat is limited and water quality is severely degraded, will require improvements in the following areas: (1) elimination of barriers to spawning habitat either through dam removal, breaching, or installation of successful fish passage facilities; (2) operation of water control structures to provide appropriate flows, especially during spawning season; (3) imposition of dredging restrictions including seasonal moratoriums and avoidance of spawning/nursery habitat; and, (4) mitigation of water quality parameters that are restricting sturgeon use of a river (i.e., DO). Additional data regarding sturgeon use of riverine and estuarine environments is needed.

The concept of a viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the Carolina DPS put them in danger of extinction throughout their range; none of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. Although the largest impact that caused the precipitous decline of the species has been curtailed (directed fishing), the population sizes within the Carolina DPS have remained relatively constant at greatly reduced levels (approximately 3 percent of historical population sizes) for 100 years. Small numbers of individuals resulting from drastic reductions in populations, such as occurred with Atlantic sturgeon due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry, 1971; Shaffer, 1981; Soulé, 1980). Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. Their late age at maturity provides more opportunities for individual Atlantic sturgeon to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, it also results increases the timeframe over which exposure to the multitude of threats facing the Carolina DPS can occur.

The viability of the Carolina DPS depends on having multiple self-sustaining riverine spawning populations and maintaining suitable habitat to support the various life functions (spawning, feeding, growth) of Atlantic sturgeon sturgeon populations. Because a DPS is a group of populations, the stability, viability, and persistence of individual populations affects the persistence and viability of the larger DPS. The loss of any population within a DPS will result in: (1) a long-term gap in the range of the DPS that is unlikely to be recolonized; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) potential loss of unique haplotypes; (5) potential loss of adaptive traits; and (6) reduction in total number. The loss of a population will negatively impact the persistence and viability of the DPS as a whole, as fewer than two individuals per generation spawn outside their natal rivers (Secor and Waldman 1999). The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, the immigration into marine habitats to grow, and then the return of adults to natal rivers to spawn.

Summary of the Status of the Carolina DPS of Atlantic Sturgeon

In summary, the Carolina DPS is estimated to number less than 3 percent of its historic population size. There are estimated to be less than 300 spawning adults per year (total of both sexes) in each of the major river systems occupied by the DPS in which spawning still occurs, whose freshwater range occurs in the watersheds (including all rivers and tributaries) from Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. Their late age at maturity provides more opportunities for individuals to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the Carolina DPS by habitat alteration and bycatch. This DPS was severely depleted by past directed commercial fishing, and faces ongoing impacts and threats from habitat alteration or inaccessibility, bycatch, and the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch that have prevented river populations from rebounding and will prevent their recovery.

The presence of dams has resulted in the loss of over 60 percent of the historical sturgeon habitat on the Cape Fear River and in the Santee-Cooper system. Dams are contributing to the status of the Carolina DPS by curtailing the extent of available spawning habitat and further modifying the remaining habitat downstream by affecting water quality parameters (such as depth, temperature, velocity, and DO) that are important to sturgeon. Dredging is also contributing to the status of the Carolina DPS by modifying Atlantic sturgeon spawning and nursery habitat. Habitat modifications through reductions in water quality are contributing to the status of the Carolina DPS due to nutrient-loading, seasonal anoxia, and contaminated sediments. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current threat to the Carolina DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may utilize multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the Carolina DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch is currently not being addressed through existing mechanisms. Further, access to habitat and water quality continues to be a problem even with NMFS' authority under the Federal Power Act to recommend fish passsage and existing controls on some pollution sources. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the Carolina DPS.

5.11 South Atlantic DPS of Atlantic sturgeon

The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers (ACE) Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. The marine range of Atlantic sturgeon from the South Atlantic DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida.

Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. We determined spawning was occurring if young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system (Table 4). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. Historically, both the Broad-Coosawatchie and St. Marys Rivers were documented to have spawning populations at one time; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. However, the spawning population in the St. Marys River, as well as any historical spawning population present in the St. Johns, is believed to be extirpated, and the status of the spawning population in the Broad-Coosawatchie is unknown. Both the St. Marys and St. Johns Rivers are used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. The use of the Broad-Coosawatchie by sturgeon from other spawning populations is unknown at this time. The presence of historical and current spawning populations in the Ashepoo River has not been documented; however, this river may currently be used for nursery habitat by young Atlantic sturgeon originating from other spawning populations. This represents our current knowledge of the river systems utilized by the South Atlantic DPS for specific life functions, such as spawning, nursery habitat, and foraging. However, fish from the South Atlantic DPS likely use other river systems than those listed here for their specific life functions.

River/Estuary	**Spawning Population**	**Data**
ACE (Ashepoo, Combahee, and Edisto Rivers) Basin, SC; St. Helena Sound	Yes	1,331 YOY (1994-2001); gravid female and running ripe male in the Edisto (1997); 39 spawning adults (1998)
Broad-Coosawhatchie Rivers, SC; Port Royal Sound	Unknown	
Savannah River, SC/GA	Yes	22 YOY (1999-2006); running ripe male (1997)
Ogeechee River, GA	Yes	age-1 captures, but high inter-annual variability (1991-1998); 17 YOY (2003); 9 YOY (2004)
Altamaha River, GA	Yes	74 captured/308 estimated spawning adults (2004); 139 captured/378 estimated spawning adults (2005)
Satilla River, GA	Yes	4 YOY and spawning adults (1995-1996)
St. Marys River, GA/FL	Extirpated	
St. Johns River, FL	Extirpated	

Table 4. Major rivers, tributaries, and sounds within the range of the South Atlantic DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

The riverine spawning habitat of the South Atlantic DPS occurs within the South Atlantic Coastal Plain ecoregion (TNC 2002b), which includes fall-line sandhills, rolling longleaf pine uplands, wet pine flatwoods, isolated depression wetlands, small streams, large river systems, and estuaries. Other ecological systems in the ecoregion include maritime forests on barrier islands, pitcher plant seepage bogs and Altamaha grit (sandstone) outcrops. Other ecological systems in the ecoregion include maritime forests on barrier islands, pitcher plant seepage bogs and Altamaha grit (sandstone) outcrops. The primary threats to biological diversity in the South Atlantic Coastal Plain listed by TNC are intensive silvicultural practices, including conversion of natural forests to highly managed pine monocultures and the clear-cutting of bottomland hardwood forests. Changes in water quality and quantity, caused by hydrologic alterations (impoundments, groundwater withdrawal, and ditching), and point and nonpoint pollution, are threatening the aquatic systems. Development is a growing threat, especially in coastal areas. Agricultural conversion, fire regime alteration, and the introduction of nonnative species are additional threats to the ecoregion's diversity. The South Atlantic DPS' spawning rivers, located in the South Atlantic Coastal Plain, are primarily of two types: brownwater (with headwaters north of the Fall Line, silt-laden) and blackwater (with headwaters in the coastal plain, stained by tannic acids).

Secor (2002) estimates that 8,000 adult females were present in South Carolina prior to 1890. Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in the state prior to 1890. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. Currently, the Atlantic sturgeon spawning population in at least two river systems within the South Atlantic DPS has been extirpated. The Altamaha River population of Atlantic sturgeon, with an estimated 343 adults spawning annually, is believed to be the largest population in the Southeast, yet is estimated to be only 6 percent of its historical population size. The abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, is estimated to be less than 1 percent of what they were historically (ASSRT 2007).

Threats

The South Atlantic DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e, being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dredging and degraded water quality is contributing to the status of the South Atlantic DPS. Dredging is a present threat to the South Atlantic DPS and is contributing to their status by modifying the quality and availability of Atlantic sturgeon habitat. Maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River and modeling indicates that the proposed deepening of the navigation channel will result in reduced DO and upriver movement of the salt wedge, curtailing spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns Rivers. Reductions in water quality from terrestrial activities have modified habitat utilized by the South Atlantic DPS. Low DO is modifying sturgeon habitat in the Savannah due to dredging, and non-point source inputs are causing low DO in the Ogeechee River and in the St. Marys River, which completely eliminates juvenile nursery habitat in summer. Low DO has also been observed in the St. Johns River in the summer. Sturgeon are more sensitive to low DO and the negative (metabolic, growth, and feeding) effects caused by low DO increase when water temperatures are concurrently high, as they are within the range of the South Atlantic DPS. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the South Atlantic DPS. Large withdrawals of over 240 million gallons per day mgd of water occur in the Savannah River for power generation and municipal uses. However, users withdrawing less than 100,000 gallons per day (gpd) are not required to get permits, so actual water withdrawals from the Savannah and other rivers within the range of the South Atlantic DPS are likely much higher. The removal of large amounts of water from the system will alter flows, temperature, and DO. Water shortages and "water wars" are already occurring in the rivers occupied by the South Atlantic DPS and will likely be compounded in the future by population growth and potentially by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the South Atlantic DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the South Atlantic DPS. The loss of large subadults and adults as a result of bycatch impacts Atlantic sturgeon populations because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Further, a total population abundance for the DPS is not available, and it is therefore not possible to calculate the percentage of the DPS subject to bycatch mortality based on the available bycatch mortality rates for individual fisheries. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the South Atlantic DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no permit requirements for water withdrawals under 100,000 gpd in Georgia, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution.)

The recovery of Atlantic sturgeon along the Atlantic Coast, especially in areas where habitat is limited and water quality is severely degraded, will require improvements in the following areas: (1) elimination of barriers to spawning habitat either through dam removal, breaching, or installation of successful fish passage facilities; (2) operation of water control structures to provide appropriate flows, especially during spawning season; (3) imposition of dredging restrictions including seasonal moratoriums and avoidance of spawning/nursery habitat; and, (4) mitigation of water quality parameters that are restricting sturgeon use of a river (i.e., DO). Additional data regarding sturgeon use of riverine and estuarine environments is needed.

A viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the South Atlantic DPS put them in danger of extinction throughout their range; none of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. Although the largest impact that caused the precipitous decline of the species has been curtailed (directed fishing), the population sizes within the South Atlantic DPS have remained relatively constant at greatly reduced levels (approximately 6 percent of historical population sizes in the Altamaha River, and 1 percent of historical population sizes in the remainder of the DPS) for 100 years. Small numbers of individuals resulting from drastic reductions in populations, such as occurred with Atlantic sturgeon due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry, 1971; Shaffer, 1981; Soulé, 1980). Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. Their late age at maturity provides more opportunities for individual Atlantic sturgeon to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, it also results increases the timeframe over which exposure to the multitude of threats facing the South Atlantic DPS can occur.

Summary of the Status of the South Atlantic DPS of Atlantic Sturgeon
The South Atlantic DPS is estimated to number fewer than 6 percent of its historical population size, with all river populations except the Altamaha estimated to be less than 1 percent of historical abundance. There are an estimated 343 spawning adults per year in the Altamaha and less than 300 spawning adults per year (total of both sexes) in each of the other major river systems occupied by the DPS in which spawning still occurs, whose freshwater range occurs in the watersheds (including all rivers and tributaries) of the ACE Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. Their late age at maturity provides more opportunities for individuals to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the South Atlantic DPS by habitat alteration, bycatch, and from the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch.

Dredging is contributing to the status of the South Atlantic DPS by modifying spawning, nursery, and foraging habitat. Habitat modifications through reductions in water quality are also contributing to the status of the South Atlantic DPS through reductions in DO, particularly during times of high water temperatures, which increase the detrimental effects on Atlantic sturgeon habitat. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current impact to the South Atlantic DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may utilize multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the South

Atlantic DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch is currently not being addressed through existing mechanisms. Further, access to habitat and water quality continues to be a problem even with NMFS' authority under the Federal Power Act to recommend fish passsage and existing controls on some pollution sources. There is a lack of regulation for some large water withdrawals, which threatens sturgeon habitat. Current regulatory regimes do not require a permit for water withdrawals under 100,000 gpd in Georgia and there are no restrictions on interbasin water transfers in South Carolina. Data required to evaluate water allocation issues are either very weak, in terms of determining the precise amounts of water currently being used, or non-existent, in terms of our knowledge of water supplies available for use under historical hydrologic conditions in the region. Existing water allocation issues will likely be compounded by population growth, drought, and potentially climate change. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the South Atlantic DPS.

6.0 ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR § 402.02). The environmental baseline for this Opinion includes the effects of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, water quality, scientific research, shipping and other vessel traffic and fisheries, and recovery activities associated with reducing those impacts.

6.1 Federal Actions that have Undergone Formal or Early Section 7 Consultation

NMFS has undertaken several ESA section 7 consultations to address the effects of actions authorized, funded or carried out by Federal agencies. Each of those consultations sought to develop ways of reducing the probability of adverse impacts of the action on listed species. Consultations are detailed below.

6.1.1 Maintenance of Federal Navigation Projects and Use of Sand Borrow Areas

USACE and NMFS have consulted previously on dredging of Federal navigation channels and borrow areas in the lower Chesapeake Bay. The use of endangered species observers began in 1994. Since then, a total of 64 sea turtles and two Atlantic sturgeon have been observed entrained in hopper dredges operating in the action area. All of these individuals were dead at the time of observation. Additionally, sea turtles and Atlantic sturgeon have been captured and released during sea turtle relocation trawling in association with hopper dredging. One sea turtle mortality has been recorded during relocation trawling. No interactions between sea turtles or Atlantic sturgeon have been observed during projects using a hydraulic pipeline or mechanical dredge. We are currently engaged in a consultation to consider the effects of dredging in all Federal navigation projects and sand borrow areas in the lower Chesapeake Bay.

6.1.2 Scientific Studies

There is currently one scientific research permits issued pursuant to Section 10(a)(1)(A) of the ESA, that authorize research on Atlantic sturgeon in the action area. Permit 16547 authorizes the US Fish and Wildlife Service to conduct research activities on Atlantic sturgeon in the Chesapeake Bay and tidal tributaries in Virginia. There is the potential for some research to take place in the action area. The permit authorizes the non-lethal capture, handling and sampling of a number of sturgeon and the unintentional mortality of three Atlantic sturgeon over the five year life of this permit. The permit expires in April 2017.

Several researchers, including the NMFS Northeast and Southeast Science Centers and several academic and independent researchers are authorized under various Section 10(a)(1)(A) permits to conduct surveys and sample sea turtles. Some of this activity may occur in the action area. More information on these permits can be obtained from: https://apps.nmfs.noaa.gov.

6.1.3 Vessel Operations

Potential adverse effects from federal vessel operations in the action area of this consultation include operations of the US Navy (USN) and the US Coast Guard (USCG), which maintain the largest federal vessel fleets, the EPA, the National Oceanic and Atmospheric Administration (NOAA), and the USACE. NMFS has conducted formal consultations with the USCG, the USN, EPA and NOAA on their vessel operations. In addition to operation of USACE vessels, NMFS has consulted with the USACE to provide recommended permit restrictions for operations of contract or private vessels around whales. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid adverse effects to listed species. Refer to the biological opinions for the USCG (September 15, 1995; July 22, 1996; and June 8, 1998) and the USN (May 15, 1997) for detail on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures. No interactions with sturgeon or sea turtles have been reported with any of the vessels considered in these Opinions.

6.1.4 Authorization of Fisheries through Fishery Management Plans

NMFS authorizes the operation of several fisheries in the action area under the authority of the Magnuson-Stevens Fishery Conservation Act and through Fishery Management Plans and their implementing regulations. Commercial and recreational fisheries in the action area employ gear that is known to harass, injure, and/or kill sea turtles and Atlantic sturgeon. In the Northeast Region (Maine through Virginia), formal ESA section 7 consultations have been conducted on the American lobster, Atlantic bluefish, Atlantic mackerel/squid/ butterfish, Atlantic sea scallop, monkfish, northeast multispecies, red crab, spiny dogfish, summer flounder/scup/black sea bass, and tilefish fisheries. These consultations have considered effects to loggerhead, green, Kemp's ridley and leatherback sea turtles. We have completed Biological Opinions on the operations of these fisheries. In each of these Opinions, we concluded that the ongoing action was likely to adversely affect but was not likely to jeopardize the continued existence of any sea turtle species. Each of these Opinions included an incidental take statement (ITS) exempting a certain amount of lethal and/or non-lethal take resulting from interactions with the fishery. These ITSs are summarized in the table below. Further, in each Opinion, we concluded that the potential for interactions (i.e., vessel strikes) between sea turtles and fishing vessels was extremely low and similarly that any effects to sea turtle prey and/or habitat would be insignificant and discountable. We have also determined that the Atlantic herring and surf clam/ocean quahog fisheries do not adversely affect any species of listed sea turtles.

NMFS' Southeast Regional Office has carried out formal ESA section 7 consultations for several FMPs with action areas that at least partially overlap with the NEAMAP action area. These include: coastal migratory pelagics, swordfish/tuna/shark/ billfish (highly migratory species), snapper/grouper, dolphin/wahoo, and the Southeast shrimp trawl fisheries. The ITSs provided with these Opinions are included in the table below.

In addition to these consultations, NMFS has conducted a formal consultation on the pelagic longline component of the Atlantic highly migratory species FMP. Portions of this fishery occur within the NEAMAP action area. In a June 1, 2004 Opinion, NMFS concluded that the ongoing action was likely to adversely affect but was not likely to jeopardize the continued existence of loggerhead, Kemp's ridley or green sea turtles but was likely to jeopardize the continued existence of leatherback sea turtles. This Opinion included a Reasonable and Prudent Alternative that when implemented would modify operations of the fishery in a way that would remove jeopardy. This fishery is currently operated in a manner that is consistent with the RPA. The RPA included an ITS which is reflected in the table below. Unless specifically noted, all numbers denote an annual number of captures that may be lethal or non-lethal.

Table 5. Information on Fisheries Opinions conducted by NMFS NERO and SERO for federally managed fisheries that operate in the action area

FMP	**Date of Most Recent Opinion**	**Loggerhead**	**Kemp's ridley**	**Green**	**Leatherback**
American lobster	August 3, 2012	1	0	0	5
Atlantic bluefish	October 29, 2010	82 (34 lethal)	4	5	4
Monkfish	October 29, 2010	173 (70 lethal)	4	5	4
Multispecies	October 29, 2010	46 in trawls (21 lethal)	4	5	4
Skate	October 29, 2010	39 (17 lethal)	4	5	4
Spiny dogfish	October 29, 2010	2	4	5	4
Mackerel/squid/butterfish	October 29, 2010	62 (25 lethal)	2	2	2
Summer flounder/scup/black sea bass	October 29, 2010	205 (85 lethal)	4	5	6
Shark fisheries as managed under the Consolidated HMS FMP	May 20, 2008	679 (349 lethal) every 3 years	2 (1 lethal) every 3 years	2 (1 lethal) every 3 years	74 (47 lethal) every 3 years
Atlantic sea scallop	July 12, 2012	2012: 301 (195 lethal); 2013 and beyond: 301 (115 lethal)	3	2	2

Coastal migratory pelagic	August 13, 2007	33 every 3 years	4 every 3 years	14 every 3 years	2 every 3 years
Pelagic longline under the HMS FMP (per the RPA)	June 1, 2004	1,905 (339 lethal) every 3 years	*105 (18 lethal) every 3 years	*105 (18 lethal) every 3 years	1764 (252 lethal) every 3 years

**combination of 105 (18 lethal) Kemp's ridley, green, hawksbill, or Olive ridley*

We are in the process of reinitiating consultations that consider fisheries actions that may affect Atlantic sturgeon. Sturgeon originating from the five DPSs considered in this consultation are known to be captured and killed in fisheries operated in the action area. At the time of this writing, no Opinions considering effects of federally authorized fisheries on any DPS of Atlantic sturgeon have been completed. As noted in the Status of the Species section above, the NEFSC prepared a bycatch estimate for Atlantic sturgeon captured in sink gillnet and otter trawl fisheries operated from Maine through Virginia. This estimate indicates that, based on data from 2006-2010, annually, an average of 3,118 Atlantic sturgeon are captured in these fisheries with 1,569 in sink gillnet and 1,548 in otter trawls. The mortality rate in sink gillnets is estimated at approximately 20% and the mortality rate in otter trawls is estimated at 5%. Based on this estimate, a total of 391 Atlantic sturgeon are estimated to be killed annually in these fisheries that are prosecuted in the action area. We are currently in the process of determining the effects of this annual loss to each of the DPSs. At this time, there is no bycatch estimate for fisheries that are regulated by NMFS SERO. Any of these fisheries that operate with sink gillnets or otter trawls are likely to interact with Atlantic sturgeon and be an additional source of mortality in the action area. Also, as noted above, NMFS SERO has reinitiated the consultation for shrimp trawling; consultation on the smooth dogfish fishery is also currently being conducted by SERO in coordination with NMFS HMS.

6.1.4 Other Federally Authorized Actions

We have completed several informal consultations on effects of in-water construction activities in the Chesapeake Bay permitted by the USACE. This includes several dock, pier and bank stabilization projects. No interactions with shortnose or Atlantic sturgeon have been reported in association with any of these projects.

We have also completed several informal consultations on effects of private dredging projects permitted by the USACE. All of the dredging was with a mechanical or cutterhead dredge. No interactions with shortnose or Atlantic sturgeon have been reported in association with any of these projects.

6.2 State or Private Actions in the Action Area

6.2.1 State Authorized Fisheries

Atlantic and shortnose sturgeon, and sea turtles may be vulnerable to capture, injury and mortality in fisheries occurring in state waters. The action area includes portions of Virginia state waters. Information on the number of sturgeon captured or killed in state fisheries is extremely limited and as such, efforts are currently underway to obtain more information on the numbers of sturgeon captured and killed in state water fisheries. We are currently working with the Atlantic States

Marine Fisheries Commission (ASMFC) and the coastal states to assess the impacts of state authorized fisheries on sturgeon. We anticipate that some states are likely to apply for ESA section 10(a)(1)(B) Incidental Take Permits to cover their fisheries; however, to date, no applications have been submitted. Below, we discuss the different fisheries authorized by the states and any available information on interactions between these fisheries and sturgeon.

American Eel
American eel (*Anguilla rostrata*) is exploited in fresh, brackish and coastal waters from the southern tip of Greenland to northeastern South America. American eel fisheries are conducted primarily in tidal and inland waters. Eels are typically caught with hook and line or with eel traps and may also be caught with fyke nets. Sturgeon and sea turtles are not known to interact with the eel fishery.

Atlantic croaker
Atlantic croaker (*Micropogonias undulates*) occur in coastal waters from the Gulf of Maine to Argentina, and are one of the most abundant inshore bottom-dwelling fish along the U.S. Atlantic coast. Atlantic croaker are managed under an ASMFC ISFMP (including Amendment 1 in 2005 and Addendum 1 in 2010), but no specific management measures are required.

Recreational fisheries for Atlantic croaker are likely to use hook and line; commercial fisheries targeting croaker primarily use otter trawls. The average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the Atlantic croaker fishery was estimated to be 70 loggerhead sea turtles (Warden 2011). Additional information on sea turtle interactions with gillnet gear, including gillnet gear used in the Atlantic croaker fishery, has also been recently published by Murray (2009a, 2009b). The average annual bycatch of loggerhead sea turtles in gillnet gear used in the Atlantic croaker fishery, based on VTR data from 2002-2006, was estimated to be 11 per year with a 95% CI of 3-20 (Murray 2009b). A quantitative assessment of the number of Atlantic sturgeon captured in the croaker fishery is not available. Mortality rates of Atlantic sturgeon in commercial trawls has been estimated at 5%. A review of the NEFOP database indicates that from 2006-2010, 60 Atlantic sturgeon (out of a total of 726 observed interactions) were captured during observed trips where the trip target was identified as croaker. This represents a minimum number of Atlantic sturgeon captured in the croaker fishery during this time period as it only considers observed trips for boats with federal permits only. We do not have an estimate of the number of interactions between sturgeon or sea turtles with the croaker fishery in the action area.

Horseshoe crabs
ASMFC manages horseshoe crabs through an Interstate Fisheries Management Plan that sets state quotas, and allows states to set closed seasons. Horseshoe crabs are present in Chesapeake Bay. Stein *et al.* (2004) examined bycatch of Atlantic sturgeon using the NMFS sea-sampling/observer database (1989-2000) and found that the bycatch rate for horseshoe crabs was very low, at 0.05%. Few Atlantic sturgeon are expected to be caught in the horeshoe crab fishery in the action area. Sea turtles are not known to be captured during horseshoe crab fishing.

Striped bass
Striped bass are managed by ASMFC through Amendment 6 to the Interstate FMP, which requires minimum sizes for the commercial and recreational fisheries, possession limits for the recreational fishery, and state quotas for the commercial fishery (ASMFC 2003). Under Addendum 2, the coastwide striped bass quota remains the same, at 70% of historical levels. Data from the Atlantic

Coast Sturgeon Tagging Database (2000-2004) shows that the striped bass fishery accounted for 43% of Atlantic sturgeon recaptures; however, no information on the total number of Atlantic sturgeon caught by fishermen targeting striped bass or the mortality rate is available. No information on interactions between sea turtles and the striped bass fishery is available.

Weakfish
The weakfish fishery occurs in both state and federal waters but the majority of commercially and recreationally caught weakfish are caught in state waters (ASMFC 2002). The dominant commercial gears include gill nets, pound nets, haul seines, and trawls, with the majority of landings occurring in the fall and winter months (ASMFC 2002). Fishing for weakfish occurs in Delaware Bay.

The average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the weakfish fishery was estimated to be 1 loggerhead sea turtle (Warden 2011). Additional information on sea turtle interactions with gillnet gear, including gillnet gear used in the weakfish fishery, has also been recently published by Murray (2009a, 2009b). The average annual bycatch of loggerhead sea turtles in gillnet gear used in the weakfish fishery, based on VTR data from 2002-2006, was estimated to be one (1) per year with a 95% CI of 0-1 (Murray 2009b).

A quantitative assessment of the number of Atlantic sturgeon captured in the weakfish fishery is not available. A review of the NEFOP database indicates that from 2006-2010, 36 Atlantic sturgeon (out of a total of 726 observed interactions) were captured during observed trips where the trip target was identified as weakfish. This represents a minimum number of Atlantic sturgeon captured in the weakfish fishery during this time period as it only considers observed trips, and most inshore fisheries are not observed. An earlier review of bycatch rates and landings for the weakfish fishery reported that the weakfish-striped bass fishery had an Atlantic sturgeon bycatch rate of 16% from 1989-2000; the weakfish-Atlantic croaker fishery had an Atlantic sturgeon bycatch rate of 0.02%, and the weakfish fishery had an Atlantic sturgeon bycatch rate of 1.0% (ASSRT 2007).

American lobster trap fishery
An American lobster trap fishery also occurs in Chesapeake Bay. This fishery is managed under the ASMFC's ISFMP. This fishery has also been identified as a source of gear causing injuries to and mortality of loggerhead and leatherback sea turtles as a result of entanglement in vertical buoy lines of the pot/trap gear. Between 2002 and 2008, the lobster trap fishery in state waters was verified as the fishery involved in at least 27 leatherback entanglements in the Northeast Region. All entanglements involved the vertical line of the gear. These verified/confirmed entanglements occurred in Maine, Massachusetts, and Rhode Island state waters from June through October (Northeast Region STDN database). While no entanglements in lobster gear have been reported for Chesapeake Bay, the potential for future entanglement exists. Atlantic sturgeon are not known to interact with lobster trap gear.

Poundnet Fishery
This fishery is managed by the states, except for regulations NMFS issued under the authority of the ESA to protect sea turtles. Pound nets with large mesh and stringer leaders set in the Chesapeake Bay have been observed to lethally take turtles as a result of entanglement in the leader. Virginia sea turtle strandings during the spring are consistently high, and given the best available information, including observer reports, the nature and location of the turtle strandings, the type of

fishing gear in the vicinity of the greatest number of strandings, and the known interactions between sea turtles and large mesh and stringer pound net leaders, pound nets were considered to be a likely contributor to high sea turtle strandings in 2001 (and likely every spring). NMFS conducted pound net monitoring during the spring of 2002 and 2003. This monitoring documented 23 sea turtles either entangled in or impinged on pound net leaders, 18 of which were in leaders with less than 12 inches (30.5 cm) stretched mesh. Nine animals were found entangled in leaders, of which 7 were dead, and 14 animals were found impinged on leaders, of which one was dead. In this situation, impingement refers to a sea turtle being held against the leader by the current, apparently unable to release itself under its own ability.

In 2004 and 2005, NMFS implemented a coordinated research program with pound net industry participants and other interested parties to develop and test a modified pound net leader design with the goal of eliminating or reducing sea turtle interactions while retaining an acceptable level of fish catch. During the 2-year study, the modified leader was found effective in reducing sea turtle interactions as compared to the unmodified leader. The final results of the 2004 study found that out of eight turtles impinged on or entangled in pound net leaders, seven were in an unmodified leader. One leatherback turtle was found entangled in the vertical lines of a modified leader. In response to the leatherback entanglement, the gear was further modified by increasing the stiffness of the vertical lines for the 2005 experiment. In 2005, 15 turtles entangled in or impinged on the leaders of unmodified leaders, and no turtles were found entangled in or impinged on modified leaders. In addition, there have been documented interactions between pound nets and Atlantic sturgeon; however, neither an interaction rate or mortality rate is currently available.

Whelk and blue crab fisheries
A whelk fishery using pot/trap gear is known to occur in offshore Virginia. This fishery operates when sea turtles may be in the area. Sea turtles (loggerheads and Kemp's ridleys in particular) are believed to become entangled in the top bridle line of the whelk pot, given a few documented entanglements of loggerheads in whelk pots, the configuration of the gear, and the turtles' preference for the pot contents. Research is underway to determine the magnitude of these interactions and to develop gear modifications to reduce these potential entanglements. In New England waters, leatherbacks have been found entangled in whelk pot lines, so if leatherback turtles overlap with this gear in the action area, entanglement may occur. The blue crab fishery using pot/trap gear also occurs in the action area. The magnitude of interactions with these pots and sea turtles is unknown, but loggerheads and leatherbacks have been found entangled in this gear. For instance, in May and June 2002, three leatherbacks were documented entangled in crab pot gear in various areas of the Chesapeake Bay. Given the plethora of crab pot gear throughout the action area, it is possible that these interactions are more frequent than what has been documented. No interactions between Atlantic sturgeon and crab pot gear has been reported to NMFS.

6.3 Other Impacts of Human Activities in the Action Area

6.3.1 Contaminants and Water Quality
Point source discharges (i.e., municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) and compounds associated with discharges (i.e., metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon populations. The compounds associated with discharges can alter the pH of receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced

egg production and survival. Agriculture and forestry occur within the Chesapeake Bay watershed, which potentially results in an increase in the amount of suspended sediment present in the river. Concentrated amounts of suspended solids discharged into a river system may lead to smothering of fish eggs and larvae and may result in a reduction in the amount of available dissolved oxygen.

Within the action area, sea turtles and optimal sea turtle habitat most likely have been impacted by pollution. Marine debris (e.g., discarded fishing line or lines from boats) can entangle turtles in the water and drown them. Turtles commonly ingest plastic or mistake debris for food, as observed with the leatherback sea turtle. The leatherback's preferred diet includes jellyfish, but similar looking plastic bags are often found in the turtle's stomach contents (Magnuson *et al.*. 1990).

Chemical contaminants may also have an effect on sea turtle reproduction and survival. While the effects of contaminants on turtles is relatively unclear, pollution may be linked to the fibropapilloma virus that kills many turtles each year (NMFS 1997). If pollution is not the causal agent, it may make sea turtles more susceptible to disease by weakening their immune systems. Furthermore, the Bay watershed is highly developed, which contributes to impaired water quality via stormwater runoff or point sources. The mainstem Chesapekae Bay has historically low levels of chemical contamination (Chesapeake Bay Program Office 1999).

Excessive turbidity due to coastal development and/or construction sites could influence sea turtle foraging ability. Turtles are not very easily affected by changes in water quality or increased suspended sediments, but if these alterations make habitat less suitable for turtles and hinder their capability to forage, eventually they would tend to leave or avoid these less desirable areas (Ruben and Morreale 1999).

Water quality issues have been reported in at least localized areas of the Chesapeake Bay since the advent of the use of industrial fertilizers in the 1830s. Pollution increased in the Bay through the 19th century as increasing amounts of land were cleared and as industrial use of the area surrounding the Bay increased. Declines in shellfish beds were first reported in 1900 and by the 1940s advancements in fishing technology lead to decreases in fish populations in the Bay. Excess pollution to the Bay continued through to the early 1970s when regulation first began with the passage of the Clean Water Act. Also in the early 1970s, decreases in Bay grasses were recorded and a significant portion of bay grasses were destroyed by Tropical Storm Agnes in 1972. The loss of native oysters throughout the second half of the 20th century, largely due to introduced disease, also affected water quality in the Bay. In 1983, the first comprehensive report of Bay water quality highlights four areas of concern: an overabundance of nitrogen and phosphorous pollution; dwindling underwater bay grasses; toxic chemical pollution; and, over-harvesting of living resources.

Since 1983, significant efforts have been made to clean up the Chesapeake Bay. While the levels of toxins and industrial pollutants have decreased, leading to largely improved water quality conditions, the Chesapeake Bay still faces many problems and remains polluted. Despite small successes in certain areas, the overall health of the Chesapeake Bay remains degraded.

Excess nutrients, such as nitrogen and phosphorous are pollutants. Rain washes nutrients off streets, rooftops, lawns, farms and industrial sites into the streams and rivers that flow into the Bay. Nutrient pollution is the largest problem currently affecting the Chesapeake Bay. Excess nutrients cause rapid growth of algae blooms which cloud the water and reduce the amount of sunlight reaching the Bay's aquatic life. When the algae blooms die, oxygen is depleted as the algae decay. Nutrients and sediment flowing into the Bay have reduced oxygen levels below what is needed by much of the aquatic life in the Bay.

Although there were improvements in the some areas of the Bay's health in 2009, the ecosystem remains in poor condition. EPA ranked the overall health of the Bay an average of 45 percent based on goals for water quality, habitats, and lower food web, and fish and shellfish abundance. This was a 6 percent increase from 2008. According to EPA, the modest gain in the health score was due to a large increase in adult blue crab population, expansion of underwater grass beds growing in the Bay's shallows, and improvements in water clarity and bottom habitat health as highlighted below:

- 12 percent of the Bay and its tidal tributaries met Clean Water Act standards for dissolved oxygen between 2007-2009, a decrease of 5 percent from 2006-2008.
- 26 percent of the tidal waters met or exceeded guidelines for water clarity, a 12 percent increase from 2008.
- Underwater bay grasses covered 9,039 more acres of the Bay's shallow waters for a total of 85,899 acres, 46 percent of the Bay-wide goal.
- The health of the Bay's bottom dwelling species reach a record high of 56 percent of the goal, improving by approximately 15 Bay-wide.
- The adult blue crab population increased to 223 million, its highest level since 1993.

7.0 Climate Change

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change in the action area (i.e., the lower Chesapeake Bay) and how listed sea turtles and sturgeon may be affected by those predicted environmental changes over the life of the proposed action (i.e., between now and 2062). Climate change is relevant to the Status of the Species, Environmental Baseline and Cumulative Effects sections of this Opinion; rather than include partial discussion in several sections of this Opinion, we are synthesizing this information into one discussion. Consideration of effects of the proposed action in light of predicted changes in environmental conditions due to anticipated climate change are included in the Effects of the Action section below (section 8.0 below).

7.1 Background Information on Global climate change

The global mean temperature has risen 0.76ºC (1.36°F) over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (Intergovernmental Panel on Climate Change (IPCC) 2007a) and precipitation has increased nationally by 5%-10%, mostly due to an increase in heavy downpours (NAST 2000). There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and other pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007b); these trends are most apparent over the past few decades. Information on future impacts of climate change in the action area is discussed below.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next century. Both of the principal climate models used by the National Assessment Synthesis Team (NAST) project warming in the southeast by the 2090s, but at different rates (NAST 2000): the Canadian model scenario shows the southeast U.S. experiencing a high degree of warming, which translates into lower soil moisture as higher temperatures increase evaporation; the Hadley model scenario projects less warming and a significant increase in precipitation (about 20%). The scenarios examined, which assume no major interventions to reduce continued growth of world greenhouse gases (GHG), indicate that temperatures in the U.S. will rise by about 3^{o}-$5^{o}C$ (5^{o}-$9^{o}F$) on average in the next 100 years which is more than the projected global increase (NAST 2000). A warming of about $0.2^{o}C$ (0.4°F) per decade is projected for the next two decades over a range of emission scenarios (IPCC 2007). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has resulted in increased precipitation, river discharge, and glacial and sea-ice melting (Greene *et al.* 2008).

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (Greene *et al.* 2008, IPCC 2006). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the earth's atmosphere caused by anthropogenic forces (IPCC 2006). The NAO impacts climate variability throughout the northern hemisphere (IPCC 2006). Data from the 1960s through the present show that the NAO index has increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2006). This warming extends over 1000m (0.62 miles) deep and is deeper than anywhere in the world oceans and is particularly evident under the Gulf Stream/ North Atlantic Current system (IPCC 2006). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (Greene *et al.* 2008, IPCC 2006). There is evidence that the NADW has already freshened significantly (IPCC 2006). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the whole earth system (Greene *et al.* 2008).

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the Delaware River, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the U.S. Warming is very likely to continue in the U.S. over the next 25 to 50 years regardless of reduction in GHGs, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 25 to 50 years, and it is possible that the rate of change will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

A warmer and drier climate is expected to result in reductions in stream flows and increases in water temperatures. Expected consequences could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch *et al.* 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants other than heat currently degrade water quality (Murdoch *et al.* 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources in the southeast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer *et al.* 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development may experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer *et al.* 2008).

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2°C (0.4°F) per decade; and 3) a rise in sea level (NAST 2000). A warmer and drier climate will reduce stream flows and increase water temperature resulting in a decrease of DO and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing. Sea level is expected to continue rising: during the 20th century global sea level has increased 15 to 20 cm (6-8 inches).

7.2 Species Specific Information on Climate Change Effects

7.2.1 Loggerhead Sea Turtles

The most recent Recovery Plan for loggerhead sea turtles as well as the 2009 Status Review Report identifies global climate change as a threat to loggerhead sea turtles. However, trying to assess the likely effects of climate change on loggerhead sea turtles is extremely difficult given the uncertainty in all climate change models and the difficulty in determining the likely rate of temperature increases and the scope and scale of any accompanying habitat effects. Additionally, no significant climate change-related impacts to loggerhead sea turtle populations have been observed to date. Over the long-term, climate change related impacts are expected to influence biological trajectories on a century scale (Parmesan and Yohe 2003). As noted in the 2009 Status Review (Conant *et al.* 2009), impacts from global climate change induced by human activities are likely to become more apparent in future years (IPCC 2007). Climate change related increasing temperatures, sea level rise, changes in ocean productivity, and increased frequency of storm events may affect loggerhead sea turtles.

Increasing temperatures are expected to result in increased polar melting and changes in precipitation which may lead to rising sea levels (Titus and Narayanan 1995 in Conant *et al.* 2009), which could result in increased erosion rates along nesting beaches. Sea level rise could result in the inundation of nesting sites and decrease available nesting habitat (Daniels *et al.* 1993; Fish *et al.* 2005; Baker *et al.* 2006). The BRT noted that the loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis *et al.* 2006; Baker *et al.* 2006; both in Conant *et al.* 2009). Along developed coastlines, and especially in areas where erosion control structures have been constructed to limit shoreline movement, rising sea levels may cause severe effects on nesting females and their eggs as nesting females may deposit eggs seaward of the erosion control structures potentially subjecting them to repeated tidal inundation. However, if global temperatures increase and there is a range shift northwards, beaches not currently used for nesting may become available for loggerhead sea turtles, which may offset some loss of accessibility to beaches in the southern portions of the range.

Climate change has the potential to result in changes at nesting beaches that may affect loggerhead sex ratios. Loggerhead sea turtles exhibit temperature-dependent sex determination. Rapidly increasing global temperatures may result in warmer incubation temperatures and highly female-biased sex ratios (*e.g.*, Glen and Mrosovsky 2004; Hawkes *et al.* 2009); however, to the extent that nesting can occur at beaches further north where sand temperatures are not as warm, these effects may be partially offset. The BRT specifically identified climate change as a threat to loggerhead sea turtles in the neritic/oceanic zone where climate change may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution. In the threats matrix analysis, climate change was considered for oceanic juveniles and adults and eggs/hatchlings. The report states that for oceanic juveniles and adults, "although the effect of trophic level change from…climate change…is unknown it is believed to be very low." For eggs/hatchlings the report states that total mortality from anthropogenic causes, including sea level rise resulting from climate change, is believed to be low relative to the entire life stage. However, only limited data are available on past trends related to climate effects on loggerhead sea turtles; current scientific methods are not able to reliably predict the future magnitude of climate change, associated impacts, whether and to what extent some impacts will offset others, or the adaptive capacity of this species.

However, Van Houtan and Halley (2011) recently developed climate based models to investigate loggerhead nesting (considering juvenile recruitment and breeding remigration) in the North Pacific and Northwest Atlantic. These models found that climate conditions/oceanographic influences explain loggerhead nesting variability, with climate models alone explaining an average 60% (range 18%-88%) of the observed nesting changes over the past several decades. In terms of future nesting projections, modeled climate data show a future positive trend for Florida nesting, with increases through 2040 as a result of the Atlantic Multidecadal Oscillation signal.

7.2.2 Kemp's Ridley Sea Turtles

The recovery plan for Kemp's ridley sea turtles (NMFS *et al.* 2011) identifies climate change as a threat; however, as with the other species discussed above, no significant climate change-related impacts to Kemp's ridley sea turtles have been observed to date. Atmospheric warming could cause habitat alteration which may change food resources such as crabs and other invertebrates. It may increase hurricane activity, leading to an increase in debris in nearshore and offshore waters, which may result in an increase in entanglement, ingestion, or drowning. In addition, increased hurricane activity may cause damage to nesting beaches or inundate nests with sea water. Atmospheric warming may change convergence zones, currents and other oceanographic features that are relevant to Kemp's ridleys, as well as change rain regimes and levels of nearshore runoff.

Considering that the Kemp's ridley has temperature-dependent sex determination (Wibbels 2003) and the vast majority of the nesting range is restricted to the State of Tamaulipas, Mexico, global warming could potentially shift population sex ratios towards females and thus change the reproductive ecology of this species. A female bias is presumed to increase egg production (assuming that the availability of males does not become a limiting factor) (Coyne and Landry 2007) and increase the rate of recovery; however, it is unknown at what point the percentage of males may become insufficient to facilitate maximum fertilization rates in a population. If males become a limiting factor in the reproductive ecology of the Kemp's ridley, then reproductive output in the population could decrease (Coyne 2000). Low numbers of males could also result in the loss of genetic diversity within a population; however, there is currently no evidence that this is a problem in the Kemp's ridley population (NMFS *et al.* 2011). Models (Davenport 1997, Hulin and Guillon 2007, Hawkes *et al.* 2007, all referenced in NMFS *et al.* 2011) predict very long-term reductions in fertility in sea turtles due to climate change, but due to the relatively long life cycle of sea turtles, reductions may not be seen until 30 to 50 years in the future.

Another potential impact from global climate change is sea level rise, which may result in increased beach erosion at nesting sites. Beach erosion may be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents. In the case of the Kemp's ridley where most of the critical nesting beaches are undeveloped, beaches may shift landward and still be available for nesting. The Padre Island National Seashore (PAIS) shoreline is accreting, unlike much of the Texas coast, and with nesting increasing and the sand temperatures slightly cooler than at Rancho Nuevo, PAIS could become an increasingly important source of males for the population.

7.2.3 Green Sea Turtles

The five year status review for green sea turtles (NMFS and USFWS 2007d) notes that global climate change is affecting green sea turtles and is likely to continue to be a threat. There is an increasing female bias in the sex ratio of green turtle hatchlings. While this is partly attributable to imperfect egg hatchery practices, global climate change is also implicated as a likely cause. This is because warmer sand temperatures at nesting beaches are likely to result in the production of more female embryos. At least one nesting site, Ascension Island, has had an increase in mean sand temperature in recent years (Hays *et al.* 2003 in NMFS and USFWS 2007d). Climate change may also affect nesting beaches through sea level rise, which may reduce the availability of nesting habitat and increase the risk of nest inundation. Loss of appropriate nesting habitat may also be accelerated by a combination of other environmental and oceanographic changes, such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion. Oceanic changes related to rising water temperatures could result in changes in the abundance and distribution of the primary food sources of green sea turtles, which in turn could result in changes in behavior and distribution of this species. Seagrass habitats may suffer from decreased productivity and/or increased stress due to sea level rise, as well as salinity and temperature changes (Short and Neckles 1999; Duarte 2002).

As noted above, the increasing female bias in green sea turtle hatchlings is thought to be at least partially linked to increases in temperatures at nesting beaches. However, at this time, we do not know how much of this bias is due to hatchery practice and how much is due to increased sand temperature. Because we do not have information to predict the extent and rate to which sand temperatures at the nesting beaches used by green sea turtles may increase in the short-term future, we cannot predict the extent of any future bias. Also, we do not know to what extent to which green sea turtles may be able to cope with this change by selecting cooler areas of the beach or shifting their nesting distribution to other beaches at which increases in sand temperature may not be experienced.

7.2.4 Leatherback sea turtles

Global climate change has been identified as a factor that may affect leatherback habitat and biology (NMFS and USFWS 2007b); however, no significant climate change related impacts to leatherback sea turtle populations have been observed to date. Over the long term, climate change related impacts will likely influence biological trajectories in the future on a century scale (Parmesan and Yohe 2003). Changes in marine systems associated with rising water temperatures, changes in ice cover, salinity, oxygen levels and circulation including shifts in ranges and changes in algal, plankton, and fish abundance could affect leatherback prey distribution and abundance. Climate change is expected to expand foraging habitats into higher latitude waters and some concern has been noted that increasing temperatures may increase the female:male sex ratio of hatchlings on some beaches (Morosovsky *et al.* 1984 and Hawkes *et al.* 2007 in NMFS and USFWS 2007b). However, due to the tendency of leatherbacks to have individual nest placement preferences and deposit some clutches in the cooler tide zone of beaches, the effects of long-term climate on sex ratios may be mitigated (Kamel and Mrosovsky 2004 in NMFS and USFWS 2007b).

Additional potential effects of climate change on leatherbacks include range expansion and changes in migration routes as increasing ocean temperatures shift range-limiting isotherms north (Robinson *et al.* 2008). Leatherbacks have expanded their range in the Atlantic north by 330 km in the last 17 years as warming has caused the northerly migration of the 15°C sea surface temperature (SST) isotherm, the lower limit of thermal tolerance for leatherbacks (McMahon and Hays 2006). Leatherbacks are speculated to be the best able to cope with climate change of all the sea turtle species due to their wide geographic distribution and relatively weak beach fidelity. Leatherback sea turtles may be most affected by any changes in the distribution of their primary jellyfish prey, which may affect leatherback distribution and foraging behavior (NMFS and USFWS 2007b). Jellyfish populations may increase due to ocean warming and other factors (Brodeur *et al.* 1999; Attrill *et al.* 2007; Richardson *et al.* 2009). However, any increase in jellyfish populations may or may not impact leatherbacks as there is no evidence that any leatherback populations are currently food-limited.

Increasing temperatures are expected to result in increased polar melting and changes in precipitation which may lead to rising sea levels (Titus and Narayanan 1995 in Conant *et al.* 2009), which could result in increased erosion rates along nesting beaches. Sea level rise could result in the inundation of nesting sites and decrease available nesting habitat (Fish *et al.* 2005). This effect would potentially be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents. While there is a reasonable degree of certainty that climate change related effects will be experienced globally (*e.g.*, rising temperatures and changes in precipitation patterns), due to a lack of scientific data, the specific effects of climate change on this species are not quantifiable at this time (Hawkes *et al.* 2009).

7.2.5 Atlantic sturgeon

Global climate change may affect all DPSs of Atlantic sturgeon in the future; however, effects of increased water temperature and decreased water availability are most likely to effect the South Atlantic and Carolina DPSs. Rising sea level may result in the salt wedge moving upstream in affected rivers. Atlantic sturgeon spawning occurs in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. Similarly, juvenile Atlantic sturgeon have limited tolerance to salinity and remain in waters with little to no salinity. If the salt wedge moves further upstream, Atlantic sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the saltwedge would be limited. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any shifts that may occur; thus, it is not possible to predict any future loss in spawning or rearing habitat. However, in all river systems, spawning occurs miles upstream of the saltwedge. It is unlikely that shifts in the location of the saltwedge would eliminate freshwater spawning or rearing habitat. If habitat was severely restricted, productivity or survivability may decrease.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with DO and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers. Atlantic sturgeon prefer water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats.

Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all Atlantic sturgeon life stages, including adults, may become susceptible to strandings or habitat restriction. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat.

7.3 Effects of Climate Change in the Action Area

In 2008, the Chesapeake Bay Program's Scientific and Technical Advisory Committee (STAC) reviewed the current understanding of climate change impacts on the tidal Chesapeake Bay and identified critical knowledge gaps and research priorities (Pyke et al. 2008). The report notes that the Bay is sensitive to climate-related forcings of atmospheric CO2 concentration, sea level, temperature, precipitation, and storm frequency and intensity and that scientists have detected significant warming and sea-level-rise trends during the 20th century in the Chesapeake Bay. Climate change scenarios for CO2 emissions examined by STAC suggest that the region is likely to experience significant changes in climatic conditions throughout the 21st century including increases in CO2 concentrations, sea level rise of 0.7 to 1.6 meters, and water temperature increasing by up to 2° to 6°C. The STAC also indicated that other changes are likely, but less certain, including increases in precipitation quantity (particularly in winter and spring), precipitation intensity, intensity of tropical and extratropical cyclones (though their frequency may decrease), and sea-level variability. Changes in annual streamflow are highly uncertain, though winter and spring flows will likely increase. The report notes that changes in human activities over the next century have the potential to either exacerbate or ameliorate the predicted climatically induced changes. Given the uncertainty in precipitation and streamflow forecasts, the direction of some changes remains unknown; however, the report states that certain consequences appear likely including increasing sea level in the Bay: increasing variability in salinity due to increases in precipitation intensity, drought, and storminess; more frequent blooms of harmful algae due to warming and higher CO_2 concentrations; potential decreases in the prevalence of eelgrass; possible increases in hypoxia due to warming and greater winter-spring streamflow; and, altered interactions among trophic levels, potentially favoring warm-water fish and shellfish species in the Bay.

In 2010, EPA conducted a preliminary assessment of climate change impacts on the Chesapeake Bay using a version of the Phase 5 Bay Watershed Model and tools developed for EPA's BASINS 4 system including the Climate Assessment Tool. Flows and associated nutrient and sediment loads were assessed in all river basins of the Chesapeake Bay with three key climate change scenarios reflecting the range of potential changes in temperature and precipitation in the year 2030. The three key scenarios came from a larger set of 42 climate change scenarios that were evaluated from 7 Global Climate Models, 2 scenarios from the IPCC Special Report on Emissions Scenarios storylines, and 3 assumptions about precipitation intensity in the largest events. The 42 climate change scenarios were run on the Phase 5 Watershed Model of the Monocacy River watershed, a subbasin of the Potomac River basin in the Piedmont region, using a 2030 estimated land use based on a sophisticated land use model containing socioeconomic estimates of development throughout the watershed.

The results provide an indication of likely precipitation and flow patterns under future potential climate conditions (Linker et al. 2007, 2008). Projected temperature increases tend to increase evapotranspiration in the Bay watershed, effectively offsetting increases in precipitation. The preliminary analysis indicated overall decreases in annual stream flow as well as decreases in nitrogen and phosphorus loads. The higher intensity precipitation events yielded estimated increases in annual sediment loads.

Assuming that there is a linear trend in increasing water temperatures, and that a predicted 2-6°C increase in water temperature by 2100 for the Chesapeake Bay would also be experienced in the action area, one could anticipate a 0.02-.07°C increase each year. Because the action considered here will be complete within one year, we expect an increase in temperature of no more than 0.07°C in the action area over the duration of the proposed action.

7.4 Effects of Climate Change in the Action Area to Atlantic sturgeon

As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on Atlantic sturgeon; however, we have considered the available information to consider likely impacts to sturgeon in the action area. The proposed action under consideration will take place in 2012-2013; thus, we consider here, likely effects of climate change during that period.

Over time, the most likely effect to Atlantic sturgeon would be if sea level rise was great enough to consistently shift the salt wedge far enough north in spawning river which would restrict the range of juvenile sturgeon and may affect the development of these life stages. However, there are no spawning rivers in the action area (the nearest is the James River, maintenance of which is not considered in this Opinion).

In the action area, it is possible that changing seasonal temperature regimes could result in changes in the timing of seasonal migrations through the area as sturgeon move throughout the area. There could be shifts in the timing of spawning; presumably, if water temperatures warm earlier in the spring, and water temperature is a primary spawning cue, spawning migrations and spawning events could occur earlier in the year. However, because spawning is not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change), it is not possible to predict how any change in water temperature or river flow by itself will affect the seasonal movements of sturgeon through the action area. However, it seems most likely that spawning would shift earlier in the year.

Any forage species that are temperature dependent may also shift in distribution as water temperatures warm. However, because we do not know the adaptive capacity of these individuals or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict how these changes may affect foraging sturgeon. If sturgeon distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food. Similarly, if sturgeon shifted to areas where different forage was available and sturgeon were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sturgeon shifted to an area or time where insufficient forage was available; however, the likelihood of this happening seems low because sturgeon feed on a wide variety of species and in a wide variety of habitats.

Limited information on the thermal tolerances of Atlantic sturgeon is available. Atlantic sturgeon have been observed in water temperatures above 30°C in the south (see Damon-Randall *et al.* 2010). In the laboratory, juvenile Atlantic sturgeon showed negative behavioral and bioenergetics responses (related to food consumption and metabolism) after prolonged exposure to temperatures greater than 28°C (82.4°F) (Niklitschek 2001). Tolerance to temperatures is thought to increase with age and body size (Ziegweid *et al.* 2008 and Jenkins *et al.* 1993), however, no information on the lethal thermal maximum or stressful temperatures for subadult or adult Atlantic sturgeon is available. Shortnose sturgeon, have been documented in the lab to experience mortality at temperatures of 33.7°C (92.66°F) or greater and are thought to experience stress at temperatures above 28°C. For purposes of considering thermal tolerances, we consider Atlantic sturgeon to be a reasonable surrogate for shortnose sturgeon given similar geographic distribution and known biological similarities.

Mean monthly ambient temperatures in the Chesapeake Bay range from 2-26°C[7]. As explained above, available predictions estimate an increase in ambient water temperature in the Bay of 0.07°C over the duration of the proposed action. This increase is extremely unlikely to affect the distribution or behavior of Atlantic sturgeon in the action area.

As described above, over the long term, global climate change may affect Atlantic sturgeon by affecting the location of the salt wedge, distribution of prey, water temperature and water quality. However, given the short duration of the proposed action, it is extremely unlikely that any of these potential effects will be experienced during the time period considered here.

7.5 Effects of Climate Change in the Action Area on Sea Turtles

As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on sea turtles; however, we have considered the available information to consider likely impacts to these species in the action area.

Sea turtles are most likely to be affected by climate change due to increasing sand temperatures at nesting beaches which in turn would result in increased female: male sex ratio among hatchlings, sea level rise which could result in a reduction in available nesting beach habitat, increased risk of nest inundation, changes in the abundance and distribution of forage species which could result in changes in the foraging behavior and distribution of sea turtle species, and changes in water temperature which could possibly lead to a northward shift in their range.

Over the time period considered in this Opinion (i.e., through 2013), any rise in sea surface temperature is expected to be extremely small (a fraction of a degree, if that). It is extremely unlikely that any change in water temperature in this period would be enough to contribute to shifts in the range or distribution of sea turtles. Theoretically we expect that as waters in the action area warm, more sea turtles could be present or sea turtles could be present for longer periods of time. However, if temperature affected the distribution of sea turtle forage in a way that decreased forage in the action area, sea turtles may be less likely to occur in the action area.

It has been speculated that the nesting range of some sea turtle species may shift northward as ambient water temperatures rise. Nesting in Virginia is relatively rare, but a small number of loggerhead nests are laid on Virginia Beach and other ocean facing beaches each year. The maximum number of nests laid in Virginia in a particular year was nine. As of the end of July 2012, seven loggerhead nests have been recorded and one Kemp's ridley nest (at Dam Neck); the first time a Kemp's ridley nest has ever been documented in Virginia and the furthest north this

[7] Information obtained from www.nodc.noaa.gov/dsdt/cwtg/satl.html; last accessed 7-25-12.

species has ever been documented to nest. It is important to consider that in order for nesting to be successful in the mid-Atlantic, fall and winter temperatures need to be warm enough to support the successful rearing of eggs and sea temperatures must be warm enough for hatchlings not to die when they enter the water. As noted above, it is extremely unlikely that any effects of global climate change would be experienced within the period that this action will be completed and any change that is experienced is not likely to be great enough to influence sea turtle nesting behavior in the action area.

8.0 EFFECTS OF THE ACTION

This section of an Opinion assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02). We have not identified any interdependent or interrelated actions. This Opinion examines the likely effects (direct and indirect) of the proposed action on five DPSs of Atlantic sturgeon and sea turtles in the action area and their habitat within the context of the species current status, the environmental baseline and cumulative effects. As explained in the Description of the Action, the action under consideration in this Opinion is dredging in Sandbridge Shoals for beach nourishment and hurricane protection, as scheduled to occur from 2012-2013. The work will be carried out with a hopper or cutterhead dredge.

The effects of dredging on listed species will be different depending on the type of dredge used. As such, the following discussion of effects of dredging will be organized by dredge type. Below, the discussion will consider the effects of dredging, including the risk of entrainment or capture of Atlantic sturgeon and sea turtles. We also consider effects of dredging and disposal on water quality, including turbidity/suspended sediment. Last, there is a discussion of other effects that are not specific to the type of equipment used. This includes effects on prey and foraging, changes in the characteristics of the dredged area and effects of dredge vessel traffic.

8.1 Hopper Dredge

Hopper dredges are self-propelled seagoing vessels that are equipped with propulsion machinery, sediment containers (hoppers), dredge pumps, and trailing suction drag-heads required to perform their essential function of excavating sediments from the channel bottom. Hopper dredges have propulsion power adequate for required free-running speed and dredge against strong currents. They also have excellent maneuverability. This allows hopper dredges to provide a safe working environment for crew and equipment dredging bar channels or other areas subject to rough seas. Hopper dredges also are more practicable when interference with vessel traffic must be minimized.

A hopper dredge removes material from the bottom of the channel in relatively thin layers, usually 2-12 inches, depending upon the density and cohesiveness of the dredged material. Pumps located within the hull, but sometimes mounted on the drag arm, create a region of low pressure around the dragheads and forces water and sediment up the drag arm and into the hopper. The more closely the draghead is maintained in contact with the sediment, the more efficient the dredging providing sufficient water is available to slurry the sediments (i.e. the greater the concentration of slurried sediment pumped into the hopper). Hopper dredges can efficiently dredge non-cohesive sands and more cohesive silts and low density clay. Draghead types may consist of IHC and California type dragheads.

California type dragheads sit flatter in the sediment than the IHC configuration which is more upright. Individual draghead designs (i.e. dimensions, structural reinforcing/configuration…) vary between dredging contractors and hopper vessels. Port openings on the bottom of dragheads also vary between contractors and draghead design. Generally speaking the port geometry is typically rectangular or square with minimum openings of ten inch by ten inch or twelve inch by twelve inch or some rectangular variation.

Industry and government hopper dredges are equipped with various power and pump configurations and may differ in hopper capacity with different dredging capabilities. An engineering analysis of the known hydraulic characteristics of the pump and pipeline system on the USACE hopper dredge "Essayons" (i.e. a 6,423 cy hopper dredge) indicates an operational flow rate of forty cubic feet per second with a flow velocity of eleven feet per second at the draghead port openings. The estimated force exerted on a one-foot diameter turtle (i.e. one foot diameter disc shaped object) at the pump operational point in this system was estimated to be twenty-eight pounds of suction or drag force on the object at the port opening of the draghead.

Dredging is typically parallel to the centerline or axis of the channel. Under certain conditions, a waffle or crisscross pattern may be utilized to minimize trenching or during clean-up dredging operations to remove ridges and produce a more level channel bottom. This movement up and down the channel while dredging is called trailing and may be accomplished at speeds of 1-3 knots, depending on the shoaling, sediment characteristics, sea conditions, and numerous other factors. In the hopper, the slurry mixture of the sediment and water is managed by a weir system to settle out the dredged material solids and overflow the supernatant water. When an economic load is achieved, the vessel suspends dredging, the drag arms are raised, and the dredge travels to the designated placement site. Because dredging stops during the trip to the placement site, the overall efficiency of the hopper dredge is dependent on the distance between the dredging location and placement sites; the more distant to the placement site, the less efficient the dredging operation resulting in longer contract periods to accomplish the work.

Sea turtle deflectors utilized on hopper dredges are rigid V-shaped attachments on the front of the dragheads and are designed and intended to plow the sediment in front of the draghead. The plowing action creates a sand wave that rolls in front of the deflector. The propagated sand wave is intended to shed the turtle away from the deflector and out of the path of the draghead. The effectiveness of the rigid deflector design and its ability to reduce entrainment was studied by the USACE through model and field testing during the 1980s and early 1990s. The deflectors are most effective when operating on a uniform or flat bottom. However, the deflector effectiveness may be diminished when significant ridges and troughs are present that prevent the deflector from plowing and maintaining the sand wave and the dragheads from maintaining firm contact with the channel bottom.

8.1.1 Entrainment in Hopper Dredges – Sea Turtles

As outlined above, sea turtles are likely to occur in Chesapeake Bay from April through mid-

November each year with the largest numbers present from June through October of any year. The majority of sea turtles in the Chesapeake bay are juvenile loggerheads; however, adult loggerheads, juvenile Kemp's ridley, adult and juvenile leatherback and adult green sea turtles have also been documented in the area. The Chesapeake Bay is an important foraging area for sea turtles and an important developmental habitat for juvenile sea turtles, particularly loggerheads.

Loggerhead, Kemp's ridley and green sea turtles are vulnerable to entrainment in the draghead of the hopper dredge. Given their large size, leatherback sea turtles are not vulnerable to entrainment. As reported by USACE, no leatherback sea turtles have been entrained in hopper dredge operations operating along the U.S. Atlantic coast (USACE Sea Turtle Warehouse, 2012). Sea turtles are likely to be feeding on or near the bottom of the water column during the warmer months, with loggerhead and Kemp's ridley sea turtles being the most common species in these waters. Although not expected to be as numerous as loggerheads and Kemp's ridleys, green sea turtles are also likely to occur seasonally in the Bay.

Sea turtles become entrained in hopper dredges as the draghead moves along the bottom. Entrainment occurs when sea turtles do not or cannot escape from the suction of the dredge. Sea turtles can also be crushed on the bottom by the moving draghead. Mortality most often occurs when turtles are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper. Because entrainment is believed to occur primarily while the draghead is operating on the bottom, it is likely that only those species feeding or resting on or near the bottom would be vulnerable to entrainment. Turtles can also be entrained if suction is created in the draghead by current flow while the device is being placed or removed, or if the dredge is operating on an uneven or rocky substrate and rises off the bottom. Recent information from the USACE suggests that the risk of entrainment is highest when the bottom terrain is uneven or when the dredge is conducting "clean up" operations at the end of a dredge cycle when the bottom is trenched and the dredge is working to level out the bottom. In these instances, it is difficult for the dredge operator to keep the draghead buried in the sand and sea turtles near the bottom may be more vulnerable to entrainment. Increased risk of entrainment in these conditions may also be related to reduced effectiveness of the turtle deflector when operating on uneven terrain.

Sea turtles have been found resting in deeper waters, which could increase the likelihood of interactions from dredging activities. In 1981, observers documented the take of 71 loggerheads by a hopper dredge at the Port Canaveral Ship Channel, Florida (Slay and Richardson 1988). This channel is a deep, low productivity environment in the Southeast Atlantic where sea turtles are known to rest on the bottom, making them extremely vulnerable to entrainment. The large number of turtle mortalities at the Port Canaveral Ship Channel in the early 1980s resulted in part from turtles being buried in the soft bottom mud, a behavior known as brumation. Since 1981, 77 loggerhead sea turtles have been taken by hopper dredge operations in the Port Canaveral Ship Channel, Florida. Chelonid turtles have been found to make use of deeper, less productive channels as resting areas that afford protection from predators because of the low energy, deep water conditions. Sea turtle brumation has not been documented in the Chesapeake Bay.

8.1.1.1 Background Information on Entrainment of Sea Turtles in Hopper Dredges

Sea turtles have been killed in hopper dredge operations along the East and Gulf coasts of the US.

Documented turtle mortalities during dredging operations in the USACE South Atlantic Division (SAD; i.e., south of the Virginia/North Carolina border) are more common than in the USACE North Atlantic Division (NAD; Virginia-Maine) presumably due to the greater abundance of turtles in these waters and the greater frequency of hopper dredge operations. For example, in the USACE SAD, over 400 sea turtles have been entrained in hopper dredges since 1980 and in the Gulf Region over 160 sea turtles have been killed since 1995. Records of sea turtle entrainment in the USACE NAD began in 1994. Through July 2012, 74 sea turtles deaths (see Table 6) related to hopper dredge activities have been recorded in waters north of the North Carolina/Virginia border (USACE Sea Turtle Database[8]); 64 of these turtles have been entrained in dredges operating in Chesapeake Bay.

Before 1994, endangered species observers were not required on board hopper dredges and dredge baskets were not inspected for sea turtles or sea turtle parts. The majority of sea turtle takes in the NAD have occurred in the Norfolk district. This is largely a function of the large number of loggerhead and Kemp's ridley sea turtles that occur in the Chesapeake Bay each summer and the intense dredging operations that are conducted to maintain the Chesapeake Bay entrance channels and for beach nourishment projects at Virginia Beach. Since 1992, the take of 10 sea turtles (all loggerheads) has been recorded during hopper dredge operations in the Philadelphia, Baltimore and New York Districts. Hopper dredging is relatively rare in New England waters where sea turtles are known to occur, with most hopper dredge operations being completed by the specialized Government owned dredge Currituck which operates at low suction and has been demonstrated to have a very low likelihood of entraining or impinging sea turtles. To date, no hopper dredge operations (other than the Currituck) have occurred in the New England District in areas or at times when sea turtles are likely to be present.

Table 6. Sea Turtle Takes in USACE NAD Dredging Operations

Project Location	**Year of Operation**	**Cubic Yardage Removed**	**Observed Takes**
Cape Henry Channel	2012	1,190,004	1 loggerhead
York Spit	2012	145,332	1 Loggerhead
Thimble Shoal Channel	2009	473,900	3 Loggerheads
York Spit	2007	608,000	1 Kemp's Ridley
Cape Henry	2006	447,238	3 Loggerheads
Thimble Shoal Channel	2006	300,000	1 loggerhead
Delaware Bay	2005	50,000	2 Loggerheads
Thimble Shoal Channel	2003	1,828,312	7 Loggerheads 1 Kemp's ridley 1 unknown

8 The USACE Sea Turtle Data Warehouse is maintained by the USACE's Environmental Laboratory and contains information on USACE dredging projects conducted since 1980 with a focus on information on interactions with sea turtles.

Cape Henry	2002	1,407,814	6 Loggerheads 1 Kemp's ridley 1 green
VA Beach Hurricane Protection Project (Cape Henry)	2002	1,407,814	1 Loggerhead
York Spit Channel	2002	911,406	8 Loggerheads 1 Kemp's ridley
Cape Henry	2001	1,641,140	2 loggerheads 1 Kemp's ridley
VA Beach Hurricane Protection Project (Thimble Shoals)	2001	4,000,000	5 loggerheads 1 unknown
Thimble Shoal Channel	2000	831,761	2 loggerheads 1 unknown
York River Entrance Channel	1998	672,536	6 loggerheads
Atlantic Coast of NJ	1997	1,000,000	1 Loggerhead
Thimble Shoal Channel	1996	529,301	1 loggerhead
Delaware Bay	1995	218,151	1 Loggerhead
Cape Henry	1994	552,671	4 loggerheads 1 unknown
York Spit Channel	1994	61,299	4 loggerheads
Delaware Bay	1994	NA	1 Loggerhead
Cape May NJ	1993	NA	1 Loggerhead
Off Ocean City MD	1992	1,592,262	3 Loggerheads
			TOTAL = 74 Turtles

It should be noted that the observed takes may not be representative of all the turtles killed during dredge operations. Typically, endangered species observers are required to observe a total of 50% of the dredge activity (i.e., 6 hours on watch, 6 hours off watch). As such, if the observer was off watch or the cage was emptied and not inspected or the dredge company either did not report or was unable to identify the turtle incident, there is the possibility that a turtle could be taken by the dredge and go unnoticed. Additionally, in older Opinions (i.e., prior to 1995), NMFS frequently only required 25% observer coverage and monitoring of the overflows which has since been determined to not be as effective as monitoring of the intakes. These conditions may have led to sea turtle takes going undetected.

NMFS raised this issue to the USACE Norfolk District during the 2002 season, after several turtles were taken in the Cape Henry and York Spit Channels, and expressed the need for 100% observer coverage. On September 30, 2002, the USACE informed the dredge contractor that when the observer was not present, the cage should not be opened unless it is clogged. This modification was to ensure that any sea turtles that were taken and on the intake screen (or in the cage area) would remain there until the observer evaluated the load. The USACE's letter further stated "Crew members will only go into the cage and remove wood, rocks, and man-made debris; any aquatic biological material is left in the cage for the observer to document and clear out when they return on duty. In addition, the observer is the only one allowed to clean off the overflow screen. This practice provides us with 100% observation coverage and shall continue." Theoretically, all sea turtle parts were observed under this scheme, but the frequency of clogging in the cage is unknown at this time. The most effective way to ensure that 100% observer coverage is attained is to have a NMFS-approved endangered species observer monitoring all loads at all times. This level of observer coverage would document all turtle interactions and better quantify the impact of dredging on turtle populations. More recently issued Opinions have required 100% observer coverage which increases the likelihood of takes being detected and reported.

It is likely that not all sea turtles killed by dredges are observed onboard the hopper dredge. Several sea turtles stranded on Virginia shores with crushing type injuries from May 25 to October 15, 2002. The Virginia Marine Science Museum (VMSM) found 10 loggerheads, 2 Kemp's ridleys, and 1 leatherback exhibiting injuries and structural damage consistent with what they have seen in animals that were known dredge takes. While it cannot be conclusively determined that these strandings were the result of dredge interactions, the link is possible given the location of the strandings (e.g., in the southern Chesapeake Bay near ongoing dredging activity), the time of the documented strandings in relation to dredge operations, the lack of other ongoing activities which may have caused such damage, and the nature of the injuries (e.g., crushed or shattered carapaces and/or flipper bones, black mud in mouth). Additionally, in 1992, three dead sea turtles were found on an Ocean City, Maryland beach while dredging operations were ongoing at a borrow area located 3 miles offshore. Necropsy results indicate that the deaths of all three turtles were dredge related. It is unknown if turtles observed on the beach with these types of injuries were crushed by the dredge and subsequently stranded on shore or whether they were entrained in the dredge, entered the hopper and then were discharged onto the beach with the dredge spoils.

A dredge could crush an animal as it was setting the draghead on the bottom, or if the draghead was lifting on and off the bottom due to uneven terrain, but the actual cause of these crushing injuries cannot be determined at this time. Further analyses need to be conducted to better understand the link between crushed strandings and dredging activities, and if those strandings need to be factored into an incidental take level. Regardless, it is possible that dredges are taking animals that are not observed on the dredge which may result in strandings on nearby beaches.

Due to the nature of interactions between listed species and dredge operations, it is difficult to predict the number of interactions that are likely to occur from a particular dredging operation. Projects that occur in an identical location with the same equipment year after year may result in interactions in some years and none in other years as noted in the examples of sea turtle takes above. Dredging operations may go on for months, with sea turtle takes occurring intermittently throughout the duration of the action. For example, dredging occurred at Cape Henry over 160 days in 2002 with 8 sea turtle takes occurring over 3 separate weeks while dredging at York Spit in 1994 resulted in 4 sea turtle takes in one week. In Delaware Bay, dredge cycles have been conducted during the May-November period with no observed entrainment and as many as two sea turtles have been entrained in as little as three weeks. Even in locations where thousands of sea turtles are known to be present (i.e., Chesapeake Bay) and where dredges are operating in areas with preferred sea turtle depths and forage items (as evidenced by entrainment of these species in the dredge), the numbers of sea turtles entrained is an extremely small percentage of the likely number of sea turtles in the action area. This is likely due to the distribution of individuals throughout the action area, the relatively small area which is affected at any given moment and the ability of some sea turtles to avoid the dredge even if they are in the immediate area.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used (sea turtles are apparently capable of avoiding pipeline and mechanical dredges as no takes of sea turtles have been reported with these types of dredges). The number of interactions may also be influenced by the terrain in the area being dredged, with interactions more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

We have compiled a dataset representing all of the hopper dredge projects in the Norfolk District that have reported the cubic yardage removed as well as the number of takes observed. The table below includes records for all projects and indicates the volume of material removed during "sea turtle season" (i.e., April - November) in the Norfolk District since 1994.

Table 7. Projects in Norfolk District since 1994

Project Location	Dredging Dates	CY of Material Removed	% during sea turtle season	Volume Removed during turtle season	total sea turtles	log	KR	green	unknown
Cape Henry Channel	1/29/12 - 4/12/12	1,190,004	16.2	192,780.65	1	1	0	0	0
York Spit	3/1/12 - 3/8/12, 4/3/12 - 4/5/2012	145,332	20.0	29,066.40	1	1	0	0	0
Cape Henry Channel	2/9/11-5/10/11	957,996	44.4	425,350.22	0	0	0	0	0
York Spit	1/9/11-4/24/11	1,503,517	15.3	230,038.10	0	0	0	0	0
Thimble Shoals	12/19/10-2/27/11; 4/19/11-4/21/11	368,104	0.000	-	0	0	0	0	0

Thimble Shoals	4/4/09-5/20/09	370,412	100.0	370,412.00	3	3	0	0	0
York Spit	6/18/07-7/03/07; 7/13/07-08/05/07	415,626	100.0	415,626.00	1	0	1	0	0
Atlantic Ocean Channel (Deepening)	12/24/05-04/8/06; 4/16/06-4/19/06	1,185,436	10.9	129,212.52	0	0	0	0	0
Cape Henry Channel	6/15/06-7/21/06	447,238	100.0	447,238.00	3	3	0	0	0
Thimble Shoal Channel	6/13/06-6/30/06; 7/10/06-7/27/06	419,624	100.0	419,624.00	1	1	0	0	0
York Spit Channel	04/01/04-04/06/04; 5/23/04-5/28/04	93,665	100.0	93,665.00	0	0	0	0	0
Thimble Shoal Channel	4/5/04-4/20/04; 4/30/04-5/01/04; 5/29/04-6/16/04	426,588	100.0	426,588.00	0	0	0	0	0
York River Entrance Channel	9/9/03-9/11/03; 10/17/03-11/30/03	268,641	100.0	268,641.00	0	0	0	0	0
Sandbridge Beach	05/1/03-5/25/03	1,500,000	100.0	1,500,000.00	0	0	0	0	0

Thimble Shoal Channel (VA Beach)	8/24/03-12/28/03	1,300,223	77.8	1,011,573.49	9	7	1	0	1
Cape Henry Channel	4/12/02-8/19/02; 10/21/02-11/02/02	2,449,285	100.0	2,449,285.00	8	6	1	1	0
York Spit Channel	8/20/02-10/21/02; 11/03/02-11/05/02	978,846	100.0	978,846.00	9	8	1	0	0
Cape Henry Channel	09/17/01-01/14/02	1,641,140	62.2	1,020,789.08	3	2	1	0	0
VA Beach Hurrican Protection (Thimble Shoal Channel)	6/26/01-11/30/01	4,000,000	100.0	4,000,000.00	6	5	0	0	1
Cape Henry Channel	04/08/00-06/02/00	541,037	100.0	541,037.00	0	0	0	0	0
Thimble Shoal Channel	6/22/00-7/31/00; 8/13/00-9/19/00; 12/16/99-1/23/00	1,370,316	66.7	914,000.77	3	2	0	0	1
Cape Henry Channel	1/5/98-3/25/98	1,169,639	0.000	-	0	0	0	0	0

York River Entrance Channel	8/22/98-11/03/98	853,743	100.0	853,743.00	6	6	0	0	0
York Spit Channel	3/26/98-5/31/98	371,200	92.4	342,988.80	0	0	0	0	0
Cape Henry Channel	1/05/98-3/25/98	1,169,639	0.000	-	0	0	0	0	0
Thimble Shoal Channel	05/07/96-06/03/96	282,431	100.0	282,431.00	1	1	0	0	0
Cape Henry Channel	02/19/95-5/16/95	534,362	40.9	218,554.06					
Cape Henry Channel	4/11/94-5/12/94; 5/27/94-6/20/94	739,642	100.0	739,642.00	5	4	0	0	1
York Spit Channel	6/21/94-6/28/94	141,434	100.0	141,434.00	4	4	0	0	0
			TOTAL:	18,442,566	***64***	**54**	**5**	**1**	**4**

8.1.1.2 Predicted Entrainment in Proposed Hopper Dredging

Based on the data in Table 7, we calculate that an average of one sea turtle is entrained for approximately every 300,000 cy removed (18,442,566 CY removed April – November divided by 64 total sea turtles). This calculation has been based on a number of assumptions including the following: that sea turtles are evenly distributed throughout all channel reaches for which takes have occurred, that all dredges will take an identical number of sea turtles, and that sea turtles are equally likely to be encountered throughout the April to November time frame. Based on these calculations, we expect that for any hopper dredging project in any of the channels or borrow areas considered in this Opinion during the time of year when sea turtles are likely to be present, one sea turtle is likely to be entrained for every 300,000 cubic yards of material removed by a hopper dredge. While this estimate is based on several assumptions, it is reasonable because it uses the best available information on entrainment of sea turtles from past dredging operations in the action area, includes multiple projects over several years, and all of the projects have had observer coverage.

Of the 64 entrained sea turtles, 60 have been identifiable to species; 54 were loggerheads, 5 Kemp’s ridley and 1 green. Overall, of those identified to species, 90% were loggerheads, 8% Kemp’s ridley and 2% green. The high percentage of loggerheads is likely due to several factors including their tendency to forage on the bottom where the dredge is operating and the fact that this species is the most numerous of the sea turtle species in Northeast and Mid-Atlantic waters. It is likely that the documentation of only one green sea turtle entrainment in Virginia dredging operations is a reflection of the low numbers of green sea turtles that occur in waters north of North Carolina.

Based on the above information, it is reasonable to expect that one sea turtle is likely to be injured or killed for approximately every 300,000 cy of material removed from the channels and borrow areas considered in this Opinion when dredging is carried out between April and November, and that 90% will be loggerheads, 8% will be Kemp's ridley and 2% will be green. Because sea turtles do not occur in the action area from December – March, we do not expect any entrainment during these months. Approximately 1.5-2.0 million cy of sand will be removed from Sandbridge Shoals. At this time, it is anticipated that the majority of the work will occur outside of the April – November time period (currently scheduled for December 1 – May 15); however, because the actual schedule is dependent on weather conditions, dredge availability and other factors, we consider here the potential that all dredging could occur in the April – November period.

Based on the information outlined above and the volume of material estimated to be removed, we anticipate that a total of seven sea turtles will be entrained, with no more than one being a Kemp's ridley or green and the remainder being loggerheads.

8.1.3 Hopper Dredge Entrainment – Atlantic Sturgeon

Atlantic sturgeon are vulnerable to entrainment in hopper dredges. Entrainment is defined as the direct uptake of aquatic organisms by the suction field generated at the draghead. As explained above, since 1994, endangered species observers have been present for at least a portion of all hopper dredging done during the April – November time frame in the action area. Only two entrained Atlantic sturgeon have been documented during any hopper dredge activity in the action area, both in YSC in April 2011. Additionally, during sea turtle relocation trawling conducted in the fall of 2003 in conjunction with the 50-foot deepening of the inbound element of the Thimble Shoal Channel, 14 Atlantic sturgeon were captured by the trawler and released live in and around the channel; no incidental takes of Atlantic sturgeon by hopper dredge were observed during this period.

Entrainment of Atlantic sturgeon during hopper dredging operations in Federal navigation channels appears to be relatively rare. The USACE has documented a total of 35 incidents of sturgeon entrainment or capture of sturgeon species (all sturgeon species) on monitored projects for all types of dredge plant (mechanical, hydraulic pipeline, and hopper dredge). Twenty of the 35 documented observations were Atlantic sturgeon entrained by hopper dredge plants. A table presenting the observed sturgeon entrained or captured on monitored USACE projects between 1990 and March 2012 is presented as Appendix C to this Opinion. USACE-Norfolk District and Baltimore District hopper dredging projects have been monitored in the Chesapeake Bay since 1994 to present. During this period, observers have been present during the removal of more than 18 million cubic yards of dredged material have been removed from the channels considered in this consultation (see Table 7 above) with only two documented entrainments of Atlantic sturgeon.

Hydraulic dredges operate for prolonged periods underwater, with minimal disturbance, but generate continuous flow fields of suction forces while dredging. Entrainment is believed to occur primarily when the draghead is not in firm contact with the channel bottom, so the potential exist that sturgeon feeding or resting on or near the bottom may be vulnerable to entrainment.

Additionally, the size and flow rates produced by the suction power of the dredge, the condition of the channel being dredged, and the method of operation of the dredge and draghead all relate to the potential of the dredge to entrain Atlantic sturgeon (Reine and Clarke, 1998). These parameters also govern the ability of the dredge to entrain other species of fish, sea turtles, and shellfish.

Another factor influencing potential entrainment is based upon the swimming stamina and size of the individual fish at risk (Boysen and Hoover, 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger sturgeon is less likely due to the increased swimming performance and the relatively small size of the draghead opening. Juvenile entrainment is possible depending on the location of the dredging operations and the time of year in which the dredging occurs. Typically major concerns of juvenile entrainment relate to fish below 200 mm (Hoover et al., 2005; Boysen and Hoover, 2009). Juvenile sturgeon are not powerful swimmers and they are prone to bottom-holding behaviors, which make them vulnerable to entrainment when in close proximity to dragheads (Hoover et al., 2011).

On a hopper dredge, it is possible to monitor entrainment because the dredged material is retained on the vessels as opposed to the direct placement of dredged material both overboard or in confined disposal facilities by a hydraulic pipeline dredge. A hopper dredge contains screened inflow cages from which an observer can inspect recently dredged contents. Typically, the observer inspection is performed at the completion of each load while the vessel is transiting to the authorized placement area and does not impact production of the dredging operations.

In the fall of 2003, the Norfolk District captured fourteen Atlantic sturgeon during sea turtle relocation trawling activities supporting hopper dredging operations in Thimble Shoals Channel in the Chesapeake Bay. The Atlantic sturgeon were captured in the immediate vicinity of the dredging operation with no entrainment observed by NMFS approved observers onboard the hopper dredge before, during or after the relocation trawling where Atlantic sturgeon were captured.

Given the large size of adults (greater than 150cm) and the size of the openings on the dragheads, adult Atlantic sturgeon are unlikely to be vulnerable to entrainment. USACE reports that from 1990-2012, 37 confirmed interactions with sturgeon occurred during dredge operations (see Appendix C). Of these, 22 interactions were reported as Atlantic sturgeon (20 individuals), with 19 of these entrained in hopper dredges. Of the entrained Atlantic sturgeon for which size is available, all were subadults (larger than 50cm but less than 150cm). Information on these interactions is presented in Table 8. Most of these interactions occurred within rivers and harbors.

Table 8. USACE Atlantic Sturgeon Entrainment Records from Hopper Dredge Operations 1990-2011

Project Location	Corps Division/District*	Month/Year Interaction Observed	Cubic Yards Removed	Observed** Entrainment

Winyah Bay, Georgetown (SC)	SAD/SAC	Oct-90	517,032	1
Savannah Harbor (GA)	SAD/SAS	Jan-94	2,202,800	1
Savannah Harbor	SAD/SAS	Dec-94	2,239,800	1
Wilmington Harbor, Cape Fear River (NC)	SAD/SAW	Sep-98	196,400	1
Charleston Harbor (SC)	SAD/SAC	Mar-00	5,627,386	1
Brunswick Harbor (GA)	SAD/SAS	2-Feb	1,459,630	1
Charleston Harbor	SAD/SAC	4-Jan	1,449,234	1
Brunswick Harbor	SAD/SAS	5-Mar	966,000	1
Brunswick Harbor	SAD/SAS	6-Dec	1,198,571	1
Savannah Entrance Channel	SAD/SAS	7-Nov	973,463	1
Sandy Hook Channel (NJ)	NAD/NANY	8-Aug	23,500	1

Savannah Entrance Channel	SAD/SAS	9-Mar	261,780	1
Brunswick Entrance Channel	SAD/SAS	10-Feb	1,728,339	3
Wilmington Harbor	SAD/SAW	10-Dec	857,726	1
York Spit (VA)	NAD/NAN	11-Apr	1,630,713	2
Charleston Harbor	SAD/SAC	12-Mar	1,100,000	1
		Total	**22,432,374**	**19**

* SAD= South Atlantic Division; NAD= North Atlantic Division; SAC=Charleston District; SAS=Savannah District; SAW=Wilmington District; NANY=New York District; NAN=Norfolk District.

** Records based on sea turtle observer reports which record listed species entrained as well as all other organisms entrained during dredge operations.

In general, entrainment of large mobile animals, such as Atlantic sturgeon, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. The risk of entrainment is likely to be higher in areas where the movements of animals are restricted (e.g., in narrow rivers or confined bays) where there is limited opportunity for animals to move away from the dredge than in unconfined areas such as wide rivers or open bays. The hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers.

The only instances of Atlantic sturgeon entrainment in hopper dredges in the NMFS Northeast Region are two sturgeon entrained at York Spit, VA in 2011 (both were killed) and one live Atlantic sturgeon entrained in Sandy Hook, NJ in 2008. As described in the discussion of sea turtles above, many other hopper dredge projects have occurred in NMFS Northeast Region; nearly all of which overlap with times and areas where Atlantic sturgeon are known to be present. Because observers have been present on these dredges and we expect that any interactions with Atlantic sturgeon would have been reported to us, the interaction rate between hopper dredges and Atlantic sturgeon seems to be very low (1 Atlantic sturgeon for every 9 mcy removed for the action area, just considering the volume of material removed when observers were present). Even just considering the projects listed in Table 8, where entrainment was recorded, we calculate an entrainment rate of one Atlantic sturgeon for approximately every 1.2 million cy of material removed. If we consider all projects in the action area where observers were present within the action area (see table 7) as well as projects outside the action area where interactions with Atlantic sturgeon were recorded (see table 8), we calculate an entrainment rate of 1 Atlantic sturgeon for every 2 mcy removed. The entrainment estimate generated above using all projects in the Chesapeake Bay where observers have been present plus all projects in rivers and bays where entrained Atlantic sturgeon have been observed is an overestimate because it does not consider other projects where no entrainment occurred. However, at this time, it is the best available estimate of entrainment rates for Atlantic sturgeon and hopper dredges. Just using the projects within Chesapeake Bay (table 7) is likely to be an underestimate because there has only been observer coverage between April and November and Atlantic sturgeon may be present year round.

Based on the above information, we expect one Atlantic sturgeon to be entrained for approximately every 2 mcy of material removed with a hopper dredge. Given the size of adult Atlantic sturgeon (greater than 150cm) and the size of observed entrained sturgeon (less than 150cm), we do not anticipate the entrainment of any adult Atlantic sturgeon. Given the location of the borrow areas to be dredged, only subadults and adults will be present; therefore, we anticipate that all entrained Atlantic sturgeon will be subadults less than 150cm in size.

There is evidence that some Atlantic sturgeon, particularly juveniles and small subadults, could be entrained in the dredge and survive. However, as the extent of internal injuries and the likelihood of survival is unknown, and the size of the fish likely to be entrained is impossible to predict, it is reasonable to conclude that any Atlantic sturgeon entrained in the hopper dredge are likely to be killed. Based on the dredge volume of up to 2 mcy, we anticipate the entrainment of no more than one subadult Atlantic sturgeon. This fish could originate from any of the five DPSs.

8.1.4 Interactions with the Sediment Plume- Hopper Dredge

Physical and biological impairments to the water column can occur from increases in turbidity which can alter light penetration. The proposed dredging will cause temporary increases in turbidity and suspension of sediments during dredging operations. As a result, the increase in turbidity can impact primary productivity and respiration of organisms within the project area. The re-suspension of sediments from dredging and dredged material placement can prevent or reduce gas-water exchanges in the gills of fish (Germano and Cary, 2005; Clarke and Wilber, 2000). The amount of impact that this can have on a species is dependent on the sensitivity of that species. This increase in turbidity can also impact prey species' predator avoidance response ability due to the decreased clarity in the water column.

Increased suspended sediment resulting from dredging can also reduce dissolved oxygen. Low dissolved oxygen conditions can be generated by the dredging operations from the resuspension of sediments and the biochemical oxygen demand of the surrounding water (Johnston, 1981). This can be particularly important during the summer months when water temperatures are warmer and less capable of holding dissolved oxygen. Dredging during the warmer months can exacerbate low dissolved oxygen conditions (Hatin et al., 2007*a*).

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the water, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including : the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

Resuspension of fine-grained dredged material during hopper dredging operations is caused by the dragheads as they are pulled through the sediment, turbulence generated by the vessel and its prop wash, and overflow of turbid water during hopper filling operations. During the filling operation, dredged material slurry is often pumped into the hoppers after they have been filled with slurry in order to maximize the amount of solid material in the hopper. The lower density, turbid water at the surface of the filled hoppers overflows and is usually discharged through ports located near the waterline of the dredge. Use of this "overflow" technique results in a larger sediment plume than if no overflow is used. In 2001, a study was done in the Delaware River of overflow and nonoverflow hopper dredging. Monitoring of the sediment plumes was accomplished using a boat-mounted 1,200-kHz Broad-Band Acoustic Doppler Current Profiler (ADCP). The instrument collects velocity vectors in the water column together with backscatter levels to determine the position and relative intensity of the sediment plume. Along with the ADCP, a MicroLite recording instrument with an Optical Backscatterance (OBS) Sensor was towed by the vessel at a depth of 15 ft. The MicroLite recorded data at 0.5-sec intervals. Navigation data for monitoring were obtained by a Starlink differential Global Positioning System (GPS). The GPS monitors the boat position from the starting and ending points along each transect.

Transects were monitored in the test area to obtain the background levels of suspended materials prior to dredging activities. A period of 8 minutes following the dredge passing during non-overflow dredging showed the level of suspended material to be returning to background levels. No lateral dispersion of the plume out of the channel was observed during the non-overflow dredging operation. During overflow dredging, a wider transect was performed to determine the lateral extent of the plume. No significant change above background levels could be detected. At 1-hr elapsed time following the end of the overflow dredging operation, the levels of suspended material returned to background conditions. Again, no lateral dispersion of the plume out of the channel area was observed.

Overall, water quality impacts are anticipated to be minor and temporary in nature. Once dredging operations are complete the project area will soon return to ambient conditions due to the dilution or re-deposition of suspended sediments along with the strong littoral currents of the Chesapeake Bay and Atlantic Ocean.

No information is available on the effects of total suspended solids (TSS) on juvenile and adult sea turtles. Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). TSS is most likely to affect sea turtles if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting sea turtle prey. As sea turtles are highly mobile they are likely to be able to avoid any sediment plume and any effect on sea turtle or whale movements is likely to be insignificant. While an increase in suspended sediments may cause sea turtles to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movement to alter course out of the sediment plume, which is expected to be limited to the navigation channel and be present at any location for no more than 8 minutes. Based on this information, any increase in suspended sediment is not likely to affect the movement of sea turtles between foraging areas or while migrating or otherwise negatively affect listed species in the action area. Based on this information, it is likely that the effect of the suspension of sediment resulting from dredging operations will be insignificant.

The life stages of sturgeon most vulnerable to increased sediment are eggs and non-mobile larvae which are subject to burial and suffocation. As noted above, because of the distance of the project from the spawning grounds, no Atlantic sturgeon eggs and/or larvae will be present in the action area. Any Atlantic sturgeon in the action area during dredging would be capable of avoiding any sediment plume by swimming around it. Laboratory studies (Niklitschek 2001 and Secor and Niklitschek 2001) have demonstrated Atlantic sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. While the increase in suspended sediments may cause sturgeon to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movement further up in the water column, or movement to an area just outside of the navigation channel. Based on this information, any increase in suspended sediment is not likely to affect the movement of Atlantic sturgeon between foraging areas and/or concentration areas during any phase of dredging or otherwise negatively affect sturgeon in the action area.

8.2 Hydraulic Cutterhead Dredge

Hydraulic pipeline dredges tend to be more efficient than the hopper style dredges because the pipeline conveys sand directly to the placement site. However, hydraulic pipeline dredges are not well-adapted to work in environments with high wave energy. Most pipeline dredges have a cutterhead on the suction end. A cutterhead is a mechanical device that has rotating blades or teeth to break up or loosen the bottom material so that it can be sucked through the dredge. Some cutterheads are rugged enough to break up rock for removal. Pipeline dredges are mounted (fastened) to barges and are not usually self-powered, but are towed to the dredging site and secured in place by special anchor piling, called spuds. To move the dredge, the operator's raises and lowers opposite spuds to crab crawl the dredge along at a much slower pace than hopper style dredges and are subsequently less maneuverable. A hydraulic pipeline dredge removes material by controlling the dragline on which the suction cutterhead is attached. This style of dredge works more efficiently when it can move slowly and remove deeper materials as it moves along using the spuds. Material is directly mixed with water as it is sucked into the pipeline and hydraulically pumped and sent directly to the spoil disposal site. This makes this style dredge more efficient that a hopper style dredge that is required to move to a pump-out site to dispose of material. The suction is created by hydraulic pumps either located on board or in route along the pipeline acting as a booster and creates the same low pressure around the drag heads as similar to a hopper dredge to force the material along the pipeline. As with the hopper style dredge, the more closely the drag head is maintained in contact with the sediment, the more efficient the dredging.

Sea turtles are not known to be vulnerable to entrainment in cutterhead dredges. This is thought to be due to the size of sea turtles and their swimming ability that allows them to escape the intake velocity near a cutterhead. There are no records of any sea turtles being entrained in cutterhead dredges in the Chesapeake Bay or anywhere else. Based on the available information, we do not anticipate any entrainment of sea turtles if a cutterhead dredge is used for this project.

8.2.1 Available Information on the Risk of Entrainment of Sturgeon in Cutterhead Dredge

As noted above, a cutterhead dredge operates with the dredge head buried in the sediment; however, a flow field is produced by the suction of the operating dredge head. The amount of suction produced is dependent on linear flow rates inside the pipe and the pipe diameter (Clausner and Jones 2004). High flow rates and larger pipes create greater suction velocities and wider flow fields. The suction produced decreases exponentially with distance from the dredge head (Boysen and Hoover 2009). With a cutterhead dredge, material is pumped directly from the dredged area to a disposal site. As such, there is no opportunity to monitor for biological material on board the dredge; rather, observers work at the disposal site to inspect material.

It is generally assumed that sturgeon are mobile enough to avoid the suction of an oncoming cutterhead dredge and that any sturgeon in the vicinity of such an operation would be able to avoid the intake and escape. However, in mid-March 1996, two shortnose sturgeon were found in a dredge discharge pool on Money Island, near Newbold Island in the upper Delaware River. The dead sturgeon were found on the side of the spoil area into which the hydraulic pipeline dredge was pumping. An assessment of the condition of the fish indicated that the fish were likely alive and in good condition prior to entrainment and that they were both adult females. The area where dredging was occurring was a known overwintering area for shortnose sturgeon and large numbers of shortnose sturgeon were known to be concentrated in the general area. A total of 509,946 cy were dredged between Florence and the upper end of Newbold Island during this dredge cycle. Since that time, dredging occurring in the winter months in the Newbold – Kinkora range of the Delaware River required that inspectors conduct daily inspections of the dredge spoil area in an attempt to detect the presence of any sturgeon. In January 1998, three shortnose sturgeon carcasses were discovered in the Money Island Disposal Area. The sturgeon were found on three separate dates: January 6, January 12, and January 13. Dredging was being conducted in the Kinkora and Florence ranges at this time which also overlaps with the shortnose sturgeon overwintering area. A total of 512,923 cy of material was dredged between Florence and upper Newbold Island during that dredge cycle. While it is possible that not all shortnose sturgeon killed during dredging operations were observed at the dredge disposal pool, USACE has indicated that due to flow patterns in the pool, it is expected that all large material (i.e., sturgeon, logs etc.) will move towards the edges of the pool and be readily observable. Monitoring of dredge disposal areas used for deepening of the Delaware River with a cutterhead dredge has occurred. Dredging in Reach C occurred from March – August 2010 with 3,594,963 cy of material removed with a cutterhead dredge. Dredging in Reach B occurred in November and December 2011, with 1,100,000 cy of material removed with a cutterhead dredge. In both cases, the dredge disposal area was inspected daily for the presence of sturgeon. No sturgeon were detected.

In an attempt to understand the behavior of sturgeon while dredging is ongoing, the USACE worked with sturgeon researchers to track the movements of tagged Atlantic and shortnose sturgeon while cutterhead dredge operations were ongoing in Reach B (ERC 2011). The movements of acoustically tagged sturgeon were monitored using both passive and active methods. Passive monitoring was performed using 14 VEMCO VR2 and VR2W single-channel receivers, deployed through the study area. These receivers are part of a network that was established and cooperatively maintained by Environmental Research and Consulting, Inc. (ERC), Delaware State University

(DSU), and the Delaware Department of Natural Resources and Environmental Control (DNREC). Nineteen tagged Atlantic sturgeon and three tagged shortnose sturgeon (all juveniles) were in the study area during the time dredging was ongoing. Eleven of the 19 juvenile Atlantic sturgeon detected during this study remained upriver of the dredging area and showed high fidelity to the Marcus Hook anchorage. Three of the juvenile sturgeon detected during this study (Atlantic sturgeons 13417, 1769; shortnose sturgeon 58626) appeared to have moved through Reach B when the dredge was working. The patterns and rates of movement of these fish indicated nothing to suggest that their behavior was affected by dredge operation. The other sturgeon that were detected in the lower portion of the study area either moved through the area before or after the dredging period (Atlantic sturgeons 2053, 2054), moved through Reach B when the dredge was shut down (Atlantic sturgeons 1774, 58628, 58629), or moved through the channel on the east side of Cherry Island Flats (shortnose sturgeon 2090, Atlantic sturgeon 2091) opposite the main navigation channel. It is unknown whether some of these fish chose behaviors (routes or timing of movement) that kept them from the immediate vicinity of the operating dredge. In the report, Brundage speculates that this could be to avoid the noisy area near the dredge but also states that on the other hand, the movements of the sturgeon reported here relative to dredge operation could simply have been coincidence.

A similar study was carried out in the James River (Virginia) (Cameron 2012). Dredging occurred with a cutterhead dredge between January 30 and February 19, 2009 with 166,545 cy of material removed over 417.6 hours of active dredge time. Six subadult Atlantic sturgeon (77.5 – 100 cm length) were caught, tagged with passive and active acoustic tags, and released at the dredge site. The study concluded that: tagged fish showed no signs of impeded up- or downriver movement due to the physical presence of the dredge; fish were actively tracked freely moving past the dredge during full production mode; fish showed no signs of avoidance response (e.g., due to noise generated by the dredge) as indicated by the amount of time spent in close proximity to the dredge after release (3.5 – 21.5 hours); and, tagged fish showed no evidence of attraction to the dredge.

Several scientific studies have been undertaken to understand the ability of sturgeon to avoid cutterhead dredges. Hoover *et al.* (2011) demonstrated the swimming performance of juvenile lake sturgeon and pallid sturgeon (12 – 17.3 cm FL) in laboratory evaluations. The authors compared swimming behaviors and abilities in water velocities ranging from 10 to 90 cm/second (0.33-3.0 feet per second). Based on the known intake velocities of several sizes of cutterhead dredges. At distances more than 1.5 meters from the dredges, water velocities were negligible (10 cm/s). The authors conclude that in order for a sturgeon to be entrained in a dredge, the fish would need to be almost on top of the drag head and be unaffected by associated disturbance (e.g., turbidity and noise). The authors also conclude that juvenile sturgeon are only at risk of entrainment in a cutterhead dredge if they are in close proximity, less than 1 meter, to the cutterhead.

Boysen and Hoover (2009) assessed the probability of entrainment of juvenile white sturgeon by evaluating swimming performance of young of the year fish (8-10 cm TL). The authors determined that within 1.0 meter of an operating dredge head, all fish would escape when the pipe was 61 cm (2 feet) or smaller. Fish larger than 9.3 cm (about 4 inches) would be able to avoid the intake when the pipe was as large as 66 cm (2.2 feet). The authors concluded that regardless of fish size or pipe size, fish are only at risk of entrainment within a radius of 1.5 – 2 meters of the dredge head; beyond that distance velocities decrease to less than 1 foot per second.

Clarke (2011) reports that a cutterhead dredge with a suction pipe diameter of 36" (larger than the one to be used for this project) has an intake velocity of approximately 95 cm/s at a distance of 1 meter from the dredge head and that the velocity reduces to approximately 40cm/s at a distance of 1.5 meters, 25cm/s at a distance of 2.0 meters and less than 10cm/s at a distance of 3.0 meters. Clarke also reports on swim tunnel performance tests conducted on juvenile and subadult Atlantic, white and lake sturgeon. He concludes that there is a risk of sturgeon entrainment only within 1 meter of a cutterhead dredge head with a 36" pipe diameter and suction of 4.6m/second.

8.2.2 Predicted Entrainment of Atlantic sturgeon in a cutterhead dredge

The risk of an individual shortnose sturgeon being entrained in a cutterhead dredge is difficult to calculate. While a large area overall will be dredged, the dredge operates in an extremely small area at any given time (i.e., the river bottom in the immediate vicinity of the intake). As Atlantic sturgeon are expected to be well distributed throughout Sandbridge Shoal and an individual would need to be in the immediate area where the dredge is operating to be entrained (i.e., within 1 meter of the dredge head), the overall risk of entrainment is low. It is likely that the nearly all Atlantic sturgeon in the action area will never encounter the dredge as they would not occur within 1 meter of the dredge. Information from the tracking studies in the James and Delaware river supports these assessments of risk, as none of the tagged sturgeon were attracted to or entrained in the operating dredges.

The entrainment of five sturgeon in the upper Delaware River indicates that entrainment of sturgeon in cutterhead dredges is possible. However, there are several factors that may increase the risk of entrainment in that area of the river as compared to the areas where cutterhead dredging will occur for the deepening. All five entrainments occurred during the winter months in an area where shortnose sturgeon are known to concentrate in dense aggregations; sturgeon in these aggregations rest on the bottom and exhibit little movement and may be slow to respond to stimuli such as an oncoming dredge. Additionally, the area where dredging was occurring is fairly narrow and constricted which may limit the ability of sturgeon to avoid the oncoming dredge. These conditions are not present in Sandbridge Shoal.

Because the only entrainment of Atlantic or shortnose sturgeon in cutterhead dredges in the United States has been the five shortnose sturgeon found at the disposal site in the upper Delaware River it is difficult to predict the number of Atlantic sturgeon that are likely to be entrained during dredging at Sandbridge Shoal. Based on the available information presented here, entrainment in a cutterhead dredge is likely to be rare, and would only occur if a sturgeon was within 1 meter of the dredge head. Based on the predicted rarity of the entrainment event and the volume of material to be removed, we expect that no more than one Atlantic sturgeon will be entrained if a cutterhead dredge is used for dredging at Sandbridge Shoal. The entrained Atlantic sturgeon is expected to be a subadult and could originate from any of the five DPSs. Due to the suction, travel through up to several miles of pipe and any residency period in the disposal area, any entrained Atlantic sturgeon are expected to be killed.

8.2.3 Interactions with the Sediment Plume

The increased turbidity and suspended sediments related to the dredging and placement activities are anticipated to have short term, temporary impacts to water quality. Placement of sand at the designated beach nourishment site will be via hydraulic pipeline. Sand will be deposited directly on the beach and graded to profile. Fine particles that may be present in the sand will be transported along with the carrier water back and dispersed in the swash zone.

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the river, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. Dredging with a pipeline dredge minimizes the amount of material re-suspended in the water column as the material is essentially vacuumed up and transported to the disposal site in a pipe.

As reported by USACE, a near-field water quality modeling of dredging operations in the Delaware River was conducted in 2001. The purpose of the modeling was to evaluate the potential for sediment contaminants released during the dredging process to exceed applicable water quality criteria. The model predicted suspended sediment concentrations in the water column at downstream distances from a working cutterhead dredge in fine-grained dredged material. Suspended sediment concentrations were highest at the bottom of the water column, and returned to background concentrations within 100 meters downstream of the dredge.

In 2005, FERC presented NMFS with an analysis of results from the DREDGE model used to estimate the extent of any sediment plume associated with the proposed dredging at the Crown Landing LNG berth (FERC 2005). The model results indicated that the concentration of suspended sediments resulting from hydraulic dredging would be highest close to the bottom and would decrease rapidly downstream and higher in the water column. Based on a conservative (i.e., low) TSS background concentration of 5mg/L, the modeling results indicated that elevated TSS concentrations (i.e., above background levels) would be present at the bottom 2 meters of the water column for a distance of approximately 1,150 feet. Based on these analyses, elevated suspended sediment levels are expected to be present only within 1,150 feet of the location of the cutterhead. Turbidity levels associated with cutterhead dredge sediment plumes typically range from 11.5 to 282 mg/L with the highest levels detected adjacent to the cutterhead and concentrations decreasing with greater distance from the dredge (see U. Washington 2001).

Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580mg/L to 700,000mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993).

The life stages of sturgeon most vulnerable to increased sediment are eggs and non-mobile larvae which are subject to burial and suffocation. As noted above, no sturgeon eggs and/or larvae will be present in the action area. Subadult and adult Atlantic sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. All sturgeon in the action area would be sufficiently mobile to avoid any sediment plume.

Therefore, any Atlantic sturgeon in the action area during dredging would be capable of avoiding any sediment plume by swimming around it.

8.3 Dredged Material Disposal

We have considered whether the disposal of sand at Sandbridge Beach would impact sea turtles. Limited loggerhead sea turtle nesting (less than 10 nests per year) occurs on Virginia Beach; no nesting is known to occur on Sandbridge Beach. The disposal of material at Sandbridge is meant to stabilize and restoring eroding habitats and maintain existing beach. None of the activity is likely to reduce the suitability of these beaches for potential future nesting.

As indicated above, all material removed by cutterhead dredge will be disposed of at a beach location. When a cutterhead dredge is used, the material is piped directly from the intake to an onshore disposal area. The pipe will extend up to 3 miles, depending on the distance between the dredge site and the disposal site. The pipe will be approximately 30" in diameter and be laid on the ocean bottom. While the presence of the pipe will cause a small amount of benthic habitat to be unavailable to sturgeon and sea turtles, the extremely small area affected will cause any effects to be insignificant and discountable. While this could cause a small increase in suspended sediment in the immediate vicinity of sand placement, any effects are likely to be minor and temporary. Impacts associated with this action include a short term localized increase in turbidity during disposal operations. During the discharge of sediment at a disposal site, suspended sediment levels have been reported as high as 500mg/L within 250 feet of the disposal vessel and decreasing to background levels (i.e., 15-100mg/L depending on location) within 1,000-6,500 feet (USACE 1983). For this project, the USACE has reported that because the dredged material is clean sand, the material will settle out quickly and any sediment plume will be localized and temporary. Any sea turtles or sturgeon in the vicinity of the beach disposal sites during disposal may temporarily avoid the disposal area; however, as any effects to movements will be small and temporary, these effects will be insignificant. Similar effects of suspended sediment and turbidity will be experienced at the ocean disposal sites; as such, effects to sturgeon and sea turtles will be insignificant and discountable. Effects of disposal on prey resources are considered in section 7.5.

8.4 Effects on Benthic Resources and Foraging

8.4.1 Effects to Sea Turtles

Since dredging involves removing the bottom material down to a specified depth, the benthic environment will be impacted by dredging operations. No sea grass beds occur in the areas to be dredged with a hopper dredge, therefore green sea turtles will not use the areas as foraging areas. Thus, NMFS anticipates that the dredging activities are not likely to disrupt normal feeding behaviors for green sea turtles. Records from previous dredge events occurring in the action area indicate that some benthic resources, including whelks, horseshoe crabs, blue crabs and rock crabs are entrained during dredging. Other sources of information indicate that potential sea turtle forage items are present in the channel, including jellyfish, clams, mussels, sea urchins, whelks, horseshoe crabs, blue crabs and rock crabs.

Of the listed species found in the action area, loggerhead and Kemp's ridley sea turtles are the most likely to utilize the channel areas for feeding with the sea turtles foraging mainly on benthic species, namely crabs and mollusks (Morreale and Standora 1992, Bjorndal 1997). As noted above, suitable sea turtle forage items occur in the channel. As preferred sea turtle and sturgeon foraging items occur at the channel areas and depths are suitable for use by sea turtles, some foraging by these species likely occurs at these sites.

Dredging can cause indirect effects on sea turtles by reducing prey species through the alteration of the existing biotic assemblages. Kemp's ridley and loggerhead sea turtles typically feed on crabs, other crustaceans and mollusks. Some of the prey species targeted by turtles, including crabs, are mobile; therefore, some individuals are likely to avoid the dredge; however, there is likely to be some entrainment of sea turtle prey items.

Previous studies in the upper Chesapeake Bay have demonstrated rapid recovery and resettlement by benthic biota and similar biomass and species diversity to pre-dredging conditions (Johnston, 1981; Diaz, 1994). Similar studies in the lower portions of the Chesapeake Bay produced rapid resettlement of dredging and placement areas by infauna (Sherk, 1972). McCauley et al. (1977) observed that while infauna populations declined significantly after dredging, infauna at dredging and placement areas recovered to pre-dredging conditions within 28 and 14 days, respectively. Therefore, the direct and indirect impacts to benthic communities are anticipated to be minimal. Rapid recovery and resettlement of benthic species is expected.

Based on this analysis, while there will be a small reduction in sea turtle prey due to dredging, these effects will be insignificant to foraging loggerhead and Kemp's ridley sea turtles. No effects to the prey base of green or leatherback sea turtles are anticipated.

8.4.2 Effects to Atlantic sturgeon

Atlantic sturgeon feed on a variety of benthic invertebrates. The proposed dredging is likely to entrain and kill at least some of these potential forage items. Given the limited mobility of most benthic invertebrates that sturgeon feed on, most are unlikely to be able to actively avoid the dredge. As noted above, recovery of the benthic community is expected to be rapid. Also as explained above for sea turtles, the area dredged in any particular year is a very small percentage of the available foraging habitat in the action area. Because effects to benthic prey will be limited to the area immediately surrounding the dredged area, the potential for disruption in foraging is low.

8.5 Dredge and Disposal Vessel Traffic

There have not been any reports of dredge vessels colliding with listed species but contact injuries resulting from dredge movements could occur at or near the water surface and could therefore involve any of the listed species present in the area. Because the dredge is unlikely to be moving at speeds greater than three knots during dredging operations, blunt trauma injuries resulting from contact with the hull are unlikely during dredging. It is more likely that contact injuries during actual dredging would involve the propeller of the vessel. Contact injuries with the dredge are more likely to occur when the dredge is moving from the dredging area to port, or between dredge locations. While the distance between these areas is relatively short, the dredge in transit would be moving at faster speeds than during dredging operations, particularly when empty while returning to the borrow area.

The dredge vessel may collide with sea turtles when they are at the surface. Sea turtles have been documented with injuries consistent with vessel interactions. It is reasonable to believe that the dredge vessels considered in this Opinion could inflict such injuries on sea turtles, should they collide. As mentioned, sea turtles are found distributed throughout the action area in the warmer months, generally from May through mid-November.

Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9% of living and dead stranded sea turtles had propeller or other boat strike injuries (Lutcavage et al. 1997). According to 2001 STSSN stranding data, at least 33 sea turtles (loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the northeast (Maine through North Carolina) were struck by a boat. This number underestimates the actual number of boat strikes that occur since not every boat struck turtle will strand, every stranded turtle will not be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem (NMFS SEFSC 2001).

Information is lacking on the type or speed of vessels involved in turtle vessel strikes. However, there does appear to be a correlation between the number of vessel struck turtles and the level of recreational boat traffic (NRC 1990). Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. The speed of the dredge is not expected to exceed 3 knots while dredging or while transiting to the pump out site with a full load and it is expected to operate at a maximum speed of 10 knots while empty. In addition, the risk of ship strike will be influenced by the amount of time the animal remains near the surface of the water. For the proposed action, the greatest risk of vessel collision will occur during transit between shore and the areas to be dredged. The presence of an experienced endangered species observer who can advise the vessel operator to slow the vessel or maneuver safely when sea turtles are spotted will further reduce the potential risk for interaction with vessels. The addition of one to two slow moving vessels in the action area have an insignificant effect on the risk of interactions between sea turtles and vessels in the action area.

Information regarding the risk of vessel strikes to Atlantic sturgeon is discussed in the Status of the Species and Environmental Baseline sections above. As explained there, we have limited information on vessel strikes and many variables likely affect the potential for vessel strikes in a given area. Assuming that the risk of vessel strike increases with an increase in vessel traffic, we have considered whether an increase in vessel traffic in the action area during dredging and disposal (one to two slow moving vessels per day) would increase the risk of vessel strike for Atlantic sturgeon in this area. Given the large volume of traffic in the action area and the wide variability in traffic in any given day, the increase in traffic of one to two vessels per day is negligible and the increased risk to Atlantic sturgeon is insignificant.

8.6 Unexploded Ordinance and Munitions of Concern

The United States Army Environmental Command (USAEC) defines unexploded ordnance (UXO) or munitions of explosive concern (MEC) as military munitions that have been (1) primed, fused, armed or otherwise prepared for action; (2) fired, dropped, launched, projected, or placed in such a manner to constitute a hazard to operations, installations, personnel, or material, and (3) remain unexploded either by malfunction, design, or any other case. UXO/MEC comes in many shapes and sizes, may be completely visible or partially or completely buried, and may be easy or virtually impossible to recognize as a military munition. UXO/MEC can be found in the ocean. UXO/MEC may look like a bullet or bomb, or be in many pieces, but even small pieces of UXO/MEC can be dangerous. If disturbed, (touched, picked up, played with, kicked, thrown, etc.) UXO/MEC may explode without warning, resulting in serious injury or even death. Sandbridge Shoal borrow area occurs in an area associated with past and current military activities and has produced UXO/MEC during dredging operations.

The presence of UXO in dredged material presents two unique challenges. First, it poses a potential explosive safety hazard to dredging or observer personnel and potential damage to equipment and vessel. Second, any subsequent beneficial use of dredged material must also address the possibility of the presence of UXO and/or its removal.

The presence of UXO was documented during the previous Sandbridge Hurricane Protection Projects constructed in 2002 and 2007. Over 100 UXO were recovered during dredging operations and were transported to and properly disposed of at an undisclosed naval installation. Recent dredging of the Cape Henry Channel, documented UXO/MEC in the observer cages on April 15, 2011 and May 8, 2011. On April 1, 2006, the Dredge Padre Island operated by the Great Lakes Dredge & Dock Company was conducting maintenance dredging activities in the Atlantic Ocean Channel (AOC) when it suffered a ruptured dredge clean out section and severed drag head as a result of an explosion presumed to be from an ordnance device that was pumped into the draghead and associated lines. Unexploded ordnance had been previously retrieved from the draghead on three different occasions in February 2006. During the last dredging cycle of the AOC in February 2011, it was documented that UXO/MEC was encountered four times, mostly 5-inch shells, two of which were determined to be live ordnance. A UXO/MEC device also is presumed to be the cause of an explosion on a hydraulic cutter-head dredge conducting maintenance dredging in Norfolk Harbor in April 2005 rupturing the primary pump casing on the dredge. The Coast Guard rendered assistance to the dredge plant to provide additional pump-out capacity for the incoming water and stabilize the plant. Fortunately, in most incidents UXO has not detonated and has been safely removed or jettisoned from the vessel.

As a safety precaution, in any area where UXO may be encountered (including some if not all portions of Sandbridge Shoal), the USACE will install special intake screening to be permanently placed over the drag head to effectively prevent any UXO from entering the hopper and/or being subsequently placed within the associated placement site. Additionally, USACE will install screening at the point where the material is discharged onto the beach. Special intake screening for UXO/MEC will be specified and installed to prevent entrainment of any material greater than 1-1/4 inches in diameter. Typical allowable openings specified by USACE-Norfolk District are 1-1/4 inches x 6 inches. While use of this screening poses challenges for monitoring interactions with listed species (see section 11 below), its use is not expected to change the entrainment rates calculated above. That is because, while it may prevent turtles or sturgeon from entering the intake pipes, it does not change the way the dredge operates or the suction power at the intake. So, while sea turtles or sturgeon may be less likely to be sucked through the dredge plant (as this could be prevented by the small size of the intakes resulting from the screening), the risk of an interaction does not change.

8.7 Bed Leveling Devices

Bed-leveling is often associated with hopper dredging (and other types of dredging) operations. Bed-levelers redistribute sediments, rather than removing them. Plows, I-beams, or other seabed-leveling mechanical dredging devices are used to lower high spots left in channel bottoms and dredged material deposition areas by hopper dredges or other type dredges. Leveling devices typically weigh about 30 to 50 tons, are fixed with cables to a derrick mounted on a barge pushed or pulled by a tugboat at about one to two knots.

We have considered the potential for sea turtles to be crushed as the leveling device passes over a turtle which fails to move or is not pushed out of the way by the sediment wedge "wave" generated by and pushed ahead of the device. Sea turtles at Brunswick Harbor, Georgia, may have been crushed and killed in 2003 by bed-leveling which commenced after the hopper dredge finished its work in a particular area. Brunswick Harbor is a site where sea turtles captured by relocation trawlers sometimes show evidence of brumating (over-wintering) in the muddy channel bottom, which could explain why, if they were in fact crushed, they failed to react quickly enough to avoid the bed-leveler.

USACE has engaged in efforts to design bed leveler devices that are more likely to push sea turtles out of the way (much like a deflector on a hopper dredge); it is thought that this would reduce any potential for crushing. The available information on bed leveling and sea turtles indicates that crushing is extremely unlikely outside of areas where sea turtles are brumating. Additionally, the proposed modifications (i.e., integrated deflector configurations) to traditional bed-levelers are expected to further reduce the potential for impacts to sea turtles.

Subadult and adult Atlantic sturgeon are likely to be able to avoid being crushed by a bed-leveler. These fish are highly mobile. The low rate of entrainment of this species in any type of dredge suggests an ability to avoid interactions with dredge gear including bed levelers. No reports of injured or dead sturgeon have been reported in association with any bed leveling activities. As such, we do not anticipate any Atlantic sturgeon to be injured or killed if a bed leveler is used.

9.0 CUMULATIVE EFFECTS

Cumulative effects, as defined in 50 CFR § 402.02, are those effects of future State or private activities, not involving Federal activities, which are reasonably certain to occur within the action area. Future Federal actions are not considered in the definition of "cumulative effects."

Actions carried out or regulated by the State of Virginia within the action area that may affect sea turtles and Atlantic sturgeon include the authorization of state fisheries and the regulation of dredged material discharges through CWA 401-Certification and point and non-point source pollution through the National Pollutant Discharge point and non-point source pollution through the National Pollutant Discharge Elimination System (NPDES). We are not aware of any local or private actions that are reasonably certain to occur in the action area that may affect listed species. It is important to note that the definition of "cumulative effects" in the section 7 regulations is not the same as the NEPA definition of cumulative effects.[9]

State Water Fisheries - Future recreational and commercial fishing activities in state waters may take shortnose and Atlantic sturgeon. Information on interactions with sea turtles and Atlantic sturgeon for state fisheries operating in the action area is summarized in the Environmental Baseline section above, and it is not clear to what extent these future activities would affect listed species differently than the current state fishery activities described in the Status of the Species/Environmental Baseline section. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the status of the species/environmental baseline section.

State PDES Permits – Virginia has been delegated authority to issue NPDES permits by the EPA. These permits authorize the discharge of pollutants in the action area. Permitees include municipalities for sewage treatment plants and other industrial users. The states will continue to authorize the discharge of pollutants through the SPDES permits. However, this Opinion assumes effects in the future would be similar to those in the past and are therefore reflected in the anticipated trends described in the status of the species/environmental baseline section.

10.0 INTEGRATION AND SYNTHESIS OF EFFECTS

In the effects analysis outlined above, we considered potential effects from planned dredging in Sandbridge Shoals in 2012-2013. These effects include: (1) dredging with cutterhead or hopper dredges; (2) bed leveling; and, (3) physical alteration of the action area including disruption of benthic communities. In addition to these categories of effects, NMFS considered the potential for collisions between listed species and project vessels. We anticipate the mortality of seven sea turtles (six loggerheads and no more than one Kemp's ridley or green sea turtle) and one Atlantic sturgeon from any of the five DPSs. Mortality of sea turtles will result from entrainment in hopper dredges operating between April and November. Mortality of Atlantic sturgeon will occur from entrainment in hopper and/or cutterhead dredges. As explained in the "Effects of the Action" section, effects of the dredging on habitat and benthic resources will be insignificant and discountable. We do not anticipate any take of sea turtles or Atlantic sturgeon due to any of the other effects including vessel traffic and dredge disposal.

In the discussion below, we consider whether the effects of the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of the listed species that will be adversely affected by the action. The purpose of this analysis is to determine whether the proposed action, in the context established by the status of the species, environmental baseline, and cumulative effects, would jeopardize the continued existence of any listed species. In the NMFS/USFWS Section 7 Handbook, for the purposes of determining jeopardy, survival is defined as,

> "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from

[9] Cumulative effects are defined for NEPA as "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."

endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter."

Recovery is defined as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." We summarize below the status of the species and consider whether the proposed action will result in reductions in reproduction, numbers or distribution of these species and then considers whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of these species, as those terms are defined for purposes of the Endangered Species Act.

10.1 Atlantic sturgeon

As explained above, the proposed action is likely to result in the mortality of no more than 1 Atlantic sturgeon. This estimate applies if a hopper or cutterhead dredge is used. We expect that the Atlantic sturgeon killed will be a subadult. No mortality of any adults is anticipated. All other effects to Atlantic sturgeon, including effects to habitat and prey due to dredging and dredge disposal, will be insignificant and discountable.

10.1.1 Determination of DPS Composition

Using mixed stock analysis explained above, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 49%; South Atlantic 20%;Chesapeake Bay 14%; Gulf of Maine 11%; and Carolina 4%. Given these percentages, it is most likely that the entrained Atlantic sturgeon would originate from the New York Bight DPS but it is possible it could originate from any of the five DPSs.

10.1.2 Gulf of Maine DPS

Individuals originating from the GOM DPS are likely to occur in the action area. The GOM DPS has been listed as threatened. While Atlantic sturgeon occur in several rivers in the GOM DPS, recent spawning has only been documented in the Kennebec and Androscoggin rivers. No total population estimates are available. At this time, there is no published population estimate for the GOM DPS as a whole or for any life stage. We expect that 11% of the Atlantic sturgeon in the action area will originate from the GOM DPS. GOM origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole. We anticipate the mortality of no more than 1 subadult Atlantic sturgeon during the activity described in this Opinion. It is possible that the fish could originate from the GOM DPS. As noted above, we do not have an estimate of the number of subadult Atlantic sturgeon in the GOM DPS, the number of adults or the size of the GOM DPS as a whole. Here, we consider the effect of the loss of one subadult on the reproduction, numbers and distribution of the GOM DPS.

The reproductive potential of the GOM DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of one subadult would have the effect of reducing the amount of potential reproduction as any dead GOM DPS Atlantic sturgeon would have no potential for future reproduction. However, because this action will result in the death of only one individual, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. Reproductive potential of other captured or injured individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where GOM DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by GOM DPS fish.

Because we do not have a population estimate for the GOM DPS, it is difficult to evaluate the effect of the mortality caused by this action on the species. However, because the proposed action will result in the loss of only one individual, it is unlikely that this death will have a detectable effect on the numbers and population trend of the GOM DPS.

The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by GOM DPS subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area where suspended sediment levels are high.

Based on the information provided above, the death of no more than one GOM DPS Atlantic sturgeon, will not appreciably reduce the likelihood of survival of the GOM DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect GOM DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one subadult GOM DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of one subadult GOM DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of one subadult GOM DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of GOM DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging GOM DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the GOM DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the GOM DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the GOM DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of GOM DPS Atlantic sturgeon and since it will not affect the overall distribution of GOM DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality (one individual) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the GOM DPS of Atlantic sturgeon. This action will not change the status or trend of the GOM DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the GOM DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual GOM DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of one subadult GOM DPS Atlantic sturgeon, is not likely to appreciably reduce the survival and recovery of this species.

10.1.3 New York Bight DPS

We expect that 49% of the Atlantic sturgeon in the action area will originate from the NYB DPS. The NYB DPS has been listed as endangered. While Atlantic sturgeon occur in several rivers in the NYB DPS, recent spawning has only been documented in the Delaware and Hudson rivers. Kahnle *et al.* (2007) estimated that there is a mean annual total mature adult population of 863 Hudson River Atlantic sturgeon. Fisheries bycatch data suggests that the ratio of subadults to adults is at least 3:1. Therefore, we estimate that there are at least 2,589 subadults. At this time, we do not have an estimate of the number of Delaware River origin Atlantic sturgeon; however, because spawning is thought to persist in the Delaware, this river contributes additional sturgeon of all life stages to the DPS. NYB DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for the Hudson or Delaware River spawning populations or for the DPS as a whole. Some Delaware River fish have a unique genetic haplotype (the A5 haplotype); however, whether there is any evolutionary significance or fitness benefit provided by this genetic makeup is unknown. Genetic evidence indicates that while spawning continued to occur in the Delaware River and in some cases Delaware River origin fish can be distinguished genetically from Hudson River origin fish, there is free interchange between the two rivers. This relationship is recognized by the listing of the New York Bight DPS as a whole and not separate listings of a theoretical Hudson River DPS and Delaware River DPS. Thus, while we can consider the loss of Delaware River fish on the Delaware River population and the loss of Hudson River fish on the Hudson River population, it is more appropriate, because of the interchange of individuals between these two populations, to consider the effects of these mortalities on the New York Bight DPS as a whole.

We have estimated that the proposed action will result in the mortality of no more than 1 subadult Atlantic sturgeon; this fish is likely to originate from the NYB DPS. Any New York Bight DPS subadults could originate from the Delaware or Hudson river. The available information suggests that the vast majority of NYB DPS subadults originate from the Hudson River, therefore, given that only one NYB DPS fish is likely to be killed it is reasonable to assume that it will be Hudson River origin.

The mortality of 1 subadult Atlantic sturgeon from the NYB DPS represents a very small percentage of subadult population (*i.e.*, approximately 0.04% of the population, just considering the minimum estimated number of Hudson River origin subadults; the percentage would be much less if the number of adults, YOY and juveniles was considered as well as any Delaware River origin subadults). While the death of one subadult Atlantic sturgeon will reduce the number of NYB DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the subadult population and an even smaller percentage of the overall population of the DPS (juveniles, subadults and adults combined). Even when converting this fish to adult equivalents[10] (using a conversion rate of 0.48 considering the adult equivalent), and assuming no growth in the adult population, the mortality of 1 subadult represents an extremely small percentage of the adult population (approximately 0.06%).

Because there will be no loss of adults, the reproductive potential of the NYB DPS will not be

[10] The "adult equivalent" rate converts a number of subadults to adult equivalents (the number of subadults that would, through natural mortality, live to be adults; for Atlantic sturgeon, this is calculated as 0.48).

affected in any way other than through a reduction in numbers of individual future spawners. The loss of 1 subadult would have the effect of reducing the amount of potential reproduction as any dead NYB DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The proposed action will also not affect the spawning grounds within the Hudson River or Delaware River where NYB DPS fish spawn. There will be no effects to spawning adults and therefore no reduction in individual fitness or any future reduction in spawning by these individuals.

The proposed action is not likely to reduce distribution because the action will not impede NYB DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the Delaware or Hudson River or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area immediately surrounding an active dredge.

Based on the information provided above, the death of one NYB DPS Atlantic sturgeon , will not appreciably reduce the likelihood of survival of the New York Bight DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect NYB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of this subadult NYB DPS Atlantic sturgeon represents an extremely small percentage of the species; (2) the death of one subadult NYB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of one subadult NYB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of one subadult NYB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of NYB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of NYB DPS Atlantic sturgeon to shelter and only an insignificant effect on individual foraging NYB DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the NYB DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the NYB DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the NYB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of NYB DPS Atlantic sturgeon and since it will not affect the overall distribution of NYB DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality (one individual) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the NYB DPS of Atlantic sturgeon. This action will not change the status or trend of the NYB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the NYB DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual NYB DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. Based on the analysis presented herein, the proposed action, resulting in the mortality of up to one subadult NYB DPS Atlantic sturgeon, is not likely to appreciably reduce the survival and recovery of this species.

10.1.4 Chesapeake Bay DPS
Individuals originating from the CB DPS are likely to occur in the action area. The CB DPS has been listed as endangered. While Atlantic sturgeon occur in several rivers in the CB DPS, recent spawning has only been documented in the James River. No estimates of the number of spawning adults, the DPS as a whole, or any life stage have been reported. We expect that 14% of the Atlantic sturgeon in the action area will originate from the CB DPS. Chesapeake Bay DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for the James River spawning population or for the DPS as a whole. Here, we consider the effect of the loss of one subadult on the reproduction, numbers and distribution of the CB DPS.

The reproductive potential of the CB DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of this subadult would have the effect of reducing the amount of potential reproduction as any dead CB DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. Reproductive potential of other captured or injured individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where CB DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by CB DPS fish.

Because we do not have a population estimate for the CB DPS, it is difficult to evaluate the effect of the mortality caused by this action on the species. However, because the proposed action will result in the loss of only one individual, it is unlikely that this death will have a detectable effect on the numbers and population trend of the CB DPS.

The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by CB DPS subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the immediate area where dredging is occurring.

Based on the information provided above, the death of no more than 1 CB DPS Atlantic sturgeon will not appreciably reduce the likelihood of survival of the CB DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect CB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 1 subadult CB DPS Atlantic sturgeon over a 50-year period represents an extremely small percentage of the species as a whole; (2) the death of 1 subadult CB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of 1subadult CB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 1 subadult CB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of CB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of CB DPS Atlantic sturgeon to shelter and only an insignificant effect on individual foraging CB DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CB DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the CB DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the CB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of CB DPS Atlantic sturgeon and since it will not affect the overall distribution of CB DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality (one individual) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the CB DPS of Atlantic sturgeon. This action will not change the status or trend of the CB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the CB DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual CB DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of one subadult CB DPS Atlantic sturgeon, is not likely to appreciably reduce the survival and recovery of this species.

10.1.4 Carolina DPS

We expect that 4% of the Atlantic sturgeon in the action area will originate from the CA DPS. The CA DPS is listed as endangered. The CA DPS consists of Atlantic sturgeon originating from at least five rivers where spawning is still thought to occur. There are no estimates of the size of the CA DPS. The ASSRT estimated that there were fewer than 300 spawning adults in each of the five spawning rivers. Carolina DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for any of the spawning populations or for the DPS as a whole. Here, we consider the effect of the loss of one subadult on the reproduction, numbers and distribution of the CA DPS.

The reproductive potential of the CA DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of one subadult would have the effect of reducing the amount of potential reproduction as any dead CA DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where CA DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by CA DPS fish.

Because we do not have a population estimate for the CA DPS, it is difficult to evaluate the effect of the mortality caused by this action on the species. However, because the proposed action will result in the loss of only one individual, it is unlikely that this death will have a detectable effect on the numbers and population trend of the CA DPS.

The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by CA DPS subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the immediate area where dredging is occurring.

Based on the analysis provided above, the death of no more than one CA DPS Atlantic sturgeon will not appreciably reduce the likelihood of survival of the CA DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect CA DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter.

This is the case because: (1) the death of one subadult CA DPS Atlantic sturgeon represents an extremely small percentage of the species as a whole; (2) the death of one subadult CA DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of one subadult CA DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of one subadult CA DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of CA DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of CA DPS Atlantic sturgeon to shelter and only an insignificant effect on individual foraging CA DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CA DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the CA DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the CA DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of CA DPS Atlantic sturgeon and since it will not affect the overall distribution of CA DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality (one individual) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the CA DPS of Atlantic sturgeon. This action will not change the status or trend of the CA DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the CA DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the CA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual CA DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of one subadult CA DPS Atlantic sturgeon, is not likely to appreciably reduce the survival and recovery of this species.

10.1.5 South Atlantic DPS

We expect that 20% of the Atlantic sturgeon in the action area will originate from the SA DPS. The SA DPS is listed as endangered. The SA DPS consists of Atlantic sturgeon originating from at least six rivers where spawning is still thought to occur. An estimate of 343 spawning adults per year is available for the Altamaha River, GA, based on fishery-independent data collected in 2004 and 2005 (Schueller and Peterson, 2006); because males and females do not spawn every year, this estimate represents a portion of the total number of Altamaha adults. Males spawn every 1-5 years and females every 2-5 years; using this information and assuming a 1:1 sex ratio, we could estimate a total adult population size of 513-855 Altamaha River origin adults. Fisheries bycatch data suggests that the ratio of subadults to adults is at least 3:1. Therefore, we estimate that there are at least 1,539-2,565 Altamaha River origin subadults. The ASSRT estimated that there are less than 300 spawning adults (total of both sexes) in each of the other river systems where spawning occurs. There are no reported population estimates for any other spawning rivers or the DPS as a whole. South Atlantic DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for any of the spawning populations or for the DPS as a whole. Here, we consider the effect of the loss of one subadult on the reproduction, numbers and distribution of the SA DPS.

The reproductive potential of the SA DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of this subadult would have the effect of reducing the amount of potential reproduction as any dead SA DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where SA DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by SA DPS fish.

The mortality of 1 subadult Atlantic sturgeon from the SA DPS represents a very small percentage of subadult population (*i.e.*, no more than 0.06% of the population, just considering the minimum estimated number of Altamaha River origin subadults; the percentage would be much less if the number of adults, YOY and juveniles was considered as well as any fish from the five other spawning rivers). While the death of one subadult Atlantic sturgeon will reduce the number of SA DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the subadult population and an even smaller percentage of the overall population of the DPS (juveniles, subadults and adults combined). Even when converting this fish to adult equivalents[11] (using a conversion rate of 0.48 considering the adult equivalent), and assuming no growth in the adult population, the mortality of 1 subadult represents an extremely small percentage of the adult population (no more than 0.09%, just considering the Altamaha River adults).

The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by SA DPS subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the immediate area where dredging is occurring.

Based on the information provided above, the death of no more than one SA DPS Atlantic sturgeon will not appreciably reduce the likelihood of survival of the SA DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect SA DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one subadult SA DPS Atlantic sturgeon represents an extremely small percentage of the species as a whole; (2) the death of 1 subadult SA DPS Atlantic sturgeon will not change the status or trends of any spawning river or the species as a whole; (3) the loss of one subadult SA DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of one subadult SA DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of SA DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of SA DPS Atlantic sturgeon to shelter and only an insignificant effect on individual foraging SA DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the SA DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in

[11] The "adult equivalent" rate converts a number of subadults to adult equivalents (the number of subadults that would, through natural mortality, live to be adults; for Atlantic sturgeon, this is calculated as 0.48).

status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the SA DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the SA DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of SA DPS Atlantic sturgeon and since it will not affect the overall distribution of SA DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality (one individual) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the SA DPS of Atlantic sturgeon. This action will not change the status or trend of the SA DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the SA DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual SA DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of one subadult SA DPS Atlantic sturgeon, is not likely to appreciably reduce the survival and recovery of this species.

10.2 Green sea turtles

In the "Effects of the Action" section above, we determined that green sea turtles could be entrained in a hopper dredge operating in any of the channels or borrow areas considered in this consultation. Based on a calculated entrainment rate of sea turtles for projects using hopper dredges in the action area, we estimate that 1 sea turtle is likely to be entrained for every 300,000 cy of material removed with a hopper dredge. Also, based on the ratio of sea turtles entrained in other hopper dredge operations in the action area, we estimate that 2% of the sea turtles entrained during project operations were likely to be greens. Based on this, we determined that, if a hopper dredge is used, no more than one green sea turtle is likely to be entrained during the dredging of Sandbridge Shoal in 2012-2013 considered here. We determined that all other effects of the action on this species, including effects to habitat and prey due to dredging and dredge disposal, will be insignificant and discountable. If a cutterhead dredge is used or all hopper dredging is completed in December – March, no interactions with green sea turtles are likely.

Green sea turtles are listed as both threatened and endangered under the ESA. Breeding colony populations in Florida and on the Pacific coast of Mexico are considered endangered while all others are considered threatened. Due to the inability to distinguish between these populations away from the nesting beach, for this Opinion, green sea turtles are considered endangered wherever they occur in U.S. waters. Green sea turtles are distributed circumglobally and can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea (NMFS and USFWS 1991; Seminoff 2004; NMFS and USFWS 2007d). As is also the case with the other sea turtle species, green sea turtles face numerous threats on land and in the water that affect the survival of all age classes.

A review of 32 Index Sites distributed globally revealed a 48% to 67% decline in the number of mature females nesting annually over the last three generations (Seminoff 2004). For example, in the eastern Pacific, the main nesting sites for the green sea turtle are located in Michoacan, Mexico, and in the Galapagos Islands, Ecuador, where the number of nesting females exceeds 1,000 females per year at each site (NMFS and USFWS 2007d). Historically, however, greater than 20,000 females per year are believed to have nested in Michoacan alone (Cliffton *et al.* 1982; NMFS and USFWS 2007d). However, the decline is not consistent across all green sea turtle nesting areas. Increases in the number of nests counted and, presumably, the numbers of mature females laying nests were recorded for several areas (Seminoff 2004; NMFS and USFWS 2007d). Of the 32 index sites reviewed by Seminoff (2004), the trend in nesting was described as: increasing for 10 sites, decreasing for 19 sites, and stable (no change) for 3 sites. Of the 46 green sea turtle nesting sites reviewed for the 5-year status review, the trend in nesting was described as increasing for 12 sites, decreasing for 4 sites, stable for 10 sites, and unknown for 20 sites (NMFS and USFWS 2007d). The greatest abundance of green sea turtle nesting in the western Atlantic occurs on beaches in Tortuguero, Costa Rica (NMFS and USFWS 2007d). Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007d). One of the largest nesting sites for green sea turtles worldwide is still believed to be on the beaches of Oman in the Indian Ocean (Hirth 1997; Ferreira *et al.* 2003; NMFS and USFWS 2007d). However, nesting data for this area has not been published since the 1980s and updated nest numbers are needed (NMFS and USFWS 2007d).

The results of genetic analyses show that green sea turtles in the Atlantic do not contribute to green sea turtle nesting elsewhere in the species' range (Bowen and Karl 2007). Therefore, increased nesting by green sea turtles in the Atlantic is not expected to affect green sea turtle abundance in other ocean basins in which the species occurs. However, the ESA-listing of green sea turtles as a species across ocean basins means that the effects of a proposed action must, ultimately, be considered at the species level for section 7 consultations. NMFS recognizes that the nest count data available for green sea turtles in the Atlantic clearly indicates increased nesting at many sites. However, NMFS also recognizes that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future. Given the late age to maturity for green sea turtles (20 to 50 years) (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004), caution is urged regarding the trend for any of the nesting groups since no area has a dataset spanning a full green sea turtle generation (NMFS and USFWS 2007d).

As described in the Status of the Species, Environmental Baseline and Cumulative Effects sections above, green sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration and other factors that result in mortality of individuals at all life stages.

The lethal removal of one green sea turtle, whether male or female, immature or mature, would reduce the number of green sea turtles as compared to the number of green that would have been present in the absence of the proposed action assuming all other variables remained the same. However, this does not necessarily mean that the species will experience reductions in reproduction, numbers or distribution in response to these effects to the extent that survival and recovery would be appreciably reduced. The loss of one green sea turtles represents a very small percentage of the species as a whole. Even compared to the number of nesting females (17,000-37,000), which represent only a portion of the number of greens worldwide, the mortality of one green represents less than 0.006% of the population. The loss of this sea turtle would be expected to reduce the reproduction of green sea turtles as compared to the reproductive output of green sea turtles in the absence of the proposed action. As described in the "Status of the Species" section above, we consider the trend for green sea turtles to be stable. However, as explained below, the death of one green sea turtle will not appreciably reduce the likelihood of survival for the species for the following reasons.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of greens because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of greens is likely to be increasing and at worst is stable. This action is not likely to reduce distribution of greens because the action will not impede greens from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors.

Based on the information provided above, the death of one green sea turtle will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect green sea turtles in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent green sea turtles from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is increasing; (2) the death of 1 green sea turtle represents an extremely small percentage of the species as a whole; (3) the loss of 1 green sea turtle will not change the status or trends of the species as a whole; (4) the loss of 1 green sea turtles is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of 1 green sea turtles is likely to have an undetectable effect on reproductive output of the species as a whole; (6) the action will have no effect on the distribution of greens in the action area or throughout its range; and (7) the action will have no effect on the ability of green sea turtles to shelter and only an insignificant effect on individual foraging green sea turtles.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that green sea turtles will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the species can rebuild to a point where listing is no longer appropriate. A Recovery Plan for Green sea turtles was published by NMFS and USFWS in 1991. The plan outlines the steps necessary for recovery and the criteria which, once met, would ensure recovery. In order to be delisted, green sea turtles must experience sustained population growth, as measured in the number of nests laid per year, over time. Additionally, “priority one” recovery tasks must be achieved and nesting habitat must be protected (through public ownership of nesting beaches) and stage class mortality must be reduced. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action will not appreciably reduce the likelihood of survival of green sea turtles. Also, it is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of green sea turtles in any geographic area and since it will not affect the overall distribution of green sea turtles other than to cause minor temporary adjustments in movements in the action area. As explained above, the proposed action is likely to result in the mortality of one green sea turtle; however, as explained above, the loss of these individuals over this time period is not expected to affect the persistence of green sea turtles or the species trend. The action will not affect nesting habitat and will have only an extremely small effect on mortality. The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the action will not prevent the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur. This is the case because while the action may result in a small reduction in the number of greens and a small reduction in the amount of potential reproduction due to the loss of one individual, these effects will be undetectable over the long-term and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that green sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual green sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and has concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of one green sea turtle, is not likely to appreciably reduce the survival and recovery of this species.

10.3 Leatherback sea turtles

As noted in sections above, the physical disturbance of sediments and entrainment of associated benthic resources could reduce the availability of sea turtle prey in the affected areas, but these reductions will be localized and temporary, and foraging turtles are not likely to be limited by the reductions and any effects will be insignificant. Also, as explained above, no leatherback sea turtles are likely to be entrained in any dredge operating during any of the projects considered here and this species is not likely to be involved in any collision with a project vessel. As all effects to leatherback sea turtles from the proposed project are likely to be insignificant or discountable, this action is not likely to adversely affect this species.

10.4 Kemp's ridley sea turtles

In the "Effects of the Action" section above, we determined that Kemp's ridleys could be entrained in a hopper dredge working in Sandbridge Shoals between April and November. Based on a calculated entrainment rate of sea turtles for projects using hopper dredges in the action area, we estimate that 1 sea turtle is likely to be entrained for every 300,000 cy of material removed with a hopper dredge. Also, based on the ratio of loggerhead and Kemp's ridleys entrained in other hopper dredge operations in the action area, we estimate that no more than 8% of the sea turtles entrained during project operations were likely to be Kemp's ridleys with the remainder loggerheads and greens. As such, the proposed action is likely to result in the entrainment and mortality of no more than 1 Kemp's ridleys. If a cutterhead dredge is used, we do not anticipate any entrainment; we also do not anticipate any entrainment if dredging is completed December – March.

Kemp's Ridley sea turtles are listed as a single species classified as "endangered" under the ESA. Kemp's ridleys occur in the Atlantic Ocean and Gulf of Mexico. The only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; USFWS and NMFS 1992; NMFS and USFWS 2007c).

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with the other sea turtle species discussed above, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles. In addition, the estimates do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females, and the age structure of the Kemp's ridley population, nest counts cannot be used to estimate the total population size (Meylan 1982; Ross 1996; Zurita *et al.* 2003; Hawkes *et al.* 2005; letter to J. Lecky, NMFS Office of Protected Resources, from N. Thompson, NMFS Northeast Fisheries Science Center, December 4, 2007). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (USFWS and NMFS 1992; TEWG 2000). From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3% per year (TEWG 2000). Current estimates suggest an adult female population of 7,000-8,000 Kemp's ridleys (NMFS and USFWS 2007c).

The most recent review of the Kemp's ridleys suggests that this species is in the early stages of recovery (NMFS and USFWS 2007b). Nest count data indicate increased nesting and increased numbers of nesting females in the population. NMFS also takes into account a number of recent conservation actions including the protection of females, nests, and hatchlings on nesting beaches since the 1960s and the enhancement of survival in marine habitats through the implementation of TEDs in the early 1990s and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico in general (NMFS and USFWS 2007b). We expect this increasing trend to continue over the time period considered in this Opinion.

The mortality of 1 Kemp's ridley represents a very small percentage of the Kemp's ridleys worldwide. Even taking into account just nesting females, the death of 1 Kemp's ridley represents less than 0.014% of the population. While the death of 1 Kemp's ridley will reduce the number of Kemp's ridleys compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species or its stable to increasing trend as this loss represents a very small percentage of the population. Reproductive potential of Kemp's ridleys is not expected to be affected in any other way other than through a reduction in numbers of individuals. A reduction in the number of Kemp's ridleys would have the effect of reducing the amount of potential reproduction as any dead Kemp's ridleys would have no potential for future reproduction. In 2006, the most recent year for which data is available, there were an estimated 7-8,000 nesting females. While the species is thought to be female biased, there are likely to be several thousand adult males as well. Given the number of nesting adults, it is unlikely that the loss of 1 Kemp's ridley would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable to increasing trend of this species. Additionally, the proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because the action will not impede Kemp's ridleys from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the proposed action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

The loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species. This is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of Kemp's ridleys because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of Kemp's ridleys is likely to be increasing and, at worst, is stable.

Based on the information provided above, the death of 1 Kemp's ridley will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect Kemp's ridleys in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent Kemp's ridleys from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is increasing; (2) the death of 1 Kemp's ridleys represents an extremely small percentage of the species as a whole; (3) the death of 1 Kemp's ridleys will not change the status or trends of the species as a whole; (4) the loss of these Kemp's ridleys is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of this Kemp's ridleys is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of Kemp's ridleys in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of Kemp's ridleys to shelter and only an insignificant effect on individual foraging Kemp's ridleys.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that green sea turtles will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that Kemp's ridleys can rebuild to a point where listing is no longer appropriate. In 2011, NMFS and the USFWS issued a recovery plan for Kemp's ridleys (NMFS and USFWS 2011). The plan includes a list of criteria necessary for recovery. These include:

1. An increase in the population size, specifically in relation to nesting females[12];
2. An increase in the recruitment of hatchlings[13];
3. An increase in the number of nests at the nesting beaches;
4. Preservation and maintenance of nesting beaches (i.e. Rancho Nuevo, Tepehuajes, and Playa Dos); and,
5. Maintenance of sufficient foraging, migratory, and inter-nesting habitat.

Kemp's ridleys have an increasing trend; as explained above, the loss of one Kemp's ridley during the proposed action will not affect the population trend. The number of Kemp's ridleys likely to die as a result of the proposed action is an extremely small percentage of the species. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed action will not affect the likelihood that criteria one, two or three will be achieved or the timeline on which they will be achieved. The action area

[12] A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos) is attained in order for downlisting to occur; an average of 40,000 nesting females per season over a 6-year period by 2024 for delisting to occur.

[13] Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos).

does not include nesting beaches; therefore, the proposed action will have no effect on the likelihood that recovery criteria four will be met. All effects to habitat will be insignificant and discountable; therefore, the proposed action will have no effect on the likelihood that criteria five will be met.

The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the action will not prevent the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur. This is the case because while the action may result in a small reduction in the number of Kemp's ridleys and a small reduction in the amount of potential reproduction due to the loss of one individual, these effects will be undetectable over the long-term and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual Kemp's ridley sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and has concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of one Kemp's ridley sea turtle, is not likely to appreciably reduce the survival and recovery of this species.

10.5 Northwest Atlantic DPS of Loggerhead sea turtles

In the "Effects of the Action" section above, we determined that loggerheads could be entrained in a hopper dredge operating in any of the channels or borrow areas considered in this consultation. Based on a calculated entrainment rate of sea turtles for projects using hopper dredges in the action area, we estimate that 1 sea turtle is likely to be entrained for every 300,000 cy of material removed with a hopper dredge. Also, based on the ratio of loggerhead and Kemp's ridleys entrained in other hopper dredge operations in the action area, we estimate that 90% of the sea turtles entrained during project operations were likely to be loggerheads. Based on this, we determined that up to six loggerheads could be entrained as a result of the proposed action. We determined that all other effects of the action on this species will be insignificant and discountable. No entrainment of loggerheads is anticipated if a cutterhead dredge is used or if all hopper dredging occurs between December and March. This number also assumes that all dredging occurs in the April – November time period when sea turtles are present in the action area; this number will be less if any dredging occurs outside of this time period. All other effects to loggerheads, including effects to habitat and prey due to dredging and dredge disposal, will be insignificant and discountable.

The Northwest Atlantic DPS of loggerhead sea turtles is listed as "threatened" under the ESA. It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS and USFWS 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in the Status of the Species, Environmental Baseline and Cumulative Effects sections above, loggerhead sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration, dredging, power plant intakes and other factors that result in mortality of individuals at all life stages. Negative impacts causing death of various age classes occur both on land and in the water. Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, many remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but whose success cannot be quantified.

The SEFSC (2009) estimated the number of adult females in the NWA DPS at 30,000, and if a 1:1 adult sex ratio is assumed, the result is 60,000 adults in this DPS. Based on the reviews of nesting data, as well as information on population abundance and trends, NMFS and USFWS determined in the September 2011 listing rule that the NWA DPS should be listed as threatened. They found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats. This stable trend is expected to continue over the time period considered in this Opinion.

As stated above, we expect the lethal entrainment of up to six loggerheads. The lethal removal of up to six loggerhead sea turtles from the action area over this time period would be expected to reduce the number of loggerhead sea turtles from the recovery unit of which they originated as compared to the number of loggerheads that would have been present in the absence of the proposed action (assuming all other variables remained the same). However, this does not necessarily mean that these recovery units will experience reductions in reproduction, numbers or distribution in response to these effects to the extent that survival and recovery would be appreciably reduced. The final revised recovery plan for loggerheads compiled the most recent information on mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (i.e., nesting groups). They are: (1) for the NRU, a mean of 5,215 loggerhead nests per year with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit.

It is likely that the loggerhead sea turtles in the action area originate from several of the recovery units. Limited information is available on the genetic makeup of sea turtles in the mid-Atlantic, where the majority of sea turtle interactions are expected to occur. Cohorts from each of the five western Atlantic subpopulations are expected to occur in the action area. Genetic analysis of samples collected from immature loggerhead sea turtles captured in pound nets in the Pamlico-Albemarle Estuarine Complex in North Carolina from September-December of 1995-1997 indicated that cohorts from all five western Atlantic subpopulations were present (Bass *et al.* 2004). In a separate study, genetic analysis of samples collected from loggerhead sea turtles from Massachusetts to Florida found that all five western Atlantic loggerhead subpopulations were represented (Bowen *et al.* 2004). Bass *et al.* (2004) found that 80 percent of the juveniles and sub-adults utilizing the foraging habitat originated from the south Florida nesting population, 12 percent from the northern subpopulation, 6 percent from the Yucatan subpopulation, and 2 percent from other rookeries. The previously defined loggerhead subpopulations do not share the exact delineations of the recovery units identified in the 2008 recovery plan. However, the PFRU encompasses both the south Florida and Florida panhandle subpopulations, the NRU is roughly equivalent to the northern nesting group, the Dry Tortugas subpopulation is equivalent to the DTRU, and the Yucatan subpopulation is included in the GCRU.

Based on the genetic analysis presented in Bass *et al.* (2004) and the small number of loggerheads from the DTRU or the NGMRU likely to occur in the action area it is extremely unlikely that the loggerheads likely to be killed during the deepening project will originate from either of these recovery units. The majority, at least 80% of the loggerheads killed, are likely to have originated from the PFRU, with the remainder from the NRU and GCRU. As such, of the 5 loggerheads likely to be killed, 3 are expected to be from the PFRU, with 1 from the NRU and 1 from the GCRU. Below, we consider the effects of these mortalities on these three recovery units and the species as a whole.

As noted above, the most recent population estimates indicate that there are approximately 15,735 females nesting annually in the PFRU and approximately 1,272 females nesting per year in the NRU. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit; however, the 2008 recovery plan indicates that the Yucatan nesting aggregation has at least 1,000 nesting females annually. As the numbers outlined here are only for nesting females, the total number of loggerhead sea turtles in each recovery unit is likely significantly higher.

The loss of 3 loggerheads represents an extremely small percentage of the number of sea turtles in the PFRU. Even if the total population was limited to 15,735 loggerheads, the loss of 3 individuals would represent approximately 0.02% of the population. Similarly, the loss of 1 loggerhead from the NRU represents an extremely small percentage of the recovery unit. Even if the total population was limited to 1,272 sea turtles, the loss of 1 individual would represent approximately 0.3% of the population. The loss of 1 loggerhead from the GCRU, which is expected to support at least 1,000 nesting females, represents less than 0.1% of the population. The loss of such a small percentage of the individuals from any of these recovery units represents an even smaller percentage of the species as a whole. Considering the extremely small percentage of the populations that will be killed, it is unlikely that these deaths will have a detectable effect on the numbers and population trends of loggerheads in these recovery units or the number of loggerheads in the population as a whole.

All of the loggerheads that are expected to be killed will be juveniles. Thus, any effects on reproduction are limited to the loss of these individuals on their year class and the loss of future reproductive potential. Given the number of nesting adults in each of these populations, it is unlikely that the expected loss of loggerheads would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable trend of this species. Additionally, the proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because the action will not impede loggerheads from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the deepening and maintenance, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of loggerheads because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of loggerheads is likely to be stable or increasing over the time period considered here.

Based on the information provided above, the death of up to six loggerheads will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect loggerheads in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent loggerheads from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is stabilizing; (2) the death of these loggerheads represents an extremely small percentage of the species as a whole; (3) the death of these loggerheads will not change the status or trends of the species as a whole; (4) the loss of these loggerheads is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of these loggerheads is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of loggerheads in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of loggerheads to shelter and only an insignificant effect on individual foraging loggerheads.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that green sea turtles will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the NWA DPS of loggerheads can rebuild to a point where listing is no longer appropriate. In 2008, NMFS and the USFWS issued a recovery plan for the Northwest Atlantic population of loggerheads (NMFS and USFWS 2008). The plan includes demographic recovery criteria as well as a list of tasks that must be accomplished. Demographic recovery criteria are included for each of the five recovery units. These criteria focus on sustained increases in the number of nests laid and the number of nesting females in each recovery unit, an increase in abundance on foraging grounds, and ensuring that trends in neritic strandings are not increasing at a rate greater than trends in in-water abundance. The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Loggerheads have an increasing trend; as explained above, the loss of six loggerheads as a result of the proposed action will not affect the population trend. The number of loggerheads likely to die as a result of the proposed action is an extremely small percentage of any recovery unit or the DPS as a whole. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed action will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; all effects to habitat will be insignificant and discountable; therefore, the proposed action will have no effect on the likelihood that habitat based recovery criteria will be achieved. The proposed action will also not affect the ability of any of the recovery tasks to be accomplished.

The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the action will not prevent the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur.

In summary, the effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the action will not prevent the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur. This is the case because while the action may result in a small reduction in the number of loggerheads and a small reduction in the amount of potential reproduction due to the loss of these individuals, these effects will be undetectable over the long-term and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that loggerhead sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual loggerhead sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of other threats, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of the NWA DPS of loggerhead sea turtles.

11.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under our jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is NMFS' biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon, Kemp's ridley or green sea turtles or the Northwest Atlantic DPS of loggerhead sea turtles and is not likely to adversely affect leatherback or hawksbill sea turtles, shortnose sturgeon or any species of listed whale. Because no critical habitat is designated in the action area, none will be affected by the proposed action.

12.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. "Fish and wildlife" is defined in the ESA "as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof." 16 U.S.C. 1532(8). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA Section 9 (51 FR 19936, June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person "to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA.]" 16 U.S.C. 1538(g). See also 16 U.S.C. 1532(13)(definition of "person"). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by USACE so that they become binding conditions for the exemption in section 7(o)(2) to apply. USACE has a continuing duty to regulate the activity covered by this Incidental Take Statement. If USACE (1) fails to assume and implement the terms and conditions or (2) fails to require any contractors to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added contracts or other documents as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, USACE must report the progress of the action and its impact on the species to us as specified in the Incidental Take Statement [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

12.1 Amount or Extent of Incidental Take

The proposed dredging to be carried out has the potential to result in the entrainment, and subsequent mortality, of sea turtles and Atlantic sturgeon. The amount of take is dependent on the dredge type used. If a cutterhead dredge is used, we do not anticipate any take of sea turtles and anticipate the lethal take of no more than 1 Atlantic sturgeon from either the NYB, GOM, SA, CA or CB DPS. If a hopper dredge is used we anticipate the lethal take of no more than 1 Atlantic sturgeon from either the NYB, GOM, SA, CA or CB DPS. If a hopper dredge is used between April 1 and November 30, we anticipate the lethal take of seven sea turtles. We expect that at least 90% of the sea turtles will be loggerheads, 8% will be Kemp's ridleys and 2% will be green. Therefore, we expect the entrainment of six loggerheads and one green or Kemp's ridley. The amount of anticipated take described here is exempted by this ITS.

When a hopper dredge is used, NMFS-approved endangered species observers are typically required on board the dredge to monitor for the entrainment of sea turtles and sturgeon. The endangered species observer program has been in place on hopper dredges since 1994 and is effective at monitoring take during hopper dredge operations. The use of observers relies on screening placed on the draghead being large enough to allow large sized pieces of biological material to pass through and be caught in cages that retain material that is then inspected by the observer. When UXO screening is in place on the draghead, the size of material that can pass through the dredge is significantly smaller, making detection by an observer extremely unlikely. As described in the Description of the Action, due to safety concerns, USACE is likely to require UXO screening for dredges working on Sandbridge Shoal. It is likely that only internal soft tissue (e.g., intestine) or small, fragmented, external parts (e.g., pieces of shell) of the crushed/impinged animal would be entrained. These parts are extremely unlikely to be detected by ESA observers, and if detected, are likely to be too small to be identifiable as a particular species (pers. comm. Chris Slay, Coast Wise Consulting, Inc.; Trish Bargo, East Coast Observers, Inc.; April 4, 2012).

Additionally, animals may impinge on the UXO screens. Animals impinged on the UXO screen may free or dislodge themselves from the screen once the suction of the dredge has been turned off. Animals that free themselves may suffer severe injuries that may result in death. As the entire interaction occurs underwater, it would not be observed by an on-board observer. As such, in these cases, we have determined that it is not reasonable and appropriate to require endangered species observers on the dredge. As there is no practical way for on board endangered species observers to monitor the impingement/entrainment of listed species during hopper dredging operations with UXO screening in place, we explored several alternatives, for monitoring the interactions as described below.

The USACE and NMFS considered the following alternatives to (1) monitor take of listed species during hopper dredge operations with UXO screening in place or (2) modify the activity to eliminate the potential for take, thereby eliminating the need to monitor take.

1. Install a camera near the draghead: A camera installed on a draghead would allow users at the surface to observe underwater interactions. However, there are technical challenges to using video, including visibility due to water clarity and available light, improper focus, inappropriate camera angle, and the range of the viewing field. The use of video would require additional resources, and it is unlikely that it would be effective for monitoring this

type of dredge work. For these dredges, turbidity levels (i.e., up to 450 mg/l) near the draghead while dredging operations are underway are too high to visually detect any animal impinged on or within the vicinity of the draghead. Therefore, this is not a reasonable and appropriate means to monitor take.

2. Use of sonar/fish finder: Sonar can be used to detect animals within the water and within the vicinity of the dredge. We concluded that sonar alone could not indicate the take of an individual animal or identify the species potentially being taken. As such, we concluded that the use of such devices would be inappropriate in monitoring for take.

3. Placement of observers on the shoreline: Observers placed on the shoreline may be able to detect stranded animals either in the water or on the shore. However, animals may not strand in the direct vicinity of the operation. Injured or deceased animal may not float to the surface immediately (i.e., it may take days for this to occur) or may drift far from the incident where injury occurred. Therefore, an injured or deceased stranded animal often cannot be definitively attributed to a specific action. As such, this is not a reasonable and appropriate means to monitor take.

4. Relocation trawling: While relocation could reduce the number of sea turtles and Atlantic sturgeon in the area being dredged and therefore minimize take, using relocation trawling would not serve to monitor the number of animals affected during dredging. Additionally, relocation trawling does not eliminiate the potential for take so we could not require relocation trawling and assume that no interactions with the dredge would occur. Therefore, while this is a good method to minimize hopper dredge takes as it is not a reasonable and appropriate means to monitor take.

5. Time of year restriction: If there was a time of year when no listed species were likely to occur in the action area, dredging could be scheduled to occur in that time of year. This would eliminate the potential for take and negate the need for monitoring. However, because Atlantic sturgeon occur in the action area year round and safety and navigational concerns require dredging year-round, this is not practicable.

6. Use of alternate dredge types: The use of a mechanical dredge would eliminate the potential for sea turtle takes and would greatly reduce the number of Atlantic sturgeon takes; similar benefits could be obtained by requiring the use of a cutterhead dredge. However, the USACE chooses the type of dredge based on practical and technological constraints, including water depth, oceanic conditions, vessel traffic and maneuverability, substrate type and distance to the disposal area. Therefore, while use of alternate dredge types may minimize take, it is not practicable to require that mechanical or cutterhead dredges be used in all instances.

Both agencies agreed that none of these methods would serve to eliminate the potential for take or were reasonable or appropriate for monitoring take. In situations where individual takes cannot be observed, a proxy must be considered. This proxy must be rationally connected to the taking and provide an obvious threshold of exempted take that, if exceeded, provides a basis for reinitiating consultation. As explained in section 7.0 of this Opinion, the estimated number of sea turtles and

Atlantic sturgeon to be adversely affected by this action is related to the volume of material removed via dredge. Therefore, the volume of material removed from the action area can serve as a proxy for monitoring actual take. As explained in the Effects of the Action, one sea turtle is entrained for every 300,000 cy of material dredged; one Atlantic sturgeon is entrained for every 2 mcy. This estimate provides a proxy for monitoring the amount of incidental take during hopper dredging at Sandbridge Shoal when UXO screening is in place and direct observations of impingements cannot occur. This will be used as the primary method of determining whether incidental take has occurred; that is, we will consider that one sea turtle (Kemp's ridley or loggerhead) has been taken for every 300,000 cubic yards material removed during hopper dredging operations. Similarly, we will consider that one subadult Atlantic sturgeon has been taken for every 2 million cubic yards of material removed during hopper dredging operations or cutterhead dredge operations. In addition, there is a possibility that a sea turtle or an Atlantic sturgeon may remain impinged on UXO screens after the suction has been turned off. These animals can be visually observed, via a lookout, when the draghead is lifted above the water. Animals documented by the lookout on the draghead will be considered a take and this monitoring will be considered as a part of the monitoring of the actual take level. Similarly, should we receive any reports of injured or killed sea turtles or sturgeon in the area (i.e., via the STSSN) and necropsy documents that interactions with the hopper dredge operating during this project was the cause of death, we will consider those animals to be taken by this action.

The USACE expects to remove a total of 2 mcy of material from Sandbridge Shoal, resulting in the entrainment of seven sea turtles and one Atlantic sturgeon. As soon as seven sea turtles are observed or believed to be taken (e.g., seven takes via proxy or one observed impinged and six via proxy, etc.), any additional take of a sea turtle will be considered to exceed the exempted level of take. We expect exceedance of the exempted level of take to be unlikely given the conservative assumptions made in calculating this estimate, particularly the assumption that all hopper dredging would occur between April and November when it is much more likely that some, if not all dredging will occur outside of this time of year. Similarly, as we expect the mortality of one Atlantic sturgeon over the course of the project, should one Atlantic sturgeon be observed or should the estimated amount of material to be removed be exceeded, we will consider take to have been exceeded. However, like sea turtles, we do not expect this to occur given the very conservative assumptions that were included in the calculation of this level of expected take. Lookouts will be present on the vessel and volumes of material removed will be continuously monitored during hopper dredge operations. Therefore, take levels can be detected and assessed early in the project and, if needed, consultation can be reinitiated.

If a cutterhead dredge is used without UXO screening, inspectors will visually inspect the area where sand is being placed; this is expected to detect any Atlantic sturgeon entrained in the cutterhead dredge.

12.2 Reasonable and prudent measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize and monitor impacts of incidental take resulting from the proposed action:

1. NMFS must be contacted prior to the commencement of dredging and again upon completion of the dredging activity.

2. If UXO screening is not used on the cutterhead dredge, an inspector, with sufficient training to identify sturgeon, must be present at the disposal site to conduct daily inspections for biological materials, including Atlantic sturgeon or sturgeon parts. The inspection schedule and procedures must be sufficient to ensure a high likelihood of documenting entrained sturgeon and must involve inspections of ponded areas and inspections at the area where water is discharged from the disposal site. This requirement applies regardless of time of year that dredging is occurring.

3. The USACE shall ensure that all hopper dredges are outfitted with state-of-the-art sea turtle deflectors on the draghead and operated in a manner that will reduce the risk of interactions with sea turtles.

4. For all hopper dredge operations where UXO screening is not in place, a NMFS-approved observer must be present on board the hopper dredge any time it is operating.

5. The USACE shall ensure that for all dredge operations where UXO screening is in place, a lookout/bridge watch, knowledgeable in listed species identification, will be present on board the hopper dredge at all times to inspect the draghead each time it is removed from the water.

6. For all hopper or cutterhead dredge operations where UXO screening is in place, USACE shall provide monthly reports to NMFS regarding the status of dredging and interactions or observations of listed species.

7. The USACE shall ensure that dredges are equipped and operated in a manner that provides endangered/threatened species observers with a reasonable opportunity for detecting interactions with listed species and that provides for handling, collection, and resuscitation of turtles injured during project activity. Full cooperation with the endangered/threatened species observer program is essential for compliance with the ITS.

8. The USACE shall ensure that all measures are taken to protect any turtles or sturgeon that survive entrainment in a hopper dredge.

9. All Atlantic sturgeon captured must have a fin clip taken for genetic analysis. This sample must be transferred to NMFS.

10. Any dead sturgeon must be transferred to NMFS or an appropriately permitted research facility NMFS will identify so that a necropsy can be undertaken to attempt to determine the cause of death. Sturgeon should be held in cold storage.

11. Any dead sea turtles must be held until proper disposal procedures can be discussed with NMFS. Turtles should be held in cold storage.

12. All sturgeon and turtle captures, injuries or mortalities associated with any dredging activity and any sturgeon and sea turtle sightings in the action area must be reported to NMFS within 24 hours.

12.3 Terms and conditions

In order to be exempt from prohibitions of section 9 of the ESA, the USACE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To implement RPM #1, the USACE must contact NMFS (Julie Crocker: by email (julie.crocker@noaa.gov) or phone (978) 282-8480 or (978)-281-9328)) within 3 days of the commencement of each dredging cycle and again within 3 days of the completion of dredging activity. This correspondence will serve both to alert NMFS of the commencement and cessation of dredging activities and to give NMFS an opportunity to provide USACE with any updated contact information or reporting forms.

2. To implement RPM #2, if UXO screening is not in place during cutterhead dredging, the USACE must require inspections at the disposal area at least four times a day in order to document any Atlantic sturgeon or their parts entrained in the dredge. The USACE must provide training in sturgeon identification to inspectors working at the dredge disposal site. Species identification must be verified by an expert.

3. To implement RPM #2, the USACE shall ensure that the disposal site is equipped and operated in a manner that provides the inspector with a reasonable opportunity for detecting interactions with listed species and that provides for handling and collection of listed species during project activity.

4. To implement RPM #3, hopper dredges must be equipped with the rigid deflector draghead as designed by the USACE Engineering Research and Development Center, formerly the Waterways Experimental Station (WES), or if that is unavailable, a rigid sea turtle deflector attached to the draghead. Deflectors must be checked and/or adjusted by a designated expert prior to a dredge operation to insure proper installment and operation during dredging. The deflector must be checked after every load throughout the dredge operation to ensure that proper installation is maintained. Since operator skill is important to the effectiveness of the WES-developed draghead, operators must be properly instructed in its use. Dredge inspectors must ensure that all measures to protect sea turtles are being followed during dredge operations.

5. To implement RPM #4, observer coverage on hopper dredges must be sufficient for 100% monitoring of hopper dredging operations. This monitoring coverage must involve the placement of a NMFS-approved observer on board the dredge for every day that dredging is occurring. The observer must work a shift schedule appropriate to allow for the observation of at least 50% of the dredge loads (e.g., 12 hours on, 12 hours off). The USACE must ensure that USACE dredge operators and/or any dredge contractor adhere to the attached "Monitoring Specifications for Hopper Dredges" with trained NMFS-approved observers, in accordance with the attached "Observer Protocol" and "Observer Criteria" (Appendix D). No observers can be deployed to the dredge site until USACE has written confirmation from NMFS that they have met the qualifications to be a "NMFS-approved observer" as outlined in Appendix D. If substitute observers are required during dredging operations, USACE

must ensure that NMFS approval is obtained before those observers are deployed on dredges.

6. To implement RPM #5, the lookout will inspect the draghead for impinged sea turtles or Atlantic sturgeon each time it is brought up from completing a dredge cycle. Should a sea turtle or Atlantic sturgeon be found impinged on the draghead, the incident should be recorded (Appendix H and/or G) and NMFS contacted.

7. To implement RPM #6, USACE will provide NMFS reports every 30 days, via email (Julie.Crocker@noaa.gov and incidental.take@noaa.gov) recording the days that dredging occurred, summaries of the bridge watch reports on draghead inspection, the volume of material removed during the previous 30 day period and any observations of listed species.

8. To implement RPM #7, the USACE shall require of the dredge operator that, when the observer is off watch, the cage shall not be opened unless it is clogged. The USACE shall also require that if it is necessary to clean the cage when the observer is off watch, any aquatic biological material is left in the cage for the observer to document and clear out when they return on duty. In addition, the observer shall be the only one allowed to clean off the overflow screen.

9. To implement RPM #7, if sea turtles are present during dredging or material transport, vessels transiting the area must post a bridge watch, avoid intentional approaches closer than 100 yards when in transit, and reduce speeds to below 4 knots if bridge watch identifies a listed species in the immediate vicinity of the dredge.

10. To implement RPM #7, the USACE must ensure that all contracted personnel involved in operating hopper dredges receive thorough training on measures of dredge operation that will minimize takes of sea turtles. Training shall include measures discussed in Appendix D.

11. To implement RPM #8, the procedures for handling live sea turtles must be followed in the unlikely event that a sea turtle survives entrainment in the dredge (Appendix E). Any live sturgeon must be photographed, weighed and measured if possible, and released immediately overboard while the dredge is not operating.

12. To implement RPM #9, the USACE must ensure that fin clips are taken (according to the procedure outlined in Appendix F) of any sturgeon captured during the project and that the fin clips are sent to NMFS for genetic analysis. Fin clips must be taken prior to preservation of other fish parts or whole bodies.

13. To implement RPM #10, in the event of any lethal takes of Atlantic sturgeon, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS. The form included as Appendix G (sturgeon salvage form) must be completed and submitted to NMFS.

14. To implement RPM #11, in the event of any lethal takes of sea turtles, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.

15. To implement RPM #10, if a decomposed turtle or turtle part is entrained during dredging operations, an incident report must be completed and the specimen must be photographed. Any turtle parts that are considered 'not fresh' (i.e., they were obviously dead prior to the dredge take and USACE anticipates that they will not be counted towards the ITS) must be frozen and transported to a nearby stranding or rehabilitation facility for review. USACE must ensure that the observer submits the incident report for the decomposed turtle part, as well as photographs, to NMFS within 24 hours of the take (see Appendix H) and request concurrence that this take should not be attributed to the Incidental Take Statement. NMFS shall have the final say in determining if the take should count towards the Incidental Take Statement.

16. To implement RPM #12, the USACE must contact NMFS within 24 hours of any interactions with sturgeon or sea turtles, including non-lethal and lethal takes. NMFS will provide updated contact information when alerted of the start of dredging activity. Until alerted otherwise, the USACE should provide reports by e-mail (julie.crocker@noaa.gov) or phone (978) 282-8480 or the Section 7 Coordinator by phone (978)281-9328 or fax 978-281-9394). Take information should also be reported by e-mail to: incidental.take@noaa.gov.

17. To implement RPM #12, the USACE must photograph and measure any sturgeon or sea turtles observed during project operations (including whole sturgeon or sea turtles or body parts observed at the disposal location or on board the dredge, hopper or scow) and the corresponding form (Appendix H) must be completed and submitted to NMFS **within 24 hours** by fax (978-281-9394) or e-mail (incidental.take@noaa.gov).

18. To implement RPM #12, the USACE must submit a final report summarizing the results of dredging and any takes of listed species to NMFS within 30 working days of the completion of each dredging contract (by mail to the attention of the Section 7 Coordinator, NMFS Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930).

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will keep us informed of when and where dredging and blasting activities are taking place and will require USACE to report any take in a reasonable amount of time, as well as implement measures to monitor for entrainment during dredging. USACE has reviewed the RPMs and Terms and Conditions outlined above and has agreed to implement all of these measures as described herein and in the referenced Appendices. The discussion below explains why each of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the action as proposed by the USACE.

RPM #1 and its implementing Terms and Conditions are necessary and appropriate because they will serve to ensure that we are aware of the dates and locations of all dredging activities. This will allow us to monitor the duration and seasonality of dredging activities as well as give us an opportunity to provide USACE with any updated contact information for NMFS staff. This is only a minor change because it is not expected to result in any delay to the project and will merely involve an occasional telephone call or e-mail between USACE and NMFS staff.

Several of the RPMs (#2,4 and 5 as well as the implementing Term and Conditions are necessary and appropriate because they require that USACE have sufficient observer coverage to ensure the detection of any interactions with listed species. This is necessary for the monitoring of the level of take associated with the proposed action. The inclusion of these RPMs and Terms and Conditions is only a minor change as the ACOE included some level of observer coverage in the original project description will represent only a small increase in the cost of the project and will not result in any delays. These also represent only a minor change as in many instances they serve to clarify the duties of the inspectors or observers.

RPM #3 and its implementing Term and Condition, is necessary and appropriate as the use of draghead deflectors is accepted standard practice for hopper dredges operating in places and at times of year when sea turtles are known to be present and has been documented to reduce the risk of entrainment for sea turtles, thereby minimizing the potential for take of these species. This represents only a minor change as all of the hopper dredges likely to be used for this project, already have draghead deflectors, dredge operators are already familiar with their use, and the use will not affect the efficiency of the dredging operation. Additionally, dredging in the action area is typically conducted with draghead deflectors in place.

RPM #6 and #9-12 and the implementing Terms and Conditions are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. Theses RPMs and Terms and Conditions represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the dredging operations.

RPM #7 and its implementing Terms and Conditions are necessary and appropriate as they will require that dredge operators use best management practices, including slowing down to 4 knots should listed species be observed, that will minimize the likelihood of take. This represents only a minor change as following these procedures should not increase the cost of the dredging operation or result in any delays of reduction of efficiency of the dredging project.

RPM #8 and its implementing Terms and Conditions are necessary and appropriate to ensure that any sea turtles or sturgeon that survive entrainment in a dredge are given the maximum probability of remaining alive and not suffering additional injury or subsequent mortality through inappropriate handling. This represents only a minor change as following these procedures will not result in an increase in cost or any delays to the proposed project.

13.0 CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that all projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species." Conservation Recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. As such, NMFS recommends that the USACE consider the following Conservation Recommendations:

(1) To the extent practicable, the USACE should avoid dredging in the spring (March-May) and fall (September – November) when listed species are most likely to occur in the action area.

(2) The USACE should conduct studies in conjunction with cutterhead dredging where disposal occurs on the beach to assess the potential for improved screening to: (1) establish the type and size of biological material that may be entrained in the cutterhead dredge, and (2) verify that monitoring the disposal site without screening is providing an accurate assessment of entrained material.

(3) The USACE should support studies to determine the effectiveness of using a sea turtle deflector to minimize the potential entrainment of sturgeon during hopper dredging.

(4) The USACE should explore alternative means for monitoring for interactions with listed species when UXO screening is in place including exploring the potential for video or other electronic monitoring.

14.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, Section 7 consultation must be reinitiated immediately.

15.0 LITERATURE CITED

Allen PJ, Nicholl M, Cole S, Vlazny A, Cech JJ Jr. 2006. Growth of larval to juvenile green sturgeon in elevated temperature regimes. Trans Am Fish Soc 135:89–96

Anchor Environmental. 2003. Literature review of effects of resuspended sediments due to dredging. June. 140pp.

Andrews, H.V., and K. Shanker. 2002. A significant population of leatherback turtles in the Indian Ocean. Kachhapa 6:19.

Andrews, H.V., S. Krishnan, and P. Biswas. 2002. Leatherback nesting in the Andaman and Nicobar Islands. Kachhapa 6:15-18.

Antonelis, G.A., J.D. Baker, T.C. Johanos, R.C. Braun and A.L. Harting. 2006. Hawaiian monk seal (Monachus schauinslandi): status and conservation issues. Atoll Research Bulletin 543: 75-101

ASMFC (Atlantic States Marine Fisheries Commission). 2002. Amendment 4 to the Interstate Fishery Management Plan for weakfish. Fishery Management Report No. 39. Washington, D.C.: Atlantic States Marine Fisheries Commission.

ASMFC (Atlantic States Marine Fisheries Commission). 2009. Atlantic Sturgeon. In: Atlantic Coast Diadromous Fish Habitat: A review of utilization, threats, recommendations for conservation and research needs. Habitat Management Series No. 9. Pp. 195-253.

ASSRT (Atlantic Sturgeon Status Review Team). 2007. Status review of Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus). National Marine Fisheries Service. February 23, 2007. 188 pp.

Attrill, M.J., J. Wright, and M. Edwards. 2007. Climate-related increases in jellyfish frequency suggest a more gelatinous future for the North Sea. Limnology and Oceanography 52:480-485.

Avens, L., J.C. Taylor, L.R. Goshe, T.T. Jones, and M. Hastings. 2009. Use of skeletochronological analysis to estimate the age of leatherback sea turtles Dermochelys coriacea in the western North Atlantic. Endangered Species Research 8:165-177.

Ayers, M.A. et al. 1994. Sensitivity of Water Resources in the Delaware River Basin to Climate Variability and Change. USGS Water Supply Paper 2422. 21 pp.

Bain, M. B. 1997. Atlantic and shortnose sturgeons of the Hudson River: Common and Divergent Life History Attributes. Environmental Biology of Fishes 48: 347-358.

Bain, M., K. Arend, N. Haley, S. Hayes, J. Knight, S. Nack, D. Peterson, and M. Walsh. 1998a. Sturgeon of the Hudson River: Final Report on 1993-1996 Research. Prepared for The Hudson River Foundation by the Department of Natural Resources, Cornell University, Ithaca, New York.

Bain, M.B., N. Haley, D. Peterson, J. R. Waldman, and K. Arend. 2000. Harvest and habitats of Atlantic sturgeon Acipenser oxyrinchus Mitchill, 1815, in the Hudson River Estuary: Lessons for Sturgeon Conservation. Instituto Espanol de Oceanografia. Boletin 16: 43-53.

Bain, Mark B., N. Haley, D. L. Peterson, K. K Arend, K. E. Mills, P. J. Sulivan. 2007. Recovery of a US Endangered Fish. PLoS ONE 2(1): e168. doi:10.1371/journal.pone.0000168

Bain, Mark B., N. Haley, D. L. Peterson, K. K. Arend, K. E. Mills, P. J. Sullivan. 2000. Annual meeting of American fisheries Society. EPRI-AFS Symposium: Biology, Management and Protection of Sturgeon. St. Louis, MO. 23-24 August 2000.

Baker, J.D., C.L. Littnan, and D.W. Johnston. 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. Endangered Species Research 2:21-30.

Balazs, G.H. 1982. Growth rates of immature green turtles in the Hawaiian Archipelago, p. 117-125. In K.A. Bjorndal (ed.), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, D.C.

Balazs, G.H. 1985. Impact of ocean debris on marine turtles: entanglement and ingestion. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-SWFSC-54:387-429.

Baldwin, R., G.R. Hughes, and R.T. Prince. 2003. Loggerhead turtles in the Indian Ocean. Pages 218-232. In: A.B. Bolten and B.E. Witherington (eds.) Loggerhead Sea Turtles. Smithsonian Books, Washington, D.C. 319 pp.

Bartol, S.M., J.A. Musick, and M.L. Lenhardt. 1999. Auditory evoked potentials of the loggerhead sea turtle (Caretta caretta). Copeia, 3: 836-840.

Bass, A.L., S.P. Epperly, and J. Braun-McNeill. 2004. Multi-year analysis of stock composition of a loggerhead turtle (Caretta caretta) foraging habitat using maximum likelihood and Bayesian methods. Conservation Genetics 5:783-796.

Bath, D.W., J.M. O'Conner, J.B. Albert and L.G. Arvidson. 1981. Development and identification of larval Atlantic sturgeon (Acipenser oxyrinchus) and shortnose sturgeon (A. brevirostrum) from the Hudson River estuary, New York. Copeia 1981:711-717.

Beamesderfer, Raymond C.P. and Ruth A. Farr. 1997. Alternatives for the protection and restoration of sturgeons and their habitat. Environmental Biology of Fishes 48: 407-417.

Belanger, S.E., J.L. Farris, D.S. Cherry, and J. Cairns, Jr. 1985. Sediment preference of the freshwater Asiatic clam, Corbicula fluminea. The Nautilus 99(2-3):66-73.

Berlin, W.H., R.J. Hesselberg, and M.J. Mac. 1981. Chlorinated hydrocarbons as a factor in the reproduction and survival of lake trout (Salvelinus namaycush) in Lake Michigan. Technical Paper 105 of the U.S. Fish and Wildlife Service, 42 pages.

Bigelow, H.B. and W.C. Schroeder. 1953. Sea Sturgeon. In: Fishes of the Gulf of Maine. Fishery Bulletin 74. Fishery Bulletin of the Fish and Wildlife Service, vol. 53.

Bilkovic, D.M, Angstadt, K. and D. Stanhope. 2009. Atlantic Sturgeon Spawning Habitat on the James River, Virginia: Final Report to NOAA/NMFS Chesapeake Bay Office. Virginia Institute of Marine Science, Gloucester Point, Virginia.

Birstein, V.J., Bemis, W.E. and J.R. Waldman. 1997. The threatened status of acipenseriform species: a summary. Environmental Biology of Fishes 48: 427-435.

Bjork, M., F. Short, E. McLeod, and S. Beers. 2008. Managing seagrasses for resilience to climate change. IUCN, Gland.

Bjorndal, K.A. 1997. Foraging ecology and nutrition of sea turtles. Pages 199-233 In: Lutz, P.L. and J.A. Musick, eds., The Biology of Sea Turtles. CRC Press, New York. 432 pp.

Blalock, H.N., and J.J. Herod. 1999. A comparative study of stream habitat and substrate utilized by Corbicula flumineain the New River, Florida. Florida Scientist 62:145-151.

Blumenthal, J.M., J.L. Solomon, C.D. Bell, T.J. Austin, G. Ebanks-Petrie, M.S. Coyne, A.C. Broderick, and B.J. Godley. 2006. Satellite tracking highlights the need for international cooperation in marine turtle management. Endangered Species Research 2:51-61.

Bolten, A.B. 2003. Variation in sea turtle life history patterns: neritic vs. oceanic developmental stages. Pages 243-257 in P.L. Lutz, J.A. Musick, and J. Wyneken, eds. The Biology of Sea Turtles, Vol. 2. Boca Raton, Florida: CRC Press.

Bolten, A.B., J.A. Wetherall, G.H. Balazs, and S.G. Pooley (compilers). 1996. Status of marine turtles in the Pacific Ocean relevant to incidental take in the Hawaii-based pelagic longline fishery. U.S. Dept. of Commerce, NOAA Technical Memorandum, NOAA-TM-NOAA Fisheries SWFSC-230.

Bolten, A.B., K.A. Bjorndal, H.R. Martins, T. Dellinger, M.J. Biscoito, S.E. Encalada, and B.W. Bowen. 1998. Transatlantic developmental migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis. Ecological Applications 8(1):1-7.

Boreman, J. 1997. Sensitivity of North American sturgeons and paddlefish to fishing mortality. Environmental Biology of Fishes 48: 399-405.

Borodin, N. 1925. Biological observations on the Atlantic sturgeon, Acipenser sturio.Transactions of the American Fisheries Society 55: 184-190.

Boulon, R., Jr. 2000. Trends in sea turtle strandings, U.S. Virgin Islands: 1982 to 1997. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-436:261-263.

Bowen, B.W. 2003. What is a loggerhead turtle? The genetic perspective. Pages 7-27 in A.B. Bolten and B.E. Witherington, (eds). Loggerhead Sea Turtles. Washington, D.C.: Smithsonian Press.

Bowen, B.W. , A. L. Bass, S. Chow, M. Bostrom, K. A.Bjorndal, A. B. Bolten, T. Okuyama, B. M. Bolker, S.Epperley, E. Lacasella, D. Shaver, M. Dodd, S. R. Hopkins-Murphy, J. A. Musick, M. Swingle, K. Rankin-Baransky, W. Teas, W. N. Witzell, and P. H. Dutton. 1992. Natal homing in juvenile loggerhead turtles (Caretta caretta). Molecular Ecology (2004) 13: 3797-3808.

Bowen, B.W., A.L. Bass, L. Soares, and R.J. Toonen. 2005. Conservation implications of complex population structure: lessons from the loggerhead turtle (Caretta caretta). Molecular Ecology 14:2389-2402.

Bowen, B.W., and S.A. Karl. 2007. Population genetics and phylogeography of sea turtles. Molecular Ecology 16:4886-4907.

Boysen, K. A. and Hoover, J. J. (2009), Swimming performance of juvenile white sturgeon (Acipenser transmontanus): training and the probability of entrainment due to dredging. Journal of Applied Ichthyology, 25: 54–59.

Braun, J., and S.P. Epperly. 1996. Aerial surveys for sea turtles in southern Georgia waters, June 1991. Gulf of Mexico Science 1996(1):39-44.

Braun-McNeill, J. , C.R. Sasso, S.P.Epperly, C. Rivero. 2008. Feasibility of using sea surface temperature imagery to mitigate cheloniid sea turtle–fishery interactions off the coast of northeastern USA. Endangered Species Research: Vol. 5: 257–266, 2008.

Braun-McNeill, J., and S.P. Epperly. 2004. Spatial and temporal distribution of sea turtles in the western North Atlantic and the U.S. Gulf of Mexico from Marine Recreational Fishery Statistics Survey (MRFSS). Marine Fisheries Review 64(4):50-56.

Brewer, K., M. Gallagher, P. Regos, P. Isert, and J. Hall. 1993. Kuvlum #1 Exploration Prospect: Site Specific Monitoring Program, Final Report. Prepared by Coastal Offshore Pacific Corporation, Walnut Creek, CA, for ARCO Alaska, Inc., Anchorage, AK. 80pp.

Brodeur, R.D., C.E. Mills, J.E. Overland, G.E. Walters, and J.D. Schumacher. 1999. Evidence for a substantial increase in gelatinous zooplankton in the Bering Sea, with possible links to climate change. Fisheries Oceanography 8(4):296-306.

Brown, J.J. and G.W. Murphy. 2010. Atlantic sturgeon vessel strike mortalities in the Delaware River. Fisheries 3 5(2):7 2-83.

Brundage, H. 1986. Radio tracking studies of shortnose sturgeon in the Delaware River for the Merrill Creek Reservoir Project, 1985 Progress Report. V.J. Schuler Associates, Inc.

Brundage, H.M. and J. C. O'Herron. 2009. Investigations of juvenile shortnose and Atlantic sturgeons in the lower tidal Delaware River. Bull. N.J. Acad. Sci. 54(2), pp1-8.Weber, RG. 2001. Preconstruction Horeshoe Crab Egg Density Monitoring and Habitat Availability at Kelly Island, Port Mahon and Broadkill Beach Study Areas, Delaware. Submitted to the USACE Philadelphia District. Available at: http://www.nap.usace.army.mil/cenap-pl/b10.pdf

Brundage, H.M. and R.E. Meadows. 1982. The Atlantic sturgeon in the Delaware River estuary.Fisheries Bulletin 80:337-343.

Brundage, H.M., III and R.E. Meadows. 1982a. Occurrence of the endangered shortnose sturgeon, Acipenser brevirostrum, in the Delaware River estuary. Estuaries 5:203-208.

Bryant, L.P. 2008. Governor's Commission on Climate Change. Final Report: A Climate Change Action Plan. Virginia Department of Environmental Quality.

Burlas, M., G. L Ray, & D. Clarke. 2001. The New York District's Biological Monitoring Program for the Atlantic Coast of New Jersey, Asbury Park to Manasquan Section Beach Erosion

Control Project. Final Report. U.S. Army Engineer District, New York and U.S. Army Engineer Research and Development Center, Waterways Experiment Station.

Burton, W. 1993. Effects of bucket dredging on water quality in the Delaware River and the potential for effects on fisheries resources. Prepared by Versar, Inc. for the Delaware Basin Fish and Wildlife Management Cooperative, unpublished report. 30 pp.

Burton, W.H. 1994. Assessment of the Effects of Construction of a Natural Gas Pipeline on American Shad and Smallmouth Bass Juveniles in the Delaware River. Prepared by Versar, Inc.for Transcontinental Gas Pipe Line Corporation.

Bushnoe, T. M., Musick, J.A. and D.S. Ha. 2005. Essential spawning and nursery habitat of Atlantic sturgeon (*Acipenser oxyrinchus*) in Virginia. Provided by Jack Musick, Virginia Institute of Marine Science, Gloucester Point, Virginia.

Caillouet, C., C.T. Fontaine, S.A. Manzella-Tirpak, and T.D. Williams. 1995. Growth of head-started Kemp's ridley sea turtles (Lepidochelys kempi) following release. Chelonian Conservation and Biology. 1(3):231-234.

Cameron, P., J. Berg, V. Dethlefsen, and H. Von Westernhagen. 1992. Developmental defects in pelagic embryos of several flatfish species in the southern north-sea. Netherlands Journal of Sea Research 29: 239-256.

Cameron, S. 2012. "Assessing the Impacts of Channel Dredging on Atlantic Sturgeon Movement and Behavior". Presented to the Virginia Atlantic Sturgeon Partnership Meeting. Charles City, Virginia. March 19, 2012.

Carlson, D.M., and K.W. Simpson. 1987. Gut contents of juvenile shortnose sturgeon in the upper Hudson estuary. Copeia 1987:796-802

Caron, F., D. Hatin, and R. Fortin. 2002. Biological characteristics of adult Atlantic sturgeon (Acipenser oxyrinchus) in the Saint Lawrence River estuary and the effectiveness of management rules. Journal of Applied Ichthyology 18: 580-585.

Carr, A.R. 1963. Pan specific reproductive convergence in Lepidochelys kempi. Ergebn. Biol. 26: 298-303.

Carreras, C., S. Pont, F. Maffucci, M. Pascual, A. Barceló, F. Bentivegna, L. Cardona, F. Alegre, M. SanFélix, G. Fernández, and A. Aguilar. 2006. Genetic structuring of immature loggerhead sea turtles (Caretta caretta) in the Mediterranean Sea reflects water circulation patterns. Marine Biology 149:1269-1279.

Casale, P., P. Nicolosi, D. Freggi, M. Turchetto, and R. Argano. 2003. Leatherback turtles (Dermochelys coriacea) in Italy and in the Mediterranean basin. Herpetological Journal 13: 135-139.

Castroviejo, J., J.B. Juste, J.P. Del Val, R. Castelo, and R. Gil. 1994. Diversity and status of sea turtle species in the Gulf of Guinea islands. Biodiversity and Conservation 3: 828-836.

Cetacean and Turtle Assessment Program (CeTAP). 1982. Final report of the cetacean and turtle assessment program, University of Rhode Island, to Bureau of Land Management, U.S. Department of the Interior. Ref. No. AA551-CT8-48. 568 pp.

Chan, E.H., and H.C. Liew. 1996. Decline of the leatherback population in Terengganu, Malaysia, 1956-1995. Chelonian Conservation and Biology 2(2): 192-203.

Chevalier, J., X. Desbois, and M. Girondot. 1999. The reason for the decline of leatherback turtles (Dermochelys coriacea) in French Guiana: a hypothesis p.79-88. In Miaud, C. and R. Guyétant (eds.), Current Studies in Herpetology, Proceedings of the ninth ordinary general meeting of the Societas Europea Herpetologica, 25-29 August 1998 Le Bourget du Lac, France.

Church, J., J.M. Gregory, P. Huybrechts, M. Kuhn, K. Lambeck, M.T. Nhuan, D. Qin, P.L. Woodworth. 2001. Changes in sea level. In: Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. Vander Linden, X. Dai, K. Maskell, C.A. Johnson CA (eds.) Climate change 2001: the scientific basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, p 639–694

Clarke, D. 2011. Sturgeon Protection. Presented to the Dredged Material Assessment and Management Seminar 24-26 May, 2011 Jacksonville, FL

Clarke, D. G., and Wilber, D. H. 2000. Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Clausner, J.; Jones, D., 2004: Prediction of flow fields near the intakes of hydraulic dredges. Web based tool. Dredging Operation and Environmental Research (DOER) Program. U.S. Army Engineer Research and Development Center, Vicksburg, MS. Available at: http://el.erdc.usace.army.mil/dots/doer/flowfields/dtb350.html

Cliffton, K., D.O. Cornejo, and R.S. Felger. 1982. Sea turtles of the Pacific coast of Mexico. Pages 199-209 in K.A. Bjorndal, ed. Biology and Conservation of Sea Turtles. Washington, D.C.: Smithsonian Institution Press.

Colligan, M., Collins, M., Hecht, A., Hendrix, M., Kahnle, A., Laney, W., St. Pierre, R., Santos, R., and Squiers, T. 1998. Status Review of Atlantic sturgeon *(Acipenser oxyrinchus oxyrinchus).* U.S. Department of the Interior and U.S. Department of Commerce.

Collins, M. R., and T. I. J. Smith. 1997. Distribution of shortnose and Atlantic sturgeons in South Carolina. North American Journal of Fisheries Management 17: 995-1000.

Collins, M. R., S. G. Rogers, and T. I. J. Smith. 1996. Bycatch of sturgeons along the Southern Atlantic Coast of the USA. North American Journal of Fisheries Management 16: 24-29.

Collins, M.R., T.I.J. Smith, W.C. Post, and O. Pashuk. 2000. Habitat Utilization and Biological Characteristics of Adult Atlantic Sturgeon in Two South Carolina Rivers. Transactions of the American Fisheries Society 129: 982–988.

Conant, T.A., P.H. Dutton, T. Eguchi, S.P. Epperly, C.C. Fahy, M.H. Godfrey, S.L. MacPherson, E.E. Possardt, B.A. Schroeder, J.A. Seminoff, M.L. Snover, C.M. Upite, and B.E. Witherington. 2009. Loggerhead sea turtle (Caretta caretta) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service, August 2009. 222 pp.

Coutant, C.C., 1987. Thermal preference: when does an asset become a liability? Environmental Biology of Fishes 18:161-172.

Coyne, M. and A.M. Landry, Jr. 2007. Population sex ratios and its impact on population models. In: Plotkin, P.T. (editor). Biology and Conservation of Ridley Sea Turtles. Johns Hopkins University Press, Baltimore, Maryland. p. 191-211.

Coyne, M.S. 2000. Population Sex Ratio of the Kemp's Ridley Sea Turtle (Lepidochelys kempii): Problems in Population Modeling. PhD Thesis, Texas A&M University. 136pp.

Crance, J. H. 1987. Habitat suitability index curves for anadromous fishes. In: Common Strategies of Anadromous and Catadromous Fishes, M. J. Dadswell (ed.). Bethesda, Maryland, American Fisheries Society. Symposium 1: 554.

Dadswell, M. 2006. A review of the status of Atlantic sturgeon in Canada, with comparisons to populations in the United States and Europe. Fisheries 31: 218-229.

Damon-Randall, K. et al. 2010. Atlantic sturgeon research techniques. NOAA Technical Memorandum NMFS-NE-215. Available at: http://www.nero.noaa.gov/prot_res/atlsturgeon/tm215.pdf

Damon-Randall, K., M. Colligan, and J. Crocker. 2012. Composition of Atlantic Sturgeon in Rivers, Estuaries, and in Marine Waters. National Marine Fisheries Service, NERO, Unpublished Report. 32 pages.

Daniels, R.C., T.W. White, and K.K. Chapman. 1993. Sea-level rise: destruction of threatened and endangered species habitat in South Carolina. Environmental Management 17(3):373-385.

Davenport, J. 1997. Temperature and the life-history strategies of sea turtles. Journal of Thermal Biology 22(6):479-488.

Davenport, J., and G.H. Balazs. 1991. 'Fiery bodies' – Are pyrosomas an important component of the diet of leatherback turtles? British Herpetological Society Bulletin 37: 33-38.

Dees, L. T. 1961. Sturgeons. United States Department of the Interior Fish and Wildlife Service, Bureau of Commercial Fisheries, Washington, D.C.

DFO (Fisheries and Oceans Canada). 2011. Atlantic sturgeon and shortnose sturgeon. Fisheries and Oceans Canada, Maritimes Region. Summary Report. U.S. Sturgeon Workshop, Alexandria, VA, 8-10 February, 2011. 11pp.

Diaz, R.J. 1994. Response of tidal freshwater macrobenthos to sediment disturbance. Hydrobiologia 278: 201-212.

Dodd, C.K. 1988. Synopsis of the biological data on the loggerhead sea turtle Caretta caretta (Linnaeus 1758). U.S. Fish and Wildlife Service Biological Report 88(14):1-110.

Dodd, M. 2003. Northern Recovery Unit - Nesting Female Abundance and Population Trends. Presentation to the Atlantic Loggerhead Sea Turtle Recovery Team, April 2003.

Doughty, R.W. 1984. Sea turtles in Texas: A forgotten commerce. Southwestern Historical Quarterly. pp. 43-70.

Dovel, W. L. and T. J. Berggren. 1983. Atlantic sturgeon of the Hudson River Estuary, New York. New York Fish and Game Journal 30: 140-172.

Dovel, W.J. 1978. The Biology and management of shortnose and Atlantic sturgeons of the Hudson River. Performance report for the period April 1, to September 30, 1978. Submitted to N.Y. State Department of Environmental Conservation.

Dovel, W.J. 1979. Biology and management of shortnose and Atlantic sturgeon of the Hudson River. New York State Department of Environmental Conservation, AFS9-R, Albany.

Duarte, C.M. 2002. The future of seagrass meadows. Environmental Conservation 29:192-206.

Dunton, K.J., A. Jordaan, K.A. McKown, D.O. Conover, and M.J. Frisk. 2010. Abundance and distribution of Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) within the Northwest Atlantic Ocean, determined from five fishery-independent surveys. Fishery Bulletin 108:450-465.

Durbin, E, G. Teegarden, R. Campbell, A. Cembella, M.F. Baumgartner, B.R. Mate. 2002. North Atlantic right whales, Eubalaena glacialis, exposed to Paralytic Shellfish Poisoning (PSP) toxins via a zooplankton vector, Calanus finmarchicus. Harmful Algae 1: 243-251.

Dutton, P.H., B.W. Bowen, D.W. Owens, A. Barragan, and S.K. Davis. 1999. Global phylogeography of the leatherback turtle (Dermochelys coriacea). Journal of Zoology 248: 397-409.

Dutton, P.H., C. Hitipeuw, M. Zein, S.R. Benson, G. Petro, J. Pita, V. Rei, L. Ambio, and J. Bakarbessy. 2007. Status and genetic structure of nesting populations of leatherback turtles (Dermochelys coriacea) in the Western Pacific. Chelonian Conservation and Biology 6(1):47-53.

Dwyer, F. James, Douglas K. Hardesty, Christopher G. Ingersoll, James L. Kunz, and David W. Whites. 2000. Assessing contaminant sensitivity of American shad, Atlantic sturgeon, and shortnose sturgeon. Final Report. U.S. Geological Survey. Columbia Environmental Research Center, 4200 New Have Road, Columbia, Missouri.

Dwyer, K.L., C.E. Ryder, and R. Prescott. 2002. Anthropogenic mortality of leatherback sea turtles in Massachusetts waters. Poster presentation for the 2002 Northeast Stranding Network Symposium.

Eckert, S.A. 1999. Global distribution of juvenile leatherback turtles. Hubbs Sea World Research Institute Technical Report 99-294.

Eckert, S.A. and J. Lien. 1999. Recommendations for eliminating incidental capture and mortality of leatherback sea turtles, Dermochelys coriacea, by commercial fisheries in Trinidad and Tobago. A report to the Wider Caribbean Sea Turtle Conservation Network (WIDECAST). Hubbs-Sea World Research Institute Technical Report No. 2000-310, 7 pp.

Eckert, S.A., D. Bagley, S. Kubis, L. Ehrhart, C. Johnson, K. Stewart, and D. DeFreese. 2006. Internesting and postnesting movements of foraging habitats of leatherback sea turtles (Dermochelys coriacea) nesting in Florida. Chel. Cons. Biol. 5(2): 239-248.

Ehrhart, L.M., D.A. Bagley, and W.E. Redfoot. 2003. Loggerhead turtles in the Atlantic Ocean: geographic distribution, abundance, and population status. Pages 157-174 in A.B. Bolten and B.E. Witherington, eds. Loggerhead Sea Turtles. Washington, D.C.: Smithsonian Institution Press.

Ehrhart. L.M., W.E. Redfoot, and D.A. Bagley. 2007. Marine turtles of the central region of the Indian River Lagoon System, Florida. Florida Scientist 70(4): 415-434.

Encyclopedia Britannica. 2010. Neritic Zone. Accessed 12 January 2010. http://www.britannica.com/eb/article-9055318.

Environmental Protection Agency (EPA). 1986. Quality Criteria for Water. EPA 440/5-86-001.

Epperly, S., L. Avens, L. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton, and C. Yeung. 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries if southeast U.S. waters and the Gulf of Mexico. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-SEFSC-490, 88pp.

Epperly, S.P. 2003. Fisheries-related mortality and turtle excluder devices. In: P.L. Lutz, J.A.

Epperly, S.P. and J. Braun-McNeill. 2002. The use of AVHRR imagery and the management of sea turtle interactions in the Mid-Atlantic Bight. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. 8pp.

Epperly, S.P., and W.G. Teas. 2002. Turtle Excluder Devices - Are the escape openings large enough? Fishery Bulletin 100:466-474.

Epperly, S.P., J. Braun, A.J. Chester, F.A. Cross, J.V. Merriner and P.A. Tester. 1995b. Winter distribution of sea turtles in the vicinity of Cape Hatteras and their interactions with the summer flounder trawl fishery. Bull. of Marine Sci. 56(2): 547-568.

Epperly, S.P., J. Braun, and A. Veishlow. 1995c. Sea turtles in North Carolina waters. Conservation Biology 9(2):384-394.

Epperly, S.P., J. Braun, and A.J. Chester. 1995a. Aerial surveys for sea turtles in North Carolina inshore waters. Fishery Bulletin 93:254-261.

Epperly, S.P., J. Braun-McNeill, and P.M. Richards. 2007. Trends in catch rates of sea turtles in North Carolina, USA. Endangered Species Research 3: 283-293.

ERC (Environmental Research and Consulting, Inc.) 2012. Acoustic telemetry study of the movements of juvenile sturgeons in reach B of the Delaware River during dredging operations. Prepared for the US Army Corps of Engineers. 38 pp.

ERC, Inc. (Environmental Research and Consulting, Inc.). 2002. Contaminant analysis of tissues from two shortnose sturgeon (Acipenser brevirostrum) collected in the Delaware River. Prepared for National Marine Fisheries Service. 16 pp. + appendices.

ERC, Inc. (Environmental Research and Consulting, Inc.). 2007. Preliminary acoustic tracking study of juvenile shortnose sturgeon and Atlantic sturgeon in the Delaware River. May 2006 through March 2007. Prepared for NOAA Fisheries. 9 pp.

Erickson, D. L., A. Kahnle, M. J. Millard, E. A. Mora, M. Bryja, A. Higgs, J. Mohler, M. DuFour, G. Kenney, J. Sweka, and E. K. Pikitch. 2011. Use of pop-up satellite archival tags to identify oceanic-migratory patterns for adult Atlantic Sturgeon, Acipenser oxyrinchus oxyrinchus Mitchell, 1815. J. Appl. Ichthyol. 27: 356–365.

Ernst, C.H. and R.W. Barbour. 1972. Turtles of the United States. Univ. Press of Kentucky, Lexington. 347 pp.

Eyler, S., M. Mangold, and S. Minkkinen. 2004. Atlantic coast sturgeon tagging database. USFWS, Maryland Fishery Resources Office. Summary Report. 60 pp.

Eyler, Sheila M., Jorgen E. Skjeveland, Michael F. Mangold, and Stuart A. Welsh. 2000. Distribution of Sturgeons in Candidate Open Water Dredged Material Placement Sites in the Potomac River (1998-2000). U.S. Fish and Wildlife Service, Annapolis, MD. 26 pp.

Fernandes, S.J. 2008. Population demography, distribution, and movement patterns of Atlantic and shortnose sturgeons in the Penobscot River estuary, Maine. University of Maine. Masters thesis. 88 pp.

Ferreira, M.B., M. Garcia, and A. Al-Kiyumi. 2003. Human and natural threats to the green turtles, Chelonia mydas, at Ra's al Hadd turtle reserve, Arabian Sea, Sultanate of Oman. Page 142 in J.A. Seminoff, compiler. Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-503.

Finkbeiner, E.M., B.P. Wallace, J.E. Moore, R.L. Lewison, L.B. Crowder, and A.J. Read. 2011. Cumulative estimates of sea turtle bycatch and mortality in USA fisheries between 1990 and 2007. Biological Conservation 144(11): 2719-2727.

Fish, M.R., I.M. Cote, J.A. Gill, A.P. Jones, S. Renshoff, and A.R. Watkinson. 2005. Predicting the impact of sea-level rise on Caribbean sea turtle nesting habitat. Conservation Biology 19:482-491.

Flournoy, P.H., S.G. Rogers, and P.S. Crawford. 1992. Restoration of shortnose sturgeon in the Altamaha River, Georgia. Final Report to the U.S. Fish and Wildlife Service, Atlanta, Georgia.

Fox, D.A. and M.W. Breece. 2010. Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) in the New York Bight DPS: Identification of critical habitat and rates of interbasin exchange; Final Report Submitted to NOAA (Award NA08NMF4050611). 62 p.

FPL (Florida Power and Light Company) and Quantum Resources. 2005. Florida Power and Light Company, St. Lucie Plant Annual Environmental Operating Report, 2002. 57 pp.

Frazer, N.B., and L.M. Ehrhart. 1985. Preliminary growth models for green, Chelonia mydas, and loggerhead, Caretta caretta, turtles in the wild. Copeia 1985: 73-79.

Fritts, T.H. 1982. Plastic bags in the intestinal tracts of leatherback marine turtles. Herpetological Review 13(3): 72-73.2003. 9pp.

Gagosian, R.B. 2003. Abrupt climate change: should we be worried? Prepared for a panel on abrupt climate change at the World Economic Forum, Davos, Switzerland, January 27,

Garner, J.A, and S.A. Garner. 2007. Tagging and nesting research of leatherback sea turtles (Dermochelys coriacea) on Sandy Point St. Croix, U.S. Virgin Islands. Annual Report to U.S. Fish and Wildlife Service. WIMARCS Publication.

Garrison, L.P., and L. Stokes. 2012. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2010. NOAA Technical Memorandum NMFS-SEFSC-624:1-53.

GCRP (U.S. Global Change Research Program). 2009. Global Climate Change Impacts in the United States.http://www.globalchange.gov/usimpacts

Geoghegan, P., M.T. Mattson and R.G Keppel. 1992. Distribution of shortnose sturgeon in the Hudson River, 1984-1988. IN Estuarine Research in the 1980s, C. Lavett Smith, Editor. Hudson River Environmental Society, Seventh symposium on Hudson River ecology. State University of New York Press, Albany NY, USA.

George, R.H. 1997. Health Problems and Diseases of Sea Turtles. Pages 363-386 in P.L. Lutz and J.A. Musick, eds. The Biology of Sea Turtles. Boca Raton, Florida: CRC Press.

Germano, J. D., and Cary, D. 2005. "Rates and effects of sedimentation in the context of dredging and dredged material placement," *DOER Technical Notes Collection* (ERDC TN-DOER-E19), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

GHD. 2005. Port of Hay Point Apron Areas and Departure Path Capital Dredging: Draft EIS. GHD Pty Ltd.

Giesy, J.P., J. Newsted, and D.L. Garling. 1986. Relationships between chlorinated hydrocarbon concentrations and rearing mortality of chinook salmon (Oncorhynchus tshawytscha) eggs from Lake Michigan. Journal of Great Lakes Research 12(1):82-98.

Gilbert, C.R. 1989. Atlantic and shortnose sturgeons. United States Department of Interior Biological Report 82, 28 pages.

Girondot, M. and J. Fretey. 1996. Leatherback turtles, Dermochelys coriacea, nesting in French Guiana 1978-1995. Chelonian Conserv Biol 2: 204–208.

Girondot, M., M.H. Godfrey, L. Ponge, and P. Rivalan. 2007. Modeling approaches to quantify leatherback nesting trends in French Guiana and Suriname. Chelonian Conservation and Biology 6(1): 37-46.

Glen, F. and N. Mrosovsky. 2004. Antigua revisited: the impact of climate change on sand and nest temperatures at a hawksbill turtle (Eretmochelys imbricata) nesting beach. Global Change Biology 10:2036-2045.

Glen, F., A.C. Broderick, B.J. Godley, and G.C. Hays. 2003. Incubation environment affects phenotype of naturally incubated green turtle hatchlings. Journal of the Marine Biological Association of the United Kingdom 83(5): 1183-1186.

GMFMC (Gulf of Mexico Fishery Management Council). 2007. Amendment 27 to the Reef Fish FMP and Amendment 14 to the Shrimp FMP to end overfishing and rebuild the red snapper stock. Tampa, Florida: Gulf of Mexico Fishery Management Council. 490 pp. with appendices.

Goff, G.P. and J.Lien. 1988. Atlantic leatherback turtle, Dermochelys coriacea, in cold water off Newfoundland and Labrador. Can. Field Nat. 102(1):1-5.

Goldenberg, S.B., C.W. Landsea, A.M. Mestas-Nunez, W.M. Gray. 2001. The recent increase in Atlantic hurricane activity: causes and implications. Science 293:474–479

Gottfried, P.K., and J.A. Osborne. 1982. Distribution, abundance and size of Corbicula manilensis (Philippi) in a spring-fed central Florida stream. Florida Scientist 45(3):178-188.

Graff, D. 1995. Nesting and hunting survey of the turtles of the island of São Tomé. Progress Report July 1995, ECOFAC Componente de São Tomé e Príncipe, 33 pp.

Greene CH, Pershing AJ, Cronin TM and Ceci N. 2008. Arctic climate change and its impacts on the ecology of the North Atlantic. Ecology 89:S24-S38.

Greene, K. 2002. Beach Nourishment: A Review of the Biological and Physical Impacts. Atlantic States Marine Fisheries Commission (ASMFC) Habitat Management Series #7. 179 pp.

Greene, R.J. Jr. 1987. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. Journal of Acoustical Society of America 82: 1315-1324.

Grunwald, C., J. Stabile, J.R. Waldman, R. Gross, and I. Wirgin. 2002. Population genetics of shortnose sturgeon (Acipenser brevirostrum) based on mitochondrial DNA control region sequences. Molecular Ecology 11: 000-000.

Guerra-Garcia, J.M. and J. C. Garcia-Gomez. 2006. Recolonization of defaunated sediments: Fine versus gross sand and dredging versus experimental trays. Estuarine Coastal and Shelf Science 68 (1-2): 328-342

Guilbard, F., J. Munro, P. Dumont, D. Hatin, and R. Fortin. 2007. Feeding ecology of Atlantic sturgeon and Lake sturgeon co-occurring in the St. Lawrence Estuarine Transition Zone. American Fisheries Society Symposium. 56: 85-104.

Haley, N. 1996. Juvenile sturgeon use in the Hudson River Estuary. Master's thesis. University of Massachusetts, Amhearst, MA, USA.

Hamann, M., C.J. Limpus, and M.A. Read. 2007. Chapter 15 Vulnerability of marine reptiles in the Great Barrier Reef to climate change. In: Johnson JE, Marshall PA (eds) Climate change and the Great Barrier Reef: a vulnerability assessment, Great Barrier Reef Marine Park Authority and Australia Greenhouse Office, Hobart, p 465–496.

Hansen, P.D. 1985. Chlorinated hydrocarbons and hatching success in Baltic herring spring spawners. Marine Environmental Research 15:59-76.

Hatase, H., M. Kinoshita, T. Bando, N. Kamezaki, K. Sato, Y. Matsuzawa, K. Goto, K . Omuta, Y. Nakashima, H. Takeshita, and W. Sakamoto. 2002. Population structure of loggerhead turtles, Caretta caretta, nesting in Japan: Bottlenecks on the Pacific population. Marine Biology 141:299-305.

Hatin, D., R. Fortin, and F. Caron. 2002. Movements and aggregation areas of adult Atlantic sturgeon (Acipenser oxyrinchus) in the St. Lawrence River estuary, Québec, Canada. Journal of Applied Ichthyology 18: 586-594.

Hatin, D., Lachance, S., D. Fournier. 2007*a*. Effect of Dredged Sediment Deposition on use by Atlantic Sturgeon and Lake Sturgeon at an Open-water Disposal Site in the St. Lawrence Estuarine Transition Zone. American Fisheries Society Symposium 56:235-255.

Hatin, D., J. Munro, F. Caron, and R. D. Simons. 2007. Movements, home range size, and habitat use and selection of early juvenile Atlantic sturgeon in the St. Lawrence estuarine transition zone. Pp. 129-155 in J. Munro, D. Hatin, J.E. Hightower, K. McKown, K.L. Sulak,A.W. Kahnle, and F. Caron (eds.) Anadromous sturgeon: habitat, threats, and management.Ammerican Fisheries Society Symposium 56, Bethesda, MD 215 pp.

Hawkes, L. A. Broderick, M. Godfrey and B. Godley. 2005. Status of nesting loggerhead turtles, Caretta caretta, at Bald Head Island (North Carolina, USA) after 24 years of intensive monitoring and conservation. Oryx. 39(1): 65-72.

Hawkes, L.A., A.C. Broderick, M.H. Godfrey, and B.J. Godley. 2007. Investigating the potential impacts of climate change on a marine turtle population. Global Change Biology 13: 1-10.

Hawkes, L.A., A.C. Broderick, M.H. Godfrey, and B.J. Godley. 2009. Climate change and marine turtles. Endangered Species Research 7:137-154.

Hawkes, L.A., A.C. Broderick, M.S. Coyne, M.H. Godfrey, L.-F. Lopez-Jurado, P. Lopez-Suarez, S.E. Merino, N. Varo-Cruz, and B.J. Godley. 2006. Phenotypically linked dichotomy in sea turtle foraging requires multiple conservation approaches. Current Biology 16: 990-995.

Hays, G.C., A.C. Broderick, F. Glen, B.J. Godley, J.D.R. Houghton, and J.D. Metcalfe. 2002. Water temperature and internesting intervals for loggerhead (Caretta caretta) and green (Chelonia mydas) sea turtles. Journal of Thermal Biology 27: 429-432.

Heppell, S.S., D.T. Crouse, L.B. Crowder, S.P. Epperly, W. Gabriel, T. Henwood, R. Marquez, and N.B. Thompson. 2005. A population model to estimate recovery time, population size, and management impacts on Kemp's ridley sea turtles. Chelonian Conservation and Biology 4(4):767-773.

Hildebrand, H. 1982. A historical review of the status of sea turtle populations in the western Gulf of Mexico, P. 447-453. In K.A. Bjorndal (ed.), Biology and conservation of sea turtles. Smithsonian Institution Press, Washington, D.C.

Hilterman, M.L. and E. Goverse. 2004. Annual report of the 2003 leatherback turtle research and monitoring project in Suriname. World Wildlife Fund - Guianas Forests and Environmental Conservation Project (WWF-GFECP) Technical Report of the Netherlands Committee for IUCN (NC-IUCN), Amsterdam, the Netherlands, 21p.

Hirth, H.F. 1971. Synopsis of biological data on the green sea turtle, Chelonia mydas. FAO Fisheries Synopsis No. 85: 1-77.

Hirth, H.F. 1997. Synopsis of the biological data of the green turtle, Chelonia mydas (Linnaeus 1758). USFWS Biological Report 97(1): 1-120.

Holland, B.F., Jr. and G.F. Yelverton. 1973. Distribution and biological studies of anadromous fishes offshore North Carolina. North Carolina Department of Natural and Economic Resources, Division of Commercial and Sports Fisheries, Morehead City. Special Scientific Report 24:1-132.

Hoover, J.J., Boysen, K.A., Beard, J.A., and H. Smith. 2011. Assessing the risk of entrainment by cutterhead dredges to juvenile lake sturgeon (*Acipenser fulvescens*) and juvenile pallid sturgeon (*Scaphirhynchus albus*). Journal of Applied Ichthyology 27:369-375.

Hoover, J.J., Killgore, K.J., Clarke, D.G., Smith, H., Turnage, A., and Beard, J. 2005. Paddlefish and sturgeon entrainment by dredges: Swimming performance as an indicator of risk. DOER Technical Notes Collection (ERDC-TN-DOER-E22), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Hulin, V., and J.M. Guillon. 2007. Female philopatry in a heterogenous environment: ordinary conditions leading to extraordinary ESS sex ratios. BMC Evolutionary Biology 7:13

Hulme, P.E. 2005. Adapting to climate change: is there scope for ecological management in the face of global threat? Journal of Applied Ecology 43: 617-627.IPCC (Intergovernmental Panel on Climate Change) 2007. Fourth Assessment Report. Valencia, Spain.

Innis, C., C. Merigo, K. Dodge, M. Tlusty, M. Dodge, B. Sharp, A. Myers, A. McIntosh, D. Wunn, C. Perkins, T.H. Herdt, T. Norton, and M. Lutcavage. 2010. Health Evaluation of Leatherback Turtles (Dermochelys coriacea) in the Northwestern Atlantic During Direct Capture and Fisheries Gear Disentanglement. Chelonian Conservation and Biology, 9(2):205-222.

Intergovernmental Panel on Climate Change (IPCC). 2007a. Climate Change 2007 – Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC. IPCC, Geneva.

Intergovernmental Panel on Climate Change (IPCC). 2007b. Climate Change 2007 - The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC. IPCC, Geneva.

Intergovernmental Panel on Climate Change. 2007. Summary for Policymakers. In Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (editors). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom, and New York, New York, USA.

James, M.C., C.A. Ottensmeyer, and R.A. Myers. 2005b. Identification of high-use habitat and threats to leatherback sea turtles in northern waters: new directions for conservation. Ecol. Lett. 8: 195-201.

James, M.C., R.A. Myers, and C.A. Ottenmeyer. 2005a. Behaviour of leatherback sea turtles, Dermochelys coriacea, during the migratory cycle. Proc. R. Soc. B, 272: 1547-1555.

Jenkins, W.E., T.I.J. Smith, L.D. Heyward, and D.M. Knott. 1993. Tolerance of shortnose sturgeon, Acipenser brevirostrum, juveniles to different salinity and dissolved oxygen concentrations. Proceedings of the Southeast Association of Fish and Wildlife Agencies, Atlanta, Georgia.

Johnson, and P.J. Eliazar (Compilers) Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351, 323 pp.

Johnson, J. H., D. S. Dropkin, B. E. Warkentine, J. W. Rachlin, and W. D. Andrews. 1997. Food habits of Atlantic sturgeon off the central New Jersey coast. Transactions of the American Fisheries Society 126: 166-170.

Johnson, M. P. & P.L. Tyack. 2003. A digital acoustic recording tag for measuring the response of wild marine mammals to sound. IEEE J. Oceanic Engng 28: 3–12.

Johnston Jr., S.A. 1981. Estuarine Dredge and Fill Activities: A Review of Impacts. Environmental Management 5(5): 427-440.

Jones A.R., W. Gladstone, N.J. Hacking. 2007. Australian sandy beach ecosystems and climate change: ecology and management. Aust Zool 34:190–202

Kahnle, A.W., K.A. Hattala, K.A. McKown. 2007. Status of Atlantic sturgeon of the Hudson River Estuary, New York, USA. American Fisheries Society Symposium. 56:347-363.

Kasparek, M., B.J. Godley, and A.C. Broderick. 2001. Nesting of the green turtle, Chelonia mydas, in the Mediterranean: a review of status and conservation needs. Zoology in the Middle East 24: 45-74.

Keevin, Thomas M. and Hempen, G. L. 1997. The Environmental Effects of Underwater Explosions with Methods to Mitigate Impacts. U. S. Army Corps of Engineers, St. Louis District.

Kreeger, D., J. Adkins, P. Cole, R. Najjar, D. Velinsky, P. Conolly, and J. Kraeuter. May 2010. Climate Change and the Delaware Estuary: Three Case Studies in Vulnerability Assessment and Adaptation Planning. Partnership for the Delaware Estuary, PDE Report No. 10-01. 1 –117 pp.

Kelle, L., N. Gratiot, I. Nolibos, J. Therese, R. Wongsopawiro, and B. DeThoisy. 2007. Monitoring of nesting leatherback turtles (Dermochelys coriacea): contribution of remote-sensing for real time assessment of beach coverage in French Guiana. Chelonian Conserv Biol 6: 142–149.

Ketten, D.R. and S.M. Bartol. (2005). Functional Measures of Sea Turtle Hearing. ONR Award No: N00014-02-1-0510.

Kieffer and Kynard in review [book to be published by AFS]. Kieffer, M. C., and B. Kynard. In review. Pre-spawning and non-spawning spring migrations, spawning, and effects of hydroelectric dam operation and river regulation on spawning of Connecticut River shortnose sturgeon.

Kieffer, M.C. and B. Kynard. 1993. Annual movements of shortnose and Atlantic sturgeons in the Merrimack River, Massachusetts. Transactions of the American Fisheries Society 1221: 1088-1103.

Kocan, R.M., M.B. Matta, and S. Salazar. 1993. A laboratory evaluation of Connecticut River coal tar toxicity to shortnose sturgeon (Acipenser brevirostrum) embryos and larvae. Final Report to the National Oceanic and Atmospheric Administration, Seattle, Washington.

Kuller, Z. 1999. Current status and conservation of marine turtles on the Mediterranean coast of Israel. Marine Turtle Newsletter 86: 3-5.

Kynard, B. and M. Horgan. 2002. Ontogenetic behavior and migration of Atlantic sturgeon, Acipenser oxyrinchus oxyrinchus, and shortnose sturgeon, A. brevirostrum, with notes on social behavior. Environmental Behavior of Fishes 63: 137-150.

LaCasella, E.L., P.H. Dutton, and S.P. Epperly. 2005. Genetic stock composition of loggerheads (Caretta caretta) encountered in the Atlantic northeast distant (NED) longline fishery using additional mtDNA analysis. Pages 302-303 in Frick M., A. Panagopoulou, A.F. Rees, and K. Williams (compilers). Book of Abstracts of the Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation. International Sea Turtle Society, Athens, Greece.

Lageux, C.J., C. Campbell, L.H. Herbst, A.R. Knowlton and B. Weigle. 1998. Demography of marine turtles harvested by Miskitu Indians of Atlantic Nicaragua. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-412: 90.

Lalli, C.M. and T.R. Parsons. 1997. Biological oceanography: An introduction – 2nd Edition.Pages 1-13. Butterworth-Heinemann Publications. 335 pp.

Laney, R.W., J.E. Hightower, B.R. Versak, M.F. Mangold, W.W. Cole Jr., and S.E. Winslow.2007. Distribution, habitat use, and size of Atlantic sturgeon captured during cooperative winter tagging cruises, 1988–2006. Pages 167-182. In: J. Munro, D. Hatin, J. E. Hightower, K. McKown, K. J. Sulak, A. W. Kahnle, and F. Caron, (editors), Anadromous sturgeons: habi-tats, threats, and management. Am. Fish. Soc. Symp. 56, Bethesda, MD.

Larson, K. and Moehl, C. 1990. “Fish entrainment by dredges in Grays Harbor, Washington”. Effects of dredging on anadromous Pacific Coast fishes. C.A. Simenstad ed., Washington Sea

Grant Program, University of Washington, Seattle. 102-12 pp.

LaSalle, M.W. 1990. Physical and chemical alterations associated with dredging. C.A. Simenstad editor. Proceedings of the workshop on the effects of dredging on anadromous Pacific coast fishes. Washington Sea Grant Program, Seattle. 1-12 pp.

Laurent, L., J. Lescure, L. Excoffier, B. Bowen, M. Domingo, M. Hadjichristophorou, L. Kornaraki, and G. Trabuchet. 1993. Genetic studies of relationships between Mediterranean and Atlantic populations of loggerhead turtle Caretta caretta with a mitochondrial marker. Comptes Rendus de l'Academie des Sciences (Paris), Sciences de la Vie/Life Sciences 316:1233-1239.

Laurent, L., P. Casale, M.N. Bradai, B.J. Godley, G. Gerosa, A.C. Broderick, W. Schroth, B. Schierwater, A.M. Levy, D. Freggi, E.M. Abd El-Mawla, D.A. Hadoud, H.E. Gomati, M. Domingo, M. Hadjichristophorou, L. Kornaraki, F. Demirayak, and C. Gautier. 1998. Molecular resolution of the marine turtle stock composition in fishery bycatch: A case study in the Mediterranean. Molecular Ecology 7: 1529-1542.

Leland, J. G., III. 1968. A survey of the sturgeon fishery of South Carolina. Bears Bluff Labs. No. 47, 27 pp.

Lewison, R.L., L.B. Crowder, and D.J. Shaver. 2003. The impact of turtle excluder devices and fisheries closures on loggerhead and Kemp's ridley strandings in the western Gulf of Mexico. Conservation Biology 17(4): 1089-1097.

Lewison, R.L., S.A. Freeman, and L.B. Crowder. 2004. Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles. Ecology Letters. 7: 221-231.

Limpus, C.J. and D.J. Limpus. 2000. Mangroves in the diet of Chelonia mydas in Queensland, Australia. Mar Turtle Newsl 89: 13–15.

Limpus, C.J. and D.J. Limpus. 2003. Loggerhead turtles in the equatorial Pacific and southern Pacific Ocean: A species in decline. In: Bolten, A.B., and B.E. Witherington (eds.), Loggerhead Sea Turtles. Smithsonian Institution.

Longwell, A.C., S. Chang, A. Hebert, J. Hughes and D. Perry. 1992. Pollution and developmental abnormalities of Atlantic fishes. Environmental Biology of Fishes 35:1- 21.

Lutcavage, M.E. and P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival, p.387-409. In P.L. Lutz and J.A. Musick, (eds.), The Biology of Sea Turtles, CRC Press, Boca Raton, Florida. 432pp.

Lutcavage, M.E. and P.L. Lutz. 1997. Diving Physiology. Pp. 277-296 in The Biology of Sea Turtles. P.L. Lutz and J.A. Musick (Eds). CRC Press.

Mac, M.J., and C.C. Edsall. 1991. Environmental contaminants and the reproductive success of lake trout in the Great Lakes: An epidemiological approach. Journal of Toxicology and Environmental Health 33:375-394.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. Endang Species Res 7: 125-136.

Magnuson, J.J., J.A. Bjorndal, W.D. DuPaul, G.L. Graham, D.W. Owens, C.H. Peterson, P.C.H. Prichard, J.I. Richardson, G.E. Saul, and C.W. West. 1990. Decline of Sea Turtles: Causes and Prevention. Committee on Sea Turtle Conservation , Board of Environmental Studies and Toxicology, Board on Biology, Commission of Life Sciences, National Research Council, National Academy Press, Washington, D.C. 259 pp.

Maier, P. P., A. L. Segars, M. D. Arendt, J. D. Whitaker, B. W. Stender, L. Parker, R. Vendetti, D. W. Owens, J. Quattro, and S. R. Murphy. 2004. Development of an index of sea turtle abundance based on in-water sampling with trawl gear. Final report to the National Marine Fisheries Service. 86 pp.

Mangin, E. 1964. Croissance en Longueur de Trois Esturgeons d'Amerique du Nord: Acipenser oxyrhynchus, Mitchill, Acipenser fulvescens, Rafinesque, et Acipenser brevirostris LeSueur. Verh. Int. Ver. Limnology 15: 968-974.

Mansfield, K. L. 2006. Sources of mortality, movements, and behavior of sea turtles in Virginia. Chapter 5. Sea turtle population estimates in Virginia. pp.193-240. Ph.D. dissertation. School of Marine Science, College of William and Mary.

Mansfield, K.L., V.S. Saba, J.A. Keinath, and J.A. Musick. 2009. Satellite tracking reveals a dichotomy in migration strategies among juvenile loggerhead turtles in the Northwest Atlantic. Marine Biology 156:2555–2570.

Marcano, L.A. and J.J. Alio-M. 2000. Incidental capture of sea turtles by the industrial shrimping fleet off northwestern Venezuela. U.S. department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-436:107.

Marcano, L.A. and J.J. Alio-M. 2000. Incidental capture of sea turtles by the industrial shrimping fleet off northwestern Venezuela. U.S. department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-436:107.

Margaritoulis, D., R. Argano, I. Baran, F. Bentivegna, M.N. Bradai, J.A. Camiñas, P. Casale, G. De Metrio, A. Demetropoulos, G. Gerosa, B.J. Godley, D.A. Haddoud, J. Houghton, L. Laurent, and B. Lazar. 2003. Loggerhead turtles in the Mediterranean Sea: Present knowledge and conservation perspectives. Pages 175-198. In: A.B. Bolten and B.E. Witherington (eds.) Loggerhead Sea Turtles. Smithsonian Books, Washington, D.C. 319 pp.

Márquez, M.R., A. Villanueva O., and M. Sánchez P. 1982. The population of the Kemp's ridley sea turtle in the Gulf of Mexico – Lepidochelys kempii. In: K.A. Bjorndal (editor), Biology and Conservation of Sea Turtles. Washington, D.C. Smithsonian Institute Press. p. 159-164.

Márquez, R. 1990. FAO Species Catalogue, Vol. 11. Sea turtles of the world, an annotated and illustrated catalogue of sea turtle species known to date. FAO Fisheries Synopsis, 125. 81pp.

Martin, R.E. 1996. Storm impacts on loggerhead turtle reproductive success. Mar Turtle Newsl 73:10–12.

Mayfield RB, Cech JJ Jr. 2004. Temperature effects on green sturgeon bioenergetics. Trans Am Fish Soc 133:961–970

Mazaris A.D., G. Mastinos, J.D. Pantis. 2009. Evaluating the impacts of coastal squeeze on sea turtle nesting. Ocean Coast Manag 52:139–145.

McCauley, J.E., Parr, R.A. and D. R. Hancock. 1977. Benthic Infauna and Maintenance Dredging: A Case Study. Water Research 11: 233-242.

McClellan, C.M., and A.J. Read. 2007. Complexity and variation in loggerhead sea turtle life history. Biology Letters 3: 592-594.

McCord, J.W., M.R. Collins, W.C. Post, and T.J. Smith. 2007. Attempts to develop an index of abundance for age-1 Atlantic sturgeon in South Carolina, USA. Am. Fisheries Society Symposium 56: 397-403.

McEnroe, M., and J.J. Cech. 1987. Osmoregulation in white sturgeon: life history aspects.American Fisheries Society Symposium 1:191-196.

McMahon, C.R., and G.C. Hays. 2006. Thermal niche, large-scale movements and implications of climate change for a critically endangered marine vertebrate. Global Change Biology 12:1330-1338.

Meylan, A. 1982. Estimation of population size in sea turtles. In: K.A. Bjorndal (ed.) Biology and Conservation of Sea Turtles. Smithsonian Inst. Press, Wash. D.C. p 135-138.

Meylan, A., B. Schroeder, and A. Mosier. 1995. Sea turtle nesting activity in the state of Florida. Fla. Mar. Res. Publ. 52: 1-51.

Meylan, A., B.E. Witherington, B. Brost, R. Rivero, and P.S. Kubilis. 2006. Sea turtle nesting in Florida, USA: Assessments of abundance and trends for regionally significant populations of Caretta, Chelonia, and Dermochelys. pp 306-307. In: M. Frick, A. Panagopoulou, A. Rees, and K. Williams (compilers). 26th Annual Symposium on Sea Turtle Biology and Conservation Book of Abstracts.

Mitchell, G.H., R.D. Kenney, A.M. Farak, and R.J. Campbell. 2003. Evaluation of occurrence of endangered and threatened marine species in naval ship trial areas and transit lanes in the Gulf of Maine and offshore of Georges Bank. NUWC-NPT Technical Memo 02-121A. March 2003. 113 pp.

Mohler, J. W. 2003. Culture manual for the Atlantic sturgeon, Acipenser oxyrinchus oxyrinchus. U.S. Fish and Wildlife Service, Hadley, Massachusetts. 70 pp.

Monzón-Argüello, C., A. Marco., C. Rico, C. Carreras, P. Calabuig, and L.F. López-Jurado. 2006. Transatlantic migration of juvenile loggerhead turtles (Caretta caretta): magnetic latitudinal influence. Page 106 in Frick M., A. Panagopoulou, A.F. Rees, and K. Williams (compilers). Book of Abstracts of the Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation. International Sea Turtle Society, Athens, Greece.

Morgan, R.P., V.J. Rasin and L.A. Noe. 1973. Effects of Suspended Sediments on the Development of Eggs and Larvae of Striped Bass and White Perch. Natural resources Institute, Chesapeake Biological Laboratory, U of Maryland, Center for Environmental and Estuarine Studies. 20 pp.

Morreale, S.J. and E.A. Standora. 1990. Occurrence, movement, and behavior of the Kemp's ridley and other sea turtles in New York waters. Annual report for the NYSDEC, Return A Gift To Wildlife Program, April 1989 - April 1990.

Morreale, S.J. and E.A. Standora. 1998. Early life stage ecology of sea turtles in northeastern U.S. waters. U.S. Dep. Commer. NOAA Tech. Mem. NOAA Fisheries-SEFSC-413, 49 pp.

Morreale, S.J., and E.A. Standora. 1993. Occurrence, movement, and behavior of the Kemp's ridley and other sea turtles in New York waters. Okeanos Ocean Research Foundation Final Report April 1988-March 1993. 70 pp.

Morreale, S.J., C.F. Smith, K. Durham, R.A. DiGiovanni, Jr., and A.A. Aguirre. 2005. Assessing health, status, and trends in northeastern sea turtle populations. Interim report - Sept. 2002 - Nov. 2004. Gloucester, Massachusetts: National Marine Fisheries Service.

Moser, M.L. and S.W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the lower Cape Fear River, North Carolina. Transactions of the American Fisheries Society 124:225-234.

Moser, Mary. 1999. Cape Fear River Blast Mitigation Tests: Results of Caged Fish Necropsies,Final Report to CZR, Inc. under Contract to US Army Corps of Engineers, Wilmington District.

Mrosovsky, N. 1981. Plastic jellyfish. Marine Turtle Newsletter 17: 5-6.

Mrosovsky, N., G.D. Ryan, M.C. James. 2009. Leatherback turtles: The menace of plastic. Marine Pollution Bulletin 58: 287-289.

Munro, J. 2007. Anadromous sturgeons: Habitats, threats, and management - synthesis and summary. Am. Fisheries Society Symposium 56: 1-15.

Murawski, S.A. and A.L. Pacheco. 1977. Biological and fisheries data on Atlantic sturgeon, Acipenser oxyrhynchus (Mitchill). National Marine Fisheries Service Technical Series Report 10: 1-69.

Murdoch, P. S., J. S. Baron, and T. L. Miller. 2000. Potential effects of climate change on surface-water quality in North America. JAWRA Journal of the American Water Resources Association, 36: 347–366.

Murphy, T.M. and S.R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. United States Final Report to NMFS-SEFSC. 73pp.

Murphy, T.M., S.R. Murphy, D.B. Griffin, and C. P. Hope. 2006. Recent occurrence, spatial distribution and temporal variability of leatherback turtles (Dermochelys coriacea) in nearshore waters of South Carolina, USA. Chel. Cons. Biol. 5(2): 216-224.

Murray, K.T. 2004. Bycatch of sea turtles in the Mid-Atlantic sea scallop (Placopecten magellanicus) dredge fishery during 2003. NEFSC Reference Document 04-11; 25 pp.

Murray, K.T. 2006. Estimated average annual bycatch of loggerhead sea turtles (Caretta caretta) in U.S. Mid-Atlantic bottom otter trawl gear, 1996-2004. NEFSC Reference Document 06-19; 26 pp.

Murray, K.T. 2007. Estimated bycatch of loggerhead sea turtles (Caretta caretta) in U.S. Mid-Atlantic scallop trawl gear, 2004-2005, and in sea scallop dredge gear, 2005. NEFSC Reference Document 07-04; 30 pp.

Murray, K.T. 2008. Estimated average annual bycatch of loggerhead sea turtles (Caretta caretta) in U.S. Mid-Atlantic bottom otter trawl gear, 1996-2004 (2nd edition). NEFSC Reference Document 08-20; 32 pp.

Murray, K.T. 2009a. Characteristics and magnitude of sea turtle bycatch in US mid-Atlantic gillnet gear. Endangered Species Research 8:211-224.

Murray, K.T. 2009b. Proration of estimated bycatch of loggerhead sea turtles in U.S. Mid-Atlantic sink gillnet gear to vessel trip report landed catch, 2002-2006. NEFSC Reference Document 09-19; 7 pp.

Murray, K.T. 2011. Sea turtle bycatch in the U.S. sea scallop (Placopecten magellanicus) dredge fishery, 2001–2008. Fish Res. 107:137-146.

Musick, and J. Wyneken (editors). The Biology of Sea Turtles Vol. II, CRC Press, Boca Raton, Florida. p. 339-353.

Musick, J.A. and C.J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. Pp. 137-164 In: Lutz, P.L., and J.A. Musick, eds., The Biology of Sea Turtles. CRC Press, New York. 432 pp.

NAST (National Assessment Synthesis Team). 2000. Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change, US Global Change Research Program, Washington DC, 2000.

NAST (National Assessment Synthesis Team). 2008. Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change, US Global Change Research Program, Washington DC, 2000 http://www.usgcrp.gov/usgcrp/Library/nationalassessment/1IntroA.pdf

National Research Council (NRC). 1990. Decline of the Sea Turtles: Causes and Prevention. Committee on Sea Turtle Conservation. Natl. Academy Press, Washington, D.C. 259 pp.

Nicholls, R.J. 1998. Coastal vulnerability assessment for sea level rise: evaluation and selection of methodologies for implementation. Technical Report R098002, Caribbean Planning for Adaption to Global Climate Change (CPACC) Project. Available at: www.cpacc.org.

Niklitschek, J. E. 2001. Bioenergetics modeling and assessment of suitable habitat for juvenile Atlantic and shortnose sturgeons (Acipenser oxyrinchus and A. brevirostrum) in the Chesapeake Bay. Dissertation. University of Maryland at College Park, College Park.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 1991. Recovery plan for U.S. population of Atlantic green turtle Chelonia mydas. Washington, D.C.: National Marine Fisheries Service. 58 pp.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 1992. Recovery plan for leatherback turtles Dermochelys coriacea in the U.S. Caribbean, Atlantic, and Gulf of Mexico. Washington, D.C.: National Marine Fisheries Service. 65 pp.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 1995. Status reviews for sea turtles listed under the Endangered Species Act of 1973. Silver Spring, Maryland: National Marine Fisheries Service. 139 pp.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 1998a. Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (Dermochelys coriacea). Silver Spring, Maryland: National Marine Fisheries Service. 65 pp.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 1998b. Recovery Plan for U.S. Pacific Populations of the Green Turtle (Chelonia mydas). Silver Spring, Maryland: National Marine Fisheries Service. 84 pp.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 2007a. Loggerhead sea turtle (Caretta caretta) 5 year review: summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland. 65 pp.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 2007b. Leatherback sea turtle (Dermochelys coriacea) 5 year review: summary and evaluation. Silver Spring, Maryland: National Marine Fisheries Service. 79 pp.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 2007c. Kemp’s ridley sea turtle (Lepidochelys kempii) 5 year review: summary and evaluation. Silver Spring, Maryland: National Marine Fisheries Service. 50 pp.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 2007d. Green sea turtle (Chelonia mydas) 5 year review: summary and evaluation. Silver Spring, Maryland: National Marine Fisheries Service. 102 pp.

NMFS (National Marine Fisheries Service) and USFWS (U.S. Fish and Wildlife Service). 2008. Recovery plan for the Northwest Atlantic population of the loggerhead turtle (Caretta caretta), Second revision. Washington, D.C.: National Marine Fisheries Service. 325 pp.

NMFS (National Marine Fisheries Service) NEFSC (Northeast Fisheries Science Center). 2011. Preliminary summer 2010 regional abundance estimate of loggerhead turtles (Caretta caretta) in northwestern Atlantic Ocean continental shelf waters. US Dept Commerce, Northeast Fisheries Science Center Reference Document 11-03; 33 pp.

NMFS (National Marine Fisheries Service), USFWS (U.S. Fish and Wildlife Service), and SEMARNAT. 2011. Bi-National Recovery Plan for the Kemp’s Ridley Sea Turtle (Lepidochelys kempii), Second Revision. National Marine Fisheries Service. Silver Spring, Maryland 156 pp. + appendices.

NMFS (National Marine Fisheries Service). 2002. Endangered Species Act Section 7 Consultation on Shrimp Trawling in the Southeastern United States, under the Sea Turtle Conservation Regulations and as Managed by the Fishery Management Plans for Shrimp in the South Atlantic and Gulf of Mexico. Biological Opinion. December 2, 2002.

NMFS (National Marine Fisheries Service). 2004. Endangered Species Act Section 7 Consultation on the Proposed Regulatory Amendments to the Fisheries Management Plan for the Pelagic Fisheries of the Western Pacific. Biological Opinion. February 23, 2004.

NMFS (National Marine Fisheries Service). 2004. Endangered Species Act Section 7 Reinitiated Consultation on the Continued Authorization of the Atlantic Pelagic Longline Fishery under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks (HMS FMP). Biological Opinion. June 1, 2004.

NMFS (National Marine Fisheries Service). 2006. Endangered Species Act Section 7 Consultation on the Proposed Renewal of an Operating Licsense for the Oyster Creek Nuclear Generating Station, Barnegat Bay, New Jersey. Biological Opinion. November 22, 2006.

NMFS (National Marine Fisheries Service). 2008b. Summary Report of the Workshop on Interactions Between Sea Turtles and Vertical Lines in Fixed-Gear Fisheries. M.L. Schwartz (ed.), Rhode Island Sea Grant, Narragansett, Rhode Island. 54 pp.

NMFS (National Marine Fisheries Service). 2011. Biennial Report to Congress on the Recovery Program for Threatened and Endangered Species, October 1, 2008 – September 30, 2010. Washington, D.C.: National Marine Fisheries Service. 194 pp.

NMFS (National Marine Fisheries Service). 2012. Reinitiation of Endangered Species Act (ESA) Section 7 Consultation on the Continued Implementation of the Sea Turtle Conservation Regulations, as Proposed to Be Amended, and the Continued Authorization of the Southeast U.S. Shrimp Fisheries in Federal Waters under the Magnuson-Stevens Act. Biological Opinion. May 8, 2012.

NMFS and USFWS. 1992. Recovery plan for leatherback turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. National Marine Fisheries Service, Washington, D.C. 65 pp.

NMFS and USFWS. 1995. Status reviews for sea turtles listed under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland. 139 pp.

NMFS and USFWS. 1998b. Recovery Plan for the U.S. Pacific Population of the Leatherback Turtle (Dermochelys coriacea). National Marine Fisheries Service, Silver Spring, Maryland.

NMFS and USFWS. 2007b. Leatherback sea turtle (Dermochelys coriacea) 5 year review: summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland. 79 pp.

NMFS SEFSC (Southeast Fisheries Science Center). 2009. An assessment of loggerhead sea turtles to estimate impacts of mortality reductions on population dynamics. NMFS SEFSC Contribution PRD-08/09-14. 45 pp.

NMFS Southeast Fisheries Science Center. 2001. Stock assessments of loggerheads and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. U.S. Department of Commerce, National Marine Fisheries Service, Miami, FL, SEFSC Contribution PRD-00/01-08; Parts I-III and Appendices I-IV. NOAA Tech. Memo NMFS-SEFSC-455, 343 pp.

NMFS. 1998. Recovery plan for the shortnose sturgeon (Acipenser brevirostrum). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland 104 pp.

NRC (National Research Council). 1990. Decline of the Sea Turtles: Causes and Prevention. Washington, D.C.: National Academy Press. 259 pp.

NYHS (New York Historical Society as cited by Dovel as Mitchell. S. 1811). 1809. Volume1. Collections of the New-York Historical Society for the year 1809.

NYSDEC (New York State Department of Environmental Conservation). 2003. "Final Environmental Impact Statement Concerning the Applications to Renew New York State Pollutant Discharge Elimination System (SPDES) Permits for the Roseton 1 and 2 Bowline 1 and 2 and IP2 and IP3 2 and 3 Steam Electric Generating Stations, Orange, Rockland and Westchester Counties" (Hudson River Power Plants FEIS). June 25, 2003.

O'Herron, J.C. and R.W. Hastings. 1985. A Study of the Shortnose Sturgeon (Acipenser brevirostrum) population in the upper tidal Delaware River: Assessment of impacts of maintenance dredging (Post- dredging study of Duck Island and Perriwig ranges), Draft final report. Prepared for the U.S. Army Corps of Engineers, Philadelphia District by the Center for Coastal and Environmental Studies, Rutgers, the State University of New Jersey, New Brunswick, NJ.

Palka , D. 2000. Abundance and distribution of sea turtles estimated from data collected during cetacean surveys. In: Bjorndal, K.A. and A.B. Bolten. Proceedings of a workshop on assessing abundance and trends for in-water sea turtle populations. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-445, 83pp.

Palmer M.A., C.A. Reidy, C. Nilsson, M. Florke, J. Alcamo, P.S. Lake, and N. Bond. 2008. Climate change and the world's river basins: anticipating management options. Frontiers in Ecology and the Environment 6:81-89.

Parmesan, C., and G. Yohe. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421:37-42.

Pearce, A.F. 2001. Contrasting population structure of the loggerhead turtle (Caretta caretta) using mitochondrial and nuclear DNA markers. Master's thesis, University of Florida.

Pearce, A.F. and B.W. Bowen. 2001. Final report: Identification of loggerhead (Caretta caretta) stock structure in the southeastern United States and adjacent regions using nuclear DNA markers. Project number T-99-SEC-04. Submitted to the National Marine Fisheries Service, May 7, 2001. 79 pp.

Pike, D.A. and J.C. Stiner. 2007. Sea turtle species vary in their susceptibility to tropical cyclones. Oecologia 153: 471–478.

Pike, D.A., R.L. Antworth, and J.C. Stiner. 2006. Earlier nesting contributes to shorter nesting seasons for the loggerhead sea turtle, Caretta caretta. Journal of Herpetology 40(1): 91-94.

Pikitch, E.K., P. Doukakis, L. Lauck, P. Chakrabarty, and D.L. Erickson. 2005. Status, trends and management of sturgeon and paddlefish fisheries. Fish and Fisheries 6: 233–265.

Pisces Conservation Ltd. 2008. The status of fish populations and ecology of the Hudson River. Prepared by R.M. Seaby and P.A. Henderson. http://www.riverkeeper.org/wp-content/uploads/2009/06/Status-of-Fish-in-the-Hudson-Pisces.pdf

Plaziat, J.C., and P.G.E.F. Augustinius. 2004. Evolution of progradation/ erosion along the French Guiana mangrove coast: a comparison of mapped shorelines since the 18th century with Holocene data. Mar Geol 208: 127–143.

Polis, D.F., S.L. Kupferman, and K. Szekielda. 1973. Physical oceanography. Delaware Bay Report Series, Vol. 4. University of Delaware, Newark, DE.

Pritchard, P.C.H. 1982. Nesting of the leatherback turtle, Dermochelys coriacea, in Pacific, Mexico, with a new estimate of the world population status. Copeia 1982: 741-747.

Pritchard, P.C.H. 2002. Global status of sea turtles: An overview. Document INF-001 prepared for the Inter-American Convention for the Protection and Conservation of Sea Turtles, First Conference of the Parties (COP1IAC), First part August 6-8, 2002.

Prusty, G., S. Dash, and M.P. Singh. 2007. Spatio-temporal analysis of multi-date IRS imageries for turtle habitat dynamics characterisation at Gahirmatha coast, India. Int J Remote Sens 28: 871–883

Rahmstorf, S. 1997. Risk of sea-change in the Atlantic. Nature 388: 825–826.

Rahmstorf, S. 1999. Shifting seas in the greenhouse? Nature 399: 523–524.

Rankin-Baransky, K., C.J. Williams, A.L. Bass, B.W. Bowen, and J.R. Spotila. 2001. Origin of loggerhead turtles stranded in the northeastern United States as determined by mitochondrial DNA analysis. Journal of Herpetology 35(4):638-646.

Rebel, T.P. 1974. Sea turtles and the turtle industry of the West Indies, Florida and the Gulf of Mexico. Univ. Miami Press, Coral Gables, Florida.

Rees, A.F., A. Saad, and M. Jony. 2005. Marine turtle nesting survey, Syria 2004: discovery of a "major" green turtle nesting area. Page 38 in Book of Abstracts of the Second Mediterranean Conference on Marine Turtles. Antalya, Turkey, 4-7 May 2005.

Reine, K., and Clarke, D. 1998. Entrainment by hydraulic dredges–A review of potential impacts. Technical Note DOER-E1. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Revelles, M., C. Carreras, L. Cardona, A. Marco, F. Bentivegna, J.J. Castillo, G. de Martino, J.L. Mons, M.B. Smith, C. Rico, M. Pascual, and A. Aguilar. 2007. Evidence for an asymmetrical size exchange of loggerhead sea turtles between the Mediterranean and the Atlantic through the Straits of Gibraltar. Journal of Experimental Marine Biology and Ecology 349:261-271.

Rhoads, D.C. and J.D. Germano. 1982. Characterization of Benthic Processes Using Sediment Profile Imaging: an Efficient Method of Remote Ecological Monitoring on the Seafloor (REMOTS System). Marine Ecology Process Series 8:115-128

Richardson A.J., A. Bakun, G.C. Hays, and M.J. Gibbons. 2009. The jellyfish joyride: causes, consequences and management responses to a more gelatinous future. Trends in Ecology and Evolution 24:312-322.

Ridgway, S.H., E.G. Weaver, J.G. McCormick, J. Palin, and J.H. Anderson. 1969. Hearing in the Giant Sea Turtle, Chelonia mydas. Proceedings of the National Academy of Sciences 64(3): 884-890.

Rivalan, P., P.H. Dutton, E. Baudry, S.E. Roden, and M. Girondot. 2005. Demographic scenario inferred from genetic data in leatherback turtles nesting in French Guiana and Suriname. Biol Conserv 1: 1–9.

Robinson, M.M., H.J. Dowsett, and M.A. Chandler. 2008. Pliocene role in assessing future climate impacts. Eos, Transactions of the American Geophysical Union 89(49):501-502.

Rochard, E., M. Lepage, and L. Meauzé. Identification et caractérisation de l'aire de répartition marine de l'esturgeon éuropeen Acipenser sturio a partir de déclarations de captures. 1997. Aquat. Living. Resour. 10: 101-109.

Rogers, S.G., and W. Weber. 1995b. Status and restoration of Atlantic and shortnose sturgeons in Georgia. Final Report to the National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, Florida.

Rosenthal, H. and D. F. Alderdice. 1976. Sublethal effects of environmental stressors, natural and pollutional, on marine fish eggs and larvae. Journal of the Fisheries Research Board of Canada 33: 2047-2065.

Ross, J.P. 1996. Caution urged in the interpretation of trends at nesting beaches. Marine Turtle Newsletter 74: 9-10.

Ross. J.P. 2005. Hurricane effects on nesting Caretta caretta. Mar Turtle Newsl 108:13–14.

Ruben, H.J, and S.J. Morreale. 1999. Draft Biological Assessment for Sea Turtles in New York and New Jersey Harbor Complex. Unpublished Biological Assessment submitted to National Marine Fisheries Service.

Ruelle, R. and C. Henry. 1992. Organochlorine compounds in pallid sturgeon. Contaminant

Ruelle, R. and C. Henry. 1994. Life history observations and contaminant evaluation of pallid sturgeon. Final Report U.S. Fish and Wildlife Service, Fish and Wildlife Enhancement, South Dakota Field Office, 420 South Garfield Avenue, Suite 400, Pierre, South Dakota 57501-5408.

Ruelle, R., and K.D. Keenlyne. 1993. Contaminants in Missouri River pallid sturgeon. Bull. Environ. Contam. Toxicol. 50: 898-906.

Sarti Martinez, L., A.R. Barragan, D.G. Munoz, N. Garcia, P. Huerta, and F. Vargas. 2007. Conservation and biology of the leatherback turtle in the Mexican Pacific. Chelonian Conservation and Biology 6(1): 70-78.

Sarti, L., S. Eckert, P. Dutton, A. Barragán, and N. García. 2000. The current situation of the leatherback population on the Pacific coast of Mexico and central America, abundance and distribution of the nestings: an update. Pages 85-87 In: H. Kalb and T. Wibbels, compilers. Proceedings of the Nineteenth Annual Symposium on Sea Turtle Conservation and Biology. NOAA Technical Memorandum NMFS-SEFSC-443.

Sarti, L., S.A. Eckert, N. Garcia, and A.R. Barragan. 1996. Decline of the world's largest nesting assemblage of leatherback turtles. Marine Turtle Newsletter 74: 2-5.

Savoy, T. 2007. Prey eaten by Atlantic sturgeon in Connecticut waters. Am. Fisheries Society Symposium 56: 157-165.

Savoy, T., and D. Pacileo. 2003. Movements and important habitats of subadult Atlantic sturgeon in Connecticut waters. Transactions of the American Fisheries Society. 132: 1-8.

Schmid, J.R., and W.N. Witzell. 1997. Age and growth of wild Kemp's ridley turtles (Lepidochelys kempi): cumulative results of tagging studies in Florida. Chelonian Conservation and Biology 2(4): 532-537.

Schubel, J.R., H.H. Carter, R.E. Wilson, W.M. Wise, M.G. Heaton, and M.G. Gross. 1978. Field investigations of the nature, degree, and extent of turbidity generated by open-water pipeline disposal operations. Technical Report D-78-30; U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., 245 pp.

Schueller, P. and D.L. Peterson. 2006. Population status and spawning movements of Atlantic sturgeon in the Altamaha River, Georgia. Presentation to the 14th American Fisheries Society Southern Division Meeting, San Antonio, February 8-12th, 2006.

Schultz, J.P. 1975. Sea turtles nesting in Surinam. Zoologische Verhandelingen (Leiden), Number 143: 172 pp.

Scott, W. B., and M. C. Scott. 1988. Atlantic fishes of Canada. Canadian Bulletin of Fisheries and Aquatic Science No. 219. pp. 68-71.

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada. Bulletin 184. pp. 80-82.

Seaturtle.org. Sea turtle tracking database. Available at http://www.seaturtle.org.

Secor, D. H. 2002. Atlantic sturgeon fisheries and stock abundances during the late nineteenth century. Pages 89-98 In: W. Van Winkle, P. J. Anders, D. H. Secor, and D. A. Dixon,(editors), Biology, management, and protection of North American sturgeon. American Fisheries Society Symposium 28, Bethesda, Maryland.

Secor, D.H. and J.R. Waldman. 1999. Historical abundance of Delaware Bay Atlantic sturgeon and potential rate of recovery. American Fisheries Society Symposium 23: 203-

Secor, D.J. and E.J. Niklitschek. 2002. Sensitivity of sturgeons to environmental hypoxia: A review of physiological and ecological evidence, p. 61-78 In: R.V. Thurston (Ed.) Fish Physiology, Toxicology, and Water Quality. Proceedings of the Sixth International Symposium, La Paz, MX, 22-26 Jan. 2001. U.S. Environmental Protection Agency Office of Research and Development, Ecosystems Research Division, Athens, GA. EPA/600/R-02/097. 372 pp.

Sella, I. 1982. Sea turtles in the Eastern Mediterranean and Northern Red Sea. Pages 417-423 in K.A. Bjorndal, ed. Biology and Conservation of Sea Turtles. Washington, D.C.: Smithsonian Institution Press.

Seminoff, J.A. 2004. Chelonia mydas. In 2007 IUCN Red List of Threatened Species. Accessed 31 July 2009. http://www.iucnredlist.org/search/details.php/4615/summ.

Shamblin, B.M. 2007. Population structure of loggerhead sea turtles (Caretta caretta) nesting in the southeastern United States inferred from mitochondrial DNA sequences and microsatellite loci. Master's thesis, University of Georgia. 59 pp.

Sherk, J.A. J.M. O'Connor and D.A. Neumann. 1975. Effects of suspended and deposited sediments on estuarine environments. In: Estuarine Research Vol. II. Geology and Engineering. L.E. Cronin (editor). New York: Academic Press, Inc.

Sherk, J.A. 1972. Current Status of the Knowledge of the Biological Effects of Suspended and Deposited Sediments in Chesapeake Bay. Chesapeake Science, vol. 13, Supplement: Biota of the Chesapeake Bay pp. S137-S144.

Sherk, J.A. 1971. Effects of suspended and deposited sediments on estuarine organisms. Chesapeake Biological Laboratory, University of Maryland. Contribution No. 443.

Shirey, C., C. C. Martin, and E. D. Stetzar. 1999. Atlantic sturgeon abundance and movement in the lower Delaware River. DE Division of Fish and Wildlife, Dover, DE, USA. Final Report to the National Marine Fisheries Service, Northeast Region, State, Federal & Constituent Programs Office. Project No. AFC-9, Grant No. NA86FA0315. 34 pp.

Shoop, C.R. 1987. The Sea Turtles. Pages 357-358 in R.H. Backus and D.W. Bourne, eds. Georges Bank. Cambridge, Massachusetts: MIT Press.

Shoop, C.R. and R.D. Kenney. 1992. Seasonal distributions and abundances of loggerhead and leatherback sea turtles in waters of the northeastern United States. Herpetological Monographs 6: 43-67.

Short, F.T. and H.A. Neckles. 1999. The effects of global climate change on seagrasses. Aquat Bot 63: 169–196.

Simpson, P.C. 2008. Movements and habitat use of Delaware River Atlantic sturgeon. Master Thesis, Delaware State University, Dover, DE 128 p.

Skjeveland, Jorgen E., Stuart A. Welsh, Michael F. Mangold, Sheila M. Eyler, and Seaberry Nachbar. 2000. A Report of Investigations and Research on Atlantic and Shortnose Sturgeon in Maryland Waters of the Chesapeake bay (1996-2000). U.S. Fish and Wildlife Service, Annapolis, MD. 44 pp.

Slay, C.K. and J.I. Richardson. 1988. King's Bay, Georgia: Dredging and Turtles. Schroeder, B.A. (compiler). Proceedings of the eighth annual conference on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFC-214, pp. 109-111.

Smith, Hugh M. and Barton A. Bean. 1899. List of fishes known to inhabit the waters of the District of Columbia and vicinity. Prepared for the United States Fish Commission. Washington Government Printing Office, Washington, D.C.

Smith, T. I. J., D. E. Marchette, and G. F. Ulrich. 1984. The Atlantic sturgeon fishery in South

Smith, T. I. J., E. K. Dingley, and D. E. Marchette. 1980. Induced spawning and culture of Atlantic sturgeon. Progressive Fish-Culturist 42: 147-151.

Smith, T.I.J. 1985. The fishery, biology, and management of Atlantic sturgeon, Acipenser oxyrhynchus, in North America. Environmental Biology of Fishes 14(1): 61-72.

Smith, T.I.J. and J.P. Clugston. 1997. Status and management of Atlantic sturgeon, Acipenser oxyrinchus, in North America. Environmental Biology of Fishes 48: 335-346.

Smith, T.I.J., D.E. Marchette and R.A. Smiley. 1982. Life history, ecology, culture and management of Atlantic sturgeon, Acipenser oxyrhynchus oxyrhynchus, Mitchill, in South Carolina. South Carolina Wildlife Marine Resources. Resources Department, Final Report to U.S. Fish and Wildlife Service Project AFS-9. 75 pp.

Snover, M.L., A.A. Hohn, L.B. Crowder, and S.S. Heppell. 2007. Age and growth in Kemp's ridley sea turtles: evidence from mark-recapture and skeletochronology. Pages 89-106 in P.T. Plotkin, ed. Biology and Conservation of Ridley Sea Turtles. Baltimore, Maryland: Johns Hopkins University Press.

Snyder, D.E. 1988. Description and identification of shortnose and Atlantic sturgeon larvae. American Fisheries Society Symposium 5:7-30.

South Carolina Department of Natural Resources. 2007. Examination of Local Movement and Migratory Behavior of Sea Turtles during spring and summer along the Atlantic coast off the southeastern United States. Unpublished report submitted to NMFS as required by ESA Permit 1540. 45 pp.

Spells, A. 1998. Atlantic sturgeon population evaluation utilizing a fishery dependent reward program in Virginia's major western shore tributaries to the Chesapeake Bay. U.S. Fish and Wildlife Service, Charles City, Virginia.

Spotila, J.R., A.E. Dunham, A.J. Leslie, A.C. Steyermark, P.T. Plotkin and F.V. Paladino. 1996. Worldwide population decline of Dermochelys coriacea: are leatherback turtles going extinct? Chelonian Conservation and Biology 2: 209-222.

Spotila, J.R., R.D. Reina, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 2000. Pacific leatherback turtles face extinction. Nature 405(6786):529-530.

Squiers, T. And M. Robillard. 1997. Preliminary report on the location of overwintering sites for shortnose sturgeon in the estuarial complex of the Kennebec River during the winter of 1996/1997. Unpublished report, submitted to the Maine Department of Transportation.

Squiers, T., L. Flagg, and M. Smith. 1982. American shad enhancement and status of sturgeon stocks in selected Maine waters. Completion report, Project AFC-20.

Stein, A.B., K.D. Friedland, and M. Sutherland. 2004. Atlantic sturgeon marine bycatch and mortality on the continental shelf of the Northeast United States. North American Journal of Fisheries Management 24: 171-183.

Stephens, S.H., and J. Alvarado-Bremer. 2003. Preliminary information on the effective population size of the Kemp's ridley (Lepidochelys kempii) sea turtle. Page 250 In: J.A. Seminoff, compiler. Proceedings of the Twenty-Second Annual Symposium on Sea Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-503.

Stetzar, E. J. 2002. Population Characterization of Sea Turtles that Seasonally Inhabit the Delaware Estuary. Master of Science thesis, Delaware State University, Dover, Delaware. 136pp.

Stevenson, J. T., and D. H. Secor. 1999. Age determination and growth of Hudson River Atlantic sturgeon, Acipenser oxyrinchus. Fishery Bulletin 97: 153-166.

Stewart, K., C. Johnson, and M.H. Godfrey. 2007. The minimum size of leatherbacks at reproductive maturity, with a review of sizes for nesting females from the Indian, Atlantic and Pacific Ocean basins. Herp. Journal 17:123-128.

Stewart, K., M. Sims, A. Meylan, B. Witherington, B. Brost, and L.B. Crowder. 2011. Leatherback nests increasing significantly in Florida, USA; trends assessed over 30 years using multilevel modeling. Ecological Applications, 21(1): 263–273.

Stocker, T.F. and A. Schmittner. 1997. Influence of CO2 emission rates on the stability of the thermohaline circulation. Nature 388: 862–865.

Suárez, A. 1999. Preliminary data on sea turtle harvest in the Kai Archipelago, Indonesia. Abstract, 2nd ASEAN Symposium and Workshop on Sea Turtle Biology and Conservation, July 15-17, 1999, Sabah, Malaysia.

Suárez, A., P.H. Dutton, and J. Bakarbessy. 2000. Leatherback (Dermochelys coriacea) nesting on the North Vogelkop Coast of Irian Jaya, Indonesia. Page 260 in H.J. Kalb and T. Wibbels, compilers. Proceedings of the Nineteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-443.

Taub, S.H. 1990. Interstate fishery management plan for Atlantic sturgeon. Fisheries Management Report No. 17. Atlantic States Marine Fisheries Commission, Washington, D.C. 73 pp.

Taubert, B.D. 1980b. Biology of shortnose sturgeon (Acipenser brevirostrum) in the Holyoke Pool, Connecticut River, Massachusetts. Ph.D. Thesis, University of Massachusetts, Amherst, 136 p.

Taubert, B.D., and M.J. Dadswell. 1980. Description of some larval shortnose sturgeon (Acipenser brevirostrum) from the Holyoke Pool, Connecticut River, Massachusetts, USA, and the Saint John River, New Brunswick, Canada. Canadian Journal of Zoology 58:1125-1128.

Taylor, A.C. 1990. The hopper dredge. In: Dickerson, D.D. and D.A. Nelson (Comps.); Proceedings of the National Workshop of Methods to Minimize Dredging Impacts on Sea Turtles, 11-12 May 1988, Jacksonville, Florida. Miscellaneous Paper EL-90-5. Department of the Army, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. February, 1990. Pp. 59-63.

Teleki, G.C. and A.J. Chamberlain. 1978. Acute Effects of Underwater Construction Blasting in Fishes in Long Point Bay, Lake Erie. J. Fish. Res. Board Can. 35: 1191-1198.

TEWG (Turtle Expert Working Group). 1998. An assessment of the Kemp's ridley (Lepidochelys kempii) and loggerhead (Caretta caretta) sea turtle populations in the Western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-409:1-96.

TEWG (Turtle Expert Working Group). 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-444:1-115.

TEWG (Turtle Expert Working Group). 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555:1-116.

TEWG (Turtle Expert Working Group). 2009. An assessment of the loggerhead turtle population in the Western North Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-575:1-131.

TEWG. 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-444, 115 pp.

TEWG. 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555, 116 pp.

TEWG. 2009. An assessment of the loggerhead turtle population in the Western North Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-575: 1-131.

Titus, J.G. and V.K. Narayanan. 1995. The probability of sea level rise. U.S. Environmental Protection Agency EPA 230-R-95-008. 184 pp.

Turtle Expert Working Group (TEWG). 1998. An assessment of the Kemp's ridley (Lepidochelys kempii) and loggerhead (Caretta caretta) sea turtle populations in the Western North Atlantic. NOAA Technical Memorandum NOAA Fisheries-SEFSC-409. 96 pp.

Tynan, C.T. and D.P. DeMaster. 1997. Observations and predictions of Arctic climatic change: potential effects on marine mammals. Arctic 50: 308-322.

U.S. Army Corps of Engineers (USACE). 2006. Biological Assessment for Research and Compilation of Baseline Data for the Use of Bed-leveling Devices at Port of Palm Beach, Palm Beach County, Florida. Prepared for USACE-Jacksonville District. March.

U.S. Army Corps of Engineers (USACE). 1994. Beach Erosion Control and Hurricane Protection Study, Virginia Beach, Virginia- General Reevaluation Report, Main Report, Environmental Assessment , and Appendices. Norfolk District.

U.S. Army Corps of Engineers (USACE), Nofrolk District. 2012. Supplemental Biological Assessment for the Potential Impacts to Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus) Resulting from Beach Nourishment Activities at Sandbridge Beach Utitizing the Sandbridge Shoal Borrow Areas. Submitted to NMFS Northeast Regional Office, April 2012. Norfolk, Virginia. 39 pp.

U.S. Army Corps of Engineers (USACE), Savannah District. 2004. Biological Assessment of Threatened and Endangered Species for Brunswick Harbor Deepening Modification to Allow Use of Bed-leveling Mechanical Dredging, Glynn County, Georgia. July.

U.S. Fish and Wildlife Service (USFWS). 1997. Synopsis of the biological data on the green turtle, Chelonia mydas (Linnaeus 1758). Biological Report 97(1). U.S. Fish and Wildlife Service, Washington, D.C. 120 pp.

Uhler, P.R. and O. Lugger. 1876. List of fishes of Maryland. Rept. Comm. Fish. MD. 1876: 67-176.

USACE Environmental Laboratory. Sea Turtle Data Warehouse. Available at http://el.erdc.usace.army.mil/seaturtles/index.cfm.

USDOI (United States Department of Interior). 1973. Threatened wildlife of the United States. Shortnose sturgeon. Office of Endangered Species and International Activities, Bureau of Sport Fisheries and Wildlife, Washington, D.C. Resource Publication 114 (Revised Resource Publication 34).

USFWS (U.S. Fish and Wildlife Service) and NMFS (National Marine Fisheries Service). 1992. Recovery plan for the Kemp's ridley sea turtle (Lepidochelys kempü). Original. St. Petersburg, Florida: National Marine Fisheries Service. 40 pp.

USFWS and NMFS. 1992. Recovery plan for the Kemp’s ridley sea turtle (Lepidochelys kempii). NMFS, St. Petersburg, Florida.hatching. Curr Biol 17: R590.

Van Den Avyle, M. J. 1984. Species profile: Life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic): Atlantic sturgeon. U.S. Fish and Wildlife Service Report No. FWS/OBS-82/11.25, and U. S. Army Corps of Engineers Report No. TR EL-82-4, Washington, D.C.

Van Eenennaam, J.P., and S.I. Doroshov. 1998. Effects of age and body size on gonadal development of Atlantic sturgeon. Journal of Fish Biology 53: 624-637.

Van Eenennaam, J.P., S.I. Doroshov, G.P. Moberg, J.G. Watson, D.S. Moore and J. Linares. 1996. Reproductive conditions of the Atlantic sturgeon (Acipenser oxyrhynchus) in the Hudson River. Estuaries 19: 769-777.

Van Houtan, K.S. and J.M. Halley. 2011. Long-Term Climate Forcing in Loggerhead Sea Turtle Nesting. PLoS ONE 6(4): e19043. doi:10.1371/journal.pone.0019043.

Van Houton, K.S. and O.L. Bass. 2007. Stormy oceans are associated with declines in sea turtle

Varanasi, U. 1992. Chemical contaminants and their effects on living marine resources. pp. 59- 71. in: R. H. Stroud (ed.) Stemming the Tide of Coastqal Fish Habitat Loss. Proceedings of the Symposium on Conservation of Fish Habitat, Baltimore, Maryland. Marine Recreational Fisheries Number 14. National Coalition for Marine Conservation, Inc., Savannah Georgia.

Vinyard, L. and W.J. O'Brien. 1976. Effects of light and turbidity on the reactive distance of bluegill (Lepomis macrochirus) J. Fish. Res. Board Can. 33: 2845-2849.

Vladykov, V.D. and J.R. Greeley. 1963. Order Acipenseroidea. Pages 24-60 in Fishes of the Western North Atlantic. Memoir Sears Foundation for Marine Research 1(Part III). xxi + 630 pp.

Von Westernhagen, H., H. Rosenthal, V. Dethlefsen, W. Ernst, U. Harms, and P.D. Hansen. 1981. Bioaccumulating substances and reproductive success in Baltic flounder Platichthys flesus. Aquatic Toxicology 1:85-99.

Waldman JR, Grunwald C, Stabile J, Wirgin I. 2002. Impacts of life history and biogeography on genetic stock structure in Atlantic Sturgeon, Acipenser oxyrinchus oxyrinchus, Gulf sturgeon A. oxyrinchus desotoi, and shortnose sturgeon, A.brevirostrum. J Appl Ichthyol 18:509-518

Waldman, J.R., J.T. Hart, and I.I. Wirgin. 1996. Stock composition of the New York Bight Atlantic sturgeon fishery based on analysis of mitochondrial DNA. Transactions of the American Fisheries Society 125: 364-371.

Wallace, B.P., S.S. Heppell, R.L. Lewison, S. Kelez, and L.B. Crowder. 2008. Impacts of fisheries bycatch on loggerhead turtles worldwide inferred from reproductive value analyses. J Appl Ecol 45:1076-1085.

Walsh, M.G., M.B. Bain, T. Squires, J.R. Walman, and Isaac Wirgin. 2001. Morphological and genetic variation among shortnose sturgeon Acipenser brevirostrum from adjacent and distant rivers. Estuaries Vol. 24, No. 1, p. 41-48. February 2001.

Waluda, C.M., P.G. Rodhouse, G.P. Podesta, P.N. Trathan, and G.J. Pierce. 2001. Surface oceanography of the inferred hatching grounds of Illex argentinus (Cephalopoda: Ommastrephidae) and influences on recruitment variability. Marine Biology 139: 671-679.

Warden, M. and K. Bisack 2010. Analysis of Loggerhead Sea Turtle Bycatch in Mid-Atlantic Bottom Trawl Fisheries to Support the Draft Environmental Impact Statement for Sea Turtle Conservation and Recovery in Relation to Atlantic and Gulf of Mexico Bottom Trawl Fisheries. NOAA NMFS NEFSC Ref. Doc.010. 13 pp.

Warden, M.L. 2011a. Modeling loggerhead sea turtle (Caretta caretta) interactions with US Mid-Atlantic bottom trawl gear for fish and scallops, 2005-2008. Biological Conservation 144:2202-2212.

Warden, M.L. 2011b. Proration of loggerhead sea turtle (Caretta caretta) interactions in U.S. Mid-Atlantic bottom otter trawls for fish and scallops, 2005-2008, by managed species landed. U.S. Department of Commerce, Northeast Fisheries Science Centter Reference Document 11-04. 8 p.

Waters, Thomas F. 1995. Sediment in Streams. American Fisheries Society Monograph 7. American Fisheries Society, Bethesda, MD. Pages 95-96.

Webster, P.J., G.J. Holland, J.A. Curry, H.R. Chang. 2005. Changes in tropical cyclone number, duration, and intensity in a warming environment. Science 309:1844–1846.

Wehrell, S. 2005. A survey of the groundfish caught by the summer trawl fishery in Minas Basin and Scots Bay. Honours Thesis. Department of Biology, Acadia University, Wolfville, Canada.

Weishampel, J.F., D.A. Bagley, and L.M. Ehrhart. 2004. Earlier nesting by loggerhead sea turtles following sea surface warming. Global Change Biology 10: 1424-1427.

Welsh, S. A., S. M. Eyler, M. F. Mangold, and A. J. Spells. 2002. Capture locations and growth rates of Atlantic sturgeon in the Chesapeake Bay. Pages 183-194 In: W. Van Winkle, P. J.Anders, D. H. Secor, and D. A. Dixon, (editors), Biology, management, and protection of North American sturgeon. American Fisheries Society Symposium 28, Bethesda,Maryland.

Welsh, Stuart A., Michael F. Mangold, Jorgen E. Skjeveland, and Albert J. Spells. 2002. Distribution and Movement of Shortnose Sturgeon (Acipenser brevirostrum) in the Chesapeake Bay. Estuaries Vol. 25 No. 1: 101-104.

Wibbels, T. 2003. Critical approaches to sex determination in sea turtle biology and conservation. In: P. Lutz et al. (editors), Biology of Sea Turtles, Vol 2. CRC Press Boca Raton. p. 103-134.

Wilber, D.H., D.G. Clarke & M.H. Burlas. (2006). Suspended sediment concentrations associated with a beach nourishment project on the northern coast of New Jersey. Journal of Coastal Research 22(5): 1035 – 1042.

Wilber, Dara H. and Douglas C. Clarke. 2001. Biological Effects of Suspended Sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. North American Journal of Fisheries Woodland, R. J. 2005. Age, growth, and recruitment of Hudson River shortnose sturgeon (Acipenser brevirostrum). Master's thesis. University of Maryland, College Park.

Wirgin, I. and T.L. King. 2011. Mixed stock analysis of Atlantic sturgeon from coastal locales and a non-spawning river. Presentation of the 2011 Sturgeon Workshop, Alexandria, VA, February 8-10.

Wirgin, I., Grunwald, C., Carlson, E., Stabile, J., Peterson, D.L. and J. Waldman. 2005. Range-wide population structure of shortnose sturgeon Acipenser brevirostrum based on sequence analysis of mitochondrial DNA control region. Estuaries 28:406-21.

Witherington, B., P. Kubilis, B. Brost, and A. Meylan. 2009. Decreasing annual nest counts in a globally important loggerhead sea turtle population. Ecological Applications 19: 30-54.

Witt, M.J., A.C. Broderick, D.J. Johns, C. Martin, R. Penrose, M.S. Hoogmoed, and B.J. Godley. 2007. Prey landscapes help identify potential foraging habitats for leatherback turtles in the NE Atlantic. Marine Ecology Progress Series 337: 231-243.

Witt, M.J., A.C. Broderick, M. Coyne, A. Formia and others. 2008. Satellite tracking highlights difficulties in the design of effective protected areas for critically endangered leatherback turtles Dermochelys coriacea during the inter-nesting period. Oryx 42: 296–300.

Witzell, W.N. 2002. Immature Atlantic loggerhead turtles (Caretta caretta): suggested changes to the life history model. Herpetological Review 33(4): 266-269.

Witzell, W.N., A.L. Bass, M.J. Bresette, D.A. Singewald, and J.C. Gorham. 2002. Origin of immature loggerhead sea turtles (Caretta caretta) at Hutchinson Island, Florida: evidence from mtDNA markers. Fish. Bull. 100:624-631.

Woodland, R.J. and D. H. Secor. 2007. Year-class strength and recovery of endangered shortnose sturgeon in the Hudson River, New York. Transaction of the American Fisheries Society 136:72-81.

Wynne, K. and M. Schwartz. 1999. Guide to marine mammals and turtles of the U.S. Atlantic and Gulf of Mexico. Rhode Island Sea Grant, Narragansett, Rhode Island. 114 pp.

Young, J. R., T. B. Hoff, W. P. Dey, and J. G. Hoff. 1998. Management recommendations for a Hudson River Atlantic sturgeon fishery based on an age-structured population model. Fisheries Research in the Hudson River. State of University of New York Press, Albany, New York. pp. 353.

Ziegeweid, J.R., C.A. Jennings, and D.L. Peterson. 2008a. Thermal maxima for juvenile shortnose sturgeon acclimated to different temperatures. Environmental Biology of Fish 3: 299-307.

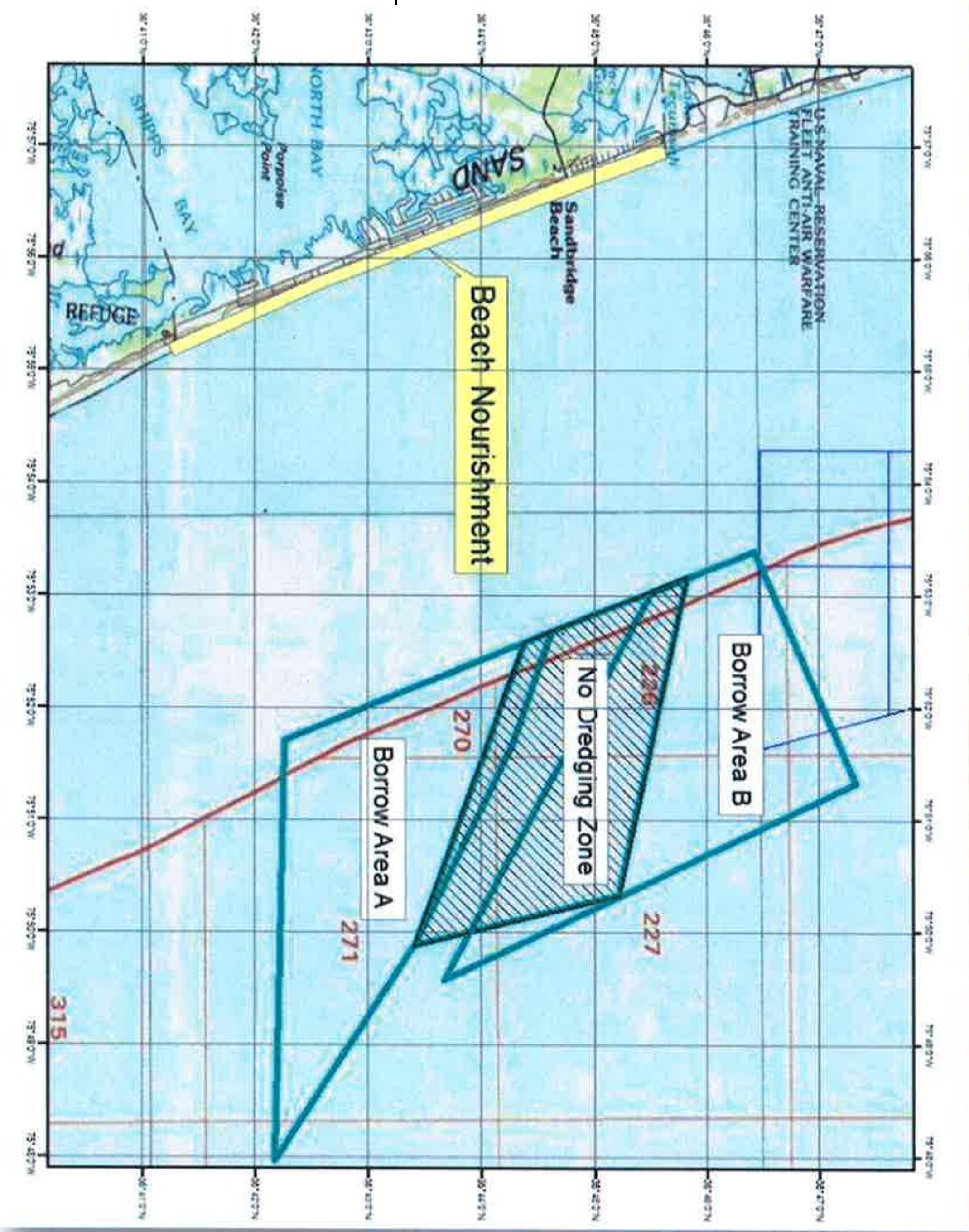
Ziegeweid, J.R., C.A. Jennings, D.L. Peterson and M.C. Black. 2008b. Effects of salinity, temperature, and weight on the survival of young-of-year shortnose sturgeon. Transactions of the American Fisheries Society 137:1490-1499.

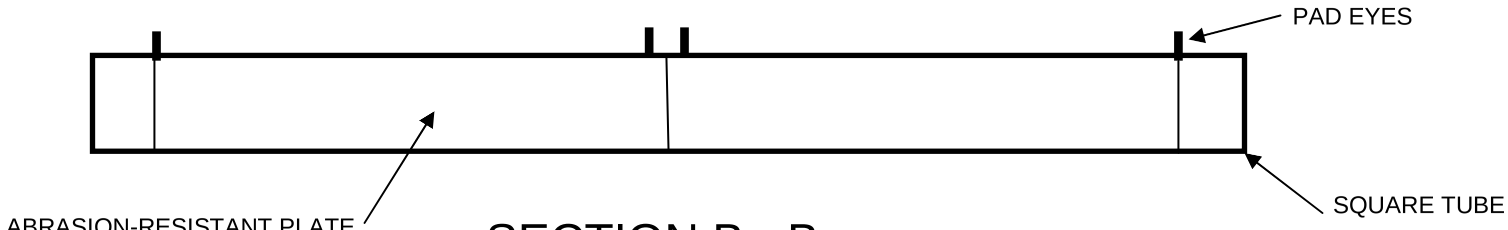
Zug, G.R., and J.F. Parham. 1996. Age and growth in leatherback turtles, Dermochelys coriacea: a skeletochronological analysis. Chelonian Conservation and Biology 2(2): 244-249.

Zurita, J.C., R. Herrera, A. Arenas, M.E. Torres, C. Calderon, L. Gomez, J.C. Alvarado, and R. Villavicencio. 2003. Nesting loggerhead and green sea turtles in Quintana Roo, Mexico. Pp. 125-127. In: J.A. Seminoff (compiler). Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-503, 308 p.

Appendix A.

Map of Sandbridge Shoal Borrow Area and location along beach where sand will be placed





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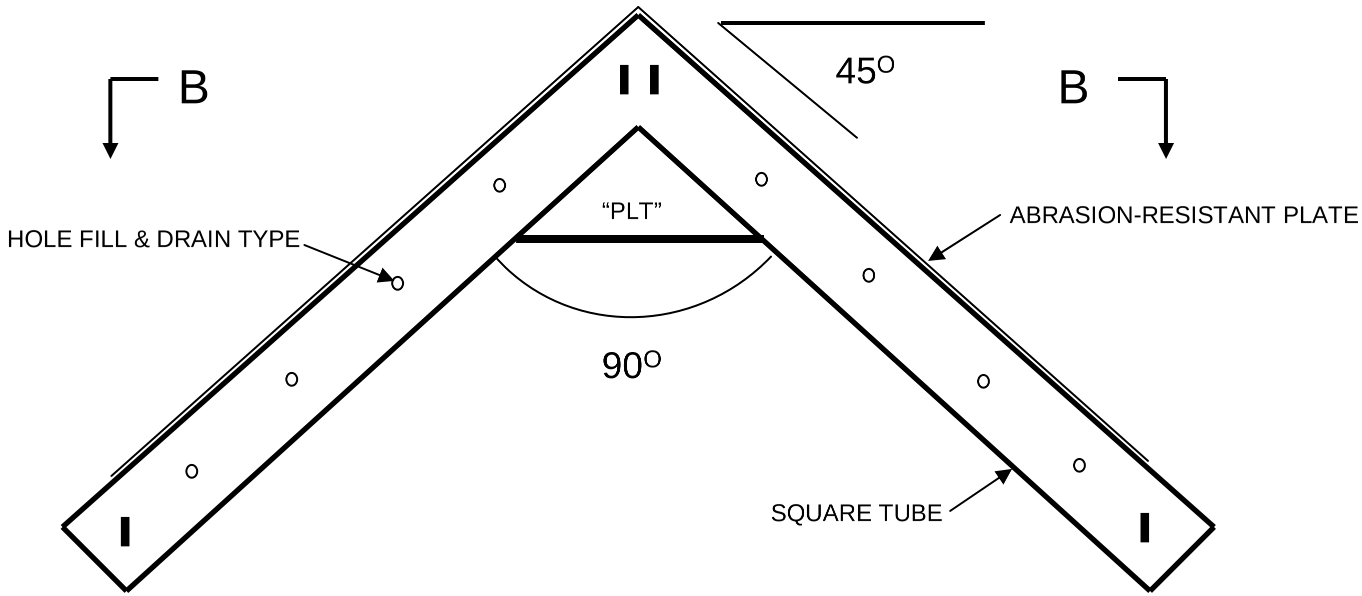
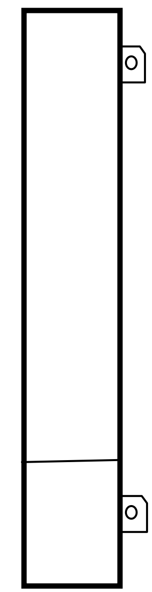


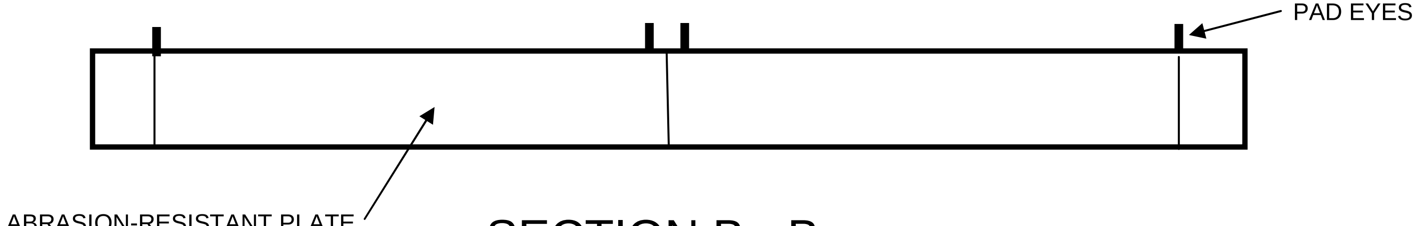
PLAN VIEW



LEFT SIDE VIEW

90 DEGREE BED LEVELER CONCEPTUAL DESIGN

90 DEGREE BED LEVELER MODEL PHOTOGRAPHS



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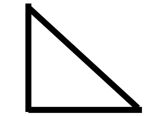

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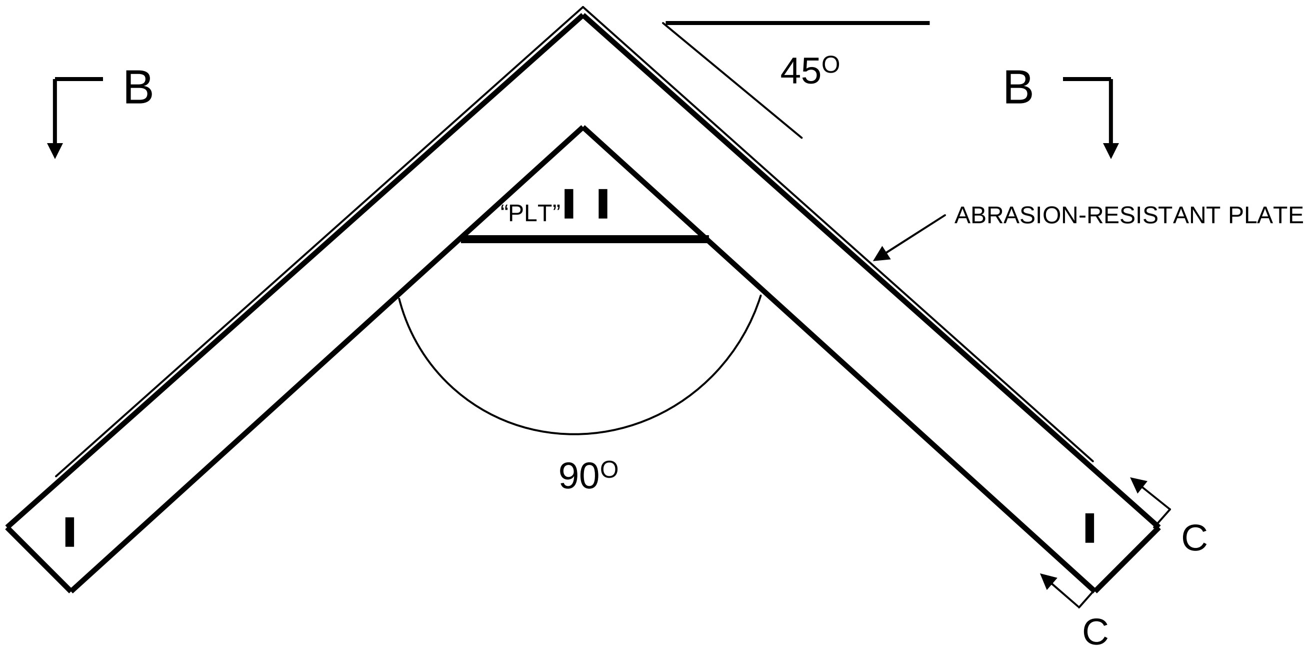

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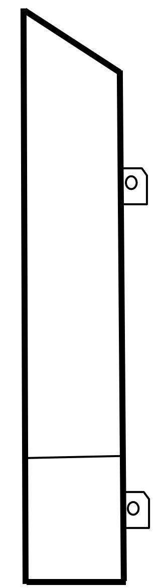
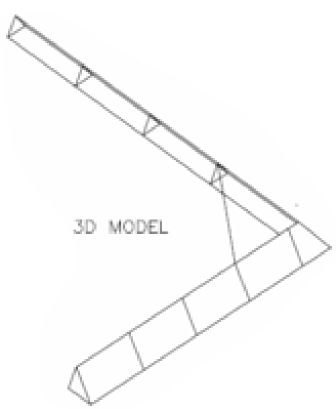
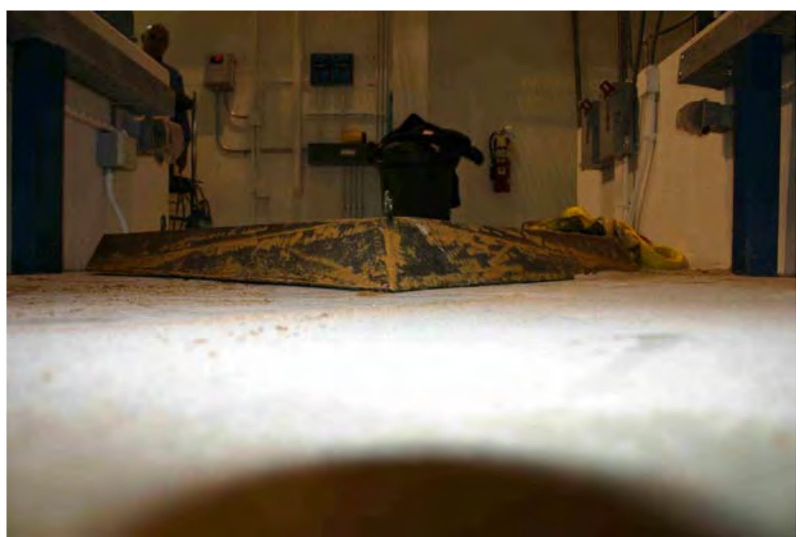


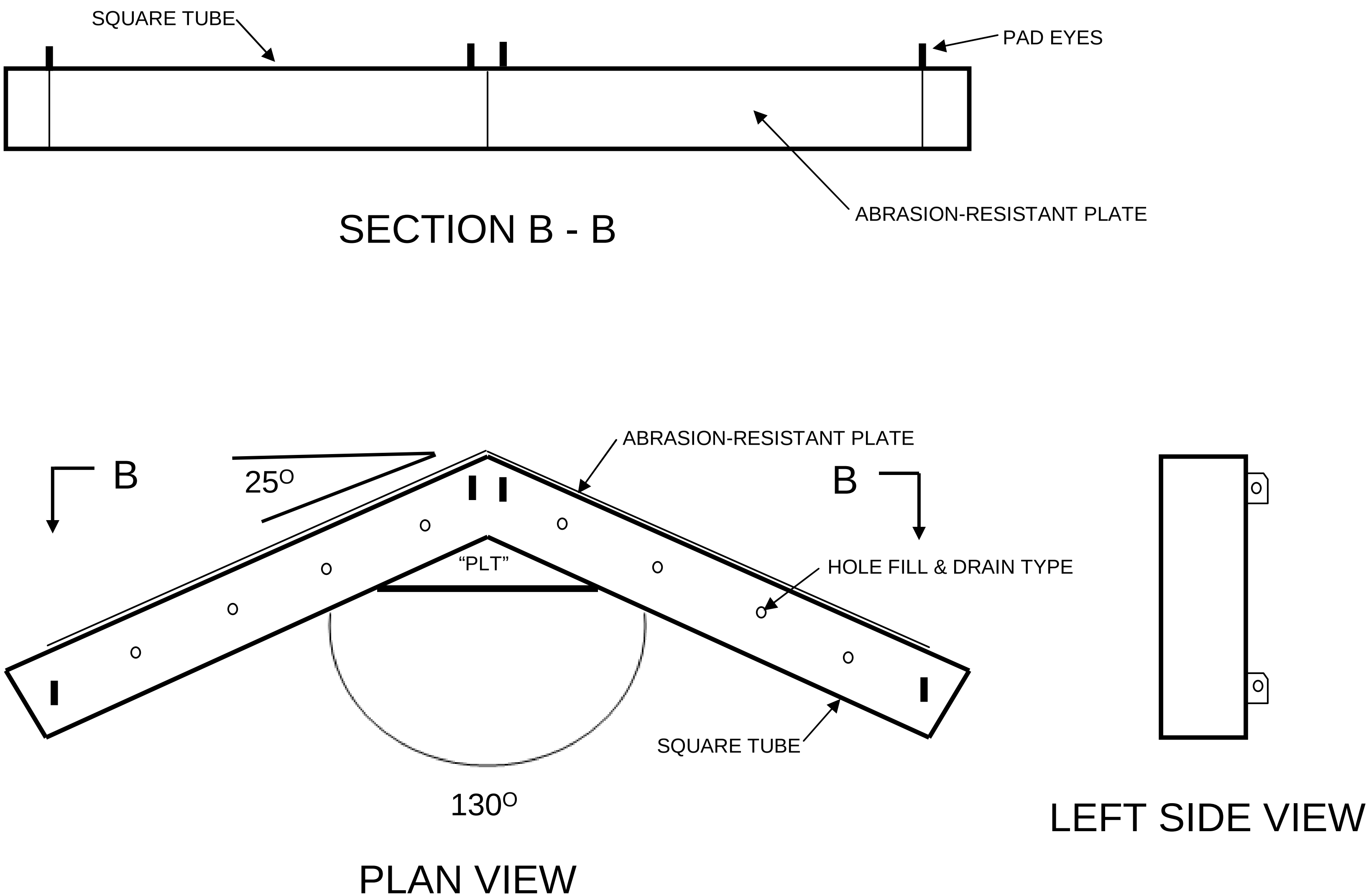
LEFT SIDE VIEW



90 DEGREE RAKED BED LEVELER CONCEPTUAL DESIGN

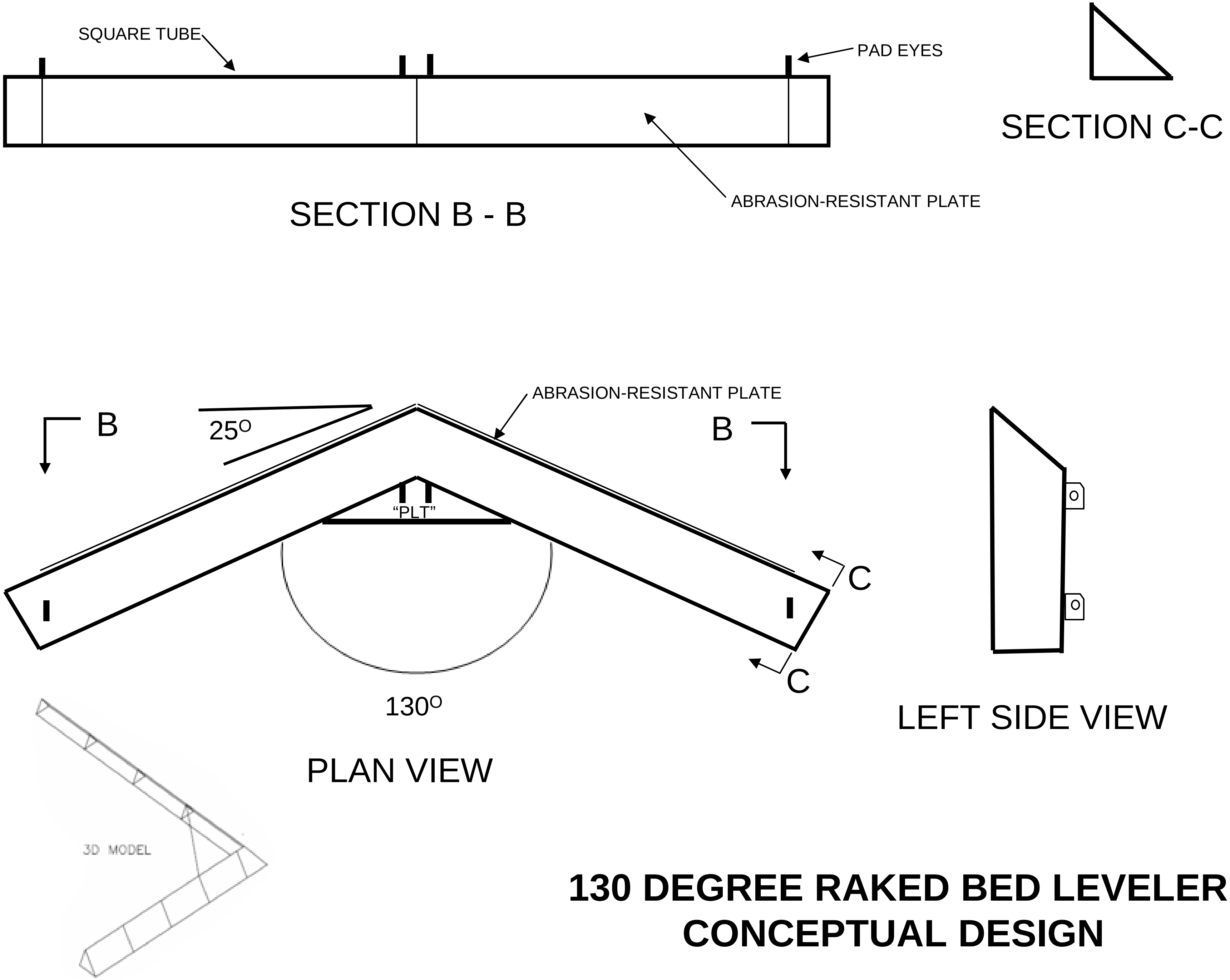
90 DEGREE RAKED BED LEVELER MODEL PHOTOGRAPHS





130 DEGREE BED LEVELER CONCEPTUAL DESIGN

130 DEGREE BED LEVELER MODEL PHOTOGRAPHS



130 DEGREE RAKED BED LEVELER CONCEPTUAL DESIGN

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
1	30 Oct 90	SAC	Winyah Bay Georgetown	A	H *Ouchita*	Dead	~69cm, rear half	Overflow Screening	N	Chris Slay pers com Observer report DACW 60-90-C-0067
2	15 Jan 94	SAS	Savannah Harbor	A	H *RN Weeks*	NA	NA	Found by Turtle observer	No	Steve Calver pers com 14 Jun 05 Observer load sheet and final rpt #DACW21-93-C-0072
3	07 Dec 94	SAS	Savannah Harbor	A	H *Dodge Island*	Live released	71cm, whole fish	Starboard Skimmer Screening	Yes We have efile	Chris Slay pers com Observer report
4	07 Dec 94 Different Load	SAS	Savannah Harbor	A	H *Dodge Island*	Dead	77.5cm, whole fish	Starboard Skimmer Screening	Yes We have efile	Chris Slay pers com Observer report
5	Feb 96	NAP	Delaware River Newbold Island	S	P *Ozark*	Dead	83cm, female w/eggs	In DMA Money Island		NMFS memo for record From Laurie Silva 19 Apr 96
6	Feb 96	NAP	Delaware River Newbold Island	S	P *Ozark*	Dead	63cm, mature male	In DMA Money Island		NMFS memo for record From Laurie Silva 19 Apr 96
7	06 Jan 98	NAP	Delaware River Kinkora Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
8	12 Jan 98	NAP	Delaware River Florence Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
9	13 Jan 98	NAP	Delaware River Florence Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
10	7 Sep 98	SAW	Wilmington Har Cape Fear River	A	H *McFarland*	Dead	Head only (1 ft long)	In turtle Inflow screen		Observer incident report Pers com Bill Adams- SAW 26 Jul 04
11	01 Mar 00	SAC	Charleston Harbor	A	H *Stuyvesant*	Dead	Missing head and tail	Main Overflow Screening	No	Chris Slay pers com Observer reporting forms
12	12 Apr 00	SAC	Charleston Harbor	A	H *Stuyvesant*	Dead	71.6cm, whole fish	Starboard Overflow screening	No	Chris Slay pers com Observer reporting forms
13	03 Dec 00	SAW	Wilmington Har MOTSU	A	C *New York*	Dead	82.5cm, whole fish decomposing	In bucket	Y Not e-file Payonk? ?	Chris Slay pers com Phil Payonk pers com 30 Jul 04 Bill Adams pers com 28 Jul 04 #DACW54-00-C-0013

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
14	24 Feb 01	SAS	Brunswick Harbor	A	H *RN Weeks*	Dead	Head only	Just mentions take on all forms, no other info.	No	Daily and Weekly Reports, Load sheet.
15	19 Jun 01	NAE	Kennebec River Bath Iron Works	A	C *??*	Live released		Put in scow, released unharmed		Julie Crocker NMFS pers com 19 Jul 04 2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001
16	30 Apr 03	NAE	Kennebec River Bath Iron Works	S	C Reed and Reed dredge company	Dead	Fish nearly cut in half		Y We have e-file	Julie Crocker NMFS pers com 19 Jul 04 2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001
17	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	38.1inches	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
18	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	37.0 inches	In hopper Did not dive Probably died	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
19	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Live	Swam away	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
20	06 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	Found alive	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
21	08 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Live	Good condition	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
22	07 Jan 04	SAC	Charleston Harbor	A	H *Manhattan Island*	Live	Whole fish 49 inches total length May have died later when released	Found by Coastwise turtle observers	Yes (We Have e-file)	Robert Chappell pers com 28 Jun 04 Observer daily report 7 Jan 04
23	13 Dec 04	SAM	Gulfport Harbor Channel	G	H *Bayport*	Dead	Trunk of fish 59.5cm	Found by turtle observers		Observer incident report Susan Rees pers com 7 Jan 05
24a	28 Dec 04	SAM	Mobile Bar Channel	G	H *Padre Island*	Dead	Trunk of fish 2 ft, 1inch	Found by Turtle observers	Yes (We Have e-file)	Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049
24b	01 Jan 05	SAM	Mobile Bar Channel	G	H *Padre Island*	Dead	Head only of fish 22.5cm	2nd part of take on 28 Dec 04	Yes taken But we Have not received	Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049
25	2 Mar 05	SAS	Brunswick Harbor	A	H *RN Weeks*	Dead	Posterior section only 60 cm section w/tail	Found by turtle observer	Yes (We Have e-file)	Chris Slay pers com 7 Jun 05 Steve Calver pers com 14 Jun 05
26	26 Dec 06	SAS	Brunswick	A	H *Newport*	Dead	Head only	Caught in port screen and	Black and	Incident and load report

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
								turtle part caught in starboard screen	White	
27	17 Jan 07	SAS	Savannah Entrance Channel	A	H *Glenn Edwards*	Dead	Whole fish, FL 104 cm	Fresh Dead, 60 Horseshoe crab in with load	Coastwise took photo	Incident and Load report
28	2 Mar 09	SAS	Savannah Entrance Channel	A	H *Dodge Island*	Dead	Total Length 111 cm	Fresh Dead, found in starboard aft inflow box, load #42		Incident, Load and Daily report
29	6 Feb 10	SAS	Brunswick Entrance Channel	A	H *Glenn Edwards*	Dead	No measurements	Fore screen contents, Load #19 with 12 Horseshoe crab		No incident report, just listed on load sheet and daily summary
30	7 Feb 10	SAS	Brunswick Entrance Channel	A	H *Glenn Edwards*	Dead	No measurements	Fore screen contents, Load #25 with 20 Horseshoe crab		No incident report, just listed on load sheet and daily summary
31	2 Feb 10	SAS	Brunswick Entrance Channel	A	H *Bayport*	Dead	No measurements, head to mid body in load #193 and mid body to tail recovered in load #194.	Stbd screen contents, load #193 and overflow screen in #194,		No incident report, just listed on load sheet and daily summary
32	7 Dec 10	SAW	Wilmington Harbor	A	H Terrapin Island	Dead	Whole fish, FL 61 cm	Fresh Dead, water temp 12 C, air 2 C, load 6	Coastwise took photo	Incident and Load report
33	10 Apr 11	NAO	York Spit Channel	A	H Terrapin Island	Dead	Total Length 24.5" in, Fork Length 13.5", Middle of anus to Anal Fin 3.8"	During Clean up. Torn in half, only posterior from pectoral region to tail, no head. Fins and tail torn but complete		Hopper daily report from, QCR, e-mail, incident report, daily report, load sheets

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
34	11Apr 11	NAO	York Spit Channel	A	H Liberty Island	Dead		During cleanup. Another piece taken on 4/13/11 matches perfectly.	Y	E-mail
35	14 Mar 12	SAC	Charleston Harbor Channel	A	H Glenn Edwards	Dead	Fresh dead, body part 26"-30" long X 13" width, no head or tail	Load 129 (0024-0345) found in starboard draghead, during cleanup mode. Given to South Carolina DNR	Yes	E-mail, load sheet, incident report
NT	25 May 05	NAO	York Spit Channel	?	H *McFarland*	Dead	Approx. 2 ft estimate from photos	Too decomposed to identify	Yes (We Have e-file)	Observer final report, REMSA 2004
NDNEF	26 Jun 96	NAN	East Rock Away Long Island	?	H Dodge Island	Dead	(~3'), couldn't identify and doesn't mention condition (fresh or dead already)? Chris Starbird.	Load sheet states Carp or sturgeon	No	Load sheet, Daily and Weekly Summary mentions. No way to confirm.
NDNEF	About 98	SAW	Wilmington Har Cape Fear River	A	P *??*	Dead				NMFS 1998 Shortnose Recovery Plan p. 53
NDNEF	About 98	SAW	Wilmington Har Cape Fear River	A	C	Dead				NMFS 1998 Shortnose Recovery Plan p. 53
NDNEF	About 98	SAJ or SAS	Kings Bay	A	H *??*	Dead				NMFS 1998 Shortnose Recovery Plan p. 52 Chris Slay pers com

Sp=sturgeon species
A=Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*)
S=Shortnose sturgeon (*Acipenser brevirostrum*)

G=Gulf sturgeon (*Acipenser oxyrhynchus desotoi*)
NT = Non-take incident by dredge
SAC=Charleston

SAW=Wilmington
SAS=Savannah
SAJ=Jacksonville
SAM=Mobile
NAE=New England
NAO=Norfolk
NAN=New York
NAP=Philadelphia
H=Hopper
P=Hydraulic Cutterhead pipeline
C=Mechanical clamshell or bucket, bucket and barge
DMA=Dredged material disposal area
NDNEF=No documentation, no evidence found to confirm citation

APPENDIX D

MONITORING SPECIFICATIONS FOR HOPPER DREDGES

I. EQUIPMENT SPECIFICATIONS

A. Baskets or screening

Baskets or screening must be installed over the hopper inflows with openings no smaller than 4 inches by 4 inches to provide 100% coverage of all dredged material and shall remain in place during all dredging operations. Baskets/screening will allow for better monitoring by observers of the dredged material intake for sea turtles, sturgeon and their remains. The baskets or screening must be safely accessible to the observer and designed for efficient cleaning.

B. Draghead

The draghead of the dredge shall remain on the bottom **at all times** during a pumping operation, except when:

1) the dredge is not in a pumping operation, and the suction pumps are turned completely off;
2) the dredge is being re-oriented to the next dredge line during borrow activities; and
3) the vessel's safety is at risk (i.e., the dragarm is trailing too far under the ship's hull).

At initiation of dredging, the draghead shall be placed on the bottom during priming of the suction pump. If the draghead and/or dragarm become clogged during dredging activity, the pump shall be shut down, the dragarms raised, whereby the draghead and/or dragarm can be flushed out by trailing the dragarm along side the ship. If plugging conditions persist, the draghead shall be placed on deck, whereby sufficient numbers of water ports can be opened on the draghead to prevent future plugging.

Upon completion of a dredge track line, the drag tender shall:

1) throttle back on the RPMs of the suction pump engine to an idling speed (e.g., generally less than 100 RPMs) **prior to** raising the draghead off the bottom, so that no flow of material is coming through the pipe into the dredge hopper. Before the draghead is raised, the vacuum gauge on the pipe should read zero, so that no suction exists both in the dragarm and draghead, and no suction force exists that can impinge a turtle on the draghead grate;
2) hold the draghead firmly on the bottom with no flow conditions for approximately 10 to 15 seconds before raising the draghead; then, raise the draghead quickly off the bottom and up to a mid-water column level, to further reduce the potential for any adverse interaction with nearby turtles;
3) re-orient the dredge quickly to the next dredge line; and
4) re-position the draghead firmly on the bottom prior to bringing the dredge pump to normal pumping speed, and re-starting dredging activity.

C. Floodlights

Floodlights must be installed to allow the NMFS-approved observer to safely observe and monitor the baskets or screens.

D. Intervals between dredging

Sufficient time must be allotted between each dredging cycle for the NMFS-approved observer to inspect and thoroughly clean the baskets and screens for sea turtles and/or turtle parts and document the findings. Between each dredging cycle, the NMFS-approved observer should also examine and clean the dragheads and document the findings.

II. OBSERVER PROTOCOL

A. Basic Requirement

A NMFS-approved observer with demonstrated ability to identify sea turtle and sturgeon species must be placed aboard the dredge(s) being used, starting immediately upon project commencement to monitor for the presence of listed species and/or parts being entrained or present in the vicinity of dredge operations.

B. Duty Cycle

Observers are required at times and locations outlined in the ITS. While onboard, the observer must work a shift schedule appropriate to allow for the observation of at least 50% of the dredge loads (e.g., 12 hours on, 12 hours off). The ACOE shall require of the dredge operator that, when the observer is off watch, the cage shall not be opened unless it is clogged. The ACOE shall also require that if it is necessary to clean the cage when the observer is off watch, any aquatic biological material is left in the cage for the observer to document and clear out when they return on duty. In addition, the observer shall be the only one allowed to clean off the overflow screen.

C. Inspection of Dredge Spoils

During the required inspection coverage, the trained NMFS-approved observer shall inspect the galvanized screens and baskets at the completion of each loading cycle for evidence of sea turtles or shortnose sturgeon. The Endangered Species Observation Form shall be completed for each loading cycle, whether listed species are present or not. If any whole (alive or dead) or turtle parts are taken incidental to the project(s), NMFS Protected Resources Division must be contacted by phone (978-281-9328) or e-mail (incidental.take@noaa.gov) within 24 hours of the take. An incident report for sea turtle/shortnose sturgeon take (Appendix D) shall also be completed by the observer and sent via FAX (978) 281-9394 or e-mail (incidental.take@noaa.gov) within 24 hours of the take. Incident reports shall be completed for every take regardless of the state of decomposition. NMFS will determine if the take should be attributed to the incidental take level, after the incident report is received. Every incidental take (alive or dead, decomposed or fresh) should be photographed, and photographs shall be sent to NMFS either electronically (incidental.take@noaa.gov) or through the mail. Weekly reports, including all completed load sheets, photographs, and relevant incident reports, as well as a final report, shall be submitted to NMFS NER, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930-2298.

D. Information to be Collected

For each sighting of any endangered or threatened marine species (including whales as well as sea turtles), record the following information on the Endangered Species Observation Form (Appendix D):

1) Date, time, coordinates of vessel
2) Visibility, weather, sea state
3) Vector of sighting (distance, bearing)
4) Duration of sighting
5) Species and number of animals
6) Observed behaviors (feeding, diving, breaching, etc.)
7) Description of interaction with the operation

E. Disposition of Parts

If any whole turtles or sturgeon (alive or dead, decomposed or fresh) or turtle or shortnose sturgeon parts are taken incidental to the project(s), NMFS Protected Resources must be contacted within 24 hours of the take (phone: 978-281-9328 or e-mail (incidental.take@noaa.gov). All whole dead sea turtles or sturgeon, or turtle or shortnose sturgeon parts, must be photographed and described in detail on the Incident Report of Sea Turtle Mortality (Appendix D). The photographs and reports should be submitted by email (incidental.take@noaa.gov) or mail (Attn: Section 7 Coodinator, NMFS, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930-2298). After NMFS is notified of the take, it may instruct the observer to save the animal for future analysis if there is freezer space. Disposition of dead sea turtles/ sturgeon will be determined by NMFS at the time of the take notification. If the species is unidentifiable or if there are entrails that may have come from a turtle, the subject should be photographed, placed in plastic bags, labeled with location, load number, date and time taken, and placed in cold storage.

Live turtles (both injured and uninjured) should be held onboard the dredge until transported as soon as possible to the appropriate stranding network personnel for rehabilitation (Appendix C). No live turtles should be released back into the water without first being checked by a qualified veterinarian or a rehabilitation facility. The NMFS Stranding Network Coordinator ((978) 282-8470) should also be contacted immediately for any marine mammal injuries or mortalities.

III. OBSERVER REQUIREMENTS

Submission of resumes of endangered species observer candidates to NMFS for final approval ensures that the observers placed onboard the dredges are qualified to document takes of endangered and threatened species, to confirm that incidental take levels are not exceeded, and to provide expert advice on ways to avoid impacting endangered and threatened species. NMFS does not offer certificates of approval for observers, but approves observers on a case-by-case basis.

A. Qualifications

Observers must be able to:

1) differentiate between leatherback (*Dermochelys coriacea*), loggerhead *Caretta caretta*), Kemp's ridley *(Lepidochelys kempii*), green (*Chelonia mydas*), and hawksbill *(Eretmochelys imbricata*) turtles and their parts, and shortnose (*Acipenser brevirostrum*) and Atlantic (*Acipenser oxyrinchus oxyrinchus*) sturgeon and their parts;
2) handle live sea turtles and sturgeon and resuscitate and release them according accepted procedures;
3) correctly measure the total length and width of live and whole dead sea turtle and sturgeon species;
4) observe and advise on the appropriate screening of the dredge's overflow, skimmer funnels, and dragheads; and
5) identify marine mammal species and behaviors.

B. Training

Ideally, the applicant will have educational background in marine biology, general experience aboard dredges, and hands-on field experience with the species of concern. For observer candidates who do not have sufficient experience or educational background to gain immediate approval as endangered species observers, the below observer training is necessary to be considered admissible by NMFS. We can assist the ACOE by identifying groups or individuals capable of providing acceptable observer training. Therefore, at a minimum, observer training must include:

1) instruction on how to identify sea turtles and sturgeon and their parts;
2) instruction on appropriate screening on hopper dredges for the monitoring of sea turtles and sturgeon (whole or parts);
3) demonstration of the proper handling of live sea turtles and sturgeon incidentally captured during project operations. Observers may be required to resuscitate sea turtles according to accepted procedures prior to release;
4) instruction on standardized measurement methods for sea turtle and sturgeon lengths and widths; and
5) instruction on how to identify marine mammals; and
6) instruction on dredging operations and procedures, including safety precautions onboard a vessel.

APPENDIX E

Sea Turtle Handling and Resuscitation

It is unlikely that sea turtles will survive entrainment in a hopper dredge, as the turtles found in the dragheads are usually dead, dying, or dismantled. However, the procedures for handling live sea turtles follow in case the unlikely event should occur. These guidelines are adapted from 50 CFR § 223.206(d)(1).

Please photograph all turtles (alive or dead) and turtle parts found during dredging activities and complete the Incident Report of Sea Turtle Take.

Dead sea turtles

The procedures for handling dead sea turtles and parts are described in Appendix D.

Live sea turtles

When a sea turtle is found in the dredge gear, observe it for activity and potential injuries.

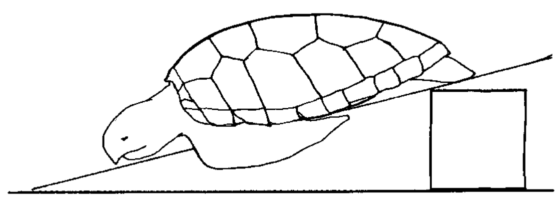
- **If the turtle is actively moving**, it should be retained onboard until evaluated for injuries by a permitted rehabilitation facility. Due to the potential for internal injuries associated with hopper entrainment, it is necessary to transport the live turtle to the nearest rehabilitation facility as soon as possible, following these steps:
  1) Contact the nearest rehabilitation facility to inform them of the incident. If the rehabilitation personnel cannot be reached immediately, please contact NMFS stranding hotline at 866-755-6622 or NMFS Sea Turtle Stranding Coordinator at 978-281-9328.
  2) Keep the turtle shaded and moist (e.g., with a water-soaked towel over the eyes, carapace, and flippers), and in a confined location free from potential injury.
  3) Contact the crew boat to pick up the turtle as soon as possible from the dredge (within 12 to 24 hours maximum). The crew boat should be aware of the potential for such an incident to occur and should develop an appropriate protocol for transporting live sea turtles.
  4) Transport the live turtle to the closest permitted rehabilitation facility able to handle such a case.

  Do not assume that an inactive turtle is dead. The onset of rigor mortis and/or rotting flesh are often the only definite indications that a turtle is dead. Releasing a comatose turtle into any amount of water will drown it, and a turtle may recover once its lungs have had a chance to drain.

- **If a turtle appears to be comatose** (unconscious), contact the designated stranding/rehabilitation personnel immediately. Once the rehabilitation personnel has been informed of the incident, attempts should be made to revive the turtle at once. Sea turtles have been known to revive up to 24 hours after resuscitation procedures have been followed.
  - Place the animal on its bottom shell (plastron) so that the turtle is right side up and elevate the hindquarters at least 6 inches for a period of 4 up to 24 hours. The

degree of elevation depends on the size of the turtle; greater elevations are required for larger turtles.

- Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches then alternate to the other side.
- Periodically, gently touch the eye and pinch the tail (reflex test) to see if there is a response.
- Keep the turtle in a safe, contained place, shaded, and moist (e.g., with a water-soaked towel over the eyes, carapace, and flippers) and observe it for up to 24 hours.
- If the turtle begins actively moving, retain the turtle until the appropriate rehabilitation personnel can evaluate the animal. The rehabilitation facility should eventually release the animal in a manner that minimizes the chances of re-impingement and potential harm to the animal (i.e., from cold stunning).
- Turtles that fail to move within several hours (up to 24) must be handled in the manner described, or transported to a suitable facility for necropsy (if the condition of the sea turtle allows and the rehabilitation facility wants to necropsy the animal).



Stranding/rehabilitation contacts

NMFS Stranding Hotline: 866-755-6622 or NERStranding.staff@noaa.gov

Virginia State Coordinator: Sea Turtle Stranding and Salvage Network
Mark Swingle (Co-Coordinator, James River South and VA Eastern Shore)
Virginia Aquarium Stranding Program
717 General Booth Boulevard
Virginia Beach, VA 23451
Office: 757-437-6022; Fax: -4976
Stranding Hotline: 757-437-6159
mswingle@vbgov.com

APPENDIX F

Procedure for obtaining fin clips from sturgeon for genetic analysis

Obtaining Sample

1. Wash hands and use disposable gloves. Ensure that any knife, scalpel or scissors used for sampling has been thoroughly cleaned and wiped with alcohol to minimize the risk of contamination.

2. For any sturgeon, after the specimen has been measured and photographed, take a one-cm square clip from the pelvic fin.

3. Each fin clip should be placed into a vial of 95% non-denatured ethanol and the vial should be labeled with the species name, date, name of project and the fork length and total length of the fish along with a note identifying the fish to the appropriate observer report. All vials should be sealed with a lid and further secured with tape Please use permanent marker and cover any markings with tape to minimize the chance of smearing or erasure.

Storage of Sample

1. If possible, place the vial on ice for the first 24 hours. If ice is not available, please refrigerate the vial. Send as soon as possible as instructed below.

Sending of Sample

1. Vials should be placed into Ziploc or similar resealable plastic bags. Vials should be then wrapped in bubble wrap or newspaper (to prevent breakage) and sent to:

Julie Carter
NOAA/NOS – Marine Forensics
219 Fort Johnson Road
Charleston, SC 29412-9110
Phone: 843-762-8547

a. Prior to sending the sample, contact Russ Bohl at NMFS Northeast Regional Office (978-282-8493) to report that a sample is being sent and to discuss proper shipping procedures.

Appendix G

STURGEON SALVAGE FORM

For use in documenting dead sturgeon in the wild under ESA permit no. 1614 (version 05-16-2012)

INVESTIGATORS'S CONTACT INFORMATION

Name: First ____________ Last ____________

Agency Affiliation ____________ Email ____________

Address ____________

____

Area code/Phone number ____________

UNIQUE IDENTIFIER (Assigned by NMFS)

DATE REPORTED:

Month ☐☐ Day ☐☐ Year 20☐☐

DATE EXAMINED:

Month ☐☐ Day ☐☐ Year 20☐☐

SPECIES: (check one)

- ☐ shortnose sturgeon
- ☐ Atlantic sturgeon
- ☐ Unidentified *Acipenser* species

Check "Unidentified" if uncertain . See reverse side of this form for aid in identification.

LOCATION FOUND: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)

River/Body of Water ____________ City ____________ State ____

Descriptive location (be specific) ____________

____

____

Latitude ____________ N (Dec. Degrees) Longitude ____________ W (Dec. Degrees)

CARCASS CONDITION at time examined: (check one)

- ☐ 1 = Fresh dead
- ☐ 2 = Moderately decomposed
- ☐ 3 = Severely decomposed
- ☐ 4 = Dried carcass
- ☐ 5 = Skeletal, scutes & cartilage

SEX:

- ☐ Undetermined
- ☐ Female ☐ Male

How was sex determined?

- ☐ Necropsy
- ☐ Eggs/milt present when pressed
- ☐ Borescope

MEASUREMENTS: Circle unit

Fork length ________ cm / in

Total length ________ cm / in

Length ☐ actual ☐ estimate

Mouth width (inside lips, see reverse side) ________ cm / in

Interorbital width (see reverse side) ________ cm / in

Weight ☐ actual ☐ estimate ________ kg / lb

TAGS PRESENT? Examined for external tags including fin clips? ☐ Yes ☐ No Scanned for PIT tags? ☐ Yes ☐ No

Tag #	Tag Type	Location of tag on carcass

CARCASS DISPOSITION: (check one or more)

- ☐1 = Left where found
- ☐2 = Buried
- ☐3 = Collected for necropsy/salvage
- ☐4 = Frozen for later examination
- ☐5 = Other (describe) ____________

Carcass Necropsied?

☐Yes ☐No

Date Necropsied: ____________

Necropsy Lead:

____

PHOTODOCUMENTATION:

Photos/vide taken? ☐ Yes ☐ No

Disposition of Photos/Video: ____________

____

____

SAMPLES COLLECTED? ☐ Yes ☐ No

Sample	How preserved	Disposition (person, affiliation, use)

Comments:

____

____

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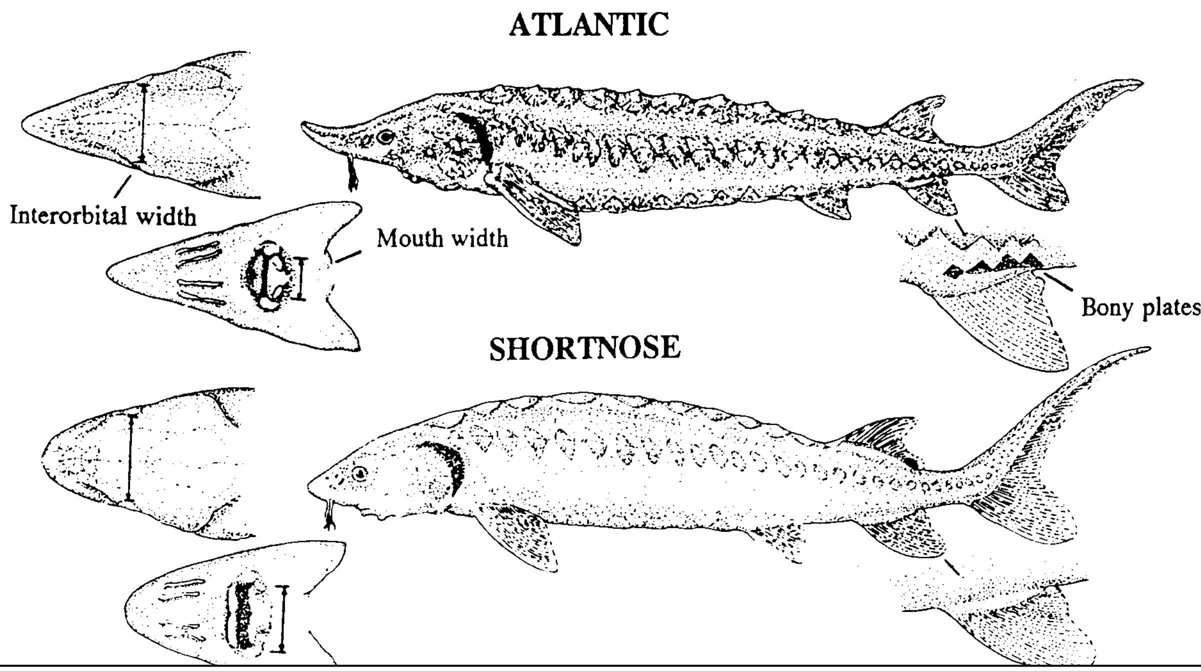
Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 07-20-2009)

Characteristic	Atlantic Sturgeon, *Acipenser oxyrinchus*	Shortnose Sturgeon, *Acipenser brevirostrum*
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004



Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). **Please note if no wounds / abnormalities are found.**

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Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

Submit completed forms (within 30 days of date of investigation) to: **Northeast Region Contacts** – Shortnose Sturgeon Recovery Coordinator (Jessica Pruden, Jessica.Pruden@noaa.gov, 978-282-8482) or Atlantic Sturgeon Recovery Coordinator (Lynn Lankshear, Lynn.Lankshear@noaa.gov, 978-282-8473); **Southeast Region Contacts**- Shortnose Sturgeon Recovery Coordinator (Stephania Bolden, Stephania.Bolden@noaa.gov, 727-824-5312) or Atlantic Sturgeon Recovery Coordinator (Kelly Shotts, Kelly.Shotts@noaa.gov, 727-551-5603).

APPENDIX H
ENDANGERED SPECIES OBSERVER FORM
Sandbridge Shoals 2012-2013

Daily Report

Date: ________________________________
Geographic Site:____
Location: Lat/Long ____________________ Vessel Name ___________________________

Weather conditions:____
____
Water temperature: Surface ____________ Below midwater (if known) ____________

Condition of screening apparatus: ____
____
____
Incidents involving endangered or threatened species? (Circle) Yes No
(*If yes, fill out Incident Report of Sea Turtle/ Sturgeon Mortality*)

Comments (type of material, biological specimens, unusual circumstances, etc:)
____
____
____

Observer's Name: ____
Observer's Signature: ____

Species	# of Sightings	# of Animals	Comments

Incident Report of Sea Turtle Take

Species ______________ Date ________________ Time (specimen found) _________________

Geographic Site ____
Location: Lat/Long ____
Vessel Name ___________________________ Load # ________________________________
Begin load time _________________________ End load time___________________________
Begin dump time ________________________ End dump time _________________________

Sampling method ____
Condition of screening ____
Location where specimen recovered____
____

Draghead deflector used? YES NO Rigid deflector draghead? YES NO
Condition of deflector ____
____

Weather conditions____
____

Water temp: Surface _________________ Below midwater (if known) _______________________

Species Information: *(please designate cm/m or inches.)*
Head width ____________________________ Plastron length _____________________________
Straight carapace length _________________ Straight carapace width_______________________
Curved carapace length __________________ Curved carapace width _______________________

Condition of specimen/description of animal (please complete attached diagram)
____
____
____

Turtle Decomposed: NO SLIGHTLY MODERATELY SEVERELY

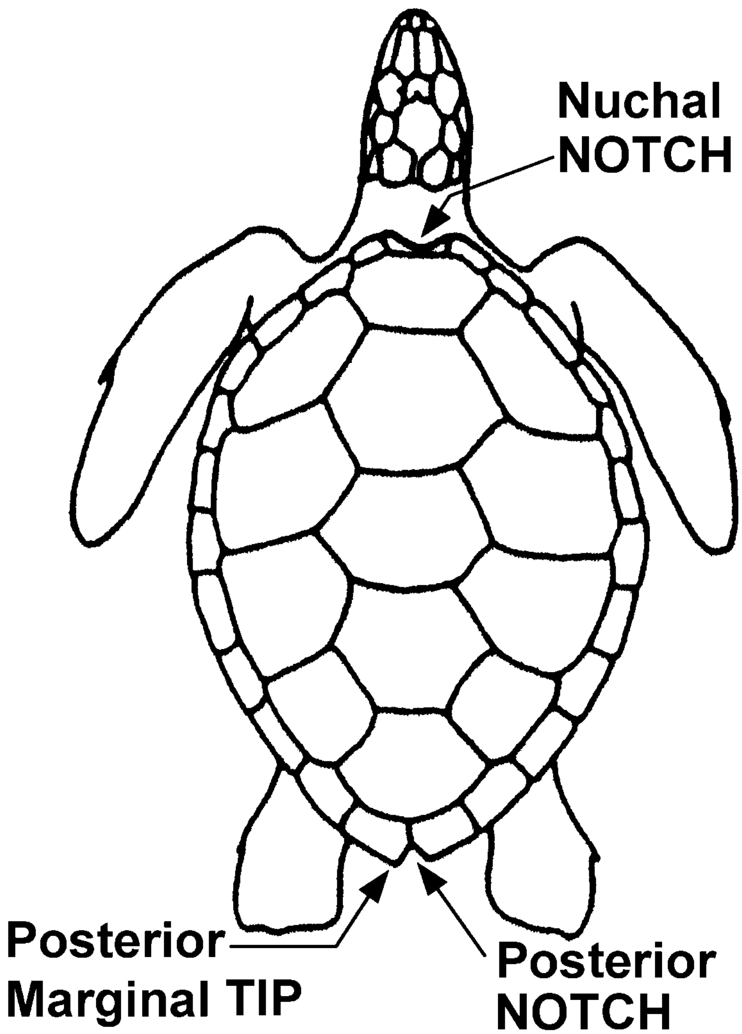
Turtle tagged: YES NO *Please record all tag numbers.* Tag # _______________________
Genetic sample taken: YES NO
Photograph attached: YES NO
(please label *species, date, geographic site* and *vessel name* on back of photograph)

Comments/other (include justification on how species was identified) _____________________
____
____

Observer's Name ____
Observer's Signature ____________________________________

Incident Report of Sea Turtle Take

Draw wounds, abnormalities, tag locations on diagram and briefly describe below.



Description of animal:

Incident Report of Sturgeon Take

Photographs should be taken and the following information should be collected from all sturgeon (alive and dead)

Date ________________ Time (specimen found) _________________

Geographic Site____
Location: Lat/Long____
Vessel Name ___________________________ Load # _____________________________
Begin load time _________________________ End load time_________________________
Begin dump time ________________________ End dump time _______________________

Sampling method ____
Condition of screening ____
Location where specimen
recovered____

____
Draghead deflector used? YES NO Rigid deflector draghead? YES NO
Condition of deflector ____

____
Weather conditions____

____
Water temp: Surface _________________ Below midwater (if known) ________________

Species Information: *(please designate cm/m or inches.)*
Fork length (or total length) ______________________ Weight ______________________

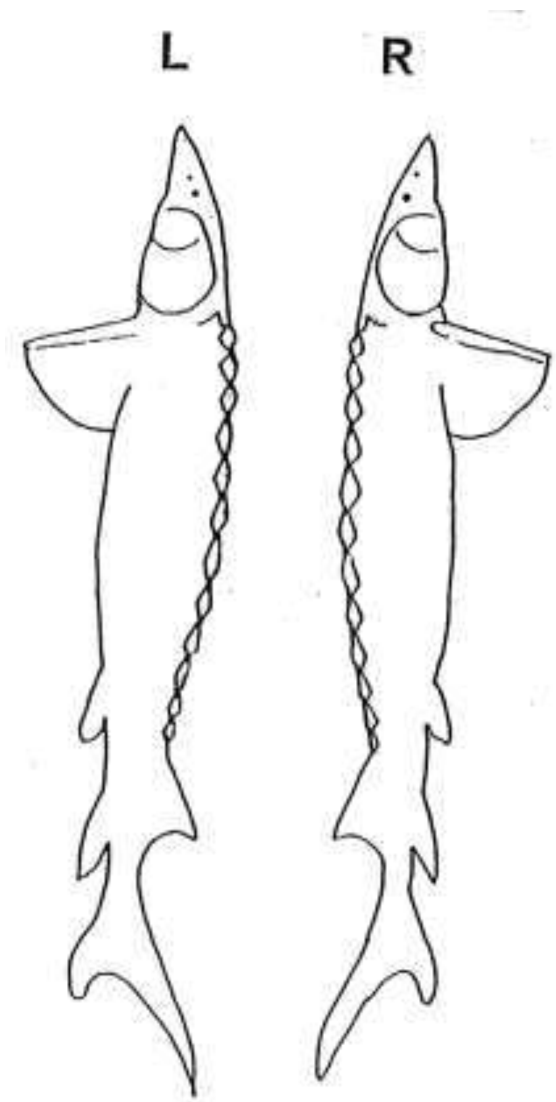
Condition of specimen/description of animal

____
____
____
____

Fish Decomposed: NO SLIGHTLY MODERATELY SEVERELY
Fish tagged: YES / NO *Please record all tag numbers.* Tag # _________________
Genetic sample taken: YES NO
Photograph attached: YES / NO
(please label *species, date, geographic site* and *vessel name* on back of photograph)
Comments/other (include justification on how species was identified)

____
____
Observer's Name ____________________Observer’s Signature______________________

Draw wounds, abnormalities, tag locations on diagram and briefly describe below



Description of fish condition:

Appendix B **-** Essential Fish Habitat Assessment

APPENDIX B

ESSENTIAL FISH HABITAT ASSESSMENT
SANDBRIDGE BEACH EROSION CONTROL
AND
HURRICANE PROTECTION PROJECT
VIRGINIA BEACH, VIRGINIA

TABLE OF CONTENTS

ESSENTIAL FISH HABITAT ASSESSMENT
SANDBRIDGE BEACH EROSION CONTROL
AND
HURRICANE PROTECTION PROJECT
VIRGINIA BEACH, VIRGINIA

I. Introduction and Background

Sandbridge Beach is located on a barrier island along coastal southeast Virginia separating the Atlantic Ocean on the east from Back Bay, a shallow freshwater sound, to the west. It is a residential community of mostly year round residents, rental properties, and summer homes located approximately 5 miles south of Virginia Beach's "resort strip." Several major storms, nor'easters, and hurricanes have struck the area in past years causing severe losses of sand and coastal flooding; the oceanfront is susceptible to wave attack on the beach berm and dunes. During the initial development of Sandbridge Beach as a residential community, sand dunes were lowered, bulldozed, and in some cases, removed for construction near the shoreline. Flooding in the winter of 1991 caused about $2 million in damages. In 1992, 166 oceanfront lots were fortified with bulkheads to control erosion; by 1996, storm damage left only 122 properties protected by bulkheads.

A Phase I Advanced Engineering and Design Study for Beach Erosion and Hurricane Protection at Virginia Beach, including Sandbridge Beach, was authorized by Section 1(a) of the Water Resources Development Act of 1974 (Public Law 93-251, 93rd Congress, H.R. 10203, 7 March 1974). In March 1992, the U.S. Army Corps of Engineers (USACE) completed a Final Feasibility Report and Environmental Assessment (EA) for Sandbridge Beach evaluating economic, engineering, and environmental concerns. The Minerals Management Service (MMS) prepared a supplemental EA in 1997, 2001, and 2006 to support the extraction and use of Outer Continental Shelf (OCS) sand in the project.

This Essential Fish Habitat (EFH) assessment was prepared by the USACE, acting as lead Federal agency, in cooperation with the MMS, to present the potential impacts that could result from beach nourishment of the oceanfront at Sandbridge Beach and the related offshore extraction of beach borrow material. The proposed maintenance project would begin in Spring/Summer 2010 and incorporate the same design criteria as previous projects.

The designated borrow site is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea (Figure 1). Estimated sand reserves are 40 million cy (Hardaway et al., 1998). In places, the shoal is about 20 ft thick. The principal sediment is fine to medium sand. There are two designated borrow areas on Sandbridge Shoal, Area B to the north and Area A to the south; depths here range from 30 to 65 feet (~10-15 m in the areas actively being dredged). The region between the two borrow sites is a no-dredge zone due to the presence of a buried Navy submarine communications cable.

Approximately 6,810,000 cy of sand were removed from Sandbridge Shoal between 1996 and 2007 for use in beach nourishment and coastal restoration projects (Figure 2). Sandbridge Shoal was first used in 1996 when 810,000 cy were dredged from Area B for shoreline protection at

Dam Neck. Dam Neck was renourished a second time by the Navy in 2003 with 700,000 cy dredged from Area B. Beach nourishment for Sandbridge Beach actually began in 1998, using 1,100,000 cy from Area B. Sandbridge Beach was renourished again in 2002 with 2,000,000 cy dredged from Area B and 2,200,000 cy in 2007 dredged from areas A and B.

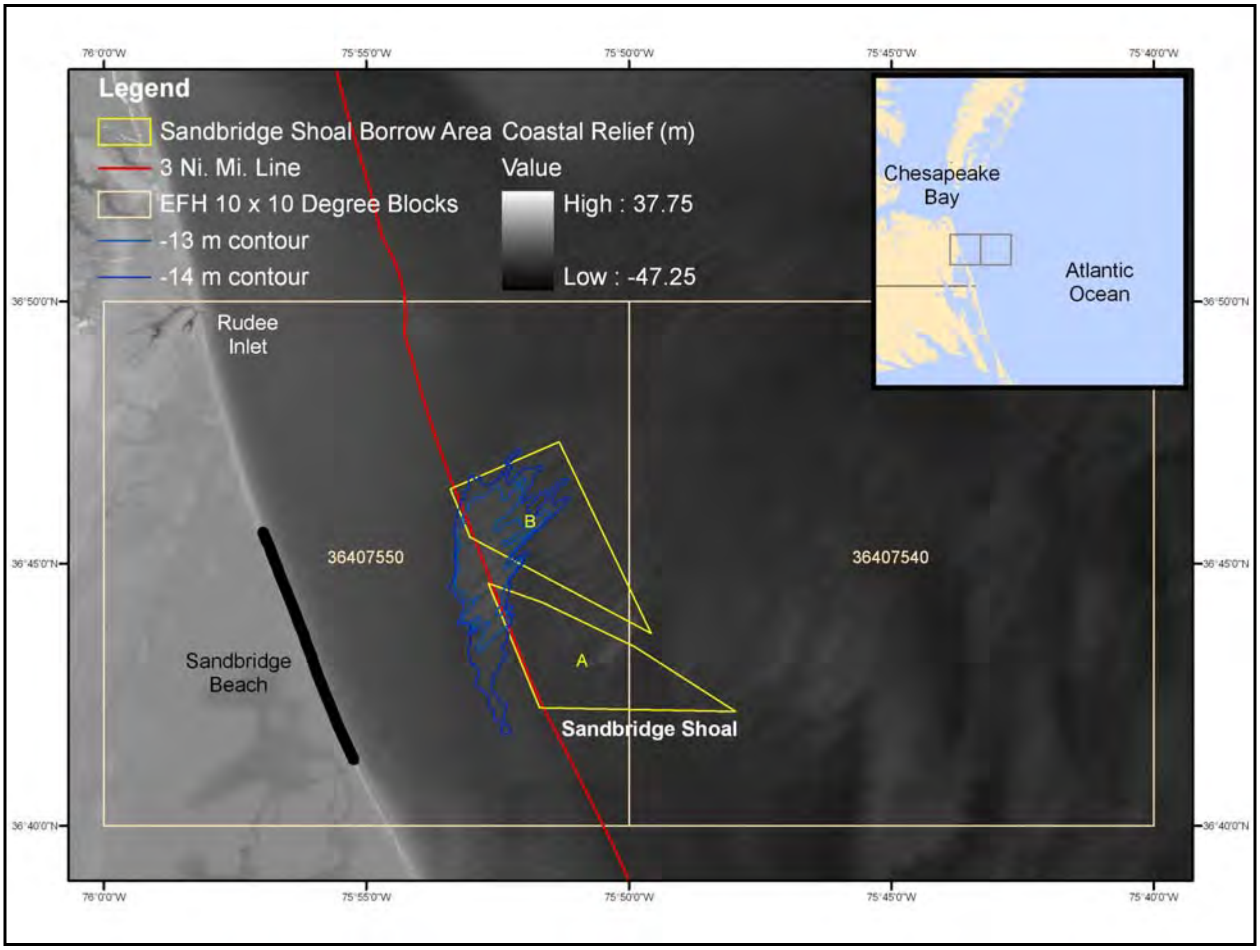


Figure 1: Location map of Sandbridge Shoal and Sandbridge Beach

II. Purpose

Provisions of the Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801) require that EFH areas be identified for each species managed under a fishery management plan, and that all Federal agencies consult with the National Marine Fisheries Service (NMFS) on all Federal actions that may adversely affect EFH. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." The EFH areas have been designated by the Fishery Management Councils and were published in March 1999 by NMFS. This EFH assessment is being prepared pursuant to Section 305(b)(2) of the Magnuson-Stevens Act, and includes the following required parts: 1) identification of species of concern; 2) a description of the proposed action; 3) an analysis of the effects of the proposed action; 4) proposed mitigation; and 5) the Federal agency's views regarding the effects of the proposed action. The purpose of this consultation process is to address specific federal actions that may adversely affect EFH, but do not have the potential to cause substantial adverse impact.

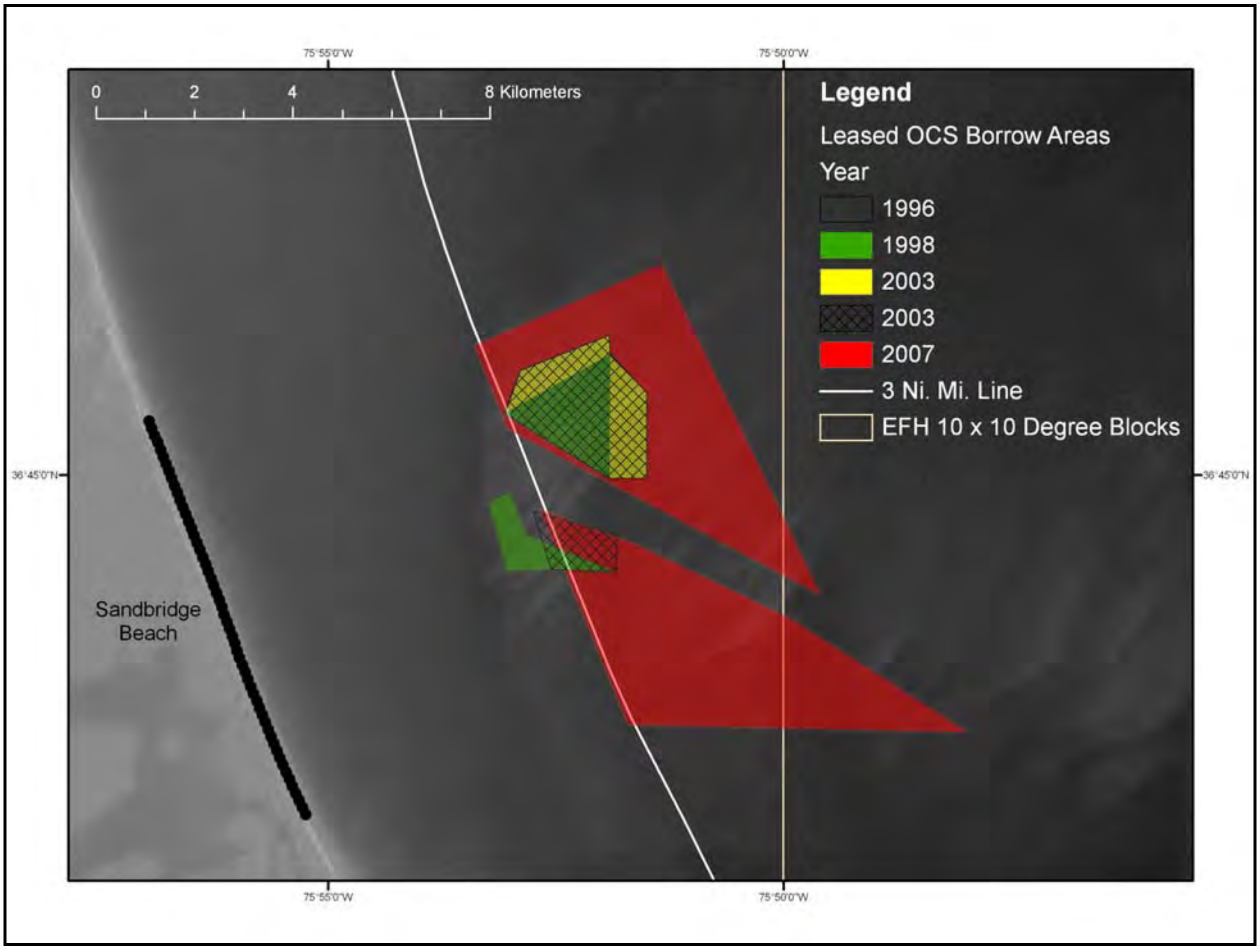


Figure 1: Location map showing borrow areas used since 1996 to obtain sand for beach nourishment projects at Sandbridge Beach and Dam Neck Naval Facility. Material was dredged from much smaller regions with each approved lease area.

III. Proposed Project

Approximately 1.5 to 2.0 million cubic yards (cy) of beach quality sand would be placed on the beach approximately every 3 years depending upon weather conditions, availability of funding, and behavior of subsequently placed material at the project site. The cycle may occur less often, but probably no less than once every 5 years. The specific beach area covered extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north to Back Bay National Wildlife Refuge to the south. The project dimensions include a 50-foot wide berm at an elevation of 6 feet North American Vertical Datum (NGVD) with a foreshore slope of approximately 1:20 (one vertical foot to 20 horizontal feet) for a distance of approximately 5 miles.

The designated borrow area for the planned spring/summer 2010 project is Borrow Area B; higher relief sand ridges on the crest of main shoal body are the primary target for dredging (Figure 3). Borrow Area A would still remain an option in the event it is deemed necessary to dredge in that location. Approximately 1.5 to 2.0 million cubic yards of beach quality sand would be removed by trailing suction hopper dredge. A hydraulic cutterhead suction dredge may be operated, but is highly unlikely; this type of dredge has not been previously utilized. The specifications for the project call for a duration of approximately 90-120 days.

A hopper dredge digs material from the bottom by making passes over the site, typically moving at 1 to 2 knots. The hopper dredge is equipped with dragarms, dragheads, and a hopper which collects and decants slurried sand. In the case of a twin-arm dredge, the material is dug in two swaths that are each the width of the draghead (typically 6-8 ft wide). To get a full load, a typical hopper dredge may make two or three passes along the target shoal. The dragheads house the pumping system, typically have teeth and pressure jets to loosen the material being dredged, and are fitted with turtle deflectors. When the hopper is full, material is transported to a pump out buoy located offshore. The material is then pumped through a discharge pipeline, which runs along the ocean floor, and up onto the beach where bulldozers and graders will distribute the material along the subaerial beach and foreshore. The project schedule would require either two medium-size hopper dredges (4,000-5,000 cubic yards capacity) delivering a total of six loads per day (three each), or one large hopper dredge (9,000 to 12,000 cy) delivering two or three loads per day.

A cutter-suction dredge uses a rotating cutterhead around the intake of a suction pipe to break up or loosen bottom material. The cutter-suction dredge is typically anchored in fixed position by a three-wire anchoring arrangement or spuds; the position is changed as the dredge finishes removing all the material it can reach. The dredge digs material from the bottom by swinging the cutterhead back and forth across an arc of 150 to 300 feet. Winches on the bow of the dredge pull the cutterhead back and forth and advance it ahead in the cut in 4- to 6-foot steps. A large centrifugal pump removes the loosened material from the ocean bottom and pumps it as a sediment-water slurry through a discharge pipeline to the placement site. But in cases where the distance from the dredge location to the placement site is beyond a few miles, the slurry is often pumped into scows for transport to the placement site. The dredge plant is supported by one or more small work boats used for surveying, line handling, anchor placement, and transporting workers. In the case of a barge-based project, operation would include one or two tugboats and one or two barges.

Historically, dredging and placement for the Sandbridge Beach project has occurred between the months of January and October. Future dredging could potentially occur during any month of the year, but substantial winter dredging would be unlikely because of hopper dredge availability, greater ocean wave energy and resultant higher risk to ships and crew, as well as difficulty of operation. Dredging and placement operations, conducted since 1996, have typically taken between 10-15 weeks to complete, but depend on the number of hopper dredges deployed.

IV. EFH Consultation History

Since EFH areas along coastal Virginia were first designated by the Mid-Atlantic Fishery Management Council and published by NOAA Fisheries in 1999, formal consultation was not initiated for initial construction at the Dam Neck Naval Facility in 1996 or Sandbridge Beach in 1998.

MMS submitted an EFH assessment in October 2001 to support leasing OCS sand from Sandbridge Shoal for the first maintenance cycle of the Corps' Sandbridge Beach Erosion Control and Hurricane Protection Project planned for 2002-2003. The assessment determined that 740 acres of EFH may experience adverse effects, with the most impact on demersal fishes. In January 2002, the Northeast Region of NOAA Fisheries offered conservation recommendations to mitigate potential impacts and monitor the extent of impacts and potential recovery of managed species and their associated habitat. The MMS responded in February 2002 indicating its intention to follow the specified measures to the maximum extent practicable. In June 2002, the MMS submitted an assessment addendum given that the timing of the proposed action had changed - the original assessment and addendum covered species present in both fall and spring. In August 2002, NOAA Fisheries determined that the assessment and addendum adequately addressed potential impacts on managed species and their habitat and found that no additional conservation recommendations were necessary.

In July 2003, the Navy submitted a new EFH assessment that considered the potential effects of using another 700,000 cubic yards of OCS sand from Sandbridge Shoal to replenish the Dam Neck Annex Beach. The assessment, addressing impacts of dredging over the fall and winter months, determined that the proposed project may have adverse effects on EFH for Federally managed species. In September 2003, Tim Goodger (NOAA Fisheries) emailed the Navy providing the identical conservation recommendations as provided to the MMS in 2002.

The MMS attempted to consult with NOAA Fisheries in 2006 for the second maintenance cycle of the Sandbridge Beach Erosion Control and Hurricane Protection Project planned for summer 2007, but did not receive any response to multiple phone or email communications.

Since new information about managed species and their associated habitat is available, the Corps and MMS have reinitiated consultation.

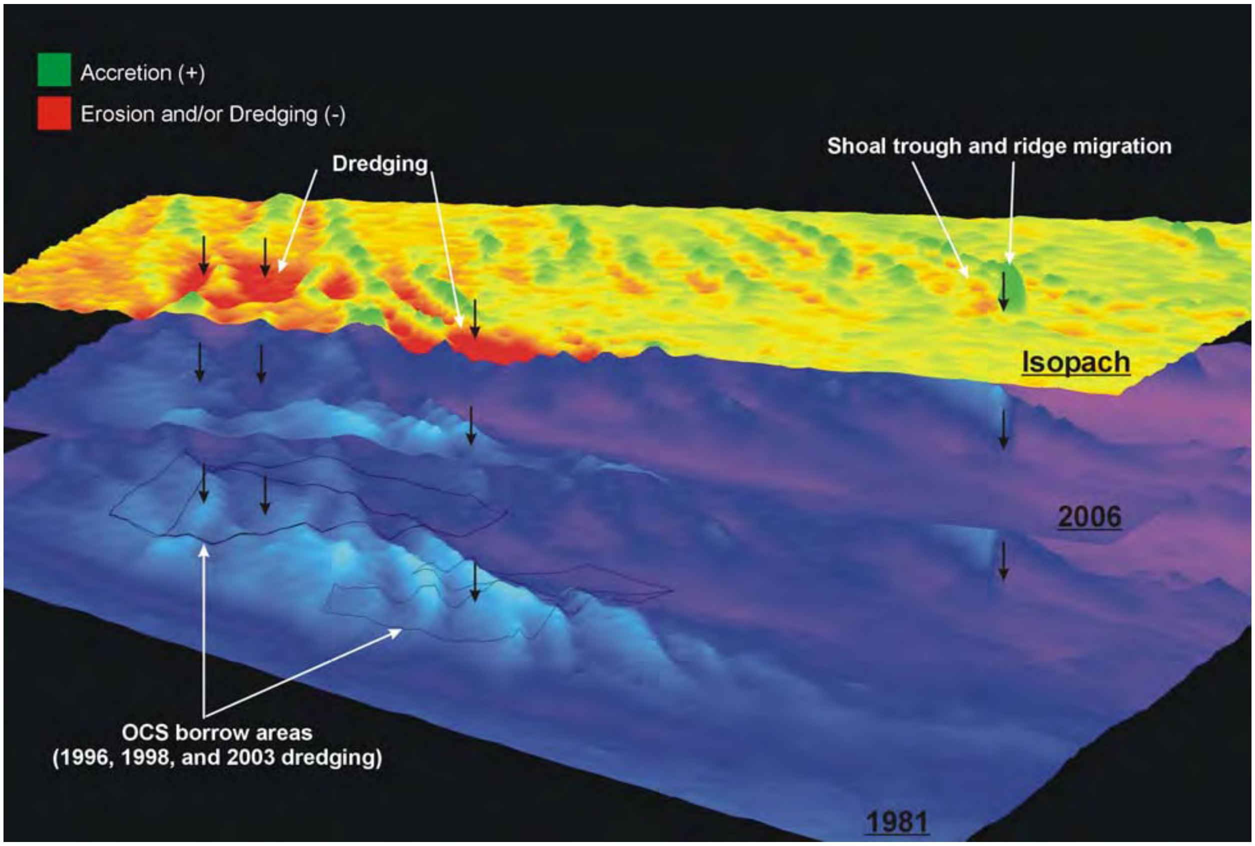


Figure 2: Bathymetric elevation models represent the seafloor in the vicinity of Sandbridge Shoal. The isopach shows the difference between the two surfaces and the physical evolution of the shoal complex during the 25 year intervening period.

V. Benthic Habitat and Biota Monitoring on Sandbridge Shoal

Physical processes dominate the sand-rich habitat of Sandbridge Shoal and the seaward series of high relief secondary shoals (Figure 3). The shoal environment is frequently exposed to high wave and current energy given its relatively shallow water depth. The seafloor of the main shoal body is characterized by fine to medium sands. Smooth-crested wave-orbital bedforms have been repeatedly documented in benthic video and stillshots (Cutter and Diaz, 1998; Diaz et al., 2003). The bottom substrate east of the shoal is increasingly silty sand and patchy, where biological activity tends to be higher.

Over decadal timeframes, the ridge and swale topography imprinted on the larger shoal body is actively migrating to the south-southwest under coupled wave-current forcing. Figure 3, which compares 1981 and 2006 bathymetric surfaces, shows three physical signatures: 1) the southward migration of trough and ridges (see as alternating bands of erosion and accretion); 2) trough deepening and ridge crest growth and steepening; and 3) localized, persistent effects of dredging along shoal flanks and crests in limited subregions of Areas A and B.

Figure 4 shows pre- and post-dredging conditions in 1998 and 2003 for a subregion of Area B, while Figure 5 shows pre- and post-dredging conditions in 2007 for a subregion of Area A. Two different dredging approaches are illustrated: (1) shallow dredging of multiple shoal ridges and (2) targeted extraction from a single shoal ridge. Some of the same shoal ridges have been dredged during more than one construction cycle, increasingly the likelihood and severity of impact. However, the shoal ridges typically targeted for dredging are large scale and high relief features. Consequently, they are not entirely eliminated during dredging. Although shoal relief and footprint are significantly reduced, the shoals are morphologically intact and continually shaped by the same physical processes. Between dredging episodes, the shoals show relatively little volumetric recovery, leading to a long-term reduction in the surface area of bottom habitat.

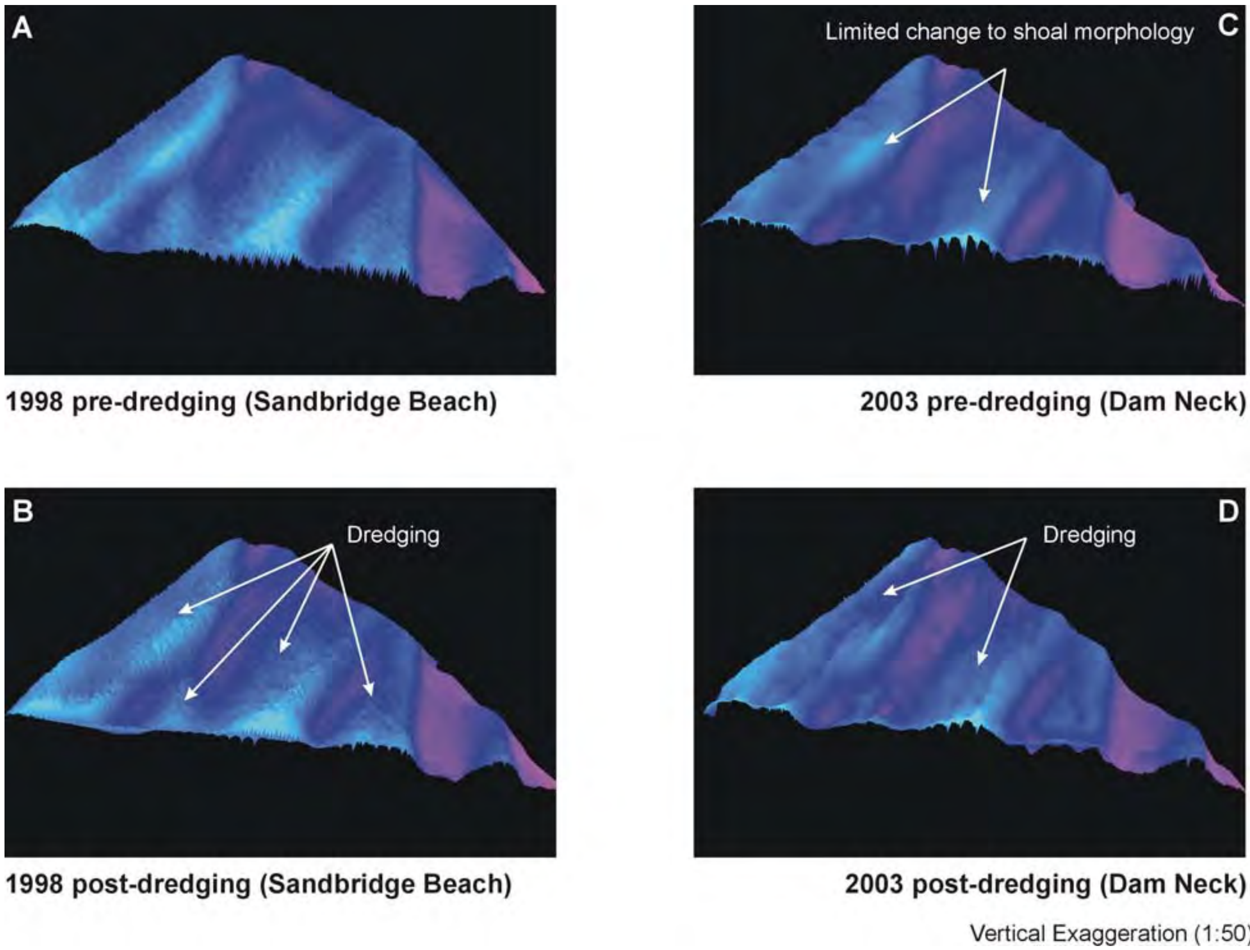


Figure 3: Pre- and post-dredging conditions in 1998 and 2003 for a subregion of Area B.

From 2002 to 2005, VIMS implemented a rigorous biological monitoring program that focused on possible biological impacts associated with dredging of Area B (Diaz et al., 2006). Results from that field campaign were compared to earlier benthic assessments (Cutter and Diaz, 1998). During survey periods in 2002, 2004, and 2005, physical processes were predominant in structuring sediment surfaces for all sampling stations in all years. Observations in 1996 and 1997 showed increasingly biologically dominated habitats with increasing distance off shoal (Cutter and Diaz, 1998). Diaz et al. (2006) have attributed some of the spatial and temporal heterogeneity to 1) energetic storms which expose and rework surface sediments, 2) infrequent, but significant benthic recruitment events, and 3) seasonal variability. Despite multiple dredging events, the shoal environment continues to host robust macrobenthic and fish communities. In the vicinity of historic dredging, no negative impacts for macrobenthos or demersal fishes were documented.

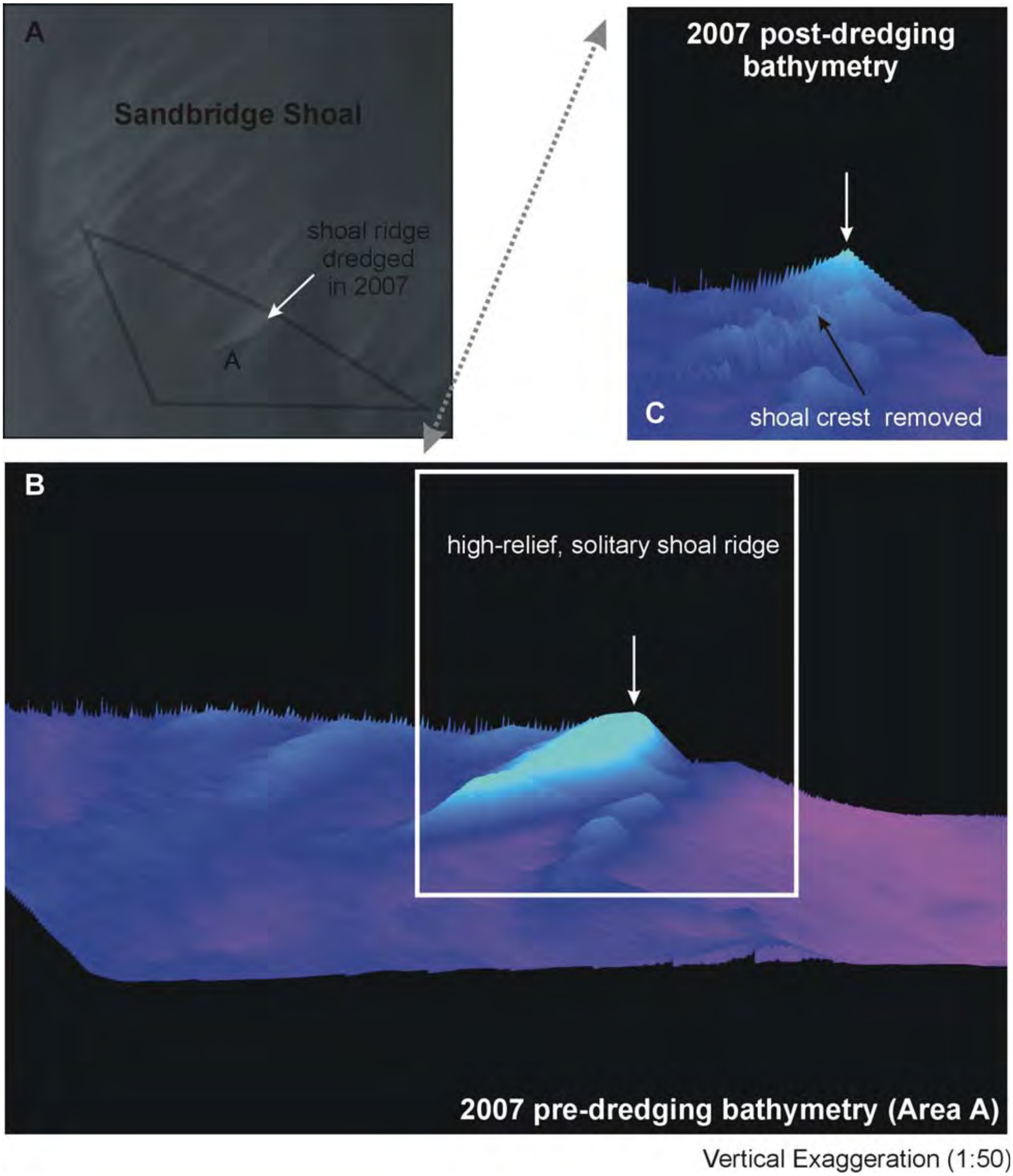


Figure 4: Pre- and post-dredging conditions in 2007 for a subregion of Area A.

The most abundant benthic, taxonomic group observed during monitoring was polychaetes. Other benthic species observed included amphiods, bivalves, lancelets, and to a lesser extent, decapods, nemerteans, echinoderms, anemonies, isopods, gastropods, phoronids, and tunicates. Interestingly, Diaz et al. (2006) observed that macrobenthic production east and west of the shoal was about 2.5 times more productive than the shoal crest. Cutter and Diaz (1998) also found benthic production to be higher off shoal relative to on shoal. The community composition on and around Sandbridge Shoal for 2002-2005 was similar to previous work. Cutter and Diaz (1998) found polychaetes, amphipods, decapods, bivalves, sand dollars, and lancelets to be the dominant groups. The average macrofaunal abundance in 1996 and 1997 was 1.5 to 2.5 times lower than 2002 to 2005 conditions. Monitoring revealed no significant difference in macrofaunal abundance between dredged areas (Area B) and controls, suggesting that dredging within Area B has had little impact on habitat value.

During the three-year monitoring period, a total of 1,600 fishes and skates, representing 12 taxa, and 1,000 invertebrates, representing 12 taxa, were collected. The most common fishes were the sea robins, accounting for 32% of all fishes. Spotted hake was the second most abundant and accounted for 26% of the fishes, even though it did not occur in any trawl in 2002. Butterfish were 16% of the fishes, even though it did not occur in 2002. Pinfish and smallmouth flounder were 16% and 6% of the fishes, respectively. Other flounders, mostly summer flounder, and black sea bass were about 1% of the fishes. The trawls also collected mobile and sessile invertebrates that were not collected quantitatively by grab sampling. The most abundant being hermit crabs (*Pagurus* spp.), and sand shrimp (*Crangon septemspinosa*), followed by the Atlantic brief squid (*Lolliguncula brevis*), and one individual of the Atlantic bobtail squid (*Rossia* sp.). There were no significant differences between sampling locations (on and off shoal) or between years in the abundance of sea robins, smallmouth flounder, or pinfish. Diaz et al. (2006) reported no statistically significant preference in use of habitat, but noted that the odds of occurrence varied through time, showing off shoal preference for some years, and on shoal for others. For the most abundant fishes, there were no differences in habitat utilization, but fishes generally showed broad preference for sandy habitat (Diaz et al., 2003). Following dredging, most demersal fishes, except the spotted hake and smallmouth flounder, were more likely to be on shoal. Gut content and stable isotopic analyses were conducted during the multi-year monitoring effort. The most common food items consumed by demersal fishes were epifaunal and/or infaunal species in the decapod, amphipod, and mysid taxonomic groups. There were notable differences in diets between fish species, but no differences in feeding patterns were observed within particular species across sampling locations or years. The food web in the vicinity of Sandbridge Shoal was generally limited to two trophic levels beyond the primary producers; primary consumers, such as bivalves and amphipods, supported secondary consumers and demersal fish at the third trophic level. Top level species were spotted hake and weakfish.

VI. Identification of Managed Species

Square I

10' x 10' Square Coordinates:

Boundary	North	East	South	West
Coordinate	36° 50.0' N	75° 50.0' W	36° 40.0' N	76° 00.0' W

Square Description: Waters within the Atlantic Ocean within the square affecting North Bay, Shipps Bay, and southern Virginia Beach. These waters affect the following: Muddy Creek, Porpoise Pt., and northern Long I., and affect Virginia Beach from Rudee Inlet on the north, south past Sandbridge Beach, VA., to east of half way down Long I., just north of the Wash Flats.

Square II

10' x 10' Square Coordinates:

Boundary	North	East	South	West
Coordinate	36° 50.0' N	75° 40.0' W	36° 40.0' N	75° 50.0' W

Square Description: Waters within the Atlantic Ocean within the square one square east of the square affecting and within North Bay and Shipps Bay and affecting southern Virginia Beach.

Compiled Species List: Square Coordinates I and II

Species	Eggs	Larvae	Juveniles	Adults
red hake *(Urophycis chuss)*	X	X	X	
witch flounder *(Glyptocephalus cynoglossus)*	X			
windowpane flounder *(Scopthalmus aquosus)*	X	X	X	
Atlantic sea herring *(Clupea harengus)*			X	X
monkfish *(Lophius americanus)*	X	X		
bluefish *(Pomatomus saltatrix)*			X	X

Species	Eggs	Larvae	Juveniles	Adults
Atlantic butterfish *(Peprilus triacanthus)*			X	
summer flounder *(Paralicthys dentatus)*			X	X
scup *(Stenotomus chrysops)*	n/a	n/a	X	X
black sea bass *(Centropristus striata)*	n/a	X	X	X
surf clam *(Spisula solidissima)*	n/a	n/a	X	
spiny dogfish *(Squalus acanthias)*	n/a	n/a	X	X
king mackerel *(Scomberomorus cavalla)*	X	X	X	X
Spanish mackerel *(Scomberomorus maculatus)*	X	X	X	X
cobia *(Rachycentron canadum)*	X	X	X	X
red drum *(Sciaenops occelatus)*	X	X	X	X
sand tiger shark *(Odontaspis taurus)*		X		X
Atl. sharpnose shark *(Rhizopriondon terraenovae)*				X
dusky shark *(Charcharinus obscurus)*		X	X	
sandbar shark *(Charcharinus plumbeus)*		X	X	X
sandbar shark *(Charcharinus plumbeus)*		HAPC	HAPC	HAPC
scalloped hammerhead shark *(Sphyrna lewini)*			X	
tiger shark *(Galeocerdo cuvieri)*		X	X	X
winter skate *(Leucoraja ocellata)*			X	
clearnose skate *(Raja eglanteria)*			X	X

Source: National Marine Fisheries Service: “Summary of EFH Designation” posted on the internet at http://www.nero.noaa.gov/hcd/webintro.html and EFH Designations for New England Skate Complex posted at http://www.nero.noaa.gov/hcd/skateefhmaps.htm

The notation "X" in a table indicates that EFH has been designated within the square for a given species and life stage.

The notation "n/a" in the tables indicates some of the species either have no data available on the designated lifestages, or those lifestages are not present in the species' reproductive cycle. These species are: redfish, which have no eggs (larvae born already hatched); long finned squid, short finned squid, surf clam, and ocean quahog which are referred to as pre-recruits and recruits (this corresponds with juveniles and adults in the tables); spiny dogfish, which have no eggs or larvae (juveniles born live); scup and black sea bass, for which there is insufficient data for the life stages listed, and no EFH designation has been made as of yet (some estuary data is available for all the life stages of these species, and some of the estuary squares will reflect this).

VII. Evaluation of Impacts on EFH Species

This section contains official EFH description language, relevant background information and an evaluation of potential impacts at Sandbridge Shoal and Sandbridge Beach for each species. Official EFH description language for all species is excerpted from the NMFS "Guide to Essential Fish Habitat Description" website http://www.nero.noaa.gov/hcd/list.htm. The descriptions describe the geographical extent in which the EFH is found, as well as the type of habitats utilized by each lifestage of the species evaluated in this report. NMFS groups three of the species, king mackerel, Spanish mackerel, and cobia, and describes them collectively under the category of "coastal migratory pelagics." EFH descriptions contained below for these individual species have been subdivided from this group. The life stages of bony and cartilaginous fish are distinct from each other at subadult stages. EFH is designated for egg, larval, juvenile, and adult life history stages of bony fish. EFH is designated for egg, neonate/early juvenile, late juvenile/subadult, and adult life history stages of cartilaginous fish. Portions of the area are designated as Habitat of Particular Concern (HAPC) for the sandbar shark.

Fish occupation of waters within the project impact area is highly variable, both spatially and temporally. Some of the species are found strictly offshore, while others may occupy both nearshore and offshore waters. Some species may be suited for open-ocean or pelagic waters, while others may be more oriented to bottom or demersal waters. This can also vary between life stages of federally managed species. Additionally, seasonal abundance is highly variable, as many species are highly migratory.

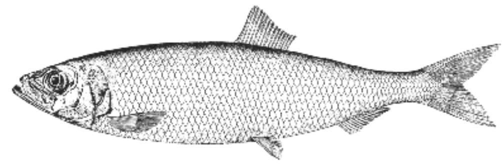
Direct impacts to each finfish species are evaluated largely based on their likelihood of being physically present, and therefore potentially physically harmed at either the proposed borrow areas or beach fill placement areas during project construction. Finfish could be directly impacted during dredging of sand by being entrained into the dredge or by being struck by the dredge plant. At Sandbridge Beach, direct impacts to finfish could potentially occur while sand is being pumped off the hopper dredge and placed (or moved along) the beach and in the surf zone. With the exception of some less motile juvenile species, most pelagic and demersal species are highly mobile and should be able to avoid entrainment in the dredge. While individual finfish of a number of species will likely be entrained into the dredge and destroyed, no detrimental impacts to the populations of any finfish are expected from the proposed project.

Indirect impacts to each finfish species could occur as a result of several aspects of the project. EFH species can be adversely impacted temporarily due to increased turbidity and decreased dissolved oxygen content during the dredging and placement, or temporary changes in local bottom habitat conditions (W.F. Baird & Associates and Research Planning, 2004). The turbidity and dissolved oxygen impacts would subside upon cessation of construction activities. There is only a minor portion of fine-grained sediment within the material to be dredged and placed, and turbidity can be pronounced locally at both sites naturally as a result of wave re-suspension of bottom sediments at any time of year. For these reasons it is assumed that indirect impacts from turbidity will be short-lived and localized (MMS, 1999). In addition, because of the open nature of Sandbridge Shoal, turbidity should decrease as the particles in the water column rapidly dissipate into the surrounding coastal ocean waters.

Relatively non-motile benthos, such as polychaetes and molluscs, will be destroyed over much of the area to be dredged; this may result in local loss of prey items for finfish following dredging until benthic communities recover. Recovery time of the benthos within both the dredging area and within the seawardly-translated surf zone of Sandbridge Beach is expected to be relatively rapid. Substantial recovery of both areas should occur within several months. Full recovery of both sites by benthos to a condition resembling pre-project conditions may take several years (Nelson, 1993; Newell et al., 1998; USACE, 2001; Jutte et al., 2002; Posey and Alphin, 2002). Naturally-occurring physical processes, often magnified by tropical and extra-tropical storms, are expected to be the foremost control on benthic habitat conditions and benthic community at any given time (Diaz et al., 2006). Recolonization of the borrow area substrate by benthos is expected to be facilitated by the likely presence of undisturbed bottom on the ridges between the furrows within the otherwise dredged area, as well as large regions of the shoal that are not dredged. Changes to the benthic community and habitat quality could result in impacts to the foodweb. These impacts are expected to be short-lived and localized.

Dredging may also result in physical alterations to the substrate and seafloor morphology. Changes in substrate could result in changes to benthic community assemblages after recolonization, or in unsuitable substrate for the spawning of some finfish species. For instance, should an area of the shoal be dredged too extensively, a substrate of course sandy material could be replaced with a substrate of clays. However, changes in substrate are not expected because dredging depths would generally be limited to depths characterized by beach-compatible sand; these suitable dredge depths are based on extensive vibracore data and minimize the probability of dissimilar substrates being exposed. Indirect impacts to finfish could potentially occur along the shoreline as shallow ocean water surf zone habitat is converted to inter-tidal and supra-tidal beach habitat. Seaward translation of the shoreline, profile equilibration, alongshore spreading, and "loss" of nearshore open water habitat is not expected to cause any significant indirect impacts to finfish; in a general sense, this habitat will only be translated seaward rather than "lost" because of the relative vastness of the seafloor.

1. Atlantic Herring (*Clupea harengus*)



A. EFH for Atlantic Herring:

Juveniles: Pelagic waters and bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras as depicted in Figure 3.3. Generally, the following conditions exist where Atlantic herring juveniles are found: water temperatures below 10° C, water depths from 15 - 135 meters, and a salinity range from 26 -32%.

Adults: Pelagic waters and bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras. Generally the following conditions exist where Atlantic herring adults are found: water temperatures below 10º C water depth from 20-130 meters, and salinity above 28 ppt.

B. Background

The Atlantic herring is a coastal pelagic species that inhabits both sides of the North Atlantic Ocean (Reid et al., 1999), as well as the northeast Pacific Ocean (Robins et al., 1986). In the western North Atlantic they range from Labrador to Cape Hatteras. Juveniles and adults undergo complex north-south and inshore-offshore migrations for feeding, spawning, and overwintering. The Georges Bank/Nantucket Shoals stock overwinter south of Cape Cod and along the mid-Atlantic coast. The stock moves north onto Georges Bank and into the Gulf of Maine in the spring before congregating on spawning grounds southeast of Nantucket and on Georges Bank in the fall. The migrations of coastal adults are less well known. Adults in the western Gulf of Maine may migrate southwest along the coast after spawning and overwinter at the western extreme of their migratory path, possibly south of Cape Cod. Vertical migrations linked to changing light intensity are pronounced and are probably related to movements of prey and avoidance of predatory seabirds. Adults have a diet dominated by krill shrimp, arrow worms, copepods, amphipods, and flying snails (pteropods). Spring and autumn spawing populations support major commercial fisheries (Reid et al., 1999). Atlantic herring were extremely abundant in northeastern U.S. waters during the 1960's and were fished intensively by a large foreign fleet. In the early 1970's the Georges Bank-Nantucket Shoals fishery stock collapsed. Landings remained low for about 10 years, but stock biomass is now high and apparently increasing. The stock complex is underutilized, although the Gulf of Maine portion of the complex may be fully exploited (Reid et al., 1999). As of 1997, Atlantic herring was not overfished (NMFS, 2001). Favored habitat for the species are pelagic waters and bottom habitats in the middle Atlantic south to Cape Hatteras in water temperatures below 50°F (10°C), water depth from 20 to 130 m (65 to 426 ft).

C. Project Impacts

Adult and juvenile Atlantic sea herring are unlikely to be present in the sand placement or dredge area because of their preference for greater water depths and colder water temperatures as noted in the EFH description. Therefore, no direct or indirect impacts from sand borrow or placement are expected.

2. Black sea bass *(Centropristis striata)*

A. EFH for Black sea bass:

Larvae: 1) North of Cape Hatteras, EFH is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all ranked ten-minute squares of the area where black sea bass larvae are collected in the MARMAP survey. 2) EFH includes estuaries where black sea bass were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, the habitats for the transforming (to juveniles) larvae are near the coastal areas and into marine parts of estuaries between Virginia and New York. When larvae become demersal, they are generally found on structured inshore habitat such as sponge beds.

Juveniles**:** 1) Offshore, EFH is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked squares of the area where juvenile black sea bass are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where black sea bass are identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Juveniles are found in the estuaries in the summer and spring. Generally, juvenile black sea bass are found in waters warmer than 43^{o} F with salinities greater than 18 ppt and coastal areas between Virginia and Massachusetts, but winter offshore from New Jersey and south. Juvenile black sea bass are usually found in association with rough bottom, shellfish and eelgrass beds, man-made structures in sandy-shelly areas; offshore clam beds and shell patches may also be used during the wintering.

Adults: 1) Offshore, EFH is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares of the area where adult black sea bass are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where adult black sea bass were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Black sea bass are generally found in estuaries from May through October. Wintering adults (November through April) are generally offshore, south of New York to North Carolina. Temperatures above 43^{o} F seem to be the minimum requirements. Structured habitats (natural and man-made), sand and shell are usually the substrate preference.

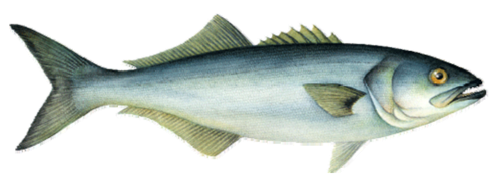
B. Background

Black sea bass is a warm temperate, demersal species that utilizes open water and structured benthic habitats for feeding and shelter. They occur from Nova Scotia to Florida in the Atlantic (Steimle et al., 1999), and throughout the entire Gulf of Mexico (Robins et al., 1986). Their distribution changes seasonally as they migrate from coastal areas to the outer continental shelf when water temperatures decline in the Fall. They also migrate from the outer shelf to inshore areas as temperatures warm in the Spring (Steimle et al., 1999). Juveniles are typically found in areas with structures, including shells, sponge beds, and cobbles and not commonly found on open unvegetated bottoms. Juveniles prey upon small epibenthic invertebrates, especially crustaceans and molluscs. Black sea bass support a commercial and recreational fishery (Steimle et al., 1999). Within the Mid-Atlantic States, recreational landings are comparable to or exceed the commercial fishery (MMS, 1999). The black sea bass population in the mid-Atlantic is overexploited (Steimle et al., 1999).

C. Project Impacts

Black sea bass larvae may be present in the inter-tidal zone during sand placement and within the borrow areas during dredging. Demersal larvae tend to be present in association with structure (e.g., shells) and depressions on the shoal seafloor, which are not commonly found in the borrow areas. Should demersal larvae be present, they may be drawn into the dredge and destroyed. No impacts to the larvae population are expected because there is no reason to expect that black sea bass larvae will be concentrated in the dredging area. Furthermore, the area to be impacted compared with the area of the continental shelf over which the larvae are likely to occur is relatively small in scale. Juveniles and adults may be present during sand placement on the Sandbridge shoreline. However, the area does not possess pronounced benthic cover or suitable substrate to which they would orient, and their numbers would likely be few. However, any black sea bass remaining on the bottom or venturing too close to the dredge intake could be entrained; juveniles would probably be more vulnerable because of their slower swimming speed. There is no reason to expect that black sea bass will be concentrated in the dredging area, therefore no significant impacts to the black sea bass population are expected (Diaz et al., 2006). Black sea bass juveniles and adults may suffer minor indirect impacts from food web disturbance caused by destruction of benthos and altered habitat conditions within the proposed borrow areas. However, because of the temporary and localized nature of the impacts, and relatively small area of bottom to be disturbed compared to the total area of comparable bottom habitat available, impacts are expected to be very minor. Enhanced topography on the shoal seafloor following dredging may provide a benefit to black sea bass by increasing bottom heterogeneity and enhancing habitat. Though, benefits would be very minor because of the relatively small scale of the area impacted. Any beneficial impacts will diminish as natural processes rework the seafloor and furrows fill in with material from the surrounding area.

3. Bluefish *(Pomatomus saltatrix)*



A. EFH for Bluefish:

Juveniles: 1) North of Cape Hatteras, EFH is pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ) from Nantucket Island, Massachusetts south to Cape Hatteras, in the highest 90% of the area where juvenile bluefish are collected in the NEFSC trawl survey. 2) South of Cape Hatteras, EFH is 100% of the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida. 3) EFH also includes the "slope sea" and Gulf Stream between latitudes 29^{o} 00 N and 40^{o} 00 N. 4) Inshore, EFH is all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida. Generally juvenile bluefish occur in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from May through October, and South Atlantic estuaries March through December, within the "mixing" and "seawater" zones. Distribution of juveniles by temperature, salinity, and depth over the continental shelf is undescribed (Fahay et al., 1999).

Adults: 1) North of Cape Hatteras, EFH is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from Cape Cod Bay, Massachusetts south to Cape Hatteras, in the highest 90% of the area where adult bluefish were collected in the NEFSC trawl survey. 2) South of Cape Hatteras, EFH is 100% of the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida. 3) Inshore, EFH is all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida. Adult bluefish are found in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from April through October, and in South Atlantic estuaries from May through January in the "mixing" and "seawater" zones. Bluefish adults are highly migratory and distribution varies seasonally and according to the size of the individuals comprising the schools. Bluefish generally found in normal shelf salinity (> 25 ppt).

B. Background

Bluefish occur in the western north Atlantic from Nova Scotia to Bermuda and in the western south Atlantic from northern South America to Argentina. They are widely but irregularly distributed elsewhere in the Atlantic and Indian Oceans (Robins et al., 1986). They travel in schools of like-sized individuals and undertake seasonal migrations, moving into the mid-Atlantic Bight during spring and south and farther offshore during fall. Bluefish adults are highly migratory and distribution varies seasonally and according to the size of the individuals comprising the schools. Adults are generally found in areas characterized with oceanic salinities of greater than 25 ppt. Eggs and larvae occur in ocean waters; juveniles have been recorded from all mid-south Atlantic Bight estuaries surveyed (Fahay et al., 1999). Typically, juvenile bluefish remain offshore until the onset of cooling water induces southern migrations. Some juveniles from the summer spawn will migrate into coastal and bay regions for the early portion of fall. They prey upon Atlantic silversides *(Menidia menidia)*, herrings, striped bass *(Morone saxatilis)*, bay anchovy, and other fish. Large population fluctuations are common (Fahay et al., 1999). Within the Mid and South Atlantic Bight, bluefish is one of the most important recreational species. Among sportfish, bluefish ranked first in the bight from 1979-1989 with catches occurring inshore and offshore. Recreational landings historically exceed commercial landings in the mid-Atlantic region which peaked in 1980 and declined steadily since that time and the stock was considered overharvested. Some improvements to the stock have been reported since 2004.

C. Project Impacts

Juveniles and adult bluefish may be present during dredging and sand placement. However, because of their high mobility they should be readily able to relocate from the project area to avoid direct detrimental impacts. Because of their open water orientation, disturbance to and alteration of bottom habitat at the borrow areas is expected to have minimal indirect impact to bluefish juveniles and adults. Food web impacts caused by the destruction of benthos and alteration of bottom habitat at the borrow areas are unlikely to impact bluefish because of the relatively small scale of the area to be impacted compared to the large abundance of comparable habitat on the continental shelf. Furthermore, prey items will be readily available from elsewhere. Food web impacts at the borrow areas will be temporary in nature, further reducing their potential impact to bluefish.

4. Atlantic Butterfish *(Peprilus triacanthus)*

A. EFH for Butterfish:

Juveniles: Offshore, EFH is the pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine through Cape Hatteras, North Carolina in areas that comprise the highest 75% of the catch where juvenile butterfish were collected in the NEFSC trawl surveys. Inshore, EFH is the "mixing" and/or "seawater" portions of all the estuaries where juvenile butterfish are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia. Generally, juvenile butterfish are collected in depths between 33 ft and 1200 ft and temperatures between 37^{o}F and 82^{o}F.

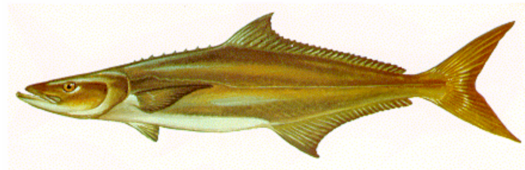
B. Background

Atlantic butterfish range along the Atlantic coast from Newfoundland to Florida, but they are most abundant from the Gulf of Maine to Cape Hatteras. They winter near the outer edge of the continental shelf in the mid-Atlantic Bight and migrate inshore in the spring. During the summer, they occur over the entire mid-Atlantic shelf, including estuaries. In late fall, butterfish move southward and offshore in response to falling water temperatures. Butterfish are primarily pelagic, and form loose schools that feed upon small fish, squid, and crustaceans. They have a high natural mortality rate and are preyed upon by many species including silver hake, bluefish, swordfish, and long-finned squid. During summer, juvenile butterfish associate with jellyfish to avoid predators. Juveniles feed mainly on planktonic prey. Butterfish support a commercial fishery (Cross et al., 1999). The stock is at a low to medium biomass level; although recruitment levels have remained high, the stock size of adults is currently well below average (Mid-Atlantic Fishery Management Council, 2000). Overall, it appears that the butterfish stock is not over fished (Overholtz, 2000).

C. Impact Assessment

Butterfish juveniles may be present in the dredge area and sand placement area, but this is unlikely since juveniles tend to prefer deeper waters as noted in the EFH description. Should juvenile butterfish be in the project areas their high mobility should allow them to relocate from either the dredging or sand placement areas to avoid direct physical harm. No indirect impacts to juvenile butterfish are expected as a consequence of alterations to bottom habitat since juveniles are largely pelagic, and not closely associated with the bottom. No indirect impacts resulting from food web impacts are expected because butterfish are planktivorous and their food items are derived from a wide area. Any food web impacts will be temporary in nature.

5. Cobia *(Rachycentron canadum)*



A. EFH for Cobia

Essential fish habitat for cobia includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone, but from the Gulf Stream shoreward, including *Sargassum.* In addition, all coastal inlets, all state-designated nursery habitats of particular importance to cobia. For cobia, essential fish habitat also includes high salinity bays, estuaries, and seagrass habitat. In addition the Gulf Stream is an essential fish habitat because it provides a mechanism to disperse coastal migratory pelagic larvae. For cobia, essential fish habitat occurs in the South Atlantic and Mid-Atlantic Bights.

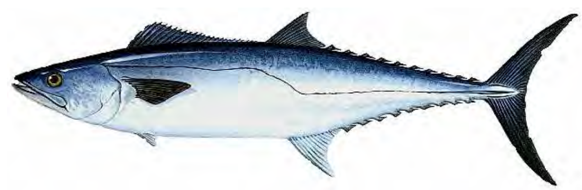
B. Background

Cobia occurs nearly worldwide in warm waters. Within the Atlantic, cobia occurs from Massachusetts to Argentina. Cobia habitat includes the coastal to open ocean; they are common around sea buoys and other floating shelter (Robins et al., 1986), and congregate in the shade of wrecks and pilings (Mills, 2000). Larval habitat is the water column. They move from one area to another and seek prey wherever local resources happen to be abundant (South Atlantic Fishery Management Council, 1998). They forage on bottom-dwelling prey such as shrimp, crab, and sinall fishes (Mills, 2000). Many of their prey species are estuarine-dependent in that they spend all or a portion of their lives in estuaries. They prefer high salinity and temperature governs the occurrence of cobia (South Atlantic Fishery Management Council, 1998). Cobia tend to move about as individuals or occasionally in small groups of two or three (Mills, 2000). East coast cobia stocks move up the coast from the Carolinas reaching tile Chesapeake Bay area in late May and early June when water temperatures rise over 20°C (68°F). Fish in the Chesapeake region migrate out of the region to deeper offshore and more southerly waters in September. Cobia support commercial and recreational fisheries. In the U.S., the cobia recreational catch is speculated to be greater than the commercial catch. Commercial harvests steadily increased along the Atlantic and Gulf coasts over the period from 1981 through the early 1990s, and have remained relatively constant through the 1990s. Current levels of fishing mortality are unknown (Mills, 2000).

C. Project Impacts

Cobia may be in the project area during construction occurring from about May to August. Individual eggs and larvae may be destroyed during dredging and sand placement. However, any cobia eggs or larvae present on the Sandbridge shoreline or within the offshore borrow areas would be widely distributed and there is no reason to believe they would be concentrated in the project area; therefore no significant impacts to the cobia population are expected. Cobia juveniles and adults may be present during dredging at the borrow areas, and cobia juveniles, because of their occurrence on beaches, may be present on the Sandbridge shoreline during sand placement conducted during these months. Because cobia feed on bottom-dwelling prey, individuals could be present on the bottom. Any cobia juveniles or adults that are present in the project area during construction could easily swim away and relocate to adjacent areas to avoid detrimental impacts. Any individuals venturing too close to the dredge intake could be entrained and destroyed, however; juveniles would probably be more vulnerable than adults because of their slower swimming speed. There is no reason to expect that cobia will be concentrated in the dredging area, therefore no significant impacts to the cobia population are expected. Destruction of benthos and alterations of bottom habitat will likely reduce the suitability of the borrow areas as a foraging area for several months to years following dredging. These disturbances are unlikely to impact cobia because abundant undisturbed bottom will remain elsewhere on the continental shelf, and food web impacts will be temporary in nature.

6. King Mackerel (*Scomberomorus cavalla*)



A. EFH for King Mackerel

Essential fish habitat for king mackerel includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone, but from the Gulf Stream shoreward, including *Sargassum.* In addition, all coastal inlets, all state-designated nursery habitats of particular importance to king mackerel. For king mackerel, essential fish habitat also includes high salinity bays, estuaries, and seagrass habitat. In addition the Gulf Stream is an essential fish habitat because it provides a mechanism to disperse coastal migratory pelagic larvae. For king mackerel, essential fish habitat occurs in the South Atlantic and Mid-Atlantic Bights.

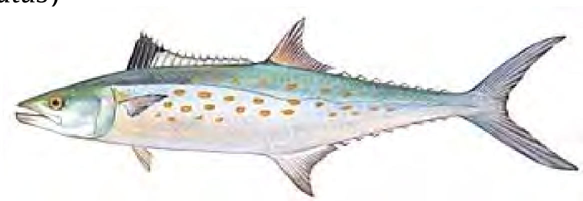
B. Background

King mackerel inhabit Atlantic coastal waters from Maine to Brazil (Godcharles and Murphy, 1986). King mackerel are surface-dwelling and occur in the nearshore in association with wrecks, towers, reefs, and other structures. The king mackerel migrate in large schools of similarly sized individuals over considerable distances along the Atlantic coast (Murdy et al., 1997). Temperature governs the occurrence of the species; it is seldom found in water temperatures less than 20°C (68°F) and they prefer high salinity (South Atlantic Fishery Management Council, 1998). King mackerel spawn in the south Atlantic (Godcharles and Murphy, 1986). Larval habitat is the water column. The species moves from one area to another and seeks prey wherever local resources happen to be abundant. Many of their prey species are estuarine-dependent in that they spend all or a portion of their lives in estuaries (South Atlantic Fishery Management Council, 1998). King mackerel principally eat fish, but shrimps and squid are also eaten (Murdy et al., 1997). They support important commercial and recreational fisheries along the Atlantic coast and throughout the Gulf of Mexico. Recent stock assessments indicate that management measures in the South Atlantic have been successful at rebuilding the stock. However, they are still in need of protection.

C. Project Impacts

King mackerel may be in the project area during construction occurring from about June to August. Any king mackerel eggs or larvae present on the Sandbridge shoreline or within the offshore borrow areas would be widely distributed and there is no reason to believe they would be concentrated in the project area. Therefore, although eggs or larvae may be destroyed during construction, no significant impacts to the king mackerel population are expected. King mackerel juveniles and adults could be present during dredging, and king mackerel juveniles, because of their occurrence on beaches, may be present on the Sandbridge shoreline during sand placement conducted during these months. However, any juveniles or adults that are present in the project area during construction could easily swim away and relocate to adjacent areas to avoid direct detrimental impacts. Alterations of bottom habitat and destruction of benthos are unlikely to impact king mackerel because abundant comparable bottom habitat occurs elsewhere. Food web impacts will be minimal because of the relatively small scale of impact and temporary nature of the disturbance.

7. Spanish Mackerel (*Scomberomorus maculatus*)



A. EFH for Spanish mackerel

Essential fish habitat for Spanish mackerel includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone, but from the Gulf Stream shoreward, including *Sargassum.* In addition, all coastal inlets, all state-designated nursery habitats of particular importance to Spanish mackerel. For Spanish mackerel, essential fish habitat also includes high salinity bays, estuaries, and seagrass habitat. In addition the Gulf Stream is an essential fish habitat because it provides a mechanism to disperse coastal migratory pelagic larvae. For Spanish mackerel, essential fish habitat occurs in the South Atlantic and Mid-Atlantic Bights.

B. Background

Spanish mackerel inhabit coastal waters from Maine to Mexico (Godcharles and Murphy, 1986). They are a near shore surface-dwelling species (Murdy et al., 1997). Temperature governs the occurrence of the species as it is seldom found in water temperatures less than 20°C. Spanish mackerel move northward each spring, spending summer in the northern part of their range, and migrating south in fall (Godcharles and Murphy, 1986). They spawn from Florida to New York (Godcharles and Murphy, 1986). The species moves from one area to another and seeks prey wherever local resources happen to be abundant. Many of their prey species are estuarine-dependent in that they spend all or a portion of their lives in estuaries (South Atlantic Fishery Management Council, 1998). Spanish mackerel principally eat small fish, shrimp, and squid (Murdy et al., 1997). They support important commercial and recreational fisheries along the Atlantic coast and throughout the Gulf of Mexico. Recent stock assessments indicate that management measures in the South Atlantic have been successful at rebuilding the stock. However, they are still in need of protection.

C. Project Impacts

Spanish mackerel may be in the project area during construction occurring from about June to August. Any Spanish mackerel eggs or larvae present on the Sandbridge shoreline or at the offshore borrow areas would be widely distributed. Therefore, although individual eggs and larvae may be destroyed, there is no reason to expect they would be concentrated in the project area. No significant impacts to the Spanish mackerel population are expected. Spanish mackerel juveniles and adults could be present during dredging, because of their occurrence on beaches.

They may be present on the Sandbridge shoreline during sand placement conducted during these months. However, any juveniles or adults that are present in the project area during construction could easily swim away and relocate to adjacent areas to avoid direct detrimental impacts. Alterations of bottom habitat are unlikely to impact Spanish mackerel because of the minor scale of impact compared to abundant bottom, and food web impacts impacting any of Spanish mackerel prey are expected to be minimal because their prey items are derived from a wide area.

8. Red Drum (*Sciaenops ocellatus*)

A. EFH for Red Drum:

Essential fish habitat includes all of the following habitats to a depth of 50 meters offshore: tidal freshwater; estuarine emergent vegetated wetlands (flooded salt marshes, brackish marsh, tidal creeks); estuarine scrub/shrub (mangrove fringe); submerged rooted vascular plants (sea grasses); oyster reefs and shell banks; unconsolidated bottom (soft sediments); ocean high salinity surf zones; and artificial reefs. The area covered includes Virginia through the Florida Keys.

B. Background

Red drumlive in coastal and estuarine waters from Massachusetts to Mexico, feeding on the bottom for crabs, shrimp, menhaden, mullet and spot. Most reach sexual maturity during their fourth year, when they are about 30 to 37 inches long. Spawning occurs in near-shore coastal waters–along beaches and near inlets and passes–from late summer and into the fall. Red drum are prolific spawners, bearing up to 2 million eggs in a single season. Their eggs hatch within 24 hours and are carried throughout the sounds and estuaries by the tides and winds. Currents into estuaries carry eggs spawned in the ocean where they hatch from August through September. Juvenile drum in these areas feed on zooplankton and invertebrates such as small crabs and shrimp. In N. Carolina, the updated stock assessment indicates that overfishing is no longer occurring and that management action, taken as a result of the 2001 Red Drum FMP, appears to have been effective. In the NMFS' most recent stock status report in 2000, it was noted there has not been a sufficient number of juvenile red drum reaching maturity and subsequently listed the stock as "overfished." Virginia's commercial catch, once as high as 180,000 pounds per year, has been insignificant since 1965.

C. Project Impacts

Red drum eggs and larvae are not likely to be in the project areas. Spawning occurs in late summer through early fall when project construction would be completed or nearing completion. However, as eggs migrate with currents inshore to estuaries, red drum eggs could be present in the project area. Although eggs or larvae may be destroyed during construction, no significant impacts to the red drum population are expected. Additionally, larvae and eggs near the Sandbridge shoreline or at the offshore borrow areas would be widely distributed and there is no reason to believe they would be concentrated in the project area. Red drum juveniles and adults are not likely to be present during the dredging but may inhabit the surface zone during sand placement. Minor impacts to the juvenile population are expected. Juvenile and adult on the

Sandbridge shoreline or at the offshore borrow areas would be widely distributed and there is no reason to believe they would be concentrated in the project area. No significant impacts to the red drum population are expected.

9. Red Hake *(Urophycis chuss)*

A. EFH for Red Hake:

Eggs: Surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where hake eggs are found: sea surface temperatures below 10°C along the inner continental shelf with salinity less than 25%. Red hake eggs are most often observed during the months from May - November, with peaks in June and July.

Larvae: Surface waters of Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where red hake larvae are found: sea surface temperatures below 19° C, water depths less than 200 meters, and salinity greater than 0.5%. Red hake larvae are most often observed from May through December, with peaks in September - October.

Juveniles: Bottom habitats with a substrate of shell fragments, including areas with an abundance of live scallops, in the Gulf of Maine, on Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where red hake juveniles are found: water temperatures below 16° C, depths less than 100 meters and a salinity range from 31 - 33%.

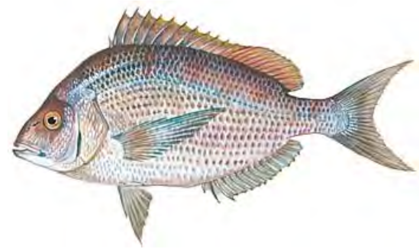
B. Background

Red hake is a demersal fish that occurs from North Carolina to Southern Newfoundland and is most abundant between Georges Bank and New Jersey. Red hake make seasonal migrations to follow preferred temperature ranges. During the warmer months, they are commonly found in depths less than 100 m. During the colder months, they are most commonly found in depths greater than 100 m. Major spawning areas occur on the southwest part of Georges Bank and on the continental shelf off southern New England and eastern Long Island, and in southern New England estuaries during the summer. The pelagic eggs of red hake are not separated from eggs of similar species in field collections; thus, the characteristics of the habitat in which red hake eggs are commonly found are poorly known. Eggs are buoyant and float near the water surface. During December through April, the undifferentiated eggs of hake species have been collected mostly at the edge of the continental shelf on southern Georges Bank and the Middle Atlantic Bight. During warmer months, hake eggs have been collected across the entire shelf in this area. Larval red hake dominate the summer ichthyoplankton in the Middle Atlantic Bight and were most abundant at mid-and outer continental shelf stations. Larval red hake have been collected in the upper water column from May through December and have been collected most abundantly during surveys in September-October. Red hake larvae have been collected on the middle to outer continental shelf of the Middle Atlantic Bight at temperatures between 8 and 23°C (most were collected between 11-19°C) within water depths between 10 and 200 m, with a few deeper occurrences. The distribution of juveniles varies with season. Recently metamorphosed juveniles remain pelagic for about two months. They then gradually descend to the bottom. Demersal settlement generally occurs between September and December with peaks in October-November. Shelter is a critical habitat requirement for red hake. Juveniles occur in depressions on the open seabed, often with living sea scallops *(Placopecten magellanicus),* Atlantic surf clam *(Spisula solidissima)* shells, biogenic depressions, moon snail egg, anemone and polychaete tubes, submerged man-made objects, debris, and artificial reefs. Larger juveniles remain near scallop beds and other structures in coastal areas and embayments; later they join older fish in an offshore migration in the Middle Atlantic Bight. In the Middle Atlantic Bight, red hake juveniles occur most frequently in coastal waters in the spring and fall; they move offshore to avoid the warm summer temperatures. In the winter, most of the population moves offshore. Winter migrants return inshore the following spring. In bottom trawl surveys, juvenile red hake were most abundant at temperatures of 3-16°C and at depths < 120 m; there were seasonal shifts in apparent preferences. Red hake may prefer silty, fine sand sediments. Larvae prey mainly on micro-crustaceans. Juvenile red hake leave shelter at night and commonly prey on small benthic and pelagic crustaceans, bristle worms, and arrow worms. Red hake (presumably mostly juveniles) are eaten by larger predatory fish, harbor porpoise *(Phocoena phocoena)* and other predators. Red hake supports a commercial fishery and is managed as two stocks, northern and southern, separated by Georges Bank. The southern stock (or overall stock) is currently considered overfished (Steimle, 1999).

C. Project Impacts

Red hake eggs are not likely to be present in the dredge and placement area because of their preference for water temperatures below 10º C; therefore, it is unlikely that red hake eggs will be directly impacted by the operation. Demersal red hake larvae are unlikely to be in the project areas. They tend to be present in association with structure (e.g., shells) and depressions on the shoal seafloor, which may be found in the troughs of ridges within the borrow areas. Should demersal larvae be present they may be drawn into the dredge and destroyed. However, because there is no reason to expect that large populations of red hake larvae will be concentrated in the dredging area, and because of the relatively small scale of the area to be impacted compared with the area of the continental shelf over which larvae are likely to occur, no significant impacts to red hake populations are expected. Juvenile red hake may be in the project area during dredging; however, they tend to prefer inshore waters further north, which match their preference for colder temperatures during the spring and summer. Furthermore, red hake favor sediments which are finer than those of the sand placement and dredge areas. Should red hake be present during dredging it is expected that because of their high mobility juveniles should easily be able to avoid intake. Any red hake juveniles remaining on the bottom or venturing too close to the dredge intake could be entrained and destroyed. Detrimental impacts to the red hake population from destruction of individual juveniles are expected to be insignificant because there is no reason to expect that red hake will be concentrated at the site. Food web impacts will be temporary in nature, further minimizing detrimental impacts. Increased bathymetric relief, left by the dredge as a series of ridges and furrows, may favor red hake larvae and juveniles. This beneficial impact would be very minor because of the relatively small size of the area impacted and would be expected to gradually dissipate as physical forces rework and smooth the shoal surface.

10. Scup *(Stenotomus chrysops)*



A. EFH for Scup:

Juveniles: 1) Offshore, EFH is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares of the area where juvenile scup are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where scup are identified as being common, abundant, or highly abundant in the ELMR database for the “mixing” and “seawater” salinity zones. Juvenile scup, in general during the summer and spring are found in estuaries and bays between Virginia and Massachusetts, in association with various sands, mud, mussel and eelgrass bed type substrates and in water temperatures greater than 45^{o} F and salinity greater than 15 ppt.

Adults: 1) Offshore, EFH is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares of the area where adult scup are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where scup were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 45^{o}F.

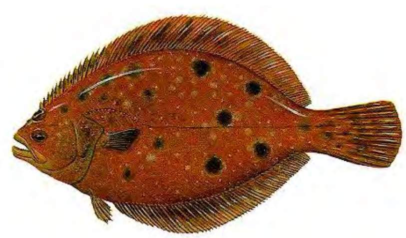
B. Background

Scup occur in the Atlantic from Nova Scotia to Florida (Robins et al., 1986), but primarily from Massachusetts to South Carolina. Scup are a temperate, demersal species that use several benthic habitats from open water to structured areas for feeding and possibly shelter. Their distribution changes seasonally as fish migrate from estuaries to the edge of the continental shelf as water temperatures decline in the winter and return from the edge of the continental shelf to inshore areas as water temperatures rise in the spring. During warmer months, juveniles live inshore in a variety of coastal habitats. Juveniles utilize biogenic depressions, troughs, and possibly mollusc shells, particularly during colder months. Adult habitats include soft sandy bottoms, on or near structures, such as rocky areas and manmade structures. Juveniles feed on small benthic invertebrates, fish eggs, and larvae. Adults prey on benthic and near bottom invertebrates, and small fish. Scup supports a commercial and recreational fishery. The mid-Atlantic stock of scup is currently considered overfished.

C. Project Impacts

Adult scup are common residents in the Middle Atlantic Bight from spring to fall and are generally found in schools on a variety of habitats, from open sandy bottom to structured habitats such as mussel beds, reefs, or rough bottom. Smaller-sized adult scup are common in larger bays and estuaries, but larger sizes tend to be in deeper waters. Scup usually congregate in schools, resulting in congregation in some areas and complete absence in other nearby areas. Schools are reported to be size-structured. During the warm months, scup stay close to shore, typically within 6 miles of the coastline. They live close to the bottom and concentrate over areas of smooth to rocky bottom. Scup feed on small, bottom-dwelling invertebrates (crabs, clams, starfish) and young finfish. With rising water temperatures in the spring, scup return inshore. Larger fish arrive first followed by schools of subadults, which have been reported to appear off southern New England slightly later. The fish reach Chesapeake Bay by April and southern New England by early May. Since scup tend to reside within estuaries during the warmer months, they are not expected to be within the dredge or placement areas during the project timeframe of Spring/Summer. If they are in the area, it is expected that juvenile and adult scup should easily be able to avoid direct detrimental impacts from dredging or sand placement, and easily relocate to adjacent waters. However, because they are demersal, individual scup may remain on the seafloor of the borrow areas during dredging. Any scup remaining on the bottom or venturing too close to the dredge intake could be entrained and destroyed. Juveniles would probably be more vulnerable than adults because of their slower swimming speed. There is no reason to expect that scup would be concentrated in the area to be dredged; therefore, no significant impacts to the scup population are expected. Because of their demersal nature, destruction of benthos and alterations in bottom habitat impacting the food web may cause negative impacts to scup. Because of the relatively small scale of the area to be impacted compared to abundant habitat elsewhere, these are expected to be minor. The impacts will also be temporary in nature, further decreasing their significance.

11. Summer flounder *(Paralichthys dentatus)*



A. EFH for Summer flounder:

Juveniles: 1) North of Cape Hatteras, EFH is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares for the area where juvenile summer flounder are collected in the NEFSC trawl survey. 2) South of Cape Hatteras, EFH is the waters over the Continental Shelf (from the coast out to the limits of the EEZ) to depths of 500 ft, from Cape Hatteras, North Carolina to Cape Canaveral, Florida. 3) Inshore, EFH is all of the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database for the "mixing" and "seawater" salinity zones. In general, juveniles use several estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas in water temperatures greater than 37^{o} F and salinity from 10 to 30 ppt range.

Adults: 1) North of Cape Hatteras, EFH is the demersal waters over the Continental Shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares for the area where adult summer flounder are collected in the NEFSC trawl survey. 2) South of Cape Hatteras, EFH is the waters over the Continental Shelf (from the coast out to the limits of the EEZ) to depths of 500 ft, from Cape Hatteras, North Carolina to Cape Canaveral, Florida. 3) Inshore, EFH is the estuaries where summer flounder were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer Continental Shelf at depths of 500 ft in colder months.

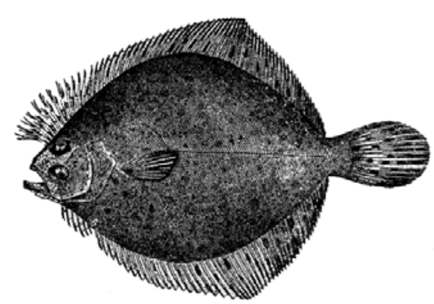
B. Background

Summer flounder, or fluke, inhabit shallow estuarine waters on the outer continental shelf from Nova Scotia to Florida, with a center of abundance in the mid-Atlantic. They exhibit strong seasonal inshore-offshore movements. Adult and juveniles normally inhabit shallow coastal and estuarine waters during the warmer months of the year, and remain offshore during the fall and winter. Smaller juveniles feed upon infauna such as polychaetes while larger juveniles feed upon fish, shrimp, and crabs in relation to their environmental abundance. Adults are opportunistic feeders with fish and crustaceans making up a substantial portion of their diet (Packer et al., 1999). Summer flounder are important both commercially and recreationally in the mid-Atlantic Bight. There is a significant offshore commercial fishery that occurs during the spring inshore migration and fall offshore migration and continues during the winter. During the summer, commercial and recreational fisheries are concentrated in coastal and estuarine waters. The stock is at a medium level of historical abundance and is over-exploited (Packer et al., 1999).

C. Project Impacts

Juveniles and adults may be in the project area during dredging and sand placement. Because of their great mobility, juvenile and adult summer flounder should easily be able to relocate elsewhere and avoid any detrimental impacts. However, because they are demersal, summer flounder may remain on the bottom during dredging. Any summer flounder remaining on the bottom or venturing too close to the dredge intake could be entrained and destroyed. Juveniles would probably be more vulnerable than adults because of their slower swimming speed. No significant impacts to the summer flounder population would be expected from destruction of individuals because there is no reason to believe that summer flounder will be concentrated in the area to be dredged. Because of their demersal nature, destruction of benthos and alterations in bottom habitat impacting the food web may cause detrimental impacts to summer flounder (Diaz et al., 2006). It is unclear whether altered habitat conditions at the borrow areas will have any other indirect impact on summer flounder. These impacts will be very minor in scale, however, when compared to abundant habitat elsewhere on the continental shelf. Food web impacts will be temporary in nature, further diminishing their impact. Any impacts associated with altered bottom habitat on the borrow areas would be expected to gradually dissipate as physical environmental forces rework and smooth the shoal surface.

12. Windowpane flounder *(Scophthalmus aquosus)*



A. EFH for Windowpane flounder:

Eggs: Surface waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where windowpane flounder eggs are found: sea surface temperatures less than 20º C and water depths less than 70 meters. Windowpane flounder eggs are often observed from February to November with peaks in May and October in the middle Atlantic and July through August on Georges Bank.

Larvae: Pelagic waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where windowpane flounder larvae are found: sea surface temperatures less than 20° C and water depths less than 70 meters. Windowpane flounder larvae are often observed from February to November with peaks in May and October in the middle Atlantic and July through August on Georges Bank.

Juveniles: Bottom habitats with a substrate of mud or fine-grained sand around the perimeter of the Gulf of Maine, on Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where windowpane flounder juveniles are found: water temperatures below 25° C, depths from 1 – 100 meters, and salinity between 5.5-36%.

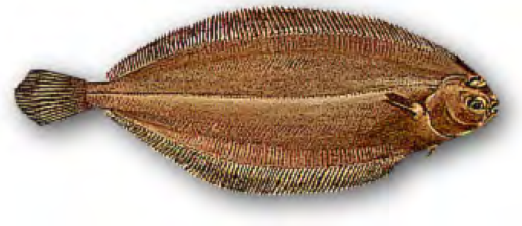
B. Background

Windowpane range from the Gulf of Saint Lawrence to northern Florida (Robins et al, 1986); in the northwest Atlantic they inhabit estuaries, nearshore waters, and the continental shelf. Windowpane juveniles that settle in shallow inshore waters move to deeper waters as they grow migrating to nearshore or estuarine habitats in the southern mid-Atlantic Bight in the autumn. Juvenile and adult windowpane feed on small crustaceans and various fish larvae. Windowpane flounder is not recreationally fished (Murdy et al., 1997), nor a target of the commercial fishing industry (Chang et al., 1999).

C. Project Impacts

Windowpane eggs and larvae are likely to be present in the dredge and placement area, but predominantly in pelagic waters. However, since the eggs are distributed widely over the continental shelf, egg and larvae destruction will not cause significant impacts to the butterfish population. Juveniles and adult windowpane flounders are likely to be in project waters during dredging and sand placement. Because of their great mobility, juveniles and adults should be able to avoid direct detrimental impacts at the dredging and placement sites. However, because they are demersal, individuals may remain on the bottom during dredging. Any windowpane remaining on the bottom or venturing too close to the dredge intake could be entrained and destroyed; juveniles would probably be more vulnerable than adults because of their slower swimming speed. Detrimental impacts to the windowpane flounder population is expected to be insignificant because there is no reason to expect that windowpane flounder will be concentrated at the site. Because of their demersal nature, destruction of benthos and alterations in bottom habitat impacting the food web may cause detrimental impacts to windowpane flounder. It is unclear whether altered habitat conditions at the borrow areas will have any other indirect impact on windowpane flounder. However, these impacts will be very minor because the scale of the area impacted is very minor when compared to abundant habitat elsewhere on the continental shelf. Food web impacts will be temporary in nature, further diminishing their impact. Any impacts associated with altered bottom habitat on borrow areas would be expected to gradually dissipate as physical environment forces rework and smooth the shoal surface.

13. Witch flounder (*Glyptocephalus cynoglossus*)



A. EFH for Witch flounder:

Eggs: Surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. Generally, the following conditions exist where witch flounder eggs are found: sea surface temperatures below 13°C (55°F) over deep water with high salinity. Witch flounder eggs are most often observed during the months from March through October.

B. Background

The witch flounder, or grey sole, range throughout the Gulf of Maine and also occur in deeper areas on Georges Bank and along the shelf edge as far south as Cape Hatteras. Witch flounder appear to be sedentary, preferring moderately deep areas; few fish are taken shallower than 27 m (88 ft) and most are caught between 110 and 275 m (360-902 ft). Spawning occurs in late spring and summer. Witch flounder are a rather sedentary species and do not appear to undertake long-distance migrations. They concentrate in selected water suitable for spawning, then disperse in the surrounding areas for feeding. A significant aspect of this species is that they appear to have a "built-in" conservation mechanism for the first several years of life. Young witch flounder are either pelagic (midwater) or they live in very deepwater areas. Witch flounder is commercially harvested but populations are currently being maintained.

C. Project Impacts

Witch flounder eggs are unlikely to be present in the sand placement area on Sandbridge Beach because of their preference for colder water temperatures and deeper waters as noted in the EFH description. No direct or indirect impacts are expected. Since witch flounder eggs are unlikely to be found on the bottom where the dredge is drawing in sediment and water, it is unlikely that witch flounder will be directly impacts by that part of the operation. No impacts to witch flounder populations are expected.

14. Monkfish (*Lophius americanus*)

A. EFH for Monkfish

Eggs: Surface waters of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras, North Carolina. Generally, the following conditions exist where monkfish egg veils are found: sea surface temperatures below 18°C (64°F) and water depths from 15-1000 meters (49-3,280 ft). Monkfish egg veils are most often observed during the months from March to September.

Larvae: Pelagic waters of the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Cape Hatteras, North Carolina. Generally, the following conditions exist where monkfish larvae are found: water temperatures 15°C (59°F) and water depths from 25-

1000 meters (82-3,280 ft). Monkfish larvae are most often observed during the months from March to September.

B. Background

The monkfish or goosefish, is a large, slow-growing, bottom-dwelling anglerfish. It occurs from the southern and eastern parts of the Grand Banks, (Newfoundland) and the northern side of the Gulf of St. Lawrence, to the east coast of Florida (to about 29 °N), but is common only north of Cape Hatteras, N. Carolina. They are occasional visitors to the lower Chesapeake Bay from late fall to early spring. The species is easily recognized because of its large spiny head and wide mouth filled with fang-like teeth. Monkfish have very broad, depressed heads (head is as wide as the fish is long) and enormous mouths with long, sharp teeth. They have a modified spine called an "esca." This spine is quite mobile and can be angled forward so it can dangle in front of the fish's mouth and be wiggled like bait to lure its prey. It is a solitary ambush predator of invertebrates. Monkfish are marine bottom-dwelling fishes they inhabit sand, mud, and broken shell bottoms from inshore areas to depths greater than 800 m (2,300 ft). Adults spend most of their time resting on the bottom, often in a depression or partially covered in sediment. Monkfish reach maturity between ages 3 and 4, and spawning can take place from spring through early fall depending on latitude. The species has several unusual aspects to its life history, including releasing its eggs in long, floating, mucus veils. Females lay a non-adhesive, buoyant gelatinous egg mass that floats as a broad raft on the water's surface. Larvae and juveniles are pelagic and remain in this stage for several months before they settle to the bottom at a size of about 3 inches. They live in the water column during the egg and larval stages and shift to a benthic existence during their juvenile and adult stages. For most or all of this life stage, the eggs occur within the mucus veil in the upper part of the water column. Severe weather can damage the veil and release isolated eggs. Eggs were collected near Cape Lookout, North Carolina in March and April, in May off Cape Hatteras, and off southern New England, but not after September (NMFS, 1999). In the NEFSC Marine Resources Monitoring, Assessment and Prediction (MARMAP) ichthyoplankton survey, larvae were first collected over deeper (>984 ft), offshore waters in the Middle Atlantic Bight during March-April; later, larvae were most abundant across the continental shelf at depths between 30 to 90 m (95 to 295 ft) and larvae were most abundant at integrated water column temperatures between 10-16° C (50° to 61° F), although there was one collection at 4° C (39°F) in January. Peak catches generally occurred at 11-15° C (52° to 59° F) regardless of the month or area.

C. Project Impacts

Monkfish eggs and larvae may be, in the project area during construction occurring from about May to early fall. Any monkfish eggs or larvae present at the offshore shoals would be widely distributed and there is no reason to believe they would be concentrated in the project area. Eggs would be unlikely to be entrained during dredging since they float. Since larvae are pelagic, dredging entrainment of larvae would also likely be minimal. Also, larvae generally prefer deeper water conditions than at the borrow area. Accordingly, no significant impacts to the monkfish population are expected. Alterations of bottom habitat and destruction of benthos at the borrow sites are unlikely to impact monkfish eggs or larvae because they lack an orientation to or dependency on bottom habitats.

15. Surfclams (*Spisula solidissima*)

A. EFH for surfclams

Juveniles and adults: Throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where surfclams were caught in the NEFSC surfclam and ocean quahog dredge surveys. Surfclams generally occur from the beach zone to a depth of about 200 feet, but beyond about 125 feet abundance is low.

B. Background

The Atlantic surfclam is a bivalve mollusk that inhabits sandy continental shelf habitats from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina. Commercial concentrations are found primarily off New Jersey, the Delmarva Peninsula, and on Georges Bank. In the Mid-Atlantic region, surfclams are found from the intertidal zone to a depth of about 60 m (197 ft) but densities are low at depths greater than 40 m (130 ft). They occur in both state (≤ 3 mi from shore) and federal waters (i.e. the Exclusive Economic Zone or "EEZ", between 3 and 200 mi from shore). The greatest concentrations of Atlantic surfclams are usually found in well-sorted, medium sand, but they may also occur in fine sand and silty-fine sand (NMFS, 1999). Maximum size is about 22.5 cm (8.9 in.) shell length and maximum age can reach 30 years. Atlantic surfclam are found in areas where bottom temperatures rarely exceed 25°C (77°F) and where salinities are higher than 28 ppt. In the Middle Atlantic Bight, spawning occurs primarily during summer, although some activity has also been documented in autumn. Full sexual maturity is attained in the second year of life at a shell length of 45 to 85 mm. Eggs and sperm are shed directly into the water column and recruitment to the bottom occurs after a planktonic larval period of about three weeks. Spawning begins and ends earlier in the south. In Virginia, for example, it may begin in May and end in July. There may be a second, minor spawning in October, caused by breakdown of the thermocline. In cold years, the second spawning may not occur. Currents play an important role in determining patterns of distribution and settlement of developing juveniles. Oceanic storms and currents may displace adults considerable distance from burrows; survivors reburrow at new sites (Cargnelli, 1999).

C. Project Impacts

The southeastern portion of the borrow area lies within an area designated as EFH for the juvenile surf clam. Dredging may destroy some surf clam habitat and surf clams living within the dredged area would be killed. While this would represent a significant short-term loss of surf clam in the impact area, although it is expected that habitat conditions for surf clam will be equivalent to those before dredging over time. It is anticipated that surf clam populations would gradually recover to pre-project levels after a several year period. Surf clam predators, including Atlantic cod, would be affected by loss of food until such time as surf clam populations recovered in each borrow site.

16. Spiny dogfish *(Squalus acanthias)*

A. EFH for Spiny dogfish

Juveniles: 1) North of Cape Hatteras, EFH is the waters of the Continental shelf from the Gulf of Maine through Cape Hatteras, North Carolina in areas that encompass the highest 90% of all ranked ten-minute squares for the area where juvenile dogfish were collected in the NEFSC trawl surveys. 2) South of Cape Hatteras, EFH is the waters over the Continental Shelf from Cape Hatteras, North Carolina through Cape Canaveral, Florida, to depths of 1280 ft. 3) Inshore, EFH is the "seawater" portions of the estuaries where dogfish are common or abundant on the Atlantic coast, from Passamaquoddy Bay, Maine to Cape Cod Bay, Massachusetts. Generally, juvenile dogfish are found at depths of 33 to 1,280 ft in water temperatures ranging between 37°F and 82°F.

Adults: 1) North of Cape Hatteras, EFH is the waters of the Continental shelf from the Gulf of Maine through Cape Hatteras, North Carolina in areas that encompass the highest 90% of all ranked ten-minute squares for the area where adult dogfish were collected in the NEFSC trawl surveys. 2) South of Cape Hatteras, EFH is the waters over the Continental Shelf from Cape Hatteras, North Carolina through Cape Canaveral, Florida, to depths of 1,476 ft. 3) Inshore, EFH is the "seawater" portions of the estuaries where dogfish are common or abundant on the Atlantic coast, from Passamaquoddy Bay, Maine to Cape Cod Bay, Massachusetts. Generally, adult dogfish are found at depths of 33 to 1,476 ft in water temperatures ranging between 37°F and 82°F.

B. Background

Spiny dogfish are a highly migratory species swimming in large schools with individuals of the same size class staying together as they grow. They are found primarily north of Cape Cod in the summer and move south to Long Island in the fall and as far south as North Carolina in the winter. The spiny dogfish is probably the most abundant shark species in the Western N. Atlantic (NMFS, 1999). Seasonal inshore-offshore movements and coastal migrations are related to water temperature. Generally, spiny dogfish spend summers in inshore waters and overwinter in deeper offshore waters. They are usually epibenthic, but occur throughout the water column and are found from nearshore shallows to offshore shelf waters to 900 m (2,952 ft). In the spring, juveniles and adults occur in deeper, generally warmer waters on the outer shelf from North Carolina to Georges Bank. In the fall, they occur in the shallower, moderately warm waters from southern New England into the Gulf of Maine. Dogfish are transient visitors to estuaries where they prefer higher salinities. The species bears live young, with a gestation period of about 18 to 22 months. Young dogfish, referred to as “pups,” are born head-first. Litter sizes range from 1-15 pups, but usually average 6-7 pups. Spiny dogfish are well known for their voracious and opportunistic predatory behavior. Swimming in large “packs,” they will attack schools of fishes smaller than themselves, including cod, haddock, capelin, mackerel, and herring.

C. Project Impacts

Spiny dogfish may be present within the borrow areas during the cooler (winter-spring) months. Adults and juveniles should easily be able to avoid any direct negative impacts because of their mobility. No detrimental indirect impacts to the population are expected because of the relatively small area to be impacted compared to the range of the species and the ready availability of more preferable habitat on the mid and south-Atlantic Bight continental shelf. Any impacts to the food web are expected to be temporary and local when compared to available habitat elsewhere.

17. Atlantic sharpnose shark (*Rhizoprionodon terraenovae*)

A. EFH for Atlantic Sharpnose***:***

Adults (85 cm TL): From Cape May, NJ south to the North Carolina/ South Carolina border; shallow coastal areas north of Cape Hatteras, NC to the 25 m isobath; south of Cape Hatteras between the 25 and 100 m isobaths; offshore St. Augustine, FL to Cape Canaveral, FL from inshore to the100 m isobath, Mississippi Sound from Perdido Key to the Mississippi River Delta to the 50 m isobath; coastal waters from Galveston to Laguna Madre, TX to the 50 m isobath.

B. Background

This sharpnose ranges as far north as New Brunswick but is rarely found north of North Carolina. The Atlantic sharpnose shark is a small shark that attains a maximum size of 1.2 meters (4 feet). Sexual maturity is reached when an individual is approximately 83 cm (33 inches). Juveniles tend to prefer the inshore environment and are found in common bays, estuaries and even in the surf and adults are primarily found in deeper, offshore waters. They prefer subtropical waters near the continental shelves from the intertidal zone out to deeper waters. They are often found near the surf zone of sandy beaches and in enclosed bays, sounds, harbors, estuaries, and river mouths. This shark is able to tolerate lower salinity levels but, they do not venture into freshwater. The young are nourished within the female, as development is viviparous. Litters of 4 to 7 pups are born in June in shallow waters or estuaries. The newborns are 22 to 35 cm (9 to 14 inches) in length. The principal diet of the sharpnose consists of shrimp, molluscs and small fishes.

C. Project Impacts

Sharpnose sharks may be present during dredging within the borrow areas and sand placement at Sandbridge Beach assuming operations take place during the warmer months. However, adults, because of their ready mobility should easily be able to avoid any direct impacts. No detrimental indirect impacts to the sharpnose shark population are expected because of the relatively small area to be impacted compared to the range of the species and the ready availability of more preferable habitat on the mid and south-Atlantic Bight continental shelf. Any impacts to the food web are expected to be temporary and local.

18. Dusky shark (*Carcharhinus obscurus*)

A. EFH for Dusky Shark***:***

Neonate/early juveniles (115 cm TL): Shallow coastal waters, inlets and estuaries to the 25 m isobath from the eastern end of Long Island, NY at 72° W south to Cape Lookout, NC at 34.5° N; from Cape Lookout south to West Palm Beach, FL (27.5° N), shallow coastal waters, inlets and estuaries and offshore areas to the 100 m isobath.

Late juveniles/subadults (116 to 300 cm TL): Off the coast of southern New England from 70° W west and south, coastal and pelagic waters between the 25 and 200 m isobaths; shallow coastal waters, inlets and estuaries to the 200 m isobath from Assateague Island at the Virginia/Maryland border (38° N) to Jacksonville, FL at 30° N; shallow coastal waters, inlets and estuaries to the 500 m isobath continuing south to the Dry Tortugas, FL at 83° W.

B. Background

The dusky shark is a common species of temperate and tropical waters nearly worldwide (Robins et al., 1986). Along the East Coast it ranges from Georges Bank to Florida and the Gulf of Mexico (Castro, 1993) from the surf zone to far offshore and from the surface to water depths of 400 m. It feeds on numerous species of bony fishes and smaller sharks (Castro, 1993), as well as crustaceans, molluscs, and sea stars (Murdy et al., 1997). Dusky shark migrates north and south with the seasons along the Atlantic coast. Coastal waters are nursery areas. Neonates occur in coastal waters of Chesapeake Bay from April through July (NMFS, 1999), although Murdy and others (1997) note that the species does not normally enter estuaries and is infrequently encountered in Chesapeake Bay. It is an important recreational fishery species (Murdy et al., 1997). The species is particularly vulnerable to overfishing because of its long period until maturity (17 years), slow growth, and limited reproductive potential. The Highly-Migratory-Species Fisheries Management Plan prohibits possession of dusky shark because of significant declines in catch rates in the last two decades (NMFS, 1999).

C. Project Impacts

Dusky shark may be present during dredging within the borrow areas and sand placement at Sandbridge Beach. However, neonates and juveniles, because of their ready mobility, should easily be able to avoid any direct impacts. No detrimental indirect impacts to the dusky shark population are expected because of the relatively small area to be impacted compared to the range of the species and the ready availability of comparable habitat on the mid and south-Atlantic Bight continental shelf. Any impacts to the food web are expected to be insignificant and temporary.

19. Sand tiger shark (*Carcharias taurus*)

A. EFH for Sand Tiger Shark*:*

Neonate/early juveniles (125 cm TL):
Shallow coastal waters from Barnegat Inlet, NJ south to Cape Canaveral, FL to the 25m isobath.

Adults (221 cm TL): Shallow coastal waters to the 25m isobath from Barnegat Inlet, NJ to Cape Lookout; from St. Augustine to Cape Canaveral, FL.

B. Background

This is a coastal species found in tropical and warm temperate waters worldwide (NMFS, 1999). In Atlantic waters, the species ranges from Maine to Florida and also from Brazil to Argentina. It was perhaps the most common shark found in coastal waters from Cape Cod to Chesapeake Bay (Robins et al., 1986). It is often found in shallow coastal waters less than 4 m deep. Sand tigers are the only shark known to come to the surface and gulp air. They store the air in their stomachs, which allows them to float motionless in the water, seeking prey. The neonates are born in March and April in southern portions of its range and migrate northward to summer nurseries in coastal estuaries. Sand tiger shark is extremely vulnerable to overfishing because adults congregate in large numbers in coastal areas during the mating season. There was a severe population decline in the 1990s, and in 1997 NMFS prohibited possession of this species in U.S. waters (NMFS, 1999).

C. Project Impacts

Sand tiger sharks may be present during dredging within the borrow areas and placement of sand at Sandbridge Beach. However, neonates, juveniles, and adults, because of their ready mobility, should easily be able to avoid any direct negative impacts. Indirect impacts to this species are expected to be insignificant because the habitats disturbed at the site and any detrimental food web impacts would be insignificant given the pervasive availability of undisturbed habitat in the Mid- and south-Atlantic Bight. Any food web impacts would be temporary, further minimizing any detrimental impacts.

20. Sandbar shark (*Carcharhinus plumbeus*)

A. EFH for Sandbar Shark*:*

Neonates/early juveniles (90 cm): Shallow coastal areas to the 25 m isobath from Montauk, Long Island, NY at 72° W, south to Cape Canaveral, FL at 80.5° W(all year); nursery areas in shallow coastal waters from Great Bay, NJ to Cape Canaveral, FL, especially Delaware and Chesapeake Bays (seasonal-summer); also shallow coastal waters to up to a depth of 50 m on the west coast of Florida and the Florida Keys from Key Largo at 80.5° W north to south of Cape San Blas, FL at 85.25° W. Typical parameters: salinity-greater than 22 ppt; temperatures-greater than 21° C.

Late juveniles/subadults (91 to 179 cm): Offshore southern New England and Long Island, all waters, coastal and pelagic, north of 40° N and west of 70° W; also, south of 40° N at Barnegat Inlet, NJ, to Cape Canaveral, FL (27.5° N), shallow coastal areas to the 25 m isobath; also, in the winter, from 39° N to 36° N, in the Mid-Atlantic Bight, at the shelf break, benthic areas between the 100 and 200 m isobaths; also, on the west coast of Florida, from shallow coastal waters to the 50 m isobath, from Florida Bay and the Keys at Key Largo north to Cape San Blas, FL at 85.5° W.

Adults (180 cm): On the east coast of the United States, shallow coastal areas from the coast to the 50 m isobath from Nantucket, MA, south to Miami, FL; also, shallow coastal areas from the coast to the 100 m isobath around peninsular Florida to the Florida panhandle at 85.5° W, near Cape San Blas, FL including the Keys and saline portions of Florida Bay.

Habitat Areas of Particular Concern: Important nursery and pupping grounds have been identified in shallow areas and the mouth of Great Bay, NJ, lower and middle Delaware Bay, lower Chesapeake Bay, MD and near the Outer Banks, NC, in areas of Pamlico Sound adjacent to Hatteras and Ocracoke Islands and offshore those islands.

B. Background

The sandbar shark is commonly found over muddy or sandy bottoms in shallow coastal waters such as bays, estuaries, harbors, or the mouths of rivers, but also swims in deeper waters (200 m or more) as well as intertidal zones. They tend to swim alone or gather in sex-segregated schools that vary in size. They are most active at night, at dawn, and at dusk. All life stages of sandbar shark are found along the Virginia coast; neonates are found from March through July in the mid and south Atlantic. The adult sandbar shark undergoes seasonal migrations. These movements are influenced mainly by temperature although it is believed that ocean currents also play a significant role. In the western North Atlantic, adult sandbars move as far north as Cape Cod during the warmer summer months and return south at the start of cooler weather. It tends to prefer waters on continental shelves, oceanic banks, and island terraces but is also commonly found in harbors, estuaries, at the mouths of bays and rivers, and shallow turbid water. The species is highly vulnerable to overfishing because of its long period until maturity (15 or more years) and two-year reproductive cycle. It is one of the most important commercial species in the shark fishery of the southeastern U.S. There have been declines in catch per unit effort in U.S. fisheries for this species as a consequence of heavy fishing pressure (NMFS, 1999).

C. Project Impacts

The sandbar shark may be present during dredging within the borrow areas and sand placement at Sandbridge Beach. Neonates, juveniles, and adults because of their ready mobility, should easily be able to avoid any direct negative impacts. However, since they are bottom dwelling, any individuals remaining on the bottom or venturing too close to the dredge intake could be entrained and destroyed. Neonates and juveniles would probably be more vulnerable than adults because of their slower swimming speed. There is no reason to expect that sandbar shark will be overly concentrated in the dredging area; therefore, no significant impacts to this species' population is expected. Because the sandbar shark is a bottom-dwelling species, indirect impacts to the food web caused by destruction of benthos and alterations in bottom habitat conditions at the borrow areas could be more detrimental. However, since these impacts will be very minor in size when compared to the size of the Mid- and South Atlantic Bight, it is expected that no significant indirect impacts to sandbar shark populations will occur. Any food web impacts are expected be temporary and local in nature.

21. Scalloped hammerhead (*Sphyrna lewini*)

A. EFH for Scalloped Hammerhead***:***

Neonate/early juveniles (45 cm TL): Shallow coastal waters of the South Atlantic Bight, off the coast of South Carolina, Georgia, and Florida, west of 79.5° W and north of 30° N, from the shoreline out to 25 miles offshore. Additionally, shallow coastal bays and estuaries less than 5 m deep, from Apalachee Bay to St. Andrews Bay, FL.

Late juveniles/subadults (46 to 249 cm TL): All shallow coastal waters of the U.S. Atlantic seaboard from the shoreline to the 200 m isobath from 39° N, south to the vicinity of the Dry Tortugas and the Florida Keys at 82° W; also in the Gulf of Mexico, in the area of Mobile Bay, AL and Gulf Islands National Seashore, all shallow coastal waters from the shoreline out to the 50 m isobath.

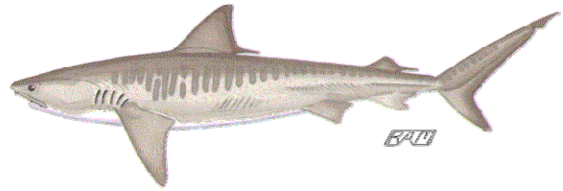
B. Background

Scalloped hammerhead ranges from New Jersey to Uruguay in the western Atlantic, and nearly worldwide in tropical waters (Robins et al., 1986). It is a warm water species seldom found in water cooler than 22°C (72° F). It is a common species found both in coastal and in oceanic waters (Castro, 1993). Juveniles utilize shallow coastal bay and estuarine habitat in waters less than 5 m deep from April through October. Adults utilize both inshore and offshore waters. Scalloped hammerhead school and migrate seasonally north-south along the eastern United States. Because it forms large schools in coastal areas, many fisheries target it and its fins are highly valued. It is probably vulnerable to overfishing (NMFS, 1999).

C. Project Impacts

Scalloped hammerhead juveniles may be in project waters during any construction that takes place between July and August. Juveniles should easily be able to avoid any direct negative impacts of either dredging or sand placement because of their ready mobility. No indirect impacts to scalloped hammerhead are expected from dredging of the borrow areas because any food web impacts resulting from this are expected to be temporary and local when compared to available habitat elsewhere.

22. Tiger shark (*Galeocerdo cuvieri*)



A. EFH for Tiger Shark***:***

Neonate/early juveniles (120cm TL): From shallow coastal areas to the 200 m isobath from Cape Canaveral, FL north to offshore Montauk, Long Island, NY (south of Rhode Island); and from offshore southwest of Cedar Key, FL north to the Florida/Alabama border from shallow coastal areas to the 50 m isobath.

Late juveniles/subadults (121 to 289cm TL): Shallow coastal areas from Mississippi Sound (just west of Mississippi/Alabama border) to the 100 m isobath south to the Florida Keys; around the peninsula of Florida to the 100 m isobath to the Florida/Georgia border; north to Cape Lookout, NC from the 25 to100 m isobath; from Cape Lookout north to just south of the Chesapeake Bay, MD from inshore to the 100 m isobath; north of the mouth of Chesapeake Bay to offshore Montauk, Long Island, NY (to south of Rhode Island between the 25 and 100 m isobaths; south and southwest coasts of Puerto Rico from inshore to the 2,000 m isobath.

Adults (290 cm TL): Offshore from Chesapeake Bay, MD south to Ft. Lauderdale, FL to the western edge of the Gulf Stream; from Cape San Blas, FL to Mississippi Sound between the 25 and 200 m isobaths; off the south and southwest coasts of Puerto Rico from inshore to the 2,000 m isobath.

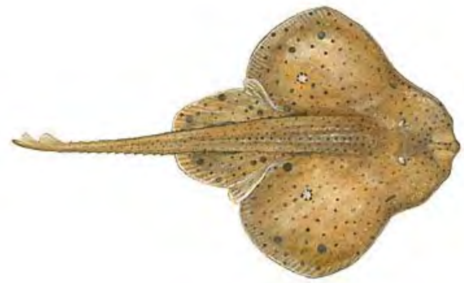
B. Background

The tiger shark ranges from Massachusetts to Uruguay, but is most common from Florida to the Caribbean. It is mostly pelagic, but commonly enters shallow bays and harbors to feed, particularly at night (Robins et al., 1986). Very little is known about the tiger shark's distribution and habitat characteristics. Nursery areas are believed to be offshore, but have not been fully described. The neonates/juveniles occur in shallow coastal waters (NMFS, 1999). The tiger shark feeds on all kinds of marine animals, including turtles, horseshoe crabs, bony fishes, smaller sharks, ray egg cases, and seagulls. It is also one of the few species of sharks that will scavenge dead animals (Castro, 1993). The tiger shark is frequently caught in coastal shark fisheries, but is usually discarded due to low fin and meat value (NMFS, 1999).

C. Project Impacts

Tiger shark may be present during dredging within the borrow areas and sand placement at Sandbridge. Neonates and juveniles should easily be able to avoid any direct negative impacts because of their ready mobility. No indirect impacts to tiger shark are expected from dredging of the borrow areas because any food web impacts resulting from this are expected to be temporary and local when compared to available habitat elsewhere.

23. Winter Skate (*Leucoraja ocellata*)



A. EFH for winter skate:

The map below represents the designation of EFH for the juvenile life history stage based on the areas of highest relative abundance of this species. Only habitats with soft bottom, rocky or gravelly substrates that occur within the shaded (blue) areas are designated as EFH.

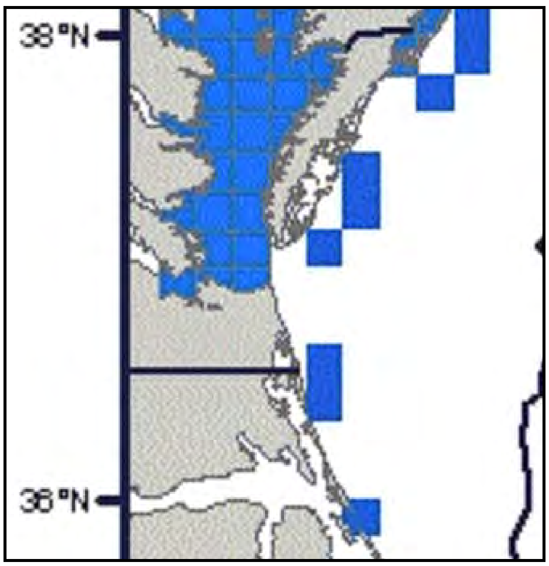


Figure 5: EFH for juvenile Winter Skate

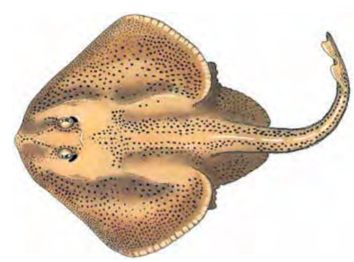
B. Background:

The winter skate occurs in waters from the surface to 90 m (300 feet) in depth, it prefers sand and gravel bottoms in shoal water in the northern portion of its range. The causes of the decline in population status have not been established, but bycatch in fisheries targeting other species is believed to be an important contributing factor. Juveniles are generally found in higher salinity, although some juveniles are found at salinities less than the 20.2 ppt. It is relatively inactive during the day remaining buried in depressions, with most activity occurring during the night time hours (Packer, 2003). The species does not undertake large scale migrations, moving mainly in response to changes in water temperature. Individuals move offshore in summer and early autumn, and move inshore during the winter. Winter skate have been termed a “winter periodic” because their seasonal migration suggests a preference for cool temperatures. The spring and fall distributions of juvenile winter skate are relative to bottom water temperature, depth, and salinity. In spring, they were found in waters between 2°C to 15°C (36°F-59°F) from southern Nova Scotia to Cape Hatteras and their depth range during that season was between about 11-70 m (36-230 ft). They were found at salinities between 32-33 ppt. During the fall, juvenile winter skate were caught over a temperature range of 5°C to 21°C (41°F-70°F) and found at depths between about 21-80 m (69-262 ft). They were found at salinities between 32-33 ppt. Its center of abundance is on Georges Bank and in the northern portion of the Mid-Atlantic Bight. Skate diets consist primarily of polychaetes, amphipods, decapod crustaceans, squid, bivalves, and small fish. Until 2000, the U.S. population of winter skate was considered to be in an overfished state. However, its status has been changed such that it is no longer considered to be in an overfished condition (NMFS 2002). In its 2002 report to Congress, NMFS (2002) reported that the most recent survey index for winter skate indicated that the current biomass was above the minimum stock size threshold and that winter skate were now officially listed as "not overfished". This status for winter skate was reaffirmed by NMFS in its 2003 report to Congress (NMFS 2003). Although winter skate are no longer considered overfished in U.S. waters, winter skate remain at comparatively low levels of abundance.

C. Project Impacts:

Turbidity may impact sight feeding, but the skates will likely flee the area to feed in neighboring waters where turbidity is reduced. Dredging, which usually occurs in late spring or early summer, does not coincide with peak abundance, as the skates have a preference for cooler waters. Although dredging activities may affect feeding success, this will be a temporary occurrence in a relatively small area. Additionally the wide range of prey increases the potential for feeding opportunities. Therefore, no more than minimal impact to the species or feeding success should occur to winter skate.

24. Clearnose Skate *(Raja eglanteria)*



The maps below represent the designation of juvenile and adult EFH for this life history stage based on the areas of highest relative abundance of this species. Only bottom habitats with mud, gravel, soft bottom, rocky or gravelly substrates and sand substrates that occur within the shaded (blue) areas in U.S. waters are designated as EFH.

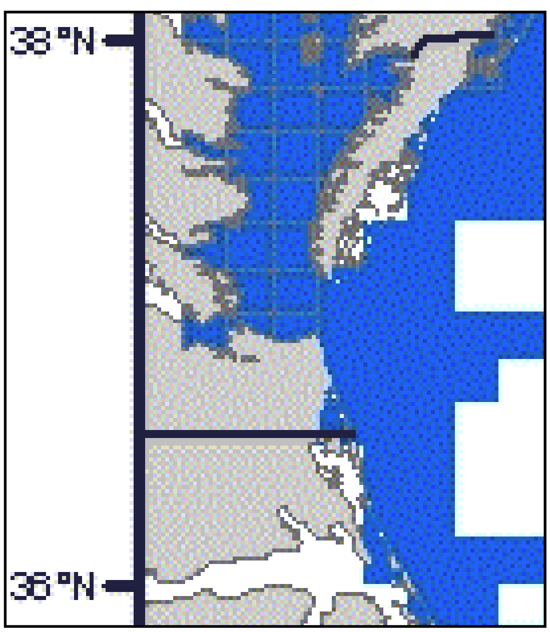


Figure 7: EFH for juvenile Clearnose Skate

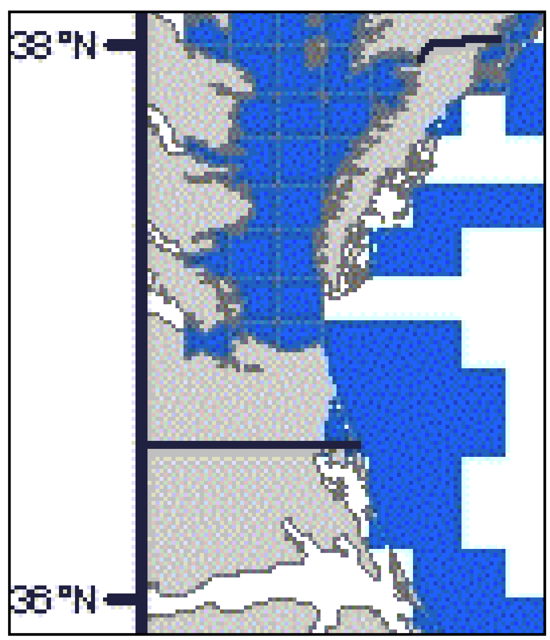


Figure 8: EFH for adult Clearnose Skate

B. Background

The clearnose skate is found in the mild, shallow shores of the Atlantic Ocean (from Massachusetts to south Florida) and in the Gulf of Mexico. It will sometimes be seen as far north as Canada. It is only a warm season visitor in the northern parts of its range, migrating south during the fall and winter. North of Cape Hatteras, it moves inshore and northward along the continental shelf during the spring and early summer, and offshore and southward during autumn and early winter when water temperatures cool to 13-16°C. Most clearnose skates are found at salinities of greater than 22 ppt and temperatures from 6°C- 27°C (43°F- 80°F). Both juveniles and adults can be found in a depth range of between 1-300m (3-985 ft.). NEFSC autumn survey biomass indices increased from the mid 1980's to 2000 but have since declined. The 2003-2005 average biomass index of 0.63 kg/tow is above both the biomass threshold reference point (0.28 kg/tow) and the Bmsy proxy (0.56 kg/tow), and hence the species is not overfished. The 2003-2005 index is lower than the 2002-2004 index of 0.75 by 16% but not by 30% (the average CV), and therefore overfishing is not occurring.

C. Project Impacts

Water quality changes during construction of the proposed project would be minimal and temporary, limited to the immediate area of the activity. Turbidity may impact sight feeding but the skates will flee the area to feed in neighboring waters and the elevated turbidity is temporary. Additionally, juveniles and adults may be found at depths ranging from less than 3 feet up to 985 feet and is broadly distributed along the eastern United States. Therefore, the proposed project would not result in significant adverse impacts to the EFH for this species.

VIII. Cumulative Impacts

It is anticipated that next nourishment of Sandbridge Beach will occur in 2010 with an estimated 1.5 - 2.0 million cubic yards of sand. The U.S. Navy will likely re-nourish the beach and berm at the Dam Neck Naval Training Facility between 2011-2012. The Navy plans to access Sandbridge Shoal to obtain no more than 1.0 million cy. The south portion of the Dam Neck facility beach abuts the northern portion of Sandbridge Beach (the two reaches are separated by a sand fence).

The 1.5 - 2.0 million cy of sand proposed to be removed from Sandbridge Shoal for placement on Sandbridge Beach represents 6 % of the estimated remaining volume of the main shoal body. If the volume present in isolated shoals located seaward of the main shoal body are included, the fraction is even less. Considered in combination with the previous dredging operations, the cumulative volume of sand removed by 2010 will represent less than 25% of the conservative estimates of the volume of Sandbridge Shoal.

It is expected that the shoal will not naturally recover the volume of the sand that is dredged. However, current research sponsored by MMS suggests dredging will not threaten the geomorphic integrity of the shoal (Rob Nairn, personal communication). However, its function as habitat may be adversely affected, but to date, there has been limited evidence of any sustained disturbance beyond transient and localized impacts. The main body of the shoal, when defined by the 13 m isobath and 14 m isobaths (Figure 1), is approximately 1650 acres and 3000 acres respectively. The entire Sandbridge Shoal complex consists of more than 13,500 acres of sand to muddy sand substrate, provided the secondary sand ridges in the immediate vicinity of borrow areas A and B are included. The currently planned project is expected to impact a relative small fraction, approximately 150-300 acres, but no more than 500 acres. The impact can be minimized temporally by rotating borrow areas and disallowing repeated dredging in the same locale. Areas of the shoal where sediment grain-size is incompatible with nourishment grain size requirements, as well as other no-dredge areas such as the submarine cable zone, will also remain intact and undisturbed, serving as feeder zone for benthic recolonization. Additionally, since borrow areas are not typically dredged perfectly flat relative to the adjacent seafloor, a portion of the dredge areas will remain morphologically intact.

Impacts to EFH occur from a vast array of sources, including neighboring navigation channel dredging. The most influential of those sources are impacts from State regulated fishing activities that conduct unsustainable fishing practices and policies. Nearly one third of U.S. marine fisheries have been officially designated as overfished or nearly so. Recreational and commercial fishing activities (scallop dredges, trawls, anchoring, and vessel operations), all directly contact habitats utilized by EFH species. As a result of these impacts commercial harvesting is now being forced to level off after decades of impressive growth. For example, bluefish landings ranked first in the mid and south Atlantic bight from 1979-1989 with catches occurring inshore and offshore. In 1980, commercial and recreational landings of bluefish peaked. Landings have steadily declined since that time and the stock is now considered overharvested.

There are several commercial fisheries that may occur in the general area have impacts to both species of concern and their habitat. Gillnet fishing may be conducted for fish species such as the spiny dogfish and striped bass. Some bycatch is caught along with the targeted species, and this could potentially reduce the population numbers of non-targeted organisms, sublegal size fish and prey species. Many commercially-caught fish species, such as bluefish and Atlantic croaker, are caught by rod and reel or hand line. Impacts include mortality of catch released because of size limits or species prohibitions. If anchoring takes place, there may be some bottom disturbance as well. Stable sand environments often support colonial epifauna such as sponges and bryzoans. When the epiflora is repeatedly removed by bottom fishing, the habitat may become less suitable for commercially valuable fish and shellfish species (Bradstock and Gordon, 1983; Poiner and Kennedy, 1984; Sainsbury, 1988).

Pots and traps may be used for blue crabs and fish species such as black sea bass. During storms these pots and traps may be dragged along the seafloor bottom tearing up benthic habitat and damaging sessile organisms. If these pots and traps break away during storms, they will continue to “fish” for marine organisms that will become trapped and unable to escape.

Trawl fisheries for various fish and invertebrate species have also fished this general area in recent years. Trawl fisheries have targeted bottom fish such as grey seatrout and summer flounder or water column species such as bluefish. Traditional bottom trawls have been shown to remove bottom dwelling organisms such as brittle stars and urchins as well as plant-like organisms and colonial worm tubes (Collie et al., 2000). Colonial epifauna have also been shown to be less abundant in areas disturbed by bottom trawling. This epifauna provides habitat for shrimp, polychaetes and small fish which are potential prey species for commercially desirable fish species. Seafloor areas that have been heavily trawled may bear tracks where trawl doors have gouged into the sediment, changing the sediment surface and in other areas the trawl has flattened the sediment surface reducing habitat for managed species and their prey. Traditional trawl techniques were known to be nonselective in their catch thus having the potential to reduce both prey species and year classes of managed species not yet mature.

Longline fishing for species such as some coastal sharks may occur. Longlining may result in the death of some juvenile and non-target fish species.

Recreational anglers have also caught designated EFH species within the vicinity of the borrow areas (i.e. bluefish, cobia, striped bas, king mackerel) via rod and reel and spear fishing. Mortality of some species is expected from the bycatch of non-target species and sub-legal catches. Additionally, disruption of bottom habitat can occur from the anchoring of recreational boats. Benthos and fish caught by the anchor may be destroyed. Repeated anchoring in same location can lead to patches void of benthic organisms. It can reasonably be assumed that States will continue to license and permit recreational vessels and operations, which do not fall under the purview of a Federal agency. As the recreational activity increases the number moralities will continue to increase as well.

Impacts to EFH can be exacerbated by non-point source pollution. Pollution in Chesapeake Bay and various smaller estuaries in the area can influence fish habitat within the project area because of buoyant plumes that move south along the coast. Runoff from agriculture, stormwater and other sources; carry toxic chemicals and excess nutrients into coastal waters. These can lead to reproductive failure, deformations, death and anoxic habitats. This is of particular concern in estuaries and wetland where reproduction, migration and larval development occur for many of the EFH species found within the project area. Impacts from the non point sources of pollution are expected to continue.

Impacts from natural sources, such as large meteorological events, can also influence EFH species. Hurricanes and nor'easters, typified by increased system energetics, can increase turbidity and destroy bottom habitat used by EFH species and their prey. This can result in detrimental indirect impacts to finfish through changes in the food web. The magnitudes of these impacts range greatly depending on their intensity. Usually they are only temporary in nature.

Given the cumulative impacts associated with the current and future planned beach nourishment projects this project will most likely not add significantly to EFH impacts over time.

IX. Mitigation Measures

Every measure that is technically and economically viable will be pursued to avoid and minimize effects on EFH. Minimization has included implementation of best management practices, extensive consultation with Federal and state agencies, and sampling of beach quality material at the offshore sand source areas to pre-select shoal areas that are most likely to contain beach quality sand. Sand lenses will be mined selectively, following existing bottom contours to the maximum extent practicable. Rotational dredging will be practiced to the maximum extent practicable. Vibracore surveys have been collected to identify the exact location of these sand lenses to minimize the footprint and the hours over which the dredge must operate. Restrictions on open-ocean dredging operations posed by winter weather conditions limit the opportunity to dredge during colder times of the year.

The Corps and MMS will consider all mitigation and recommendations that NMFS proposes through this consultation. Several measures have already been considered and integrated in project plans for reducing impacts to sea turtles and whales. The measures set forth to protected listed species will likely benefit the fish species and habitat described in this assessment. Additionally, the following measures have already been identified:

1) Implement best engineering and management practices.

2) Complete a hydrographic survey before and after dredging covering the entire area where the dredged is expected to operate.

3) Coordinate with NMFS to develop a long-term strategy and dredging management plan to be implemented after the next renourishment cycle that identifies rotation criteria and advance schedule for specific shoal use.

X. Conclusion and Agency View

The severity of the impact to EFH and supported species is dictated by: 1) the spatial extent of the impact and 2) the chronic or long-term nature of the impact. The areas that have been designated as EFH in the project area have been given this classification because they are believed to be "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U. S. C. 1802). HAPC, a separate designation within EFH, is based on one or more of the following considerations: 1) the importance of the ecological function, 2) extent to which the habitat is sensitive to human-induced degradation, 3) whether and to what extent development activities are stressing the habitat type, or 4) rarity of habitat type [50 CFR 600.815(a)(8)].

The two borrow areas within Sandbridge Shoal are Area B to the north and Area A to the south. Area B is approximately 3,519 acres, and Area A is approximately 2,325 acres. During each dredging cycle, approximately 150 to 500 acres of benthic habitat may actually be adversely impacted within those borrow areas in order to obtain needed borrow material. Previous estimates, in excess of 500 acres, were calculated presuming the entire leased area was actually dredged. Compared to the entire shoal complex habitat and the ridge and swale topography in the Mid-Atlantic Bight offshore Virginia, the area of potential impact is relatively small.

If hydrodynamics and sediment transport are locally modified because of dredging, physical changes to the seafloor geomorphology may occur (e.g., substrate type and composition, surface texture, water circulation, and nutrient distribution). Some of the localized physical changes that have been observed in other locations following dredging include: 1) lower sand content; 2) higher silt/clay content; 3) poorer sorting (greater variation in grain size of sediment); and 4) accumulation of fine sediment (Jutte et al., 2002; Diaz et al., 2004). These changes have not been observed to date at Sandbridge Shoal (Diaz et al., 2006). Areas that have high rates of sediment transport (sand, not fine-grained sediment), such as depositional shoals, may experience rapid refilling rates, but that also assumes physical depressions are being created during dredging operations (Greene, 2002). Utilizing hopper dredges to extract thin layers of sediment (approximately 3 ft) over larger areas, rather than dredging single shoals to greater depths over smaller areas, often creates a complex fabric of meso-ridges and furrows. The ridges are essentially the areas missed by the hopper dredge dragarm due to the dredge's inability to completely remove all of the sediment. Shallow cuts are expected to have a smaller impact on waves and currents at the borrow area and presumably decrease the likelihood of exposure of and or infilling by finer-grained sediments. One of the primary concerns regarding the impact of dredging is whether the removal of sand from the shoal will somehow disrupt the physical processes that maintain the shape of sand ridges and shoal bodies. The concern would be that the shoal might deflate or unravel, losing its form over time. Ridge crests are intensely stirred by relatively high wave energy and consist of mixed coarse sediment with low organic material (Diaz et al., 2004; Hayes and Nairn, 2004). Comparatively, the trailing slope of the feature (up wave) is often characterized by a very gentle slope, moderate surface sediment mixing, and deposition of organically enriched fines. There may be at least two other unique physical habitats common to ridge features: 1) the leading side of the ridge is steeper and is depositional in nature (many ridges will be slowly migrating in the direction of this side of the ridge); and 2) deep troughs between the ridges that are relatively sheltered from wave action (due to both depth and breaking of waves over the crest of the ridge) often feature relatively finer sediments. The benthic communities and fish populations associated with each of these habitats are likely to be different (Diaz et al., 2004). It may be inferred that if a shoal did deflate due to dredging impacts, these different community structures could be adversely impacted.

Despite the prevalence of these features along the East Coast, little is documented about the ecological relationships of these features and their associated biological communities (Slacum et al., 2006; Vasslides and Able, 2008). Physical impacts caused by dredging are important only if they result in a coupled biological impact, either directly or indirectly. Dredging will lead to direct mortality of the benthic infauna that live in the substrate. Analysis of sediment core samples taken after dredging has demonstrated that remaining epibenthics are decimated (Parr et al., 1978). Studies investigating the recovery of benthic communities following dredging (Blake et al., 1996; Newell et al., 1998; Van Dolah et al., 1992; Van Dolah et al., 1998; Brooks et al., 2006; Diaz et al., 2006) have indicated that communities of similar total abundance and diversity can be expected to re-colonize dredge sites within several years. In a study off the coast of Panama City, Florida (Saloman et al., 1982), benthic community characteristics, such as species diversity, faunal abundance, and species composition, were equivalent to those of the surrounding communities within 3 months of the sediment disturbance. However, there is uncertainty whether the new benthic communities will fill the same trophic function and provide the same energy transfer to higher trophic levels, as did the original communities (Michel et al., 2007).

Regional research has noted significant seasonal and inter-annual variations in species richness and abundance at shoals and reference sites in the Mid-Atlantic Bight (Slacum et al., 2006). A study, sponsored by the Minerals Management Service, investigated impacts of sand dredging on benthos of the southwest Florida shallow continental shelf. At the Egmont Key study site, benthos were collected before, during, and after dredging activities at three stations (two dredged and one control). Post-dredging sampling occurred at 9 months and 17 months following completion of dredging. Statistical analyses demonstrated that each of the three stations experienced different temporal patterns in benthic community composition. The two dredged stations showed more temporal variation from one another than the control station. However, it was not possible to establish that the differences between the benthic community in the control stations and the dredged stations were due solely to dredging disturbances (Blake at al, 1995). In some instances, the natural variability may be larger than any influence of dredging, especially in physically-dominated environments.

Finfish species could potentially be harmed at the borrow area by entrainment in the dredge. But the extent of the impact may depend on seasonal and daily conditions, as recent research as shown that pelagic fish use such habitat differently between day and night (Slacum et al., 2006). Adult pelagic species, such as bluefish and Atlantic butterfish, should be able to avoid the entrainment into the dredge due to their high mobility. Demersal species, such as the windowpane flounder and the summer flounder, are mobile and should be able to avoid dredge entrainment as well. However, because of their demersal nature, individuals that remain on the seafloor of the borrow area during dredging, could be entrained and destroyed; demersal eggs may be entrained as well. Juveniles are likely more vulnerable than adults due to their slower swimming speed. Finfish species that have eggs and larvae in surface waters may be impacted by the hopper dredge making numerous transits through the borrow area; any eggs in the path of the dredge are likely to be destroyed by the ship's propeller. Because eggs and larvae are widely distributed over the continental shelf, egg destruction is not expected to cause significant impacts to fish populations. While some individual finfish will likely be entrained into the dredge and destroyed, no detrimental impacts to populations of any finfish are expected from the proposed project. Dredging may also result in physical alterations to the substrate of EFH which could result in unsuitable substrate for spawning of some finfish species. However, significant changes in substrate are not expected because dredging cut depths would be based on vibracore data to minimize dissimilar substrates (MMS, 2006).

Finfish and benthic species could also be harmed in the surf zone and foreshore while sand is being pumped onto the beach. The project shoreline is 27,815 linear feet (5.26 miles, 4.57 nautical miles) in length. Approximately 80 acres of shallow water or surf zone habitat will be impacted through the placement of the borrow material along the shoreline during beach nourishment operations. Characteristic of high-energy beaches, benthic communities exhibit low species diversity and are typically highly adapative. Typical benthic communities in the nearshore habitat of Sandbridge Beach include polychaete worms, bivalve mollusks and amphipod crustaceans. The dominant epibenthos are blue mussel (*Mytilus edulis*), common squid (*Loligo pealei*), hermit crab (*Paragus longicarpus*), windowpane flounder *(Scopthalmus aquosus*) and spotted hake (*Urophycis regia*).The majority of fish living nearshore are motile and can easily escape from sand placement. For many shellfish and other invertebrates it would be more difficult. The greatest impacts of sand placement are the initial decrease in fish abundance, potential for gill clogging caused by increased turbidity and direct burial of demersal fish. These impacts would be short-term and localized, and they would not cause significant impacts to populations of any finfish. In July 2001, the USACE ERDC released results of an $8.6 million dollar, eight year biological monitoring program of beach nourishment activities at the Asbury Park to Manasquan Inlet Beach Erosion Control Project in New Jersey (Burlas et al., 2001). Primary findings included: 1) no long-term and systematic impacts to surf zone finfish distribution and abundance patterns; 2) there was no sustained biological indicator (i.e., fish abundance or distribution pattern that distinguished nourished from non-nourished beach habitat); and 3) bluefish were essentially absent during nourishment, while benthic feeders (silversides and kingfish) were potentially attracted to the nourishment area, either related to re-suspended benthic material (silversides) or the general nourished condition (kingfish). Feeding habits of benthic-feeding surf zone fish were also examined, including northern kingfish, rough silverside, and Atlantic silverside. They found that the percentage of fish with filled stomachs did not differ, nor did the relative composition of prey items. Finally, the study also investigated the effects to surf zone and nearshore ichthyoplankton. Comparisons of reference and control beaches revealed no obvious differences in surf zone ichthyoplankton abundance, size and species composition.

The sandbar shark (*Charcharinus plumbeus*), is designated as having a Habitat Area of Particular Concern (HAPC), which is described in regulations as a subset of EFH that is rare; particularly susceptible to human-induced degradation, especially ecologically important; or located in an environmentally-stressed area. There may be an increase in turbidity and sedimentation associated with dredging and sand placement, but the adverse impacts of such changes will be localized and temporary. It is generally viewed that elevated levels of turbidity generated by trailing suction hopper dredge operations in open ocean waters does not represent a significant ecological impact (W.F. Baird & Associates and Research Planning, 2004). Given their mobility, sharks can avoid turbidity plumes and, if necessary, survive short-term elevated turbidity. The beach nourishment area (surf zone) and borrow area are not located within nursery or pupping grounds for the Sandbar Shark. Given that the shark can be found from the intertidal zone to waters more than 655 feet deep and are widely distributed along the East Coast, the borrow area represents a fraction of available forage habitat.

As discussed and evaluated in this Assessment and in the accompanying EA, offshore dredging, dredge transit, and placement along the Sandbridge Beach shoreline are not expected to impact “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” to any appreciable extent over a significantly large area or over any significant period of time. Impacts would be limited and short-lived. Also, HAPC for the sandbar shark is not anticipated to be impacted by the project in any of the following ways: 1) the importance its ecological function, 2) by human-induced or long-term degradation, 3) by stressing the habitat type, or 4) by compromising or jeopardizing the habitat, fully considering the rarity of habitat type. From a finfish perspective, demersal species will be most impacted. The other pelagic species should only be minimally impacted. Given the relatively small-size of the impacted area relative to the large geographic ranges of transitory fishes, the proposed activities, even when considered cumulatively under present conditions, would have only minor impacts on the populations of finfish evaluated in this analysis.

Accordingly, USACE and MMS have determined that the proposed project may have adverse effects on EFH for Federally managed species, but adverse effects on EFH species, due to construction, will largely be temporary and localized within the dredged footprints and beach nourishment areas in the surf zone. In conclusion, the project is not anticipated to significantly impact EFH species or habitat (including HAPC) that may be in the project area.

XI. References

Blake , N.J., L.J. Doyle, and J.J. Culter, 1996. Impacts and direct effects of sand dredging for beach nourishment on the benthic organisms and geology of the west Florida Shelf. OCS Report MMS 95-0005, U.S. Department of the Interior, Minerals Management Service, 109 pp.

Bradstock, M., and Gordon, D. P. 1983. Coral-like bryozoan growths in Tasman Bay, and their protection to conserve commercial fish stocks. New Zealand Journal of Marine and Freshwater Research, 17: 159–163.

Brooks, R.A., C.N. Purdy, S.S. Bell, and K.J. Sulak, 2006. The benthic community of the eastern U.S. continental shelf: a literature synopsis of benthic faunal resources. Continental Shelf Research 26: 804-818.

Burlas, M., G. Ray, and D. Clarke, 2001. The New York District's Biological Monitoring Program for the Atlantic Coast of New Jersey, Asbury Park to Manasquan Section Beach Erosion Control Project. U.S. Army Corps of Engineers, Engineer Research and Development Center, Waterways Experiment Station.

Castro, J.I. 1993. A field guide to the sharks commonly caught in commercial fisheries of the southeastern United States. NOAA Technical Memorandum NMFS-SEFSC-338, 47 pp. Online edition excerpts: http://www.na.nmfs.gov/sharks/species/species.html.

L.M. Cargnelli, S.J. Griesbach, D.B. Packer, and E. Weissberger. 1999. Essential fish habitat source document: Atlantic surfclam, Spisula solidissima, life history and habitat characteristics. NOAA Technical Memorandum NMFS-NE-142.
http://www.nefsc.noaa.gov/nefsc/publications/tm/tm142/

Chang, S., P.L. Bemen, D.L. Johnson, and C. McBride, 1999. Essential fish habitat source document: windowpane, Scophthalmus aquosus, life history and habitat characteristics. September 1999. NOAA Technical Memorandum NMFS-NE-137. Online edition:
http://www.nefsc.nmfs.gov/publications/text/nefscseries/current/techmemo/windowpane137.pdf

City of Virginia Beach. 2007. 3rd Annual Report on the Tax Increment Financing Districts and Special Service Districts in Virginia Beach, Virginia.

Collie, J.S., G.A. Escanero, and P.C. Valentine, 1997. Effects of bottom fishing on the benthic megafauna of Georges Bank. Marine Ecology Progress Series 155: 159-172.

Cross, J.N., C.A. Zetlin, P.L. Berrien, D.L. Johnson, and C. McBride, 1999. Essential fish habitat source document: butterfish, Peprilus triacanthus, life history and habitat characteristics. September 1999. NOAA Technical Memorandum NMFS-NE-145. Online edition:
http://www.nefsc.nmfs.gov/publications/text/nefscseries/current/techmemo/butterfish145.pdf

Cutter, G.R. and R.J. Diaz, 1998. Benthic habitats and biological resources of the Virginia coast: 1996 and 1997. In: Hobbs, C.H. (Ed.), Environmental Studies relative to Potential Sand Mining in the Vicinity of the City of Virginia Beach, Virginia. U.S. Department of the Interior, Minerals Management Service, OCS Study 2000-055.

Diaz, R.J., G.R. Cutter, and C.H. Hobbs, 2003. The importance of physical and biogenic structure to juvenile fishes on the shallow inner continental shelf. Estuaries 26(1): 12-20.

Diaz, R.J., G.R. Cutter, and C.H. Hobbs, 2004. Potential impacts of sand mining offshore of Maryland and Delaware: Part 2—biological considerations. Journal of Coastal Research 20(1): 61-69.

Diaz, R.J., C.O. Tallent, and J.A. Nestlerode, 2006. Benthic Resources and Habitats at the Sandbridge Borrow Aera: A Test of Monitoring Protocols. In: Hobbs, C.H. (Ed.) , Field Testing of a Physical/Biological Monitoring Methodology for Offshore Dredging and Mining Operations. U.S. Deptartment of the Interior, Minerals Management Service, MMS OCS Report 2005-056.

Fahay, M.P., P.L. Berrien, D.L. Johnson, and W.W. Morse. 1999. Essential fish habitat source document: bluefish, *Pomatomus saltatrix*, life history and habitat characteristics.

Godcharles, M.F., and M.D. Murphy. 1986. Species profiles: life history and environmental requirements of coastal fishes and invertebrates (south Florida) -- king mackerel and Spanish mackerel. U.S. Fish and Wildlife Service Biological Report 82(11.58). U.S. Army Corps of Engineers, TR EL-82-4. 18 pps.

Greene, K., 2002. Beach Nourishment: A Review of the Biological and Physical Impacts. ASMFC Habitat Management Series. Washington, D.C. 174 pp.

Hardaway, C.S., D.A. Milligan, G.R. Thomas, and C.H. Hobbs, 1998. Preliminary Shoreline Adjustments to Dam Neck Beach Nourishment Project, Southeast Virginia Coast. In: Hobbs, C.H. (Ed.), Environmental Studies relative to Potential Sand Mining in the Vicinity of the City of Virginia Beach, Virginia. U.S. Department of the Interior, Minerals Management Service, OCS Study 2000-055.

Hayes, M.O. and R.B. Nairn, 2004. Natural Maintenance of Sand Ridges and Linear Shoals on the U.S. Gulf and Atlantic Continental Shelves and the Potential Impacts of Dredging. Journal of Coastal Research, 20(1): 138-148.

Jutte, P.C., R.F. Van Dolah, and P.T. Gayes, 2002. Recovery of benthic communities following offshore dredging, Myrtle Beach, South Carolina. Shore & Beach 70(3): 25-30.

Mid-Atlantic Fishery Management Council. 2000. Atlantic mackerel, Loligo, Illex, and butterfish specifications. Final Environmental Assessment Regulatory Impact Review Final Regulatory Flexibility Analysis. Dover, Delaware. Online edition: http://www.nero.nmfs.gov/ro/doc/y2ksmbspfr.pdf.

Michel, J., R. Nairn, Peterson, C.H., Ross, S.W., Weisberg, R. and Randall, R. 2007. Critical Technical Review and Evaluation of Site-Specific Studies Techniques for the MMS Marine Minerals Program. Minerals Management Service, MMS OCS Report 2007-047. 47 pp. + appendices.

Mills, S. 2000. A cobia by any other name...Virginia Marine Resources Commission Bulletin, 32(1): 2-11.

Mills, S., 2000. Cobia diet. Virginia Marine Resources Commission Bulletin, 32(1): 12-13.

Minerals Management Service, 1997. Environmental Assessment: Issuance of a Noncompetitive Lease for Sandbridge Shoal Sand and Gravel Borrow Area (Unit I) –Sandbridge Beach Erosion Control and Hurricane Protection Project, Virginia Beach, Virginia. November 14, 1997.

Minerals Management Service, 1999. Environmental report. Use of Federal offshore sand resources for beach and coastal restoration in New Jersey, Maryland, Delaware, and Virginia. U.S. Department of the Interior, Minerals Management Service. MMS OCS Report 99-0036.

Minerals Management Service, 2001. Development and Design of Biological and Physical Monitoring Protocols to Evaluate the Long-term Impacts of Offshore Dredging Operations on the Marine Environment. Prepared for: International Activities and Marine Minerals Division

Minerals Management Service, U.S. Department of Interior Herndon, Virginia. Prepared by: Research Planning, Inc. Columbia, South Carolina, W.F. Baird & Associates Ltd. Madison, Wisconsin Applied Marine Sciences, Inc. Livermore, California.

Minerals Management Service, 2006. Environmental Assessment: Issuance of a Noncompetitive Lease for Sandbridge Shoal Sand (Borrow Areas A and B), Sandbridge Beach Erosion Control and Hurricane Protection Project, Virginia Beach, Virginia. March 2006.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. Fishes of Chesapeake Bay. Smithsonian Institution Press, Washington. 324 p.

National Marine Fisheries Service. 1999. Essential fish habitat designations within the northeast region (Maine to Virginia).Working copy. March 1, 1999. Excerpted from the Fishery Management Plans.

National Marine Fisheries Service. 1999. Final fishery management plan for Atlantic tunas, swordfish, and sharks. Volume II. NMFS Highly Migratory Species Management Division, Silver Spring, Md. U.S. Department of Commerce, National Ocean and Atmospheric Administration.

National Marine Fisheries Service. 2001. Essential fish habitat website. Online edition:
http://www.nero.nmfs.gov/ro/doc/list.htm;
http://www.nero.nmfs.gov/ro/doc/efhtables.pdf;
http://www.nero.nmfs.gov/ro/STATES4/virginia/virginia/36507550.html

National Marine Fisheries Service. 2002. James J. Howard Marine Sciences Lab., 74. Magruder Rd., Highlands, NJ 07732. Annual Report to Congress on the Status of U.S. Fisheries-2001, U.S. Dep. Commerce, NOAA, Natl. Mar. Fish. Serv., Silver Spring, MD, 142 p.

National Marine Fisheries Service. 2002. Annual Report to Congress on the Status of U.S. Fisheries--2001, U.S. Dep. Commerce, NOAA, Natl. Mar. Fish. Serv., Silver Spring, MD, 142 p.

Nelson, W.G. 1993. Beach restoration in the southeastern US: environmental effects and biological monitoring. Ocean and Coastal Management, 19: 157-182.

Newell, R.C., L.J. Seiderer, and D.R. Hitchcock. 1998. The impact of dredging works in coastal waters: a review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed. Oceanography and Marine Biology: an Annual Review, 36: 127-78.

Overholtz, W. 2000. Butterfish. Species and status of northwest Atlantic marine fish and invertebrates. Online edition: http://www.nefsc.nmfs.gov/sos/spsyn/op/butter/.

Packer, David.B., S.J. Griesbach, P.L. Berrien, C.A. Zetlin, D.L..Johnson, and W.W. Morse. 1999. Essential fish habitat source document: summer flounder, *Paralichthys dentatus*, life history and habitat characteristics. September 1999. U.S. Dept. of Commerce. NOAA Technical Memorandum NMFS-NE-151. Online edition: http://www.nefsc.nmfs.gov/nefsc/publications/text/nefscseries/current/techmemo/SummerFlounderl51.pdf.

Packer, David B., Christine A. Zetlin, and Joseph J. Vitaliano. 2003. Essential Fish Habitat Source Document: Winter Skate, *Leucoraja ocellata*, Life History and Habitat Characteristics.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration National Marine Fisheries Service, Northeast Region, Northeast Fisheries Science Center Woods Hole, Massachusetts. March, 2003.

Parr, T., D. Diner, and S. Lacy, 1978. Effects of Beach Replenishment on the Nearshore Sand Fauna at Imperial Beach, California. Miscellaneous Paper No. 78-4, U. S. Army Corps of Engineers, Coastal Engineering Research Center, Fort Belvoir,Virginia. 125 pp.

Poiner, I.R. and R. Kennedy, 1984. Complex patterns of changes in the macrobenthos of a large sandbank following dredging. Marine Biology 78: 335-352.

Posey, M. and T. Alphin, 2002. Resilience and stability in an offshore benthic community: response to sediment borrow activities and hurricane disturbance. Journal of Coastal Research 18: 685-697.

Reid, R.N., L.M. Cargnelli, S.J. Griesbach, D.B. Packer, D.L. Johnson, C.A. Zetlin, W.W. Morse, and P.L. Berrien, 1999. Essential Fish Habitat Source Document: Atlantic Herring, *Clupea harengus,* Life History and Habitat Characteristics.

National Marine Fisheries Service, NOAA Technical Memorandum NMFS-NE-126. Online edition:http://www.nefsc.nmfs.gov/nefsc/publications/text/nefscseries/current/techmemo /Atlantic Herring 126.pdf.

Robins, C.R., G.C. Ray, J. Douglas, and R. Freud. 1986. Atlantic coast fishes. Peterson Field Guides 32. Houghton Mifflin Company, N.Y. 354 p.

Sainsbury, K. J. 1988. The ecological basis of multispecies fisheries and management of a demersal fishery in tropical Australia. In Fish Population Dynamics, 2nd ed, pp. 349– 382. Ed. by J. A. Gulland. John Wiley & Sons, London. 422 pp.

Saoloman, C.H., S.P. Naughton, and J.L. Taylor, 1982. Benthic community response to dredging borrow pits, Panama City Beach, Florida. U.S. Army Corps of Engineers Coastal Engineering Research Center, Misc. Report No. 82-3.

Slacum, H.W., W.H. Burton, J. Volstad, J. Dew, E. Weber, R. Llanso, and D. Wong, 2006. Comparisons between marine communities residing on sand shoals and uniform-bottom substrates in the Mid-Atlantic Bight. U.S. Department of the Interior, Minerals Management Service. MMS OCS Report 2005-042. 149 pp. + appendices.

South Atlantic Fishery Management Council. 1998. Final habitat plan for the South Atlantic region: essential fish habitat requirements for fishery management plans of the South Atlantic Fishery Management Council. October 1998. Online edition: http://www.safmc.noaa.gov/safmcweb/Habitat/habitat.html.

Steimle, F.W., C.A. Zetlin, P.L. Berrien, D.L. Johnson, and S. Chang, S. 1999. Essential fish habitat source document: scup, *Stenotomus chrysops*, life history and habitat characteristics. September 1999. U.S. Dept. of Commerce. NOAA Technical Memorandum NMFS-NE-149. Online edition:
http://www.nefsc.nmfs.gov/nefsc/publications/text/nefscseries/current/techmemo/Scup149.pdf.

Steimle, F.W., C.A. Zetlin, P.L. Berrien, and S. Chang, S. 1999. Essential fish habitat source document: black sea bass, *Centropristis striata*, life history and habitat characteristics. September 1999. U.S. Dept. of Commerce. NOAA Technical Memorandum NMFS-NE-143. Online edition:
http://www.nefsc.nmfs.gov/nefsc/publications/text/nefscseries/current/techmemo/BlackS eaBass143.pdf

Steimle, F.W., W.W. Morse, P.L. Berrien, and D.L. Johnson. 1999. Essential Fish Habitat Source Document: Red Hake, *Urophycis chuss*, Life History and Habitat Characteristics. National Marine Fisheries Service. NOAA Technical Memorandum NMFS-NE-133. Online edition:http://www.nefsc.nmfs.gov/nefsc/publications/text/nefscseries/current/techmemo /RedHake133.pdf.

Steimle, Frank W., Wallace W. Morse, and Donna L. Johnson. 1999. NOAA Technical Memorandum NMFS-NE-127 Essential Fish Habitat Source Document: Goosefish, *Lophius americanus*, Life History and Habitat Characteristics. U. S. Department of Commerce, National

Oceanic and Atmospheric Administration National Marine Fisheries Service, Northeast Region. Northeast Fisheries Science Center Woods Hole, Massachusetts. September, 1999.

Vasslides, J.M. and K.W. Able, 2008. Importance of shoreface sand ridges as habitat for fishes off the northeast coast of the United States. Fish. Bull. 106: 93-107.

U.S. Army Corp of Engineers, Norfolk District, 1992. Final Feasibility Report and Environmental Assessment, Sandbrdige Beach, Virginia Beach, Virginia. Hurricane and Storm Damage Reduction. March 1992.

Van Dolah, R.F., P.H. Wendt, R.M. Martore, M.V. Levisen, and W.A. Roumillat, 1992. A physical and biological monitoring study of the Hilton Head beach nourishment project. Final Report, Marine Resources Research Institute, South Carolina Marine Resources Division, Charleston, SC, 159 pp.

Van Dolah, R.F., B.J. Digre, P.T. Gayes, P. Donovan-Ealy, and M.W. Dowd. 1998. An evaluation of Physical Recovery Rates in Sand Borrow Sites used for Beach Nourishment Projects in South Carolina. Final Report, Marine Resources Research Institute, South Carolina Marine Resources Division, Charleston, South Carolina Center for Marine and Wetland Studies, Coastal Carolina University, Conway, South Carolina; U.S. Army Corps of Engineers, Charleston District, South Carolina submitted to the Minerals Management Service. 77 pp.

W.F. Baird & Associates Ltd. and Research Planning, Inc., 2004. Review of Existing and Emerging Environmentally Friendly Offshore Dredging Technologies. U.S. Department of the Interior, Minerals Management Service. MMS OCS Report 2004-076. 95 pp. + appendices.

Appendix C - Correspondence & Coordination Letters

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
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NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF

December 11, 2007

Planning and Policy Branch

See List of Addressees

Dear Sir/Madam:

The Norfolk District Corps of Engineers is reviewing and preparing an updated Environmental Assessment for the Sandbridge Beach Erosion and Hurricane Protection Project, which is located in Virginia Beach, Virginia. The Project was authorized by Section 1(a) of the Water Resources Development Act of 1974 (Public Law 93-251, 93rd Congress, H.R. 10203, 7 March 1974). In March 1992, The U.S. Army Corps of Engineers (USACE) completed the original Final Feasibility Report and Environmental Assessment for Sandbridge, and beach nourishment began in 1998. The current effort will evaluate whether or not the proposed action has the potential for creating significant impacts to the environment and address any changes that may have occurred since the 1992 Environmental Assessment was prepared. The evaluations are based on Federal, state, and local statutory requirements and an assessment of USACE environmental, engineering, and economic regulations.

The proposed action would involve beach nourishment at the Sandbridge oceanfront, an area approximately 5 miles long and 125 feet wide. The specific beach area covered is between Virginia Beach south of the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck, and North of the Back Bay National Wildlife Refuge. The designated borrow site is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline outside of Virginia's territorial sea. Approximately 1.5 million cubic yards of beach quality sand would be placed on a bi-annual cycle depending upon weather conditions, availability of funding, and behavior of subsequently placed material at the project site.

I am interested in the occurrence of any significant environmental resources under your purview within the project area. Any information you could provide would be helpful in our assessment of potential environmental effects. Any other comments or concerns you may have in regard to this project would be appreciated.

If you have any questions, please contact Elisabeth Sears of my office at (757) 201-7766, or email her at elisabeth.j.sears@usace.army.mil) or Craig Seltzer at (757) 201-7390, or email him at craig.l.seltzer@usace.army.mil. Thank you for your time, and we look forward to hearing from you.

Sincerely,

Mark T. Mansfield
Chief, Planning and Policy Branch

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Mr. David O'Brien
Center For Coastal Resource Management
Virginia Institute of Marine Science
P.O. Box 1346
Gloucester Point, VA 23062-1346

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF:

March 4, 2008

Planning and Policy Branch

Ms. Renee Orr
Chief, Sand and Gravel Program
Minerals Management Service
381 Elden Street, Mail Stop 4010
Herndon, VA 22071

Dear Ms. Orr:

The U.S. Army Corps of Engineers, Norfolk District, is preparing an updated Environmental Assessment for the Sandbridge Beach Erosion and Hurricane Protection Project, located in Virginia Beach, Virginia. The proposed action would involve beach nourishment of the oceanfront, an area approximately 5 miles long and 125 feet wide. The designated borrow site is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea. Approximately 1.5 million cubic yards of beach quality sand would be dredged from the shoal on a bi-annual cycle. We intend to seek a Memorandum of Agreement (MOA) from the Minerals Management Service (MMS) for such sand removal.

Pursuant to 40 CFR 1501, the Norfolk District requests the participation of the MMS as a cooperating agency during the required National Environmental Policy Act (NEPA) process. The purpose of this request is to designate the Corps as a lead agency and MMS as a cooperating agency. The Norfolk District will arrange a meeting to establish roles and responsibilities including information acquisition and analyses, specialized expertise, scope of contributions, and establish other appropriate elements of our working relationship for the EA. It is not anticipated that this arrangement will include financial contributions from the Norfolk District. MMS would use their own funds to accomplish these responsibilities. Pursuant to 50 CFR 402, Norfolk District will notify the U.S. Fish and Wildlife Service and NOAA National Marine Fisheries Service of its lead role and MMS' cooperating role, provided that you are in agreement with this arrangement. While it is MMS' policy to negotiate a new MOA per nourishment event (for use of outer continental shelf sand), we would like to discuss the option of negotiating a continuing MOA provided there are no major changes in the project footprint.

Please advise us, at your earliest convenience, as to your agency's willingness to serve as a cooperating agency in the NEPA process for the Sandbridge Beach Erosion and Hurricane Protection Project. If you have any questions or information regarding this project, please contact Elisabeth Sears at (757) 201-7766 or email to elisabeth.j.sears@usace.army.mil. Thank you for your time and we look forward to hearing from you.

Sincerely,

Mark T. Mansfield
Chief, Planning and Policy Branch

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Washington, DC 20240

MAR 21 2008

Mr. Mark T. Mansfield
Chief, Planning and Policy Branch
Department of the Army
Corps of Engineers, Norfolk District
803 Front Street
Norfolk, Virginia 23510

Dear Mr. Mansfield:

Thank you for your March 4, 2008, letter requesting that the Minerals Management Service (MMS) become a cooperating agency during the required National Environment Act (NEPA) process for the Sandbridge Beach Erosion and Hurricane Protection Project. The MMS welcomes the opportunity to participate in the NEPA effort and agrees to serve as a cooperating agency. As a cooperating agency we expect to: participate in the NEPA process at the earliest possible time; participate in the scoping process; assume, on the request of U.S. Army of Corps of Engineers (USACE), responsibility for developing information and preparing environmental analyses for which the MMS has special expertise; make available staff support at the lead agency's request to enhance the interdisciplinary capability of the USACE; and use our own funds to accomplish these responsibilities.

The MMS also agrees to participate in: the required Endangered Species Act (ESA) Section 7 consultation; the Magnuson-Stevens Fishery and Conservation Management Act Essential Fish Habitat consultation (Section 305); the National Historic Preservation Act Section 106 process; and the Coastal Zone Management Act Section 307 consistency determination. As the lead federal agency for ESA Section 7 and the Essential Fish Habitat consultations, the USACE must notify U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) of its lead role and MMS' cooperating role. We would expect to jointly submit with the USACE the ESA Section 7 and Essential Fish Habitat assessments to FWS and NMFS, and/or expect the USACE, as lead agency, to work with the MMS to ensure existing biological opinions from FWS and NMFS are applicable to MMS' part of the Federal action.

The USACE proposed plan requires approximately 1.5 million cubic yards of borrow material from Sandbridge Shoal be dredged on a bi-annual cycle over the remaining life of the 50-year project. The sand would be used for beach nourishment of the oceanfront, an area about 5 miles long and 125 feet wide. It is MMS policy to negotiate a new agreement for each use of OCS material (or per nourishment event); therefore, this agreement only applies to the NEPA and environmental requirements for this maintenance cycle. The final NEPA document, as well as the outcome of the other environmental requirements, may be used to establish stipulations or conditions in a future negotiated agreement. The MMS looks forward to working with you during this process. We ask that the following staff be included on all communication regarding this project, Geoffrey Wikel, Leasing Division, (703) 787-1283 and Sally Valdes, Environmental Division, (703) 787-1707. If you would like to discuss any of these items further, please contact Sally Valdes at (703) 787-1707.

Sincerely,

James F. Bennett
Chief, Branch of Environmental Assessment
Environmental Division

cc: Ms. Elisabeth Sears, Norfolk District, Corps of Engineers
Department of the Army
Corps of Engineers, Norfolk District
803 Front Street
Norfolk, Virginia 23510

May 12, 2008

Planning and Policy Branch

Ms. Joanna Wilson
Office of Review and Compliance
Department of Historic Resources
2801 Kensington Avenue
Richmond, Virginia 23221

Dear Ms. Wilson:

The Norfolk District Corps of Engineers is currently the planning next cycle of beach nourishment for the Sandbridge shoreline in Virginia Beach, VA. This project was initially constructed in 1998 under the authorization of Section 1(a) of the Water Resources Development Act of 1974. This shoreline has been renourished several times since initial construction, most recently in 2007.

The proposed action will involve placement of about 1.5 million cubic yards of beach quality sand along a stretch of eroding oceanfront approximately 5 miles long and 125 feet wide. The specific beach area covered is located between the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck and the Back Bay National Wildlife Refuge (see Figure 1). The proposed site for the borrow material is Sandbridge Shoal, which is located approximately three nautical miles from the shoreline, outside of Virginia's territorial waters. Within the shoal are two specific areas proposed for borrow material: Area B to the north and Area A to the south (see Figure 2). The area in between these two areas is not suitable because it is the location of a buried Navy communications cable. Either a hydraulic cutterhead suction dredge or a trailing suction hopper dredge would be used to remove the material from the borrow site and then pump it along the beach.

Several remote sensing surveys have been carried out in connection with previous beach nourishment projects at Sandbridge. Earlier, Christopher Goodwin and Associates carried out a literature search and remote sensing survey of portions of Areas A and B for the Navy's beach nourishment project at Dam Neck, resulting in a recommendation of no further work for the six anomalies discovered in that survey. In 1998, Tidewater Atlantic Research (TAR) carried out a remote sensing survey of part of Area B, which resulted in a recommendation of no additional investigation. In 2006, TAR carried out a remote sensing survey of Area A and the part of Area B that was not previously surveyed. This survey resulted in the identification of 46 anomalies which were judged as requiring additional investigation or otherwise avoided.

There are no known archaeological or architectural sites along the shoreline where the sand will be placed. However, the Little Island Coast Guard Station, a structure of local interest, is located landward of the beach near the Little Island City Park, a city maintained beach facility. This structure was built in 1925 as a U.S. Coast Guard Lifeboat Station, was deactivated in 1964, and is currently used as a maintenance and support facility for the Little Island City Park.

At this point in our study, it appears that there are no known significant resources within the area of potential effect (beach and offshore borrow areas) which will be affected by the proposed action. The dredge will avoid all areas within the borrow areas that contain anomalies of potential historical interest. In accordance with Section 106 of the National Historic Preservation Act, we are requesting concurrence with our determination of no effect on historic resources by June 15, 2008.

We will be preparing an environmental assessment as part of the National Environmental Policy Act compliance process, and that document will be coordinated later this year with your agency as well as other state, Federal, and local agencies and other interested persons. In the meantime, if you have any questions or concerns about this project, please contact Helene Haluska of my staff at (757) 201-7008.

Sincerely,

Mark T. Mansfield
Chief, Planning and Policy Branch

Enclosures

COMMONWEALTH *of* VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Department of Historic Resources
2801 Kensington Avenue, Richmond, Virginia 23221-0311

Kathleen S. Kilpatrick
Director

Tel: (804) 367-2323
Fax: (804) 367-2391
TDD: (804) 367-2386
www.dhr.virginia.gov

May 15, 2008

Ms. Helene Haluska
Planning and Policy Branch
US Army Corps of Engineers, Norfolk District
803 Front Street
Norfolk, VA 23510

Re: Offshore Borrow and Beach Nourishment Areas, Sandbridge Beach
DHR File # 2007-0458

Dear Ms. Haluska:

We have received a notice of intent to complete an environmental assessment for the above referenced project. As the notice states, archaeological survey of the proposed borrow areas identified multiple sonar and magnetic targets, some of which were recommended for avoidance or further investigation if they could not be avoided by dredging activities. We understand that the proposed dredging for beach nourishment purposes will avoid these anomalies, but your letter does not provide information regarding how that avoidance will be accomplished. Please provide this information at your earliest convenience so that we may better understand the scope of the undertaking. As well, a search of our archives indicates that we have no information about the Little Island Coast Guard Station. Please provide photographs of this property and information regarding how the beach nourishment activity may affect it. We will complete our review upon receipt of this information.

If you have any questions about our comments or the Section 106 process, please call me at (804) 367-2323, Ext. 140.

Sincerely,

Joanna Wilson, Archaeologist
Office of Review and Compliance

Administrative Services
10 Courthouse Avenue
Petersburg, VA 23803
Tel: (804) 863-1624
Fax: (804) 862-6196

Capital Region Office
2801 Kensington Ave.
Richmond, VA 23221
Tel: (804) 367-2323
Fax: (804) 367-2391

Tidewater Region Office
14415 Old Courthouse Way, 2nd Floor
Newport News, VA 23608
Tel: (757) 886-2807
Fax: (757) 886-2808

Roanoke Region Office
1030 Penmar Ave., SE
Roanoke, VA 24013
Tel: (540) 857-7585
Fax: (540) 857-7588

Northern Region Office
5357 Main Street
PO Box 519
Stephens City, VA 22655
Tel: (540) 868-7031
Fax: (540) 868-7033

June 19, 2008

Planning and Policy Branch

Ms. Joanna Wilson
Office of Review and Compliance
Department of Historic Resources
2801 Kensington Avenue
Richmond, Virginia 23221

Dear Ms. Wilson:

Thank you for your letter of May 15, 2008 regarding the beach nourishment project at Sandbridge Beach in Virginia Beach (DHR File # 2007-0458). The letter requested additional information concerning two features of the project. The first item concerned the planned avoidance of the anomalies that were identified during the remote sensing survey. The anomalies will be avoided by establishing a buffer of at least 200 feet (radius) around the target coordinates. This restriction will be placed in the plans and specifications that are prepared for the construction contract.

The second item requested pictures of the Little Island Coast Guard Station and information on potential impacts to the structure. Enclosed are five pictures of various views of the former lifesaving station. Since maintenance dredging was recently completed in the fall of 2007, the view of the Coast Guard Station from the shoreline, as shown in Photo 5, is likely very similar to the expected appearance of the area after completion of the next maintenance dredging, which is currently estimated to occur in the summer of 2010. No effect on the Coast Guard Station is expected as a result of the next dredging and beach nourishment because of the distance of the Coast Guard Station from the actual area where sand will be placed and the fact that the Station is located behind the existing dune line. All the construction activities will take place to the east of the existing dune line well beyond the building.

We hope this information will assist you in completing your review of the proposed project. If you have any questions or concerns about this project, please contact Helene Haluska of my staff at (757) 201-7008.

Sincerely,

Mark T. Mansfield
Chief, Planning and Policy Branch

Enclosures

COMMONWEALTH of VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Department of Historic Resources
2801 Kensington Avenue, Richmond, Virginia 23221-0311

Kathleen S. Kilpatrick
Director

Tel: (804) 367-2323
Fax: (804) 367-2391
TDD: (804) 367-2386
www.dhr.virginia.gov

July 17, 2008

Ms. Helene Haluska
Planning and Policy Branch
US Army Corps of Engineers, Norfolk District
803 Front Street
Norfolk, VA 23510

Re: Offshore Borrow and Beach Nourishment Areas, Sandbridge Beach
DHR File # 2007-0458

Dear Ms. Haluska:

We have received the additional information requested, and appreciate your providing this data for our review. With the understanding that all anomalies will be avoided, and with the understanding that the Coast Guard Station is located away from the proposed nourishment area, we are of the opinion that the project will not adversely affect historic properties.

If you have any questions about our comments or the Section 106 process, please call me at (804) 367-2323, Ext. 140.

Sincerely,

Joanna Wilson, Archaeologist
Office of Review and Compliance

Administrative Services
10 Courthouse Avenue
Petersburg, VA 23803
Tel: (804) 863-1624
Fax: (804) 862-6196

Capital Region Office
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Fax: (757) 886-2808

Roanoke Region Office
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Tel: (540) 857-7585
Fax: (540) 857-7588

Northern Region Office
5357 Main Street
PO Box 519
Stephens City, VA 22655
Tel: (540) 868-7031
Fax: (540) 868-7033

From: Grayson, Ron [mailto:Ron.Grayson@dhr.virginia.gov]
Sent: Thursday, February 05, 2009 9:51 AM
To: Wikel, Geoffrey L
Subject: RE: Section 106 Process for Sandbridge Beach Hurricane Protection and Storm Damage Reduction Project

Geoffrey:

Thank you for this information. We will indicate that the Corps is the Lead Federal Agency for Section 106 on the project.

Ron

From: Wikel, Geoffrey L [mailto:Geoffrey.Wikel@mms.gov]
Sent: Tuesday, February 03, 2009 3:40 PM
To: Grayson, Ron
Cc: Stright, Melanie; Sears, Elisabeth J. NAO; Helene.Haluska@usace.army.mil
Subject: Section 106 Process for Sandbridge Beach Hurricane Protection and Storm Damage Reduction Project

Hi Ron,
The Minerals Management Service (MMS) is notifying the Virginia Department of Historical Resources (DHR) of our involvement in the Sandbridge Beach Hurricane Protection and Storm Damage Reduction Project. The MMS has jurisdiction over the development of mineral and alternative energy resources on the Federal Outer Continental Shelf (OCS). The MMS was invited by the U.S. Army Corps of Engineers (USACE), the lead federal agency, to participate as a cooperating agency in the preparation of an Environmental Assessment under the National Environmental Policy Act, since the proposed project involves the use of OCS sand from Sandbridge Shoal. The MMS also agreed to participate in the National Historic Preservation Act (NHPA) section 106 process. Per 36 CFR 800.2(2), the MMS requested that the Corps of Engineers serve as the lead federal agency for section 106 compliance with MMS acting in a consulting role. The Corps did not notify DHR of their lead role and our involvement in the proposed action or their intention to fulfill collective responsibilities under section 106. Please find the section 106 correspondence between the Corps and DHR attached. The MMS would appreciate an email response acknowledging the same. If you have any questions or require additional information, please feel free to contact me, or our Historic Preservation Officer, Melanie Stright, at Melanie.Stright@mms.gov. I appreciate your cooperation and assistance in this matter.

Geoffrey Wikel
Environmental Division Minerals Management Service
381 Elden Street, MS 4042
Herndon, VA 20170
(703) 787-1283 Geoffrey.Wikel@mms.gov www.mms.gov

From: McDonald, Brad (DHR)
[mailto:Brad.McDonald@dhr.virginia.gov]
Sent: Friday, March 09, 2012 9:58 AM
To: Haynes, John H. NAO
Subject: RE: Additional Information: Offshore Borrow and Beach Nourishment Areas, Sandbridge Beach
DHR File #2007-0458 (UNCLASSIFIED)

Hi John,

Thanks for your update on this project. The proposed additions to the contract seem reasonable and are acceptable to me. I'll add this information to the project file.

Brad McDonald
Project Review Archaeologist

-----Original Message-----
From: Haynes, John H. NAO [mailto:John.H.Haynes@usace.army.mil]
Sent: Thursday, March 08, 2012 9:33 AM
To: McDonald, Brad (DHR)
Subject: Additional Information: Offshore Borrow and Beach Nourishment Areas, Sandbridge Beach DHR
File #2007-0458 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Brad,
I am writing to update DHR on the US Army Corps of Engineers progress on the above referenced project. While the previously surveyed borrow area has not changed, and the solicitation will include the avoidance of targets identified in the remote sensing surveys as agreed upon, no consideration was previously made of the effects of the pipeline system which shall deliver the dredged material to the beach. The configuration of pipelines would vary depending on the type of dredge used, either a 'hopper' dredge or a cutter head dredge (see Attachment A for description). If a hopper dredge is used, the vessel would transport load of sand from the borrow area to a pump out buoy anchored at the 30 foot bathyscaph, about 2500 feet off shore, and then via a fixed pipeline resting on the bottom to the beach. If a cutter head dredge is used the dredge material is transferred from the dredge via a floating pipeline to a fixed booster, and from there via a fixed pipeline resting on the bottom to the beach. The booster for the cutter head dredge would be anchored near the borrow area, about 3 miles offshore.

There is a potential for adverse effects to any submerged archaeological resources from the anchoring of the pump out buoy or booster barge, as well as the submerged pipeline. Areas potentially affected would be limited to the anchorage and pipeline route, and there would only be one or two of these. While this is a very limited area of potential effect, this section of the coast is known to have been the scene of a large number of shipwrecks (Attachment B).

Accordingly, and similar to requirements for the borrow area; we are adding the following stipulation to the contract:

1.20 Avoidance of Historic Resources

Not less than thirty calendar days from the start of dredging operations, the Contractor shall perform a marine remote sensing survey at the site(s) of any booster(s) or Scott's buoy/anchored pumpout buoy locations to ensure that potential historic resources are not located within his work area. If potential resources are identified during the survey, Contractor shall immediately notify the Contracting Officer's Representative, giving the location and nature of the findings. Contractor shall relocate his construction areas and establish a 100-ft buffer around the discovery. Do not anchor or spud in any such historic-resource, buffer zone nor disturb the buffer area in any way. A proposed revised buoy site or booster location shall be surveyed to ensure no historic resources are within any revised work area."

I am attaching copies of previous correspondence on this project for your convenience.

John H. Haynes
Archaeologist
US Army Corps of Engineers,
Norfolk District (NAO)
803 Front Street
Norfolk, VA 23510
757-201-7008
fax 757-201-7646
john.h.haynes@usace.army.mil

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
6669 Short Lane
Gloucester, VA 23061

January 3, 2008

Colonel Dionysios Annios
District Engineer
Norfolk District, Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

Attn: Elisabeth Sears
Planning Branch

Re: Sandbridge Beach Erosion and Hurricane Protection Project Norfolk, Virginia

Dear Colonel Annios:

The U.S. Fish and Wildlife Service (Service) has reviewed your December 11, 2007 request for information on federally listed species that occur around the Sandbridge Beach Erosion and Hurricane Protection project area. The Service provides the following information in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat.401, as amended; 16 U.S.C. 661 *et seq.*) and Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

You are updating the Environmental Assessment for the Sandbridge Beach Erosion and Hurricane Protection Project in Virginia Beach, Virginia. The study proposes to nourish an area of the Sandbridge oceanfront approximately 5 miles long and 125 feet wide. The specific beach nourishment area is between Virginia Beach, south of the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck, and north of the Back Bay National Wildlife Refuge. The borrow area identified as a potential sand source is Sandbridge Shoals. Approximately 1.5 million cubic yards would be place on a bi-annual cycle, depending on weather conditions, funding, and need. There are recorded observations of the loggerhead sea turtle (*Caretta caretta*), federally listed threatened, and they nest along the entire stretch of beach identified for nourishment in this project. A record of a roseate tern (*Sterna dougallii dougallii*), federally listed endangered was recorded at the southern end of the stretch of beach.

The Service will continue to coordinate with you on this project. Our planning aid report and coordination act report will provide detailed comments and descriptions of the potentially affected species. We also recommend you coordinate with the Virginia Department of Game and Inland Fisheries and NOAA Fisheries regarding species under their purview. We thank you for the opportunity to coordinate with you. Please contact Sumalee Hoskin of this office at (804) 693-6694 extension 136 if you have questions or to discuss the project further.

Sincerely,

Karen Mayne
Supervisor
Virginia Field Office

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF:

June 19, 2008

Planning and Policy Branch

Ms. Sumalee Hoskin
U.S. Fish and Wildlife Service
Virginia Field Office
6669 Short Lane
Gloucester, VA 23061

Dear Ms. Hoskin:

The U.S. Army Corps of Engineers, Norfolk District, is proposing beach nourishment at the Sandbridge oceanfront to occur within the next two years. The Norfolk District, acting as a lead agency, and the Minerals Management Service, acting as a joint agency, are currently updating the Environmental Assessment (EA) to evaluate whether or not the proposed action has the potential for creating significant impacts to the environment and address any changes that may have occurred since the previous EA was prepared in 1992. The proposed action would involve beach nourishment along an area approximately 5 miles long and 125 feet wide. The specific beach area covered is between Virginia Beach south of the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck and North of the Back Bay National Wildlife Refuge (Figure 1). The designated borrow site is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea. Beach quality sand would be removed by either hydraulic cutterhead suction dredge or by trailing suction hopper dredge. Approximately 1 to 2 million cubic yards of beach quality sand would be placed on the beach on a bi-annual cycle depending upon weather conditions, availability of funding, and behavior of subsequently placed material at the project site. The cycle may occur less often, but probably no less than once every 4 years.

The USFWS Service lists 65 listed threatened and/or endangered species in Virginia. Of those species, the following may occur along the Atlantic Coast of Southern Virginia:

Whales
E- Blue whale *Balaenoptera musculus*
E- Finback whale *Balaenoptera physalus*
E- Humpback whale *Megaptera novaengliae*
E- Right whale *Eubalaena glacialis*
E- Sei whale *Balaenoptera borealis*
E- Sperm whale *Physeter macrocephalus*

Birds
T- Piping plover *Charadrius melodus*
E- Roseate tern *Sterna dougallii dougallii*

Fish
E- Shortnose sturgeon *Acipenser brevirostrum*

Turtles
T- Loggerhead sea turtle *Caretta caretta*
T- Green sea turtle *Chelonia mydas*
E- Leatherback sea turtle *Dermochelys coriacea*
E- Hawksbill sea turtle Eretmochelys imbricata
E- Kemp's ridley sea turtle *Lepidochelys kempii*

Plants
T- Seabeach amaranth *Amaranthus pumilus*

Of the listed species, only the sea turtles, right whale, humpback whale and finback whale may be potentially affected by this action. A review of the listed shortnose sturgeon, piping plover, roseate tern and seabeach amaranth indicated a low likelihood of occurrence within the project area however; their proximity to Sandbridge Beach warranted continued consideration in the updated draft Environmental Assessment.

On April 2, 1993, the National Marine Fisheries Service (NMFS) issued a Biological Opinion (BO) for borrow area dredging and transport to Sandbridge Beach. Due to funding delays, the project was not completed until 1998, at which time the reasonable and prudent measures and terms and conditions outlined in the 1993 BO were incorporated into the current project specifications. The Incidental Take Statement (ITS) was updated in 2001 following new information on sea turtles resuscitation, hopper dredge interactions and reporting requirements. Recent coordination with the NMFS on December 2007, concluded that the current ITS and BO remain valid for the upcoming dredging and beach nourishment operations provided Norfolk District adhere to all reasonable and prudent measures and terms and conditions as outlined in the 2001 ITS and 1993 BO.

The Norfolk District will adhere to all terms and conditions and reasonable and prudent measures established during the course of previous Section 7 consultation with your office and the NMFS. If dredging occurs between May 1 and November 30, with the use of a hopper dredge, turtle deflectors will be outfitted on the draghead and trained turtle observers would be onboard during this time. Additionally, between May 1 and November 30, only sections of the beach undergoing re-nourishment will be monitored for sea turtles, their nests and nesting activities. Because of these conditions, it is recognized that the proposed beach re-nourishment is not likely to adversely affect sea turtles. The Norfolk District will employ trained personnel to conduct this monitoring consistent to our agreement. Under current project planning scenarios, these efforts will be continued into future nourishment cycles to fulfill our requirements under the Endangered Species Act. In November 2002, your office issued a letter stating that the project is not likely adversely affect sea turtles if qualified personnel conduct the monitoring.

Based on this information, the Norfolk District finds that the proposed activity would not adversely affect any listed threatened and/or endangered species. Under Section 7 coordination of the Endangered Species Act, the Norfolk District requests your concurrence with the determination for dredging at Sandbridge Shoal and beach nourishment at Sandbridge Beach.

Should you require any further assistance, please call Elisabeth Sears at (757) 201-7766 or email to: elisabeth.j.sears@usace.army.mil. Thank you for your time and we look forward to hearing from you.

Sincerely,

Mark T. Mansfield
Chief, Planning and Policy Branch

PLATE C-1

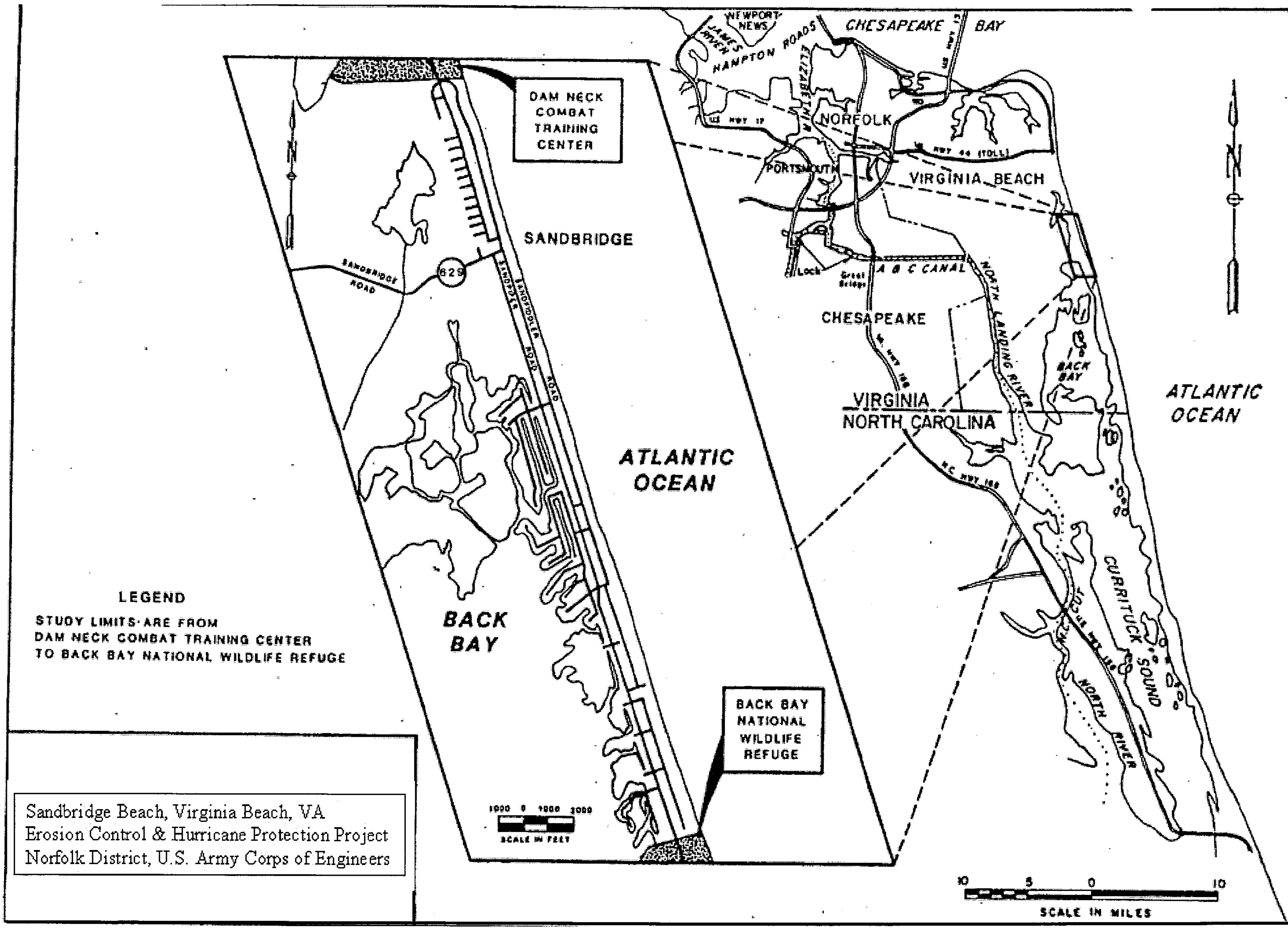

Figure 1

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
6669 Short Lane
Gloucester, VA 23061

October 10, 2008

Colonel Dionysios Anninos
District Engineer
Norfolk District, Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

Attn: Ms. Elisabeth Sears

Re: Sandbridge Proposed Beach Nourishment Project, Virginia Beach, Virginia, Project # 2008-I-0649

Dear Colonel Anninos:

We have received your request for concurrence on your determination, made under the authority of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.). You have determined that the above referenced project is not likely to adversely affect the endangered green sea turtle (*Chelonia mydias*), hawksbill sea turtle (*Eretmochelys imbricate*), Kemp's ridley sea turtle (*Lepidochelys kempi*), leatherback sea turtle (*Dermochelys coriacea*) shortnose sturgeon (*Acipenser brevirostrum*), and roseate tern (*Sterna dougallii dougallii*), and the threatened loggerhead sea turtle (*Caretta caretta),* piping plover (*Charadrius melodus*), and seabeach amaranth (*Amaranthus pumilus*). The Service has reviewed information on federally listed and proposed endangered and threatened species and designated critical habitat and provides the following comments under provisions of the.

The U.S. Army Corps of Engineers proposes to conduct beach nourishment activities along the Sandbridge oceanfront over the next four years. You plan to dredge beach quality sand from Sandbridge Shoal and nourish an area approximately 5 miles long and 125 wide. Approximately 1 to 2 million cubic yards will be placed on the beach on a bi-annual basis.

Most sea turtles in the Virginia Beach/Sandbridge area are loggerhead sea turtles, but this consultation addresses all sea turtles that could potentially be in the area: green, hawksbill, Kemp's ridley, and leatherback. As stated in your June 19, 2008, letter you have coordinated with the National Marine Fisheries Service regarding your dredging activities and agree to adhere to the previsions stated in our November 2002 letter. Specifically, you agree to use qualified personnel to monitor for sea turtle activities and nests on the sections of beach undergoing nourishment. During actual beach nourishment activities, you will have trained personnel on-site with instructions to cease activities and to contact the Service if a sea turtle attempts to nest. If nesting occurs, project activities will be modified to avoid potential impacts to turtles.

Transient listed species that travel through the area and may occasionally occur in the vicinity of the project area include the piping plover, roseate tern, and shortnose sturgeon. The piping plover is an uncommon summer resident in the lower Chesapeake Bay. They breed and forage along the barrier islands and bays on the Atlantic coast in Virginia from March to October. They have not been documented within the project area. Migrating plovers from across the northeast also pass through the area during spring and fall migration. The roseate tern is rare in the area, and may only be in the coastal area during the summer. Historically it nested on the Eastern Shore but nesting has not been documented there since 1927. The shortnose sturgeon was reported in the Potomac River in January 2006, and it is believed to have passed through the Chesapeake Bay in order to reach the Potomac. The Service believes the project may have a temporary, small effect on a small portion of the potential habitat of these transient species. During construction, the Service expects that any individuals of these species in the area immediately adjacent to the project would move to other areas. No long-term negative impacts to habitat for these species are anticipated. These effects are expected to be insignificant and discountable.

The seabeach amaranth is unlikely to occur in the project area, and has never been recorded at the site. Historically, seabeach amaranth was native to Atlantic coast barrier island beaches from Massachusetts to South Carolina, and may have occurred on the project area. The species' primary habitat consists of overwash flats at accreting ends of barrier islands, and lower foredunes and upper strands of non-eroding beaches. Because the species is not known to occur in the project area, impacts from construction are not expected to occur. The proposed project is not expected to have any long-term negative effects to habitat in the project area.

If the previously mentioned protective measures for sea turtles are followed, the Service believes the proposed action is not likely to adversely affect federally listed or proposed species or designated critical habitat. Should project plans change or if additional information on listed and proposed species becomes available, this determination may be reconsidered. If you have any questions or need further assistance, please contact Sumalee Hoskin of this office at (804) 693-6694, extension 136.

Sincerely,

Susan Lingenfelser

Susan Lingenfelser
Acting Supervisor
Virginia Field Office

cc: FWS, BBNWR (John Gallegos)
NOAA Fisheries, Gloucester, VA (David O'Brien)
NOAA Fisheries, Gloucester, MA
VDGIF, Painter, VA (Ruth Boettcher)

From: Sumalee_Hoskin@fws.gov
Sent: Friday, February 10, 2012 5:26 PM
To: Underwood, Martin K. NAO
Cc: Wikel, Geoffrey L; Armstrong, Jennifer R. NAO; Pruhs, Robert S NAO;
Conner, Susan L. NAO
Subject: Re: Sandbridge Beach Renourishment Update (UNCLASSIFIED)
Attachments: FWS Letter Sandbridge 10 Oct 08.pdf

Hi Marty,
Nothing has changed in regards to the T&E determination we made in our 2008 letter. Since the construction phase won't be starting until December we recommend you check our on-line system (IPAC) just in case anything may change between now and when renourishment will begin. The on-line system, IPAC, I'm referring to is part of our on-line project review system, which you can find in step #2 of our office website (address below).

Let me know if you have any further questions,
Sumalee
****
Sumalee Hoskin
US Fish & Wildlife Service
6669 Short Lane
Gloucester, VA 23061

Tel: 804-693-6694 ex. 128
Fax: 804-693-9032
Visit us at http://www.fws.gov/northeast/virginiafield/

"Underwood, Martin K. NAO" <Martin.K.Underwood@usace.army.mil>
02/09/2012 02:08 PM
To: "sumalee_hoskin@fws.gov" <sumalee_hoskin@fws.gov>
cc: "Wikel, Geoffrey L" <Geoffrey.Wikel@boem.gov>, "Armstrong, Jennifer R. NAO" <Jennifer.R.Armstrong@usace.army.mil>, "Conner, Susan L. NAO" <Susan.L.Conner@usace.army.mil>, "Pruhs, Robert S NAO" <Robert.S.Pruhs@usace.army.mil>

Subject: Sandbridge Beach Renourishment Update (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hi Sumalee,

My name is Marty Underwood and I have taken on some of Elisabeth Sears duties here at the USACE Norfolk District Office. Your office provided concurrence on the Sandbridge Beach Renourishment project back in October of 2008 and I saw that you worked with

Elisabeth on the Section 7 consultation. We are just now getting to the construction phase that we are hoping to start this coming December.

Nothing has changed in regards to the project, we have just been delayed. I wanted to make sure if anything has changed in regards T&E species since the concurrence letter in October of 2008. BOEM (formerly MMS) is authorizing the use of the offshore dredging borrow site and require an update before they provide us with an MOA that allows us to use the borrow site.

If we can get an email for the record from your office stating there are no current issues with T&E species or otherwise it would help us move forward. If you have any questions or comments feel free to email or call me at (757) 201-7766.

Thanks,

Marty

Sears, Elisabeth J. NAO

From: Amy.Ewing@dgif.virginia.gov
Sent: Tuesday, February 19, 2008 5:17 PM
To: Sears, Elisabeth J. NAO
Cc: John.Kleopfer@dgif.virginia.gov; Ruth.Boettcher@dgif.virginia.gov; Jeff.Cooper@dgif.virginia.gov
Subject: ESSLog# 21667_update to EA_Sandbridge Beach Erosion and Hurricane Protection Project

In response to your letter of request for information for inclusion in an updated Environmental Assessment (EA) for the subject project, we offer the following comments and recommendations:

According to our records, federal Endangered roseate tern, federal Endangered Kemp's Ridley sea turtle, state Threatened eastern glass lizard and state Threatened bald eagle have been documented in the project area.

In terms of impacts associated with the dredging of materials at a site located off the shore of Virginia, northeast of False Cape, we recommend that all reasonable measures are taken to avoid and minimize adverse impacts upon sea turtles. This should include, but not be limited to, use of rigid turtle deflector devices, inflow screening on the dredges and the use of trained observers for locating turtles during dredging operations. We recommend a time of year restriction on hopper dredging from April 1 through November 30 of any year.

With respect to impacts upon sea turtles from the proposed beach nourishment activities, we recommend a time of year restriction on these activities from May 15 through October 31, the peak egg-laying season and egg hatching. We recommend monitoring for sea turtle nesting activities in sections of beach that undergo nourishment activities. Further, we recommend that beach nourishment be performed in such a way as to increase nesting habitat available to sea turtles. This may include leveling any escarpments prior to the nesting season.

To best protect eastern glass lizard, we recommend that beach nourishment not occur during egg-laying and hatching season for this species in areas identified as suitable habitat. Egg-laying usually begins in early June and hatching my not be complete until late October. We recommend that all beach nourishment in areas identified as suitable habitat adhere to a time of year restriction from June 1 through October 31 for the protection of eastern glass lizard.

Roseate tern is not believed to breed in Virginia any longer as the last breeding confirmation was in 1927. However, we recommend that the EA for this project include information related tot he protection of this species and any need for further survey efforts to confirm or deny its presence in the project area.

A bald eagle nest has been documented northeast of False Cape along the South Inlet. This puts the nest approximately 5,000' inland. Therefore, it is unlikely that beach nourishment activities will impact this species. However, we recommend that the EA address possible impacts upon this species.

Further information regarding the protection of shorebirds and sea turtles should be directed to VDGIF's Easter Shore Biologist, Ruth Boettcher, at 757-787-5911 or at Ruth.Boettcher@dgif.virginia.gov.

Further information regarding the protection of eastern glass lizard should be coordinated with John (JD) Kleopfer, VDGIF Region I Wildlife Diversity Biologist/Herpetologist, at 804-829-6580, or at

John.Kleopfer@dgif.virginia.gov.

Further information regarding the protection of bald eagle should be coordinated with Jeff Cooper, VDGIF Region V Wildlife Diversity Biologist, at 540-899-4169, or at Jeff.Cooper@dgif.virginia.gov.

Thank you.

Amy M. Ewing
Environmental Services Biologist
Virginia Dept. of Game and Inland Fisheries 4010 West Broad Street
Richmond, VA 23230
804-367-2211
amy.ewing@dgif.virginia.gov

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF:

March 4, 2008

Planning and Policy Branch

Ms. Amy M. Ewing
Environmental Services Biologist
Virginia Department of Game and Inland Fisheries
4010 West Broad Street
Richmond, VA 23230

Dear Ms. Ewing:

The U.S. Army Corps of Engineers, Norfolk District, is in receipt of your email dated February 19, 2008. Comments and recommendations received were in reference to the proposed maintenance of the Sandbridge Beach Erosion and Hurricane Protection Project, Virginia Beach, Virginia. The recommendations included the protection of Federally endangered roseate tern, Federally endangered sea turtles, state threatened eastern glass lizard and state threatened bald eagle.

Roseate terns began to decline from its historical range in the late 1800's resulting from human activity, gull competition, and predation. They formerly bred from Nova Scotia to Virginia, but currently no longer breed south of Long Island, NY. The Migratory Bird Treaty Act of 1918 enabled some populations to reestablish and increase, however terns were ultimately extirpated from Maryland and Virginia. No known nests have been documented in Virginia since 1927. The species may visit the project area during the summer months but this occurrence would be rare. Potential impacts related to the roseate tern will be addressed in the updated draft Environmental Assessment, to be released in the near future.

The Norfolk District will adhere to all terms and conditions and reasonable and prudent measures established during the course of previous Section 7 consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service. If dredging occurs between May 1 and November 30, with the use of a hopper dredge, turtle deflectors will be outfitted on the draghead and trained turtle observers would be onboard during this time. Additionally, between May 1 and November 30, sections of the beach undergoing re-nourishment will be monitored for sea turtles, their nests and nesting activities. The Norfolk District will employ trained personnel to conduct this monitoring consistent to our agreement with the U.S. Fish and Wildlife Service. With implementation of these measures, no time of year restrictions have been required through previous project coordination. Under current project planning scenarios, these efforts will be continued into future nourishment cycles to fulfill our requirements under the Endangered Species Act. Potential impacts related to sea turtles will be addressed in the updated draft Environmental Assessment.

The Eastern Glass Lizard is a State listed species found in pine flatwoods and around wetlands in sandy habitats. They are most common in Back Bay National Wildlife Refuge and False Cape State Park and unlikely to occur within the project area.

Norfolk District will continue to follow conservation measures to avoid or minimize adverse impacts to bald eagles. Given the indication of a bald eagle nest located approximately 5,000 feet from the project site, the nourishment activities would not disturb the eagle or its nest due to its distance from the project. National Bald Eagle Management Guidelines set forth by the U.S. Fish and Wildlife Service would be considered for any activities that may affect the species.

Additional comments regarding this project may be directed to Elisabeth Sears at: (757) 201-7766 or email to: elisabeth.j.sears@usace.army.mil. Thank you for your involvement in our planning process.

Sincerely,

Craig Seltzer
for Mark T. Mansfield
Chief, Planning and Policy Branch

-----Original Message-----
From: Dorie_Stolley@fws.gov [mailto:Dorie_Stolley@fws.gov]
Sent: Tuesday, March 18, 2008 4:11 PM
To: John_Gallegos@fws.gov
Cc: Sears, Elisabeth J. NAO
Subject: RE: Sandbridge Beach (UNCLASSIFIED)

John (and Elisabeth),
Here is the 2007 sea turtle report for BBNWR. All is well here...but busy!

Dorie
(See attached file: Sea Turtle Annual Report 2007.doc)

Dorie Stolley
Visitor Services Manager
Eastern Shore of Virginia National Wildlife Refuge
5003 Hallett Circle
Cape Charles, VA 23310
Phone: (757) 331-2760

John Gallegos/R5/FWS/DOI
To Dorie Stolley/R5/FWS/DOI
03/18/2008 01:59 PM
Subject RE: Sandbridge Beach (UNCLASSIFIED) (Document link: Dorie Stolley)

Hi Dorie,
Glad to hear that you're settling into your new position.
I don't have an electronic version of the 2007 Sea Turtle Report. I'll bet you've got a copy squirreled away someplace and can send it to me. It has the updated (2000-2007) sea turtle info in it that Elisabeth Sears (below) is looking for. I have a hard copy of the document that provides the graph and table, but not an electronic version. I've got all the other years Reports but 2007's.
Let me know if you can find it or not. Thanks!

John G.
John B. Gallegos, Wildlife Biologist
U.S. Fish & Wildlife Service
Back Bay N.W.R.
4005 Sandpiper Road,
Virginia Beach, VA 23456-4347
E-Mail: John_Gallegos@fws.gov
Phone: (757) 721-2412/3896
Fax: (757) 721-6141
http://backbay.fws.gov

Dorie Stolley/R5/FWS/DOI
To "Sears, Elisabeth J. NAO"<Elisabeth.J.Sears@usace.army.mil>
03/14/2008 10:56AM
cc Ruth.Boettcher@dgif.virginia.gov, John Gallegos/R5/FWS/DOI@FWS
Subject RE: Sandbridge Beach (UNCLASSIFIED) (Document link: John Gallegos)

Elizabeth,

I am forwarding your request on to John Gallegos, since I am no longer at Back Bay NWR.
Ruth, if you have already sent the info to Elizabeth, would you please let John know? Thanks!

Dorie
Dorie Stolley
Visitor Services Manager
Eastern Shore of Virginia National Wildlife Refuge
5003 Hallett Circle
Cape Charles, VA 23310
Phone: (757) 331-2760

"Sears, Elisabeth J. NAO"<Elisabeth.J.Sears@usace.army.mil>
<Dorie_Stolley@fws.gov><Ruth.Boettcher@dgif.virginia.gov>
Subject RE: Sandbridge Beach (UNCLASSIFIED)

Hi again,
We have detailed sea turtle monitoring reports (what I can find) in our office up to the year 2000. I am trying to put together a graph in our updated EA that includes the location and number of each nest and false crawls- just like what you have on page 19 of your activity report and nesting summary years 1980-2000. The attachment is from that report - the format I would like to follow.

I just need to know what has been recorded from 2000-2007 at each site. I would appreciate any help......and if you had those reports.

Thank You!!
Elisabeth S.

-----Original Message-----
From: Lewandowski, Jill [mailto:Jill.Lewandowski@mms.gov]
Sent: Wednesday, March 25, 2009 8:57 AM
To: Lingenfelser, Susan
Cc: Wikel, Geoffrey L; Skrupky, Kimberly A; Sears, Elisabeth J. NAO
Subject: FW: FWS concurrence on Sandbridge project????

Ms. Lingenfelser,

Elisabeth Sears with ACOE recently forwarded me your letter regarding the Section 7 ESA consultation on the Sandbridge project. As you may be aware, MMS is the Federal agency responsible for granting the ACOE authority to dredge and collect sands from Sandbridge Shoals for this beach renourishment project. I notice from your concurrence letter that there is no mention of MMS as a joint agency on this consultation. I just wanted to clarify with you, in writing, as to whether MMS is covered under this consult. We just want to be sure we have our ESA compliance requirements in place. Again, MMS is simply granting the authority to collect sands from the shoal and there is no additional direct or indirect activity which would add to the level of effects to ESA-listed species or designated critical habitat.

Please advise when you can. Thanks for your time and attention.

Thanks,
Jill

Jill Lewandowski
Protected Species Coordinator
Environmental Division
Minerals Management Service
U.S. Department of Interior
381 Elden Street, MS 4042
Herndon, VA 20170
(703) 787-1703
fax (703) 787-1026
email Jill.Lewandowski@mms.gov
Internet www.mms.gov

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF

January 31, 2007

Planning and Policy Branch

Ms. Julie Crocker
National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298

Dear Ms. Crocker,

The Norfolk District Corps of Engineers is currently preparing for the maintenance of a beach nourishment project at Sandbridge Beach, Virginia Beach, Virginia, that is planned to begin in spring 2007. The original Federal beach nourishment at Sandbridge was constructed in 2002 by the Norfolk District. The upcoming project incorporates the same design criteria as the 2002 project, namely a 50-foot-wide berm at an elevation of 6 feet (NGVD) with a foreshore slope of approximately 1:20 for a shoreline distance of approximately 5 miles from the Dam Neck Fleet Training Center to the Back Bay National Wildlife Refuge.

The state permits cover the placement of a total of 3.5 million cubic yards (MCY) of beach quality sand obtained from a borrow source located outside of Virginia's Territorial Sea. This volume of sand supplied the approximately 1.5 MCY necessary for the initial nourishment that was completed in 2002. At the time the permits were processed, two maintenance cycles of one MCY each were tentatively planned for 2004 and 2006. However, due to lack of funding, no nourishment cycle occurred during 2004. Therefore, we anticipate utilizing the remaining volume of the permit (2 MCY) for one nourishment event scheduled for late spring/early fall 2007.

All requirements of the Section 7 consultation with NMFS regarding measures to minimize/eliminate impacts to threatened and endangered species are outlined in correspondence from your agency dated August 20, 2001 and April 6, 2006. In accordance with the terms and conditions of the Biological Opinion (BO) for the Sandbridge Beach project, a turtle observer is required on hopper dredges operating during the period of April 1st through November 30th.

Recent developments indicate the potential to encounter small caliber unexploded ordnance (UXO) in the mid-Atlantic region including the borrow areas for this project. As a safety precaution, the U.S. Army Corps of Engineers is requiring that a screen be placed over the drag head to effectively prevent any of the UXO from entering the hopper and/or being placed on the beach. To be successful it was determined that the screen should be made of vertical metal bars with a gap of no more than 1.5 inches.

This will allow for the sand to pass but retard the UXO. It will also have the added advantage of preventing turtles from being entrained in the drag head.

Since the screen has such a narrow opening, the likelihood of a turtle being entrained is minute to impossible. If something biological was to be captured through the one inch slots it would not be caught in the cages on the dredge since the openings are much larger. Therefore, the cages should be empty and the need for an observer is negated. Based on your recent correspondence with the Corps Baltimore District (August 30, 2006), the Norfolk District is requesting that your office remove the requirement to have a turtle observer on board the dredge while performing beach nourishment activities at Sandbridge Beach. All other terms and conditions of the BO will remain in effect.

It is requested that your office consider this request and reply by February 20, 2007, in order for us to begin modifying our contract in a timely manner. If there are any questions concerning this request please contact Mr. Craig Seltzer at (757) 201-7390.

Sincerely,

Craig Seltzer

for Mark T. Mansfield
Chief, Planning and Policy Branch

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

FEB - 7 2007

Mark T. Mansfield, Chief
Planning and Policy Branch
Department of the Army
Norfolk District, Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

Attn: Planning and Policy Branch, Craig Seltzer

Dear Mr. Mansfield,

This is in response to your letter dated January 31, 2007 regarding dredging activities proposed as part of the Sandbridge Beach nourishment project. Consultation originally occurred between the Army Corps of Engineers (ACOE) and NOAA's National Marine Fisheries Service (NMFS) in 1993. On April 2, 1993, NMFS issued a Biological Opinion (BO) which concluded that the proposed Sandbridge beach nourishment project, which involved the removal of 3.5 million cubic yards (cy) of sand from an offshore borrow site, was likely to adversely affect, but not likely to jeopardize the continued existence of any species listed as threatened or endangered by NMFS. Included with the Opinion was an Incidental Take Statement (ITS) and non-discretionary Terms and Conditions with implementing Reasonable and Prudent Measures.

Further coordination occurred between NMFS and ACOE in 2001 which resulted in revisions to the ITS. Due to funding constraints, the first dredging cycle did not occur until 2002. A second and final phase of dredging was scheduled for 2004 but due to a lack of funding has not yet occurred. The ACOE now proposes to complete the project in the spring of 2007. The final phase of dredging will involve the removal of approximately 2 million cy of sand from the offshore borrow site with placement at Sandbridge. Dredging is scheduled to take place in the spring of 2007.

As noted in your letter, recent developments indicate that the dredge operating this spring is likely to encounter small caliber unexploded ordnance (UXO) in the borrow areas for this project. As a safety precaution, the ACOE is requiring that a screen be placed over the drag head to effectively prevent any of the UXO from entering the hopper and/or being subsequently placed on the beach. The screen will be made of vertical metal bars with a gap of no more than 1.5 inches.

The ITS issued for this project requires that NMFS approved endangered species observers be on board the dredge during the period of April 1 – November 30, or whenever water temperatures are above 11°C to monitor the hopper spoil, overflow, screening and dragheads for sea turtles and their remains. Observer coverage is required to allow for the screening of 100% of dredged material. In the January 31 letter, the ACOE has requested that this requirement be waived for the 2007 dredging season as the installation of the screen on the draghead will preclude sea turtles from becoming entrained in the draghead and will prevent any sea turtles or sea turtle parts from being observed.

Sea turtles are known to be vulnerable to entrainment in large ocean-going hopper dredges. As noted above, one dredge cycle for this project has been completed. In May 2002, 1.5 million cy of material were removed from the offshore borrow site. No sea turtles were observed during this dredge cycle. While no sea turtles have been observed during dredging operations associated with this project, 59 sea turtles have been killed during dredging operations in the ACOE Norfolk district since 1994 and several others have been killed in other hopper dredging projects in the Northeast. NMFS agrees that the installation of the screening on the draghead will prevent sea turtles from becoming entrained in the draghead. For example, the hopper dredge Currituck has screening on the intake with 4" openings and studies have demonstrated that this screening effectively eliminates the potential for sea turtles to become entrained in the draghead of the Currituck.

As the screens will prevent sea turtles from becoming entrained in the dredge it is not necessary to have an observer onboard to inspect for sea turtle parts. As such, NMFS agrees to ACOE's request to remove the observer requirement for the 2006 dredging. Removing this requirement does not modify the action in a manner that causes an effect to listed species that was not considered in the April 2, 1993 Opinion and 2001 revisions; therefore, it is not necessary to reinitiate consultation. Additionally, the removal of the requirement does not alter the conclusions reached in the 1993 Opinion and 2001 revisions. Should you have any questions regarding these comments, please contact Julie Crocker of my staff at (978)281-9300 x6530 or by e-mail (Julie.Crocker@noaa.gov).

Sincerely,

Mary A. Colligan
Assistant Regional Administrator
for Protected Resources

Cc: Scida, F/NER3
McNulty, F/NER3

File Code: Sec 7 ACOE Sandbridge Beach Nourishment 2007
PCTS: I/NER/2007/00607

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

Mark T. Mansfield, Chief
Planning and Policy Branch
Department of the Army
Norfolk District, Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

DEC 20 2007

Attn: Elisabeth Sears or Craig Seltzer

Dear Mr. Mansfield,

This is in response to your letter dated December 11, 2007 regarding the preparation of an updated Environmental Assessment for the Sandbridge Beach Erosion and Hurricane Protection Project in Virginia Beach, Virginia. The proposed project would involve beach nourishment at the Sandbridge oceanfront, an area approximately 5 miles long and 125 feet wide. The designated borrow site is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline outside of Virginia's territorial sea. Approximately 1.5 million cubic yards of beach quality sand would be placed on a bi-annual cycle depending on weather conditions, availability of funding, and behavior of subsequently placed material at the project site. Your letter requested information on the presence of federally-protected species recognized by NOAA's National Marine Fisheries Service (NMFS) within the project area.

As you know, several species of threatened and endangered whales and sea turtles occur seasonally off the coast of Virginia. Federally endangered North Atlantic right whales (*Eubalaena glacialis*) and humpback whales (*Megaptera novaeangliae*) may be found seasonally in Virginia waters. North Atlantic right whales have been off the coast of Virginia from November 1 through May 31. Humpback whales feed during the spring, summer, and fall over a range that encompasses the east coast of the U.S. and may be found in Virginia waters from September 1 to April 30. Federally endangered fin whales (*Balaenoptera physalus*) are also seasonally present in the waters off of Virginia, but are typically found in deeper, offshore waters. Fin whales are likely to be present off the coast of Virginia from October to January.

Several species of sea turtles are known to be present off the coast of Virginia from April 1 to November 30 each year. Federally threatened loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) as well as federally endangered Kemp's ridley (*Lepidochelys kempi*) sea turtles are present in Virginia's coastal waters, including Chesapeake Bay, mainly during late spring, summer, and early fall when water temperatures are relatively warm. Federally endangered leatherback sea turtles (*Dermochelys coriacea*), although predominantly oceanic, would be expected to occur in these waters during the same time frame. Leatherbacks are often observed feeding on jellyfish prey near the mouth of Chesapeake Bay during warm months.

Consultation on this project originally occurred between the Army Corps of Engineers (ACOE) and NMFS in 1993. On April 2, 1993, NMFS issued a Biological Opinion (BO) which concluded that the proposed Sandbridge Beach nourishment project was likely to adversely affect, but not likely to jeopardize the continued existence of any species listed as threatened or endangered by NMFS. Included with the BO was an Incidental Take Statement (ITS), which included terms and conditions as well as reasonable and prudent measures which must be completed for the ITS to remain valid. As such, as it is the understanding of NMFS that the ACOE will adhere to the terms and conditions and reasonable and prudent measures of the 1993 BO, the ITS that accompanied that BO remains valid for this project and no additional consultation pursuant to Section 7 of the ESA is required.

We look forward to continuing to work cooperatively with you and your staff on dredging projects in the Norfolk District. Should project plans change or new information become available that changes the basis for this determination, or a new species be listed or critical habitat designated, consultation should be reinitiated. Should you have any questions regarding these comments, please contact William Barnhill of my staff at (978) 281-9300 ext. 6510 or by e-mail (William.Barnhill@noaa.gov). Information regarding essential fish habitat and other NOAA trust resources in the project area should arrive under separate cover.

Sincerely,

Mary Colligan

Mary A. Colligan
Assistant Regional Administrator
for Protected Resources

cc: Nichols, F/NER4

File Code: Sec 7 technical assistance 2007 – ACE NAO Sandbridge Beach nourishment project
PCTS: I/NER/2007/08011

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Washington, DC 20240

JUN 0 2 2008

Ms. Mary Colligan
Assistant Regional Administrator
National Marine Fisheries Service
One Blackburn Drive
Gloucester, Massachusetts 01930

Dear Ms. Colligan:

The National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) indicated in a December 20, 2007 letter to the U.S. Army Corps of Engineers (ACOE), Norfolk District (see enclosed) that the planned biannual maintenance of the Sandbridge Beach Erosion and Hurricane Protection Project (Project) in Virginia Beach, Virginia was covered under an April 1993 NOAA Fisheries Endangered Species Act (ESA) biological opinion (BO) and associated Incidental Take Statement. This BO concluded that the dredging for the Project was likely to adversely affect but not likely to jeopardize the continued existence of any ESA-listed species nor adversely modify any designated critical habitat.

The ACOE has requested authorization from the Minerals Management Service (MMS) to dredge an offshore borrow area covered under the Outer Continental Shelf Lands Act, 43 U.S.C. § 1337(k) and considered in the analysis of the BO. Consequently, the MMS is required under the ESA to consult with NOAA Fisheries to ensure that approval of the use of sand from this offshore site does not jeopardize the continued existence of ESA-listed species or adversely modify any designated critical habitat. Based on recent guidance provided by Ms. Julie Crocker of your staff, this letter serves to request concurrence from NOAA Fisheries that MMS's authorization of the use of this sand will not take or affect ESA-listed species or designated critical habitat as this authorization is purely administrative in nature. Further, the MMS also requests acknowledgement from NOAA Fisheries that MMS has met its ESA Section 7 requirements for this project.

Please provide a written response regarding this concurrence no later than 45 days from receipt of this letter. If you have any questions or require additional information, please contact Ms. Jill Lewandowski at Jill.Lewandowski@mms.gov or (703) 787-1703. We appreciate your cooperation and assistance in this matter.

Sincerely,

Judy Wilson
Acting, CED

Gregory J. Gould
Chief, Environmental Division

Enclosure

cc: Craig Seltzer, U.S. Army Corps of Engineers, Norfolk District
Renee Orr, Minerals Management Service, Leasing Division
James Bennett, Minerals Management Service, Environmental Division
Geoffrey Wikel, Minerals Management Service, Environmental Division
Jill Lewandowski, Minerals Management Service, Environmental Division

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF:

April 16, 2009

Planning and Policy Branch

Ms. Mary Colligan
Protected Resources
National Marine Fisheries Service
Northeast Regional Office
55 Great Republic Drive
Gloucester, MA 01930-2276

Dear Ms. Colligan:

The U.S. Army Corps of Engineers (USACE), Norfolk District is currently preparing for the maintenance of a beach nourishment project at Sandbridge Beach, Virginia Beach, Virginia that is planned to begin in spring/summer 2010. The last beach nourishment was completed in October 2007. The upcoming project incorporates the same design criteria as the 2007 project, a 50-foot-wide berm at an elevation of 6 feet (NGVD) with a foreshore slope of approximately 1:20 for a shoreline distance of approximately 5 miles from the Dam Neck Fleet Training Center to the Back Bay National Wildlife Refuge. The USACE, acting as a lead agency, and the Minerals Management Service (MMS), acting as a cooperating/joint agency, have updated the enclosed Draft Environmental Assessment (EA) to address beach renourishment and sand borrow from Sandbridge Shoal. The shoal is located approximately three (3) nautical miles from the shoreline, outside of Virginia's territorial sea. Beach quality sand would be removed by either hydraulic cutterhead suction dredge or by trailing suction hopper dredge.

All requirements of the Section 7 consultation with NMFS regarding measures to minimize/eliminate impacts to threatened and endangered species were previously outlined in a correspondence letter from your agency dated December 20, 2007. The letter stated that the current Incidental Take Statement (ITS) and Biological Opinion (BO) would remain valid for the upcoming dredging and beach nourishment operations provided Norfolk District adheres to all reasonable and prudent measures and terms and conditions as outlined in the 2001 ITS and 1993 BO. Your office concluded that the proposed project was likely to adversely affect sea turtles, but not likely to jeopardize the continued existence of the species. In accordance with the terms and conditions of the BO for the project, if dredging occurs between May 1 and November 30, with the use of a hopper dredge, turtle deflectors will be outfitted on the draghead. The ITS issued for this project also requires that NMFS approved endangered species observers be on board the dredge during the period of May 1-November 30, or whenever-water temperatures are above 11°C to monitor the hopper dredged sand, overflow, screening and dragheads for sea turtles and their remains. Observer coverage is required to allow for the screening of 100% of dredged material.

During an archaeological remote sensing survey conducted in 2007, it was determined that the borrow area (Sandbridge Shoal) had high potential for other materials, such as small caliber unexploded ordnance (UXO). Historically, the shoal was within an area designated as a range for coastal ordnance training and military weapons experiments. As a safety precaution, the Corps has required that a screen be placed over the drag head to effectively prevent any of the UXO from entering the hopper 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.

On January 31, 2007, the Corps requested that the requirement for endangered species observers on board the dredge be waived for the 2007 dredging season as the installation of the screen on the draghead would preclude sea turtles from becoming entrained in the draghead and prevent any sea turtles or sea turtle parts from being observed. Your office responded by letter dated February 7, 2007, and agreed that the installation of the screening on the draghead would prevent sea turtles from becoming entrained in the draghead. The letter stated it was not necessary to have an observer onboard to inspect for sea turtle parts and agreed to the Corps request to remove the observer requirement for the 2007 dredging project. Furthermore, your office stated that removal of the observer requirement did not alter the conclusions reached in the 1993 Opinion and 2001 revisions. The Norfolk District is hereby requesting concurrence with these previous agreements.

All other terms and conditions of the BO and ITS will remain in effect. It is requested that your office review the enclosures and reply by May 20, 2009, which concludes a 30-day comment period for the Draft EA. Should you have any questions as you review the document or need any additional information, please do not hesitate to call Ms. Elisabeth J. Sears of my staff at (757) 201-7766 or email to: elisabeth.j.sears@usace.army.mil. Thank you for your time and we look forward to hearing from you.

Sincerely,

Mark T. Mansfield
Chief, Planning and Policy Branch

Enclosures

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

SEP - 7 2012

Mark T. Mansfield, Chief
Planning and Policy Branch
Department of the Amy
Norfolk District, Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

Dear Mr. Mansfield,

Please find enclosed a copy of the Biological Opinion on the effects of your proposal to conduct dredging at Sandbridge Shoal in 2012-2013 as part of the Sandbridge Beach Hurricane Protection Project. This work will be carried out by the U.S. Army Corps of Engineers (USACE) or their contractors. The Bureau of Ocean Energy Management (BOEM) will authorize the use of sand from an Outer Continental Shelf (OCS) sand borrow area for the project under the OCS Lands Act, 43 U.S.C. §1337(k). In this Opinion, we conclude that the proposed action is likely to adversely affect, but not likely to jeopardize the continued existence of the Northwest Atlantic Distinct Population Segment (DPS) of loggerhead sea turtles, or Kemp's ridley, green or leatherback sea turtles or the threatened Gulf of Maine DPS of Atlantic sturgeon or the endangered New York Bight, Chesapeake Bay, South Atlantic or Carolina DPSs of Atlantic sturgeon. We also conclude that the proposed action may affect but is not likely to adversely affect shortnose sturgeon, hawksbill sea turtles, or North Atlantic right, humpback or fin whales.

Our Opinion includes an Incidental Take Statement (ITS). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements, including any state endangered species laws or regulations, except for the prohibition against taking in ESA Section 9. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The ITS specifies reasonable and prudent measures necessary to minimize and monitor take of Atlantic sturgeon. The measures described in the ITS are non-discretionary and must be implemented for the exemption in section 7(o)(2) to apply. USACE, as the lead Federal agency, has a continuing duty to regulate the activity covered by this ITS. If you (1) fail to assume and implement the terms and conditions or (2) fail to require your contractors to adhere to the terms and conditions of the ITS through enforceable terms that are added to permits and/or contracts as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, you must report the progress of the action and its impact on the species to us as specified in the Incidental Take Statement [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

If a hopper dredge is used, this ITS exempts the lethal take of six loggerhead sea turtles and one Kemp's ridley or green sea turtle as well as one Atlantic sturgeon from any of the five DPSs. If a hydraulic pipeline dredge is used, the ITS exempts the take of one Atlantic sturgeon from any of the five DPSs. No take of sea turtles is anticipated if a pipeline dredge is used.

This Opinion concludes formal consultation for the proposed action as currently defined. Reinitiation of this consultation is required if: (1) the amount or extent of taking specified in the ITS is exceeded; (2) new information reveals effects of these actions that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) project activities are subsequently modified in a manner that causes an effect to the listed species that was not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

Should you have any questions regarding this Opinion please contact Julie Crocker of my staff at (978) 282-8480 or by e-mail (Julie.Crocker@noaa.gov). I look forward to continuing to work with you and your staff on our ongoing consultation regarding other Chesapeake Bay dredging projects.

Sincerely,

George H. Darcy

for John K. Bullard
Regional Administrator

ec: Crocker - F/NER3
O'Brien – F/NER4
Underwood, Pruhs – ACOE NAO
BOEM

File Code: Sec 7 ACOE Norfolk – Chesapeake Bay entrance 2012
PCTS: F/NER/2012/01587

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF:

April 16, 2009

Planning and Policy Branch

See List of Addresses

Dear Madam:

Enclosed you will find a copy of the Draft Environmental Assessment (EA) for the project at Sandbridge Beach, located in Virginia Beach, Virginia. The project will provide maintenance for hurricane protection and storm damage reduction. This EA was prepared by the U.S. Army Corps of Engineers, Norfolk District in cooperation with the U.S. Department of Interior, Minerals Management Service, to present the impacts that could potentially result from beach nourishment at Sandbridge and the associated sand mining from an offshore borrow site for continuing maintenance of beach nourishment and storm damage reduction. The purpose of the project is to provide protection from erosion induced damages including limited protection to the beach and to residential structures from storm damage.

We would appreciate you making this complete report available as a reference document in your library to those who may be interested. A 30-day public comment period for the Draft EA will conclude on May 20, 2009. Please inform those interested in submitting comments, they should be directed to Ms. Elisabeth J. Sears, email elisabeth.j.sears@usace.army.mil or written comments may be submitted to the following address:

U.S. Army Corps of Engineers
Norfolk District
Planning and Policy Branch
803 Front Street
Norfolk, VA 23510-1096

If you have any questions on this document or need additional information, please contact Mr. Brian Rheinhart, Project Manager at (757) 201-7768 or Ms. Elisabeth J. Sears, Technical Team Leader at (757) 201-7766.

Sincerely,

Mark Mansfield

MARK T. MANSFIELD
Chief, Planning and Policy Branch

Enclosures

LIST OF ADDRESSEES:

Ms. Marcy Sims
Library Director
Meyera E. Oberndorf Central Library
4100 Virginia Beach Blvd.
Virginia Beach, VA 23452

Ms. Neva White
Area Librarian
Princess Anne Area Library
1444 Nimmo Parkway
Virginia Beach, VA 23456

Ms. Diane Wetterlin
Acting Manager
Oceanfront Area Library
700 Virginia Beach Boulevard
Virginia Beach, VA 23451

NOTICE OF AVAILABILITY

The U.S. Army Corps of Engineers, Norfolk District (USACE), has completed a Draft Environmental Assessment (EA) entitled "Sandbridge Beach Erosion Control and Hurricane Protection Project Virginia Beach, Virginia." The purpose of the project is to provide protection from erosion induced damages including limited protection to the beach and to residential structures from storm damage. The EA was prepared by the USACE in cooperation with the U.S. Department of Interior, Minerals Management Service, to present the impacts that could potentially result from beach nourishment at Sandbridge and the associated sand mining from an offshore borrow site for continuing maintenance of beach nourishment and storm damage reduction.

The EA is electronically available for viewing and copying at the Norfolk District website (projects tab) http://www.nao.usace.army.mil/

Hard copies are available to the public to review at three local Virginia Beach libraries: Meyera E. Oberndorf Central Library, Princess Anne Area Library, & the Oceanfront Area Library.

Additionally, a hard copy will be sent upon written request to elisabeth.j.sears@usace.army.mil, or at the following address:

U.S. Army Corps of Engineers • Norfolk District
Planning and Policy Branch
803 Front Street • Norfolk, VA 23510-1096

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Continued from Page

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DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

REPLY TO
ATTENTION OF:

April 16, 2009

Planning and Policy Branch

Mr. David O'Brien
National Marine Fisheries Service
NOAA Fisheries Habitat Conservation Division
P.O. Box 1346
7580 Spencer Road
Gloucester Point, VA 23062

Dear Mr. O'Brien:

The U.S. Army Corps of Engineers (USACE), Norfolk District is proposing maintenance of a beach nourishment project at the Sandbridge oceanfront, Virginia Beach, Virginia. Construction is expected to begin in spring/summer 2010; the last beach nourishment was completed in October 2007. The upcoming project incorporates the same design criteria as the 2007 project, a 50-foot-wide berm at an elevation of 6 feet (NGVD) with a foreshore slope of approximately 1:20 for a shoreline distance of approximately 5 miles from the Dam Neck Fleet Training Center to the Back Bay National Wildlife Refuge. The Norfolk District, acting as a lead agency, and the Minerals Management Service (MMS), acting as a cooperating/joint agency, have updated the enclosed Draft Environmental Assessment (EA) and Essential Fish Habitat (EFH) Assessment in association with beach renourishment and sand borrow from Sandbridge Shoal. The shoal is located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea. Beach quality sand would be removed by either hydraulic cutterhead suction dredge or by trailing suction hopper dredge. By this letter and the information contained therein, the USACE and the MMS are requesting to initiate EFH consultation.

EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act as..."those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity." The designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities. The 1996 amendments to the Magnuson-Stevens Fishery Management and Conservation Act require Federal agencies to consult with the National Marine Fisheries Service regarding the potential effects of their actions on EFH. The project area includes the waters of Sandbridge Shoal and oceanfront of Sandbridge Beach.

The following species were designated as having a Fishery Management Plan: windowpane flounder (*Scopthalmus aquosus*), bluefish (*Pomatomus saltatrix*), Atlantic butterfish (*Peprilus triacanthus*), summer flounder (*Paralicthys dentatus*), witch flounder (*Glyptocephalus cynoglossus*), scup (*Stenotomus chrysops*), Atlantic sea herring (*Clupea harengus*), surfclam (*Spisula solidissima*), black sea bass (*Centropristis striata*), monkfish (*Lophius americanus*), spiny dogfish (*Squalus acanthias*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), cobia (*Rachycentron canadum*), red drum (*Sciaenops occelatus*), red hake (*Urophycis chuss*), sand tiger shark (*Charcharias taurus*), Atlantic sharpnose shark (*Rhizoprinodon terraenovae*), dusky shark (*Charcharinus obscurus*), sandbar shark (*Charcharinus plumbeus*), scalloped hammerhead shark (*Spyrna lewini*), tiger shark (*Galeocerdo cuvieri*), clearnose skate (*Raja eglanteria*), little skate (*Raja erinacea*), and winter skate (*Raja ocellata*). Those bottom habitats with mud, gravel, and sand substrate that occur within the project area are designated as EFH for the clearnose skate. Those bottom habitats with soft bottom, rocky, or gravelly substrates that occur within the project area are designated as EFH for the little skate. For the winter skate, those bottom habitats with a substrate of sand and gravel or mud that occur within the project area are designated as EFH. The NMFS designated a "habitat area of particular concern" (HAPC) for the sandbar shark but not for any other Atlantic highly migratory species (HMS) due to a general lack of scientific information detailing HMS-habitat associations. There are no management or fisheries restrictions in place in or around the project area at this time. A detailed discussion and assessment of impacts to EFH for the above species are included in Appendix B of the enclosed Draft EA.

Adverse effects on EFH species, related to dredging and construction activities will be temporary, minimal, and largely within the dredged footprints and beach nourishment areas in the surf zone. The EFH Assessment concluded that the project is not anticipated to significantly impact EFH species or habitat (including HAPC) that may be in the project area, and that the overall impact to identified species is considered negligible. Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265) we request your concurrence with the conclusion of this assessment.

It is requested that your office review the enclosures and reply by May 20, 2009, which also concludes a 30-day comment period for the Draft EA. Should you have any questions as you review the attached information or need any additional information, please do not hesitate to call Ms. Elisabeth J. Sears of my staff at (757) 201-7766 or email to: elisabeth.j.sears@usace.army.mil. Thank you for your time and we look forward to hearing from you.

Sincerely,

Mark Mansfield

Mark T. Mansfield
Chief, Planning and Policy Branch

Enclosures

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

JUN 19 2009

Mr. Mark T. Mansfield
Chief, Operations, Planning and Policy Branch
US Army Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, VA 23510-1096

Re: Sandbridge Beach Erosion Control and Hurricane Protection Project;
Essential Fish Habitat Assessment

Dear Mr. Mansfield:

The National Marine Fisheries Service (NMFS), Northeast Region's Habitat Conservation Division has reviewed the draft environmental assessment (EA) and essential fish habitat (EFH) assessment prepared pursuant to Section 305 (b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297; 11 October 1996) for the Sandbridge Beach erosion control and hurricane protection project, located in the City of Virginia Beach, Virginia. The current proposal uses the same design criteria as previous Sandbridge beach nourishment projects, involving the mining of beach-compatible sand for the creation of a 50 ft. wide berm at an elevation of 6 ft. (NGVD) with a foreshore slope of 1:20. The project extends for approximately five miles from the U.S. Navy's Dam Neck Fleet Training Center, south to the U.S. Fish and Wildlife Service's Back Bay National Wildlife Refuge. The current project is scheduled to be conducted during the spring/summer of 2010. Continued beach nourishment along Sandbridge Beach is anticipated on a two to five year maintenance cycle. The proposed borrow area for the nourishment of Sandbridge Beach is identified in the draft EA and EFH assessment as Sandbridge Shoal, an area approximately 48 km^2 located approximately three nautical miles from shore beyond Virginia's state waters. Sand mining for this project will target approximately 1.5-2.0 million cubic yards of material from the higher relief sand ridges on the crest of the main shoal in borrow area "B" using a trailing suction hopper dredge. Excavated sandy material will be transported by hopper dredge to an offshore pump-out buoy, conveyed to the beach via a pipeline, and distributed using heavy equipment to produce the designed beach profile.

General Comments

As identified in the EFH assessment, the general project area including Sandbridge Beach and Sandbridge Shoal has been designated as EFH for 22 federally managed species, and is a habitat area of particular concern (HAPC) for sandbar sharks (*Carcharhinus plumbeus)*. Beach nourishment has been conducted previously along Sandbridge Beach, beginning in 1998 and again in 2002. The last nourishment project for Sandbridge Beach was completed in October 2007. Sand mined from Sandbridge Shoal has been the source of material for each of these nourishment projects. In addition, the U.S. Navy used Sandbridge Shoal to nourish the beach at the Dam Neck Fleet Training facility in 1996 and again in 2003.

The draft EA indicates that Sandbridge Shoal exhibits relatively little volumetric recovery between dredging events, leading to the long-term reduction in the surface area of bottom habitat. As stated in the EFH assessment, the sand mining and beach nourishment projects discussed above have cumulatively extracted nearly 25% of the estimated sand volume at Sandbridge Shoal. It appears that at this historic extraction rate, sand reserves at Sandbridge Shoal will be exhausted before the end of the Sandbridge Beach projected 50-year project life.

The EFH assessment states that despite multiple dredging events, no negative impacts on the macrobenthic and fish communities have been documented to date, and that monitoring between dredged and non-dredged control areas has revealed no significant differences in macrofauna abundance. However, the draft EA indicates that "some of the sand shoal ridges have been dredged during more than one construction cycle, increasing the likelihood and severity of impact."

The biological data collected to date on and adjacent to Sandbridge Shoal (Diaz et al., 2006) appears insufficient to conclude that the cumulative, long-term impacts of sand mining on EFH and managed species are not significant. In a study that analyzed two trawl survey time series totaling 14 years of data off the coast of New Jersey, Vasslides and Able (2008) concluded that sand ridges, such as Sandbridge Shoal, are important features of the inner continental shelf, positively influencing fish assemblages and abundance.

The EFH assessment states that full recovery of the benthos within the borrow sites is anticipated to occur within a few years. However, sand mining at Sandbridge Shoal and the resulting destruction of the benthic epifauna and infauna communities every two to five years prohibits the benthos from ever fully recovering, thus adversely affecting EFH and higher trophic levels including managed species. We concur with the ACOE's determination that the proposed 2010 maintenance cycle of the Sandbridge Beach erosion control and hurricane protection project will not have a substantial adverse effect on EFH or HAPC for sandbar shark. We do not agree that the long-term, cumulative impacts on EFH and managed species resulting from the continued mining of sand from Sandbridge Shoal are temporary and localized. Given the two to five year maintenance cycle for beach nourishment across the projected 50-yr. life of the Sandbridge Beach erosion control and hurricane protection project, NMFS provides the following conservation recommendations to help avoid and minimize individual and cumulative adverse impacts on EFH and managed species.

Essential Fish Habitat Conservation Recommendations
As discussed in Section IX of the EFH assessment (Mitigation Measures), NMFS supports the incorporation of best management practices into the project and the following mitigative measures proposed by the ACOE:

- Use of pre-dredge vibracore surveys to identify shoal areas of beach quality sand;
- Following the existing bottom contours to the maximum extent practicable to maintain seafloor ridge and swale heterogeneity;

- Use of rotational dredging to the maximum extent practicable to preclude the mining of the same sand ridge during sequential dredging projects and to minimize the footprint and time over which the dredge operates;
- Conduct pre- and post-dredging bathymetric surveys across those portions of the borrow area where dredging will occur;
- Coordinate with NOAA Fisheries Service to develop a long-term strategy and management plan that identifies rotation dredging criteria and an advance schedule for the mining of sand from specific shoals.

Conclusions

The proposed sand mining of Sandbridge Shoal and beach nourishment of Sandbridge Beach will affect EFH and sandbar shark HAPC. However, we concur with your determination that the 2010 project, in and of itself, will not significantly adversely affect EFH or HAPC. Nonetheless, NOAA Fisheries Service has concerns regarding the long-term, cumulative impacts on Sandbridge Shoal, EFH, managed species, and their prey species based on the historic and projected continued use of Sandbridge Shoal as a source of beach compatible sand. The conservation recommendations provided above are intended to avoid and minimize the cumulative adverse effects of sand mining and beach nourishment on managed species, their prey species, and other aquatic resources.

Section 305(b)(4)(B) of the MSA requires the ACOE to respond to NMFS regarding the EFH conservation recommendations provided here. In the case where your response is inconsistent with NMFS' recommendations, the ACOE must substantiate its reasons for not accepting the recommendations pursuant to 50 CFR 600.920(k). NMFS has no intention to pursue the matter provided the recommendations provided here are accepted. This correspondence concludes the EFH consultation process. However, please understand that if new information becomes available or the project is substantially revised in such a manner that affects the basis for the above recommendations, EFH consultation must be reinitiated.

Thank you for the opportunity to review and provide comment on the draft EA and EFH assessment for the Sandbridge Beach erosion control and hurricane protection project. We look forward to your favorable response to our recommendations. Please feel free to contact Mr. David O'Brien of our Gloucester Point, VA field office at 804-684-7828 (David.L.O'Brien@noaa.gov) if you have any questions regarding these recommendations.

Sincerely,

Peter D. Colosi, Jr.
Assistant Regional Administrator
for Habitat Conservation

Literature Cited

Diaz, R.J., C.O.Tallent and J.A. Nestlerode. 2006. Benthic resources and habitats at the Sandbridge borrow area: A test of monitoring protocols. In: Hobbs, C.H., III, (Ed.) Field testing of a physical/biological monitoring methodology for offshore dredging and mining operations. U.S. Department of the Interior, Minerals Management Service. OCS Study MMS 2005-056.

Vasslides, J.M. and K.W. Able. 2008. Importance of shoreface sand ridges as habitat for fishes off the northeast coast of the United States. Fish. Bull. 106:93-107.

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 1105, Richmond, Virginia 23218
TDD (804) 698-4021
www.deq.virginia.gov

L. Preston Bryant, Jr.
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4020
1-800-592-5482

June 2, 2009

Mark T. Mansfield
Chief, Planning and Policy Branch
Department of the Army
Norfolk District, U.S. Army Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, Virginia 23510-1096

RE: Draft Environmental Assessment and Federal Consistency Determination for the Sandbridge Beach Erosion Control and Hurricane Protection Project, Virginia Beach, Virginia, DEQ 09-078F

Dear Mr. Mansfield:

The Commonwealth of Virginia has completed its review of the above-referenced Draft Environmental Assessment (EA), which includes a federal consistency determination (FCD). The Department of Environmental Quality (DEQ) is responsible for coordinating Virginia's review of federal environmental documents prepared pursuant to the National Environmental Policy Act and responding to appropriate federal officials on behalf of the Commonwealth. DEQ is also responsible for coordinating state reviews of federal consistency determinations submitted under the Coastal Zone Management Act. The following agencies, planning district commission and locality joined in this review:

Department of Environmental Quality
Department of Game and Inland Fisheries
Department of Conservation and Recreation
Department of Mines, Minerals and Energy
Marine Resources Commission
Department of Health
Department of Historic Resources
Virginia Institute of Marine Science
Hampton Roads Planning District Commission
City of Virginia Beach

The Department of Agriculture and Consumer Services was also invited to comment.

PROJECT DESCRIPTION

The U.S. Army Corps of Engineers (Corps) proposes beach nourishment at the Sandbridge oceanfront. The nourishment area is approximately 5 miles long and 125 feet wide and extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north to Back Bay National Wildlife Refuge to the south. Approximately 1.5 to 2.0 million cubic yards (cy) of beach quality sand would be placed on the beach approximately every 3 years depending upon weather conditions, availability of funding, and behavior of subsequently placed material at the project site.

Beach nourishment at Sandbridge began in 1998 and several beach nourishment maintenance projects have been completed since the original nourishment in 1998. This EA is an updated evaluation of the project to determine whether the proposed nourishment has the potential for creating significant impacts to the environment and to consider any changes to the environment that may have occurred since the original EA was prepared in 1992.

The designated borrow area is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea. The two selected borrow areas within Sandbridge Shoal are Area B to the north and Area A to the south; depths range from 30 to 65 feet. Beach quality sand would most likely be removed by trailing suction hopper dredge. The hopper dredge is equipped with dragheads and a hopper which collects sand. When the hopper is full, material is transported to a pump-out buoy located offshore and then pumped through a discharge pipeline. The pipeline runs along the ocean floor and up onto the beach where bulldozers and graders will distribute the material.

SUMMARY

In general, the Commonwealth of Virginia supports the beneficial use of suitable dredged material for beach nourishment provided it is carried out in accordance with all applicable laws, regulations, and policies. This position is consistent with the Code of Virginia § 10.1-704 which state "the beaches of the Commonwealth shall be given priority consideration as sites for the disposal of that portion of dredged material determined to be suitable for beach nourishment." Pursuant to Virginia regulation governing the placement of sandy dredged material along beaches in Virginia (4 VAC-20-400-50), the project should be engineered in a manner which results in the least environmental impact while providing an efficient and cost effective construction plan.

Dredging in Virginia waters for the sole purpose of obtaining beach nourishment material would require permits from the Virginia Marine Resources Commission (VMRC) and a public interest review. During its review of such dredging applications, VMRC would consider those factors identified in Section 28.2-1205 of the Code of Virginia. That would include the dredge project's effect on the following:

- Other reasonable and permissible uses of state waters and state-owned bottomlands;
- Marine and fisheries resources of the Commonwealth;
- Tidal wetlands, except when this has or will be determined under the provisions of Chapter 13 of this title;
- Adjacent or nearby properties;
- Water quality; and
- Submerged aquatic vegetation (SAV).

In the case of the Sandbridge Nourishment project, it is VMRC's understanding that the borrow area is outside Virginia's Territorial Sea (beyond 3 miles). If this is the case, VMRC has no direct permit authority over the dredging/borrow operation. However, we recommend that consideration be given, but not limited to, the project's potential impacts on existing natural resources and habitats. These include, inter alia, existing finfish, shellfish, turtle and avian species and their critical time periods for spawning, nesting and nursery functions in areas of submerged aquatic vegetation, wetlands and submerged or intertidal and beach habitat.

GENERAL COMMENTS ON THE PROJECT DOCUMENT

The Virginia Institute of Marine Science (VIMS) reviewed the draft EA and provided the following comments to DEQ and directly to the Corps. These comments are outlined below and are also attached to report for your convenience.

- The Draft EA is not clear concerning the volume of sand within Sandbridge Shoal. Based on statements from pages 39 and 40, the volume is defined as both ~30 x106 million cubic yards (m3) or 20% less than ~30 x106 m3. As stated in the EA (page 39), "given the likelihood of future dredging at Sandbridge Shoal, it is important to fully consider the potential impacts of continued dredging." VIMS has concerns that given competing interests for the sand on the shoal (Virginia Beach, Navy, others), it is unclear if the shoal can continue to support its proposed uses over the next 40 years.

- Research of the direct effects on, and recovery of, the benthic community and cascading impacts on the pelagic and demersal fishes and crustaceans in the borrow area should continue in order to improve understanding of the impacts on ecosystem services.

- Bulrush (*Scirpus validus)* has been renamed *Schoenoplectus tabernaemontani*, and southern bayberry (*Myrica cerifera var. cerifera*), has been renamed *Morella cerifera*. This should be corrected in the final EA.

ENVIRONMENTAL IMPACTS AND MITIGATION

1. Water Quality. The FCD (Enclosure 1) states that there will be no impacts to wetlands. A State Water Quality Certification under Section 401 of the Clean Water Act will be obtained. The certification is required because of discharges of sand into waters of the United States.

1(a) Agency Jurisdiction. The State Water Control Board (SWCB) promulgates Virginia's water regulations, covering a variety of permits to include Virginia Pollutant Discharge Elimination System Permit (VPDES), Virginia Pollution Abatement Permit, Surface and Groundwater Withdrawal Permit, and the Virginia Water Protection (VWP) Permit. The VWP Permit is a State permit which governs wetlands, surface water, and surface water withdrawals/impoundments. It also serves as § 401 certification of the federal Clean Water Act § 404 permits for dredge and fill activities in waters of the U.S. The VWP Permit Program is under the Office of Wetlands and Water Protection and Compliance, within the DEQ Division of Water Quality Programs. In addition to Central Office staff who review and issue VWP permits for transportation and water withdrawal projects, the seven DEQ regional offices perform permit application reviews and issue permits for the covered activities.

1(b) Finding. The DEQ-Tidewater Regional Office (TRO) states that a VWP permit will be required for the project. The Corps should submit a Joint Permit Application (JPA) to the Virginia Marine Resources Commission to begin the permitting process. All VWP regulatory issues will be resolved during the permitting issuance process.

1(c) Recommendations. A VWP permit (water quality certification) must be obtained from DEQ prior to project implementation. For more information, contact the DEQ Tidewater Regional Office.

2. Subaqueous Lands Management. The FCD (Enclosure 1) states that project activities will encroach upon state-owned bottomlands. The Corps received a Virginia Marine Resources Commission (VMRC) permit for previous activities at Sandbridge (VMRC # 01-0951); however, the permit expired in 2006. The Corps will work with the VMRC to receive an updated permit.

2(a) Agency Jurisdiction. The Virginia Marine Resources Commission, pursuant to Virginia Code *§ 28.2-1200* through *1400*, regulates encroachments in, on or over state-owned subaqueous beds as well as tidal wetlands throughout the Commonwealth. Also, the VMRC serves as the clearinghouse for the JPA used by the:

- U.S. Army Corps of Engineers for issuing permits pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act;
- DEQ for issuance of a Virginia Water Protection permit;
- VMRC for encroachments on or over state-owned subaqueous beds as well as tidal wetlands; and
- local wetlands board for impacts to wetlands.

The VMRC will distribute the completed JPA to the appropriate agencies. Each agency will conduct its review and respond.

2(b) Findings. According to the VMRC, the proposed beach nourishment efforts along the Sandbridge Beach shoreline will require the submittal of a JPA and a permit from the VMRC.

2(c) Recommendations. For additional information on requirements pertaining to the submission of the JPA, contact the VMRC.

3. Wildlife and Fisheries Resources. The draft EA (page 41) states that re-establishing beach habitat that supports a variety of associated flora and fauna contributes to the success and continual survival of several species such as sea turtles and shorebirds.

Also, adverse effects on Essential Fish Habitat (EFH) species, due to dredging and construction activities, will largely be temporary and minimal within the dredged footprints and beach nourishment areas in the surf zone. In general, the project is not anticipated to significantly impact EFH species or Habitat Areas of Particular Concern that may be in the project area (EA, page 33).

3(a) Agency Jurisdiction. The Department of Game and Inland Fisheries (DGIF) and the VMRC administer the fisheries management enforceable policy of the VCP. Also, the Department of Game and Inland Fisheries, as the Commonwealth's wildlife and freshwater fish management agency, exercises enforcement and regulatory jurisdiction over wildlife and freshwater fish, including state or federally listed endangered or threatened species, but excluding listed insects (*Virginia Code* Title 29.1). DGIF is a consulting agency under the U.S. Fish and Wildlife Coordination Act (16 U.S.C. sections 661 *et seq.*) and provides environmental analysis of projects or permit applications coordinated through DEQ and several other state and federal agencies. DGIF determines likely impacts upon fish and wildlife resources and habitat, and recommends appropriate measures to avoid, reduce, or compensate for those impacts. For more information, see the DGIF website at www.dgif.virginia.gov.

3(b) Comments. According to the information in the draft EA, the incidental take statement and biological opinion previously issued by National Marine Fisheries Service for this project are still valid.

3(c) Findings. The Fisheries Management Division of the VMRC states that there would be no significant impact to blue crabs as long as there is no sediment placement in the offshore surface waters. Run off from the beach should not have an impact on the blue crab.

DGIF's records indicate that the following species have been documented in the project area:

- Loggerhead sea turtle: A federally-listed threatened species, the loggerhead sea turtle is known to nest on the beaches in the project area. As stated in the draft EA, beach nourishment and associated dredging activities are likely to adversely impact this species. However, DGIF indicates that if the beach fill is not properly matched to native materials, a decrease in the quality of nesting habitat for this species may result.

- West Indian manatee: A federally-listed endangered species which has been documented in the project area. The draft EA does not appear to evaluate possible impacts to this species.

- Roseate tern: This is a federally-listed endangered species that has been documented in the project area. However, DGIF does not think that this species nests in the project area. Therefore, impacts upon this species are not anticipated to result from the proposed work.

- Bald eagle: This state-listed threatened species is known to be located in the project area. However, the project site is located outside the management zone for known nesting sites; therefore, impacts upon this species are not anticipated to result from the proposed work.

3(d) Recommendations. DGIF has the following recommendations:

- Address possible impacts upon the West Indian manatee in the final EA.
- Coordinate with the NMFS regarding the protection of loggerhead sea turtles, other sea turtles, and sea mammals known from the project area.
- Adhere to the requirements outlined in the incidental take statement and biological opinion previously issued by NMFS for this project.
- Coordinate with the FWS regarding possible impacts upon federally-listed species and for information about whether this project will result in adverse impacts upon Back Bay National Wildlife Refuge.
- Match all fill materials in color, grain size, and composition to native materials as closely as possible.
- Adhere to the requirements for sea turtle protection (such as time-of-year restrictions, matching of beach fill materials to native materials, hopper dredge retrofitting, use of observers, routine monitoring, etc.) outlined in the incidental take statement and biological opinion.

For additional information on these recommendations, contact DGIF.

3(e) Conclusion. Assuming appropriate erosion and sediment controls are in place during beach nourishment, both the VMRC and DGIF find that the project consistent with the fisheries management enforceable policy of the VCP.

4. Dunes Management. The FCD (Enclosure 1) states that there will be no alteration or destruction of primary sand dunes related to this project.

4(a) Agency Jurisdiction. Dune protection is carried out pursuant to the Coastal Primary Sand Dune Protection Act and is intended to prevent destruction or alteration of primary dunes. This program is administered by the Marine Resources Commission (Virginia Code 28.2-1400 through 28.2-1420) with the Virginia Institute of Marine Science serving in a technical advisory role during in the JPA process.

4(b) Comments. VIMS states that the consistency determination should be revised to address impacts to beaches. The FCD references the dunes management enforceable policy, but based upon Virginia Code §28.2 1400 *et seq.*, the enforceable policy also addresses beaches.

The VRMC did not provide comments on impacts to dune resources under its jurisdiction.

5. Natural Heritage Resources. The draft EA does not address natural heritage resources.

5(a) Agency Jurisdiction. The mission of the Virginia Department of Conservation and Recreation (DCR) is to conserve Virginia's natural and recreational resources. DCR supports a variety of environmental programs organized within seven divisions including the Division of Natural Heritage (DNH). DCR's Natural Heritage Program's mission is conserving Virginia's biodiversity through inventory, protection, and stewardship. The Virginia Natural Area Preserves Act, 10.1-209 through 217 of the Code of Virginia, was passed in 1989 and codified DCR's powers and duties related to statewide biological inventory: maintaining a statewide database for conservation planning and project review, land protection for the conservation of biodiversity, and the protection and ecological management of natural heritage resources.

5(b) Biotics Data System. DCR-DNH has searched its Biotics Data System for occurrences of natural heritage resources from the project area. Natural heritage resources are defined as the habitat of rare, threatened, or endangered plant and animal species, unique or exemplary natural communities, and significant geologic formations.

5(c) Findings. DCR states that the Biotics Data System documents the presence of natural heritage resources in the project area. However, as long as the beach nourishment does not include the dune field, DCR does not anticipate that this project will adversely impact these natural heritage resources. DCR concurs with the guidelines set by the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) (EA, Appendix A).

5(d) Threatened and Endangered Plant and Insect Species. The Endangered Plant and Insect Species Act of 1979, Chapter 39, §3.1-102- through 1030 of the Code of Virginia, as amended, authorizes the Virginia Department of Agriculture and Consumer Services (VDACS) to conserve, protect and manage endangered species of plants and insects. VDACS Virginia Endangered Plant and Insect Species Program personnel cooperates with the U.S. Fish and Wildlife Service (FWS), DCR-DNH and other agencies and organizations on the recovery, protection or conservation of listed threatened or endangered species and designated plant and insect species that are rare throughout their worldwide ranges. In those instances where recovery plans, developed by FWS, are available, adherence to the order and tasks outlined in the plans should be followed to the extent possible.

VDACS has regulatory authority to conserve rare and endangered plant and insect species through the Virginia Endangered Plant and Insect Species Act. Under a Memorandum of Agreement established between the Virginia Department of Agriculture and Consumer Services (VDACS) and DCR, DCR has the authority to report for VDACS on state-listed plant and insect species. DCR found that the current activity will not affect any documented state-listed plant and insect species. VDACS did not respond to our request for comments.

5(e) Natural Area Preserves. DCR found that there are no State Natural Area Preserves under its jurisdiction in the project vicinity.

5(f) Recommendations. The DCR-Division of Natural Heritage has the following recommendations:

- Follow the FWS and NMFS guidelines for beach nourishment found in the draft EA, Appendix A.
- Contact DCR-DNH (telephone, (804) 786-7951) if a significant amount of time passes before the project is implemented, since new and updated information is continually added to Biotics.

6. Coastal Lands Management and Chesapeake Bay Preservation Areas. Neither the draft EA nor the FCD addresses Chesapeake Bay Preservation Areas.

6(a) Agency Jurisdiction. The Department of Conservation and Recreation's (DCR) Division of Chesapeake Bay Local Assistance (DCBLA) administers the coastal lands management enforceable policy of the Virginia Coastal Program which is governed by the Chesapeake Bay Preservation Act (Virginia Code §10.1-2100-10.1-2114) and Chesapeake Bay Preservation Area Designation and Management Regulations (9 VAC 10-20 *et seq.*).

6(b) Findings. The DCR-DCBLA states that Sandbridge Beach is located outside of the Chesapeake Bay watershed and therefore, lies outside of the City of Virginia Beach's designated Chesapeake Bay Preservation Areas. Hence, there are no requirements under the Chesapeake Bay Preservation Act that must be met by the proposed project.

7. Air Pollution Control. Minor air pollution increases will occur due to the operation of construction equipment. The increases will be short-term and below *de minimis* threshold levels (FCD, Enclosure 1).

7(a) Agency Jurisdiction. DEQ's Air Quality Division, on behalf of the State Air Pollution Control Board, is responsible for developing regulations that become Virginia's Air Pollution Control Law. The DEQ is charged with carrying out mandates of the state law and related regulations as well as Virginia's federal obligations under the Clean Air Act as amended in 1990. The objective is to protect and enhance public health and quality of life through control and mitigation of air pollution. The Division ensures the safety and quality of air in Virginia by monitoring and analyzing air quality data, regulating sources of air pollution, and working with local, state and federal agencies to plan and implement strategies to protect Virginia's air quality. The appropriate regional office is directly responsible for the issuance of necessary permits to construct and operate all stationary sources in the region as well as monitoring emissions from these sources for compliance. As a part of this mandate, Environmental Impact Reports of projects to be undertaken in the State are also reviewed. In the case of certain projects, additional evaluation and demonstration must be made under the general conformity provisions of state and federal law.

7(b) Ozone Maintenance Area. According to the DEQ Air Division, the project site is located in an ozone (O_3) maintenance area and an emission control area for the volatile organic compounds (VOCs) and oxides of nitrogen (NO_x), which are contributors to ozone pollution. Therefore, the applicant should take all reasonable precautions to limit emissions of VOCs and NO_x principally by controlling or limiting the burning of fossil fuels.

7(c) Fugitive Dust. During project activities, fugitive dust must be kept to a minimum by using control methods outlined in 9 VAC 5-50-60 *et seq.* of the Regulations for the Control and Abatement of Air Pollution. These precautions include covering open equipment when conveying materials.

7(d) Fuel Burning Equipment. An air permit may be required for any fuel-burning equipment. For more information, contact at DEQ's Tidewater Regional Office.

8. Solid and Hazardous Wastes and Hazardous Materials. The draft EA (page 9) states that no Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites are located within 4 miles of the project area, but one Resource Conservation and Recovery Information System (RCRIS) generator at False Cape State Park is located within four miles of the project area.

Also, during an archaeological remote sensing survey conducted in 2007, it was determined that Sandbridge Shoal had high potential for other materials, such as ordnance, because the shoal was within an area designated as a range for coastal ordnance training and military weapons experiments (Watts, 2007). Since small caliber unexploded ordnance (UXO) may be encountered in the borrow areas during dredging operations, the Corps requires that a screen be placed over the drag head to effectively prevent any UXO from entering the hopper and/or being subsequently placed on the beach.

8(a) Agency Jurisdiction. Solid and hazardous wastes in Virginia are regulated by the Virginia Department of Environmental Quality, the Virginia Waste Management Board (VWMB) and the U.S. Environmental Protection Agency. They administer programs created by the federal Resource Conservation and Recovery Act, Comprehensive Environmental Response Compensation and Liability Act, commonly called Superfund, and the Virginia Waste Management Act. DEQ administers regulations established by the VWMB and reviews permit applications for completeness and conformance with facility standards and financial assurance requirements. All Virginia localities are required, under the Solid Waste Management Planning Regulations, to identify the strategies they will follow on the management of their solid wastes to include items such as facility siting, long-term (20-year) use, and alternative programs such as materials recycling and composting.

8(b) Comments. The DEQ-Tidewater Regional Office, Waste Permit Program states that any UXO and other debris encountered during project activities must be managed in accordance with the Virginia Hazardous Waste Management Regulations and the Virginia Solid Waste Management Regulations.

Also, the DEQ-Waste Division states that the EA addresses hazardous waste issues and included a search of waste-related databases. The EA does not address solid waste issues. A GIS database search did not reveal any waste sites within a half mile radius that would impact or be impacted by the project site.

8(c) Findings. Staff reviewed the Waste Division's data files and determined that several solid waste facilities are located within the same zip code as the installation; however their proximity to the subject site is unknown. These sites are as follows.

<u>Solid waste</u>

- SPSA - Landstown Transfer, PBR 191, Transfer Station
- SPSA - Landstown Transfer, SWP 537, Transfer Station
- Virginia Beach City - Mt Trashmore Landfill II, SWP 324, Closed Sanitary Landfill
- Virginia Beach City - Mt Trashmore Landfill II, SWP 367, Closed Sanitary Landfill
- Virginia Beach City - Mt Trashmore Landfill II, SWP 398, Sanitary Landfill
- Tidewater Recyclable Products Incorporated, SWP 596, CDD Landfill

8(d) Recommendations. DEQ encourages all projects to implement pollution prevention principles, including:

- the reduction, reuse, and recycling of all solid wastes generated; and
- the minimization and proper handling of generated hazardous wastes.

For further information, contact Paul Kohler, DEQ-Waste Division, at (804) 698-4208.

9. Historic Structures and Archaeological Resources. The draft EA (page 23) states that within the study area, there are no known archaeological or historical sites eligible for or listed on the National Register of Historic Places. However, archaeological surveys (2007) of the offshore borrow areas near Sandbridge Beach resulted in the identification of numerous magnetic anomalies. The remote sensing survey recorded 51 unidentified magnetic anomalies and one side-scan sonar target in proposed Borrow Area A, and 37 unidentified magnetic anomalies and one side-scan sonar target within proposed Borrow Area B. The side-scan sonar target recorded in Borrow Area A has been identified as a small barge. Five of the magnetic anomalies were associated with this feature. The side-scan sonar target and five associated magnetic anomalies recorded in Borrow Area B have been tentatively identified as a potentially significant historic shipwreck site. Of the remaining 46 unidentified magnetic anomalies in Area A, 29 are considered to be potentially representative of historic shipwreck sites. The Corps will avoid the two side-scan targets by 500 feet, which will also result in the avoidance of all associated magnetic anomalies (EA, page 37).

9(a) Agency Jurisdiction. The Department of Historic Resources (DHR) conducts reviews of projects to determine their effect on historic structures or cultural resources under its jurisdiction. DHR, as the designated State's Historic Preservation Office, ensures that federal actions comply with *Section 106 of the National Historic Preservation Act of 1966* (NHPA), as amended, and its implementing regulation at 36 CFR Part 800. The NHPA requires federal agencies to consider the effects of federal projects on properties that are listed or eligible for listing on the National Register of Historic Places. Section 106 also applies if there are any federal involvements, such as licenses, permits, approvals or funding. DHR also provides comments to DEQ through the state EIR review process.

9(b) Finding. The DHR has been in direct consultation with the Corps and has determined that the project will not affect historic properties.

10. Geologic Resources. The draft EA (page 25) states that the proposed project would remove approximately 1.5 to 2.0 million cy of sand from Sandbridge Shoal. The sediments in the shoal are approximately 96 percent sand, 1.5 percent gravel, and about 2.5 percent fines. Mean grain size at the placement site ranges between 0.25 mm and 0.35 mm, medium grained sand. There would be no significant impacts to sediment quality at the borrow area or at the placement site.

10(a) Agency Jurisdiction. The Virginia Department of Mines, Minerals and Energy (DMME), through its six divisions, regulates the mineral industry, provides mineral research and offers advice on the wise use of resources. The Department's mission is to enhance the development and conservation of energy and mineral resources in a safe and environmentally sound manner in order to support a more productive economy in Virginia. The DMME Division of Geology and Mineral Resources (DGMR), serving as Virginia's geological survey, generates, collects, compiles and evaluates geologic data, creates and publishes geologic maps and reports, works cooperatively with other state and federal agencies, and is the primary source of information on geology, mineral and energy resources, and geologic hazards for both the mineral and energy industries and the general public. DMME DGMR also provides the necessary geologic support for those divisions of DMME that regulate the permitting of new mineral and fuel extraction sites, miner safety and land reclamation.

10(b) Agency Finding. DMME-DGMR states the project involves the beneficial use of a mineral resource. Therefore, DMME-DGMR does not anticipate negative impacts to mineral resources within the nourishment area.

11. Waterworks Operation.

11(a) Findings. The Virginia Department of Health (VDH), Office of Drinking Water (ODW) states that there are no records of public groundwater sources within a 1-mile radius and there is no public surface water source within a 5-mile radius of the project site. Therefore, the VDH-ODW finds no apparent impacts to drinking water sources resulting for this project.

12. Regional Planning Area. The Hampton Roads Planning District Commission (PDC) and the City of Virginia Beach were invited to comment.

12(a) Agency Jurisdiction. In accordance with the Code of Virginia, Section 15.2-4207, planning district commissions encourage and facilitate local government cooperation and state-local cooperation in addressing, on a regional basis, problems of greater than local significance. The cooperation resulting from this is intended to facilitate the recognition and analysis of regional opportunities and take account of regional influences in planning and implementing public policies and services. Planning district commissions promote the orderly and efficient development of the physical, social and economic elements of the districts by planning, and encouraging and assisting localities to plan, for the future.

12(b) Regional Agency Comments. The Hampton Roads PDC states that the proposed project is generally consistent with local and regional plans and policies.

12(c) Locality Comments. The City of Virginia Beach has no comment on the proposed project.

FEDERAL CONSISTENCY UNDER THE COASTAL ZONE MANAGEMENT ACT

Pursuant to the Coastal Zone Management Act of 1972, as amended, federal activities located inside or outside of Virginia's designated coastal management area that can have reasonably foreseeable effects on coastal resources or coastal uses must, to the maximum extent practicable, be implemented in a manner consistent with the Virginia Coastal Resources Management Program (VCP) (also called the Virginia Coastal Zone Management Program). The VCP consists of a network of programs administered by several agencies. The DEQ coordinates the review of federal consistency determinations with agencies administering the Enforceable and Advisory Policies of the VCP.

The draft EA includes a federal consistency determination and accompanying analysis of the enforceable policies of the VCP (Enclosure 1). The FCD states that the implementation of the plan would have no effect on the wetlands management, dunes management, and shoreline sanitation management enforceable policies of the VCP. The reviewing agencies that are responsible for the administration of specific enforceable policies generally agree with the Corps's determination. However, in order to be consistent with the VCP, the Corps must obtain all applicable permits and approvals prior to commencing the project.

PUBLIC PARTICIPATION

In accordance with 15 CFR §930.2, the public was invited to participate in the Commonwealth's review of the FCD. A public notice for this proposed action was published on the DEQ website from April 24, 2009 to May 20, 2009. No comments were received in response to the public notice.

CONSISTENCY CONCURRENCE

Based on our review of the draft EA and the FCD and the comments submitted by agencies administering the enforceable policies of the VCP, DEQ concurs that the proposal is consistent to the maximum extent practicable with the VCP provided all applicable permits and approvals are obtained. However, other State approvals which may apply to this project are not included in this consistency concurrence. Therefore, the Corps must ensure that this project is implemented in accordance with all applicable Federal, State, and local laws and regulations.

REGULATORY AND COORDINATION NEEDS

1. Water Quality. Authorization under a Virginia Water Protection (VWP) permit (9 VAC 25-210-50) is required. A completed Joint Permit Application (JPA) should be submitted and a VWP permit obtained prior to project commencement. For receive a JPA, contact VMRC at (757) 247-2200. The VMRC will distribute the application to the appropriate agencies and each agency will conduct its review and respond. For additional information on the VWP permit program, contact Bert Parolari of DEQ's Tidewater Regional Office (telephone, (757) 518-2166).

2. Subaqueous Lands. The Virginia Marine Resources Commission, pursuant to <u>Virginia Code</u> *§ 28.2-1200* through *1400*, regulates encroachments in, on or over any state-owned bays, rivers, streams or creeks throughout the Commonwealth. Contact VMRC at (757) 247-2200 for a JPA. In order to achieve consistency with the subaqueous lands management enforceable policy of the VCP, the Corps must submit a Joint Permit Application to the VMRC for review and approval. For information on permits issued by the VMRC, contact Justin Worrell at (757) 247-8063.

3. Air Quality Regulations. This project may be subject to air regulations administered by the Department of Environmental Quality. The following sections of Virginia Administrative Code are applicable:

- 9 VAC 5-50-60 *et seq.* governing fugitive dust emissions; and

For more information regarding air permits that may be required, contact Jane Workman, DEQ-TRO at (757) 518-2112.

4. Protected Species Legislation. Questions regarding biological resources can be addressed to Amy Ewing of DGIF (telephone, (804) 367-2211) or Rene Hypes of DCR (telephone, (804) 371-2708).

Thank you for the opportunity to review the draft Environmental Assessment and the federal consistency determination for this undertaking. Detailed comments of reviewing agencies are attached for your review. Please contact me at (804) 698-4325 or Anne Pinion at (804) 698-4488 for clarification of these comments.

Sincerely,

Ellie L. Irons, Manager
Office of Environmental Impact Review

Enclosures

cc: Michelle Hollis, DEQ-TRO
Amy Ewing, DGIF
Keith Tignor, VDACS
Justin Worrell, VMRC
Roger Kirchen, DHR
Dwight Farmer, Hampton Roads PDC
Clay Bernick, Virginia Beach

Pinion,Anne

From: Worrell, Justin (MRC)
Sent: Thursday, May 21, 2009 2:54 PM
To: Pinion,Anne
Cc: Watkinson, Tony (MRC)
Subject: FW: EIR Project Reminder

Anne,

Sorry for the delay in commenting. As we previously permitted a Sandbridge Beach nourishment project in the past, further proposed beach nourishment efforts along the Sandbridge Beach shoreline in Virginia Beach will require the submittal of a JPA and a permit from the Virginia Marine Resources Commission.

Feel free to call me if you have questions. The Corps is also aware of our permitting requirements.

Thanks

Justin D. Worrell
Environmental Engineer
Habitat Management Division
Virginia Marine Resources Commission
(757) 247-8063 telephone
(757) 247-8062 fax

From: Pinion,Anne [mailto:Anne.Pinion@deq.virginia.gov]
Sent: Wednesday, May 20, 2009 8:08 AM
To: Ewing, Amy (DGIF); Tignor, Keith (VDACS); Watkinson, Tony (MRC); Heller, Matthew (DMME); Pam Mason; Claire JONES; cbernick@vbgov.com
Subject: EIR Project Reminder

Reviewers,

Comments for the following project are due today, May 20, 2009.

- 09-078F Corps-Sandbridge Beach Erosion Control and Hurricane Protection Project

If you have any questions, please contact me.

Thanks,
Anne

Anne N. Pinion
Department of Environmental Quality

Pinion,Anne

From: O'Reilly, Rob (MRC)
Sent: Monday, June 01, 2009 9:33 AM
To: Pinion,Anne
Cc: Travelstead, Jack (MRC)
Subject: FW: VA Policy on Beach Nourishment -DEQ-09078

Anne: please find Fr. McConnaugha's response, relative to the project impact on blue crab.

Thanks
Rob

From: Mcconaugha, John [mailto:jmcconau@odu.edu]
Sent: Sunday, May 31, 2009 8:13 PM
To: O'Reilly, Rob (MRC)
Subject: RE: VA Policy on Beach Nourishment -DEQ-09078

Rob,

Sorry for the delay. I don't have a problem with the beach nourishment as long as there is no sediment in the offshore surface waters. Run off from the beach should not have an impact.

John

John McConaugha
Chief Departmental Advisor
Ocean Earth and Atmospheric Sciences
jmconau@odu.edu

From: Pinion,Anne [mailto:Anne.Pinion@deq.virginia.gov]
Sent: Thursday, May 28, 2009 3:04 PM
To: Watkinson, Tony (MRC); Travelstead, Jack (MRC); O'Reilly, Rob (MRC)
Cc: Grabb, Bob (MRC); Worrell, Justin (MRC)
Subject: RE: VA Policy on Beach Nourishment -DEQ-09078

Tony,

Thanks for the response...I have forwarded it to Ellie, which might prompt some discussion. And yes, the dredging of Sandbridge Shoal is, according to the document, outside of Virginia's territorial sea.

Jack and or Rob,

Any comments on the fisheries aspects of this project? I have attached a brief project description below.

PROJECT DESCRIPTION

The U.S. Army Corps of Engineers (Corps) proposes beach nourishment at the Sandbridge oceanfront. The nourishment area is approximately 5 miles long and 125 feet wide and extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north to Back Bay National Wildlife Refuge to the south. Approximately 1.5 to 2.0 million cubic yards (cy) of beach quality sand would be placed on the beach approximately every 3 years depending upon weather conditions, availability of funding, and behavior of subsequently placed material at the project site.

Beach nourishment at Sandbridge began in 1998 and several beach nourishment maintenance projects have been completed since the original nourishment in 1998. This EA is an updated evaluation of the project to determine whether the proposed nourishment has the potential for creating significant impacts to the environment and to consider any changes to the environment that may have occurred since the original EA was prepared in 1992.

The designated borrow area is Sandbridge Shoal, located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea. The two selected borrow areas within Sandbridge Shoal are Area B to the north and Area A to the south; depths range from 30 to 65 feet. Beach quality sand would most likely be removed by trailing suction hopper dredge. The hopper dredge is equipped with dragheads and a hopper which collects sand. When the hopper is full, material is transported to a pump-out buoy located offshore and then pumped through a discharge pipeline. The pipeline runs along the ocean floor and up onto the beach where bulldozers and graders will distribute the material.

From: Watkinson, Tony (MRC)
Sent: Thursday, May 28, 2009 2:58 PM
To: Pinion,Anne
Cc: Grabb, Bob (MRC); Travelstead, Jack (MRC); O'Reilly, Rob (MRC); Worrell, Justin (MRC)
Subject: RE: VA Policy on Beach Nourishment -DEQ-09078

Anne,
Agree that the reference to enforceable policies should also include beaches as well as dunes. Ellie's Summary looks good, but believe it more accurately reflects projects that would generate suitable sandy dredge material from navigation projects. Dredging in Virginia waters for the sole purpose of obtaining beach nourishment material would require permits and a public interest review. We would consider those factors identified in Section 28.2-1205 of the code of Virginia. That would include the dredge project's effect on the following:
1. Other reasonable and permissible uses of state waters and state-owned bottomlands;
2. Marine and fisheries resources of the Commonwealth;
3. Tidal wetlands, except when this has or will be determined under the provisions of Chapter 13 of this title;
4. Adjacent or nearby properties;
5. Water quality; and
6. Submerged aquatic vegetation (SAV).

It has been my understanding that the borrow area for the Sandbridge Nourishment project is outside Virginia's Territorial Sea (beyond 3 miles). As such, we have no direct permit authority over the dredging/borrow operation. However, I'm not sure if our Fisheries Mangement Division would want to provide any further comment. I am copying Jack Travelstead and Rob O'Reilly on this, but it may be best if you contacted them directly. I have also include the VIMS comment for their consideration.

Tony
<<vims comments.doc>>

From: Pinion,Anne [mailto:Anne.Pinion@deq.virginia.gov]
Sent: Thursday, May 28, 2009 1:57 PM
To: Worrell, Justin (MRC)
Cc: Watkinson, Tony (MRC)
Subject: FW: VA Policy on Beach Nourishment -DEQ-09078

Justin,
Ellie had the following questions (please see below) I need VMRC to respond by June 1?
I have attached VIMS' comments for reference.

<< File: vims comments.doc >>

Thanks,
Anne

From: Irons,Ellie
Sent: Thursday, May 28, 2009 1:52 PM
To: Pinion,Anne
Subject: VA Policy on Beach Nourishment -DEQ-09078

Anne:

Please include the summary below in our response to the EA. Virginia has been recommending beach nourishment over the years and I noticed that responses provided did not reflect this position. Also, please contact VMRC to see if they support VIMS statement on dunes enf pol as well as if they wish to comment on potential impacts to fisheries. If you already did, please reflect their response on the dunes and fisheries management enforceable policy. Depending on the response from VMRC, a conditional concurrence may be better. Thanks.

SUMMARY

In general, the Commonwealth of Virginia supports the beneficial use of suitable dredged material for beach nourishment provided it is carried out in accordance with all applicable laws, regulations, and policies. This position is consistent with the Code of Virginia § 10.1-704 which state "the beaches of the Commonwealth shall be given priority consideration as sites for the disposal of that portion of dredged material determined to be suitable for beach nourishment." Pursuant to Virginia regulation governing the placement of sandy dredged material along beaches in Virginia (4 VAC-20-400-50), the project should be engineered in a manner which results in the least environmental impact while providing an efficient and cost effective construction plan. During the Virginia Marine Resources Commission's review of dredging applications, consideration will be given, but not limited to, the project's potential impacts on existing natural resources and habitats. These include, inter alia, existing finfish, shellfish, turtle and avian species and their critical time periods for spawning, nesting and nursery functions in areas of submerged aquatic vegetation, wetlands and submerged or intertidal and beach habitat.

Ellie Irons
Program Manager
Office of Environmental Impact Review
629 East Main Street, Room 631
Richmond, VA 23219
Telephone: (804) 698-4325
Fax: (804) 698-4319
email address: elirons@deq.virginia.gov
http://www.deq.virginia.gov

DEPARTMENT OF ENVIRONMENTAL QUALITY
TIDEWATER REGIONAL OFFICE
ENVIRONMENTAL IMPACT REVIEW COMMENTS

May 12, 2009

PROJECT NUMBER: **09-078F**

PROJECT TITLE: Sandbridge Beach Erosion Control and Hurricane Protection

As Requested, TRO staff has reviewed the supplied information and has the following comments:

Petroleum Storage Tank Cleanups:
No comments.

Petroleum Storage Tank Compliance/Inspections:
No comments.

Virginia Water Protection Permit Program (VWPP):
A VWP permit will be required for this project. Once a Joint Permit Application is submitted, all pertinent VWP regulatory issues will be resolved satisfactorily during the permit issuance process.

Air Permit Program :
No comments.

Water Permit Program :
VPDES Permit Section – No Comment. Activities described in this document are not impacted by the VPDES permit program.

GW – No comments.

Waste Permit Program :
Any UXO and other debris encountered must be managed in accordance with the Virginia Hazardous Waste Management Regulations and the Virginia Solid Waste Management Regulations.

The staff from the Tidewater Regional Office thanks you for the opportunity to provide comments.

Sincerely,

Michelle R. Hollis
Environmental Specialist
5636 Southern Blvd.
VA Beach, VA 23462
(757) 518-2146
mrhollis@deq.virginia.gov

To: Interested Parties
From: Pam Mason
Re: 09-078F Corps-Sandbridge Beach Erosion Control and Hurricane Protection Project
Date: May 20, 2009

Based on the following 3 statements (pages 39 and 40), what is the current volume of Sandbridge shoal, (~30 x106 m3), or 20% less than (~30 x106 m3)?

1. To date, approximately ~6x106 m3 of OCS sand have been excavated from the shoal, representing approximately 20% of the estimated shoal volume (~30 x106 m3).
2. The 2 million cubic yards of sand potentially removed in this proposed action represents 6% of the estimated volume remaining in the main shoal body (~30 x106 m3).
3. Considered in combination with past dredging operations, the cumulative volume of sand removed through 2010 will represent less than 25% of fairly conservative volume estimates of Sandbridge Shoal. (pages 39 and 40).

We note the following comment from the EA (page 39)
"Given the likelihood of future dredging at Sandbridge Shoal, it is important to fully consider the potential impacts of continued dredging". Given competing interests (Virginia Beach, Navy, others) will the shoal continue to support proposed uses including those proposed in this project; every 3-5 years over the next 40 years?

Research of the direct effects on, and recovery of, the benthic community and cascading impacts on the pelagic and demersal fishes and crustaceans in the borrow area should continue in order to improve understanding of the impacts on ecosystem services.

Detailed comments:
In section **6.1.3 Terrestrial Environment** (page 5), bulrush (*Scirpus validus)* has been renamed *Schoenoplectus tabernaemontani*, and southern bayberry (*Myrica cerifera var. cerifera*), has been renamed *Morella cerifera.*

We also note the following on the second page of Enclosure 1, Consistency Determination, the reference in the table to the Dunes Management (based upon the enforceable policy found in VAC 28.2 1400 et seq. Coastal Primary Sand Dunes **and Beaches**) should address beaches.

Center for Coastal Resources Management
Virginia Institute of Marine Science

Center for Coastal Resources Management
P.O. Box 1346 | Route 1208 Greate Road
Gloucester Point, Virginia 23062-1346 USA
Phone: 804-684-7380 | FAX: 804-684-7179
www.ccrm.vims.edu

WILLIAM & MARY
VIMS
Virginia Institute of Marine Science
School of Marine Science

Pinion,Anne

From: Amy.Ewing@dgif.virginia.gov
Sent: Wednesday, May 20, 2009 2:53 PM
To: Pinion,Anne; brian.k.rheinhart@usace.army.mil
Cc: Ruth.Boettcher@dgif.virginia.gov; John.Kleopfer@dgif.virginia.gov
Subject: ESSLog# 26509_Sandbridge Beach Erosion Control and Hurricane Protection Project

We have reviewed the draft Environmental Assessment (EA) for the subject project that proposes to perform beach nourishment along an area approximately 5 miles long and 125 feet wide near Sandbridge in Virginia Beach. Materials for the nourishment will be collected from the borrow site at Sandbridge Shoal, located greater than three nautical miles of the coast of Virginia.

According to our records, federal Endangered roseate tern has been documented from the project area. However, to our knowledge, this species does not nest in this project area. Therefore, impacts upon this species are not anticipated to result from the proposed work.

State Threatened bald eagle has also been documented from the project area. However, the project site is located outside the management zone for the known nesting sites. Therefore, impacts upon this species are not anticipated to result from the proposed work.

Also documented from the proejct site is federal Threatened loggerhead sea turtle. This species is known to nest on the beaches in the project area. As stated in the draft EA, beach nourishment and associated dredging activities are likely to adversely impact this species. The addition of beach fill, if not properly matched to native materials, may result in a decrease in the quality of nesting habitat for this species. We recommend that all fill materials be matched in color, grain size, and composition to native materials as closely as possible. According to the information in the draft EA, the incidental take statement and biological opinion previously issued by NMFS for this project are still valid. We recommend adherence to the requirements for sea turtle protection (such as time of year restrictions, matching of beach fill materials to native materials, hopper dredge retrofitting, use of observers, routine monitoring, etc.) outlined in these documents.

We document federal Endangered West Indian manatee from the project area. It does not appear that possible impacts upon this species were evaluated in the draft EA. We recommend that possible impacts upon this species be addressed in the EA for this project.

We recommend continued coordination with NMFS regarding the protection of loggerhead sea turtles, other sea turtles, and sea mammals known from the project area and upon which adverse impacts resulting from the project are anticipated to occur. We recommend adherence to the requirements outlined in the incidental take statement and biological opinion previously issued by NMFS for this project.

We recommend coordination with the USFWS regarding possible impacts upon federally listed species and for information about whether this project will result in adverse impacts upon Back Bay NWR.

Assuming appropriate erosion and sediment controls are in place during beach nourishment, we find this project consistent with the parts of the Fisheries Management Section of the CZMA over which we have authority (inland fisheries). We defer to VMRC for concurrence that dredging and piping of materials are consistent with the aspects of the Fisheries Management section of the CZMA that addresses marine habitats.

Thank you. Amy

Amy M. Ewing
Environmental Services Biologist
Virginia Dept. of Game and Inland Fisheries
4010 West Broad Street
Richmond, VA 23230
804-367-2211
amy.ewing@dgif.virginia.gov

L. Preston Bryant, Jr.
Secretary of Natural Resources

Joseph H. Maroon
Director

COMMONWEALTH of VIRGINIA

DEPARTMENT OF CONSERVATION AND RECREATION

203 Governor Street
Richmond, Virginia 23219-2010
(804) 786-6124

MEMORANDUM

Date: May 19, 2009

TO: Anne Pinion, DEQ

From: Robert S. Munson, Planning Bureau Manager, DCR-DPRR

Subject: DEQ 09-078F, Sandbridge Beach Erosion Control and Hurricane Protection Project

Division of Natural Heritage

The Department of Conservation and Recreation's Division of Natural Heritage (DCR) has searched its Biotics Data System for occurrences of natural heritage resources from the area outlined on the submitted map. Natural heritage resources are defined as the habitat of rare, threatened, or endangered plant and animal species, unique or exemplary natural communities, and significant geologic formations.

Biotics documents the presence of natural heritage resources in the project area. However, as long as the nourishment does not include the dune field, we do not anticipate that this project will adversely impact these natural heritage resources. DCR concurs with the guidelines set by the United States Fish and Wildlife Service and National Marine Fisheries Service.

In addition, our files do not indicate the presence of any State Natural Area Preserves under DCR's jurisdiction in the project vicinity.

Under a Memorandum of Agreement established between the Virginia Department of Agriculture and Consumer Services (VDACS) and the Virginia Department of Conservation and Recreation (DCR), DCR represents VDACS in comments regarding potential impacts on state-listed threatened and endangered plant and insect species. The current activity will not affect any documented state-listed plants or insects.

New and updated information is continually added to Biotics. Please contact DCR for an update on this natural heritage information if a significant amount of time passes before it is utilized.

The Virginia Department of Game and Inland Fisheries maintains a database of wildlife locations, including threatened and endangered species, trout streams, and anadromous fish waters that may contain information not documented in this letter. Their database may be accessed from http://vafwis.org/fwis/ or contact Shirl Dressler at (804) 367-6913.

Division of Chesapeake Bay Local Assistance

The proposed activity lies outside of the City of Virginia Beach's designated Chesapeake Bay Preservation Areas, as Sandbridge Beach is located along the shoreline of the Atlantic Ocean and therefore outside of the Chesapeake Bay watershed. As such, there are no requirements under the Chesapeake Bay Preservation Act.

The remaining DCR divisions have no comments regarding the scope of this project. Thank you for the opportunity to comment.

Pinion,Anne

From: Heller, Matthew (DMME)
Sent: Friday, May 22, 2009 2:38 PM
To: Pinion,Anne
Subject: RE: New EA and Consistency-Sandbridge Beach Erosion Control and Hurricane Protection Project (DEQ# 09-078F)

Anne,

I have reviewed the information that you provided for this project. Based on my review, this project involves the beneficial use of a mineral resource. I do not anticipate a negative impact to mineral resource potential in the nourishment area.

Sincerely,

Matt Heller

Matthew J. Heller, P.G.
Manager, Geologic Mapping
Virginia Department of Mines, Minerals and Energy
Division of Geology and Mineral Resources
900 Natural Resources Drive, Suite 500
Charlottesville, Virginia, 22903
Phone: (434) 951-6351
Fax: (434) 951-6366

<http://www.dmme.virginia.gov/divisionmineralresources.shtml>

Please fill out our customer survey at:
<http://www.dmme.virginia.gov/DmrQualitySurvey>

From: Pinion, Anne (DEQ)
Sent: Friday, May 22, 2009 1:27 PM
To: Heller, Matthew
Subject: FW: New EA and Consistency-Sandbridge Beach Erosion Control and Hurricane Protection Project (DEQ# 09-078F)

From: Pinion,Anne
Sent: Thursday, April 23, 2009 9:50 AM
To: Ewing, Amy (DGIF); Tignor, Keith (VDACS); Rhur, Robbie (DCR); Matthews, Barry (VDH); Kohler,Paul; Narasimhan,Kotur; Hollis,Michelle; Watkinson, Tony (MRC); Kirchen, Roger; Holma, Marc; Heller, Matthew (DMME); Pam Mason; 'Claire JONES'; 'cbernick@vbgov.com'
Subject: New EA and Consistency-Sandbridge Beach Erosion Control and Hurricane Protection Project (DEQ# 09-078F)

Reviewers,

Attached is a new project from the U.S. Army Corps of Engineers. The comments are due May 20, 2009.

Here is a link to the project document.

http://www.deq.virginia.gov/eir/documents/09-078F-ProjectDocument.pdf

You can respond to the project by email or use the form attached. However, send me an electronic version of your comments if possible.

Pinion,Anne

From: Matthews, Barry (VDH)
Sent: Tuesday, April 28, 2009 1:04 PM
To: Pinion,Anne
Subject: RE: New EA and Consistency-Sandbridge Beach Erosion Control and Hurricane Protection Project (DEQ# 09-078F)

VDH - Office of Drinking Water has reviewed Federal Project 09 - 078F - Sandbridge Beach Erosion. Potential impacts to public water distribution systems or sanitary sewage collection systems must be verified by the local utility. Below are our comments as they relate to proximity to public drinking water sources (groundwater wells, springs and surface water intakes).

- There are no records of active public drinking water wells within a mile radius of the project site.
- There are no records of active Public Surface Water intakes within 5 miles of the project site.
- NO IMPACT

Barry E. Matthews, P.G.
Department of Health
James Madison Building
Office of Drinking Water, Room 621
Construction Assistance, Planning and Policy
109 Governor Street
Richmond, VA 23219
804 864-7515 (w)
804 864-7520 (fax)
barry.matthews@vdh.virginia.gov

From: Pinion,Anne [mailto:Anne.Pinion@deq.virginia.gov]
Sent: Thursday, April 23, 2009 9:50 AM
To: Ewing, Amy (DGIF); Tignor, Keith (VDACS); Rhur, Robbie (DCR); Matthews, Barry (VDH); Kohler, Paul (DEQ); Narasimhan, Kotur (DEQ); Hollis, Michelle (DEQ); Watkinson, Tony (MRC); Kirchen, Roger; Holma, Marc; Heller, Matthew (DMME); Pam Mason; Claire JONES; cbernick@vbgov.com
Subject: New EA and Consistency-Sandbridge Beach Erosion Control and Hurricane Protection Project (DEQ# 09-078F)

Reviewers,

Attached is a new project from the U.S. Army Corps of Engineers. The comments are due May 20, 2009.

Here is a link to the project document.

http://www.deq.virginia.gov/eir/documents/09-078F-ProjectDocument.pdf

You can respond to the project by email or use the form attached. However, send me an electronic version of your comments if possible.

Please let me know if you have any questions.

Thanks,

Anne

<<EIR review form.pdf>>

Anne N. Pinion

If you cannot meet the deadline, please notify ANNE N. PINION at 804/698-4488 prior to the date given. Arrangements will be made to extend the date for your review if possible. An agency will not be considered to have reviewed a document if no comments are received (or contact is made) within the period specified.

REVIEW INSTRUCTIONS:

A. Please review the document carefully. If the proposal has been reviewed earlier (i.e. if the document is a federal Final EIS or a state supplement), please consider whether your earlier comments have been adequately addressed.

B. Prepare your agency's comments in a form which would be acceptable for responding directly to a project proponent agency.

C. Use your agency stationery or the space below for your comments. **IF YOU USE THE SPACE BELOW, THE FORM MUST BE SIGNED AND DATED.**

Please return your comments to:

MS. ANNE N. PINION
DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL IMPACT REVIEW
629 EAST MAIN STREET, SIXTH FLOOR
RICHMOND, VA 23219
FAX #804/698-4319
anpinion@deq.virginia.gov

ANNE N. PINION
ENVIRONMENTAL PROGRAM PLANNER

COMMENTS

DHR has been in direct consultation with the Corps of Engineers regarding this project and reached consensus that the Sandbridge Beach Erosion Control Project will result in no adverse effect to historic properties. DHR has no further comment at this time.

(signed) [signature] (date) 4/24/09

(title) ARCHAEOLOGIST

(agency) DHR (FILE #2007-0458)

PROJECT #09-078F **2/09**

04/24/2009 14:34 8043672391 DEPT OF HISTORIC RES PAGE 01/01

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

MEMORANDUM

TO: Anne Pinion, Environmental Program Planner

FROM: Paul Kohler, Waste Division Environmental Review Coordinator

DATE: May 17, 2009

COPIES: Sanjay Thirunagari, Waste Division Environmental Review Manager; file

SUBJECT: Environmental Impact Report: Sandbridge Beach Erosion Control and Hurricane Protection Project; 09-078F

The Waste Division has completed its review of the Environmental Impact report for the Sandbridge Beach Erosion Control and Hurricane Protection Project in Virginia Beach, Virginia. We have the following comments concerning the waste issues associated with this project:

Hazardous waste, but not solid waste, issues were addressed in the report. The report did include a search of waste-related data bases. A GIS database search did not reveal any waste sites within a half mile radius that would impact or be impacted by the subject site. The Waste Division staff performed a cursory review of its data files and determined that a number of solid waste sites are located within the same zip code, however their proximity to the subject site are unknown. These are as follows.

SW:
SPSA - Landstown Transfer, PBR 191, Transfer Station
SPSA - Landstown Transfer, SWP 537, Transfer Station
Virginia Beach City - Mt Trashmore Landfill II, SWP 324, Closed Sanitary Landfill
Virginia Beach City - Mt Trashmore Landfill II, SWP 367, Closed Sanitary Landfill
Virginia Beach City - Mt Trashmore Landfill II, SWP 398, Sanitary Landfill
Tidewater Recyclable Products Incorporated, SWP 596, CDD Landfill

Any soil that is suspected of contamination or wastes that are generated during construction-related activities must be tested and disposed of in accordance with applicable Federal, State, and local laws and regulations. Some of the applicable state laws and regulations are: Virginia Waste Management Act, Code of Virginia Section 10.1-1400 *et seq.*; Virginia Hazardous Waste Management Regulations (VHWMR) (9VAC 20-60); Virginia Solid Waste Management Regulations (VSWMR) (9VAC 20-80); Virginia Regulations for the Transportation of Hazardous Materials (9VAC 20-110). Some of the applicable Federal laws and regulations are: the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. Section 6901 *et seq.*, and the applicable regulations contained in Title 40 of the Code of Federal

Regulations; and the U.S. Department of Transportation Rules for Transportation of Hazardous materials, 49 CFR Part 107.

Also, all structures being demolished/renovated/ removed should be checked for asbestos-containing materials (ACM) and lead-based paint prior to demolition. If ACM or LBP are found, in addition to the federal waste-related regulations mentioned above, State regulations 9VAC 20-80-640 for ACM and 9VAC 20-60-261 for LBP must be followed.

Please note that DEQ encourages all construction projects and facilities to implement pollution prevention principles, including the reduction, reuse, and recycling of all solid wastes generated. All generation of hazardous wastes should be minimized and handled appropriately.

If you have any questions or need further information, please contact Paul Kohler at (804) 698-4208.

DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR PROGRAM COORDINATION

ENVIRONMENTAL REVIEW COMMENTS APPLICABLE TO AIR QUALITY

TO: Anne N. Pinion **DEQ - OEIA PROJECT NUMBER: 09 – 078F**

PROJECT TYPE: ☐ STATE EA / EIR **X FEDERAL EA / EIS** ☐ SCC

X CONSISTENCY DETERMINATION

RECEIVED
APR 2? 2009
DEQ-Office of Environmental Impact Review

PROJECT TITLE: SANDBBRIDGE BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT

PROJECT SPONSOR: DOD / ARMY / U. S. ARMY CORPS OF ENGINEERS

PROJECT LOCATION: ☒ **OZONE MAINTENANCE AREA**

REGULATORY REQUIREMENTS MAY BE APPLICABLE TO: **X** **CONSTRUCTION**
☐ OPERATION

STATE AIR POLLUTION CONTROL BOARD REGULATIONS THAT MAY APPLY:

1. ☐ 9 VAC 5-40-5200 C & 9 VAC 5-40-5220 E – STAGE I
2. ☐ 9 VAC 5-40-5200 C & 9 VAC 5-40-5220 F – STAGE II Vapor Recovery
3. ☐ 9 VAC 5-40-5490 et seq. – Asphalt Paving operations
4. **X 9 VAC 5-40-5600 et seq. – Open Burning**
5. **X 9 VAC 5-50-60 et seq. Fugitive Dust Emissions**
6. ☐ 9 VAC 5-50-130 et seq. - Odorous Emissions; Applicable to________________
7. ☐ 9 VAC 5-50-160 et seq. – Standards of Performance for Toxic Pollutants
8. ☐ 9 VAC 5-50-400 Subpart_____, Standards of Performance for New Stationary Sources, designates standards of performance for the________________________
9. ☐ 9 VAC 5-80-10 et seq. of the regulations – Permits for Stationary Sources
10. ☐ 9 VAC 5-80-1700 et seq. Of the regulations – Major or Modified Sources located in PSD areas. This rule may be applicable to the ________________________
11. ☐ 9 VAC 5-80-2000 et seq. of the regulations – New and modified sources located in non-attainment areas
12. ☐ 9 VAC 5-80-800 et seq. Of the regulations – Operating Permits and exemptions. This rule may be applicable to ____

COMMENTS SPECIFIC TO THE PROJECT:

Being in an ozone maintenance area, all precautions are to be taken to restrict the emissions of volatile organic compounds (VOC) and oxides of nitrogen (NO_X) during construction.

K. S. Narasimhan

(Kotur S. Narasimhan)
Office of Air Data Analysis

DATE: April 24, 2009

HAMPTON ROADS
PLANNING DISTRICT COMMISSION

BRUCE C. GOODSON, CHAIRMAN • STAN D. CLARK, VICE CHAIRMAN • JAMES O. McREYNOLDS, TREASURER
DWIGHT L. FARMER, EXECUTIVE DIRECTOR/SECRETARY

May 20, 2009

Ms. Anne N. Pinion
Department of Environmental Quality
Office of Environmental Impact Review
629 East Main Street, Sixth Floor
Richmond, Virginia 23219

Re: Sandbridge Beach Erosion Control and Hurricane Protection Project
DEQ #09-078F (ENV:GEN)

Dear Ms. Pinion:

Pursuant to your request, the staff of the Hampton Roads Planning District Commission (HRPDC) has reviewed the Draft Environmental Assessment for the proposed erosion control and hurricane protection project at Sandbridge Beach. We have contacted the City of Virginia Beach concerning this project.

Based on this review, the proposal is generally consistent with local and regional plans and policies.

We appreciate the opportunity to review this project. If you have any questions, please do not hesitate to call.

Sincerely,

Dwight L. Farmer
Executive Director/Secretary

MLJ/fh

Copy: Mr. H. Clayton Bernick III

HEADQUARTERS • THE REGIONAL BUILDING • 723 WOODLAKE DRIVE • CHESAPEAKE, VIRGINIA 23320 • (757) 420-8300
PENINSULA OFFICE • 2101 EXECUTIVE DRIVE • SUITE C • HAMPTON, VIRGINIA 23666 • (757) 262-0094

Pinion,Anne

From: Clay Bernick [CBernick@vbgov.com]
Sent: Thursday, May 28, 2009 11:25 AM
To: Pinion,Anne
Subject: RE: Corps EA - Sandbridge Beach Nourishment

Anne-

Sorry for the delay; the City decided not to comment on the project.

Clay

Clay Bernick
Administrator
City of Virginia Beach Department of Planning
Environmental Management Center
2405 Courthouse Drive
Building 2, Room 115
Municipal Center
Virginia Beach, VA 23456-9040
(757) 385-4621 MAIN
(757) 385-5667 FAX
(757) 385-4899 DIRECT
(757) 377-3120 MOBILE

Reduce, Reuse, Recycle - please print only when necessary!

From: Pinion,Anne [mailto:Anne.Pinion@deq.virginia.gov]
Sent: Wednesday, May 27, 2009 9:17 AM
To: Clay Bernick
Subject: Corps EA - Sandbridge Beach Nourishment

Clay,

If Virginia Beach wants to comment on the project, I need to comments today.

Thanks,

Anne

Anne N. Pinion

Department of Environmental Quality

629 East Main Street

Richmond, Virginia 23219

(804) 698-4488

NEW EMAIL: anne.pinion@deq.virginia.gov

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
TIDEWATER REGIONAL OFFICE
5636 Southern Boulevard, Virginia Beach, Virginia 23462
(757) 518-2000 Fax (757) 518-2009
www.deq.virginia.gov

Doug Domenech
Secretary of Natural Resources

David K. Paylor
Director

Francis L. Daniel
Regional Director

June 10, 2010

U.S. Army Corps of Engineers, Planning and Policy Branch
Attn: Mr. Mark Mansfield
803 Front Street
Norfolk, Virginia 23510

City of Virginia Beach, Department of Public Works
Attn: Mr. Philip J. Roehrs
Municipal Center, Bldg. 2, Rm. 340
2405 Courthouse Drive
Virginia Beach, Virginia 23456-9031

RE: Final VWP Individual Permit
Joint Permit Application Number 09-1686
Sandbridge Beach Erosion Control and Hurricane Protection Project
Virginia Beach, Virginia

Gentlemen:

Pursuant to the Virginia Water Protection (VWP) Permit Program Regulation 9 VAC 25-210-10 and § 401 of the Clean Water Act Amendments of 1977, Public Law 95-217, the Department of Environmental Quality (DEQ) has enclosed the original VWP individual permit for the above-referenced project involving beach nourishment activities at the Sandbridge Beach oceanfront.

This permit is valid for fifteen years from the date of issuance. Issuance of a new permit may be necessary if any portion of the authorized activities or any permit requirement have not been completed, or if permitted activities are to continue beyond the permit term.

As provided by Rule 2A:2 of the Supreme Court of Virginia, you have 30 calendar days from the date of service (the date you actually received this decision or the date it was mailed to you, whichever occurred first) within which to appeal this decision by filing a notice of appeal in accordance with the Rules of the Supreme Court of Virginia with the Director, Department of Environmental Quality. In the event that this decision is served on you by mail, three days are added to that period. Refer to Part 2A of the Rules of the Supreme Court of Virginia for additional requirements governing appeals from administrative agencies.

Alternatively, any owner under §§62.1-44.16, 62.1-44.17 and 62.1-44.19 of the State Water Control Law aggrieved by any action of the board taken without a formal hearing, or by inaction of the board, may demand in writing a formal hearing of such owner's grievance, provided a petition requesting such hearing is filed with the board. Said petition must meet the requirements set forth in the board's Procedural Rule Number 1 (9 VAC 25-230-130 B). In cases involving actions of the board, such petition must be filed within 30 calendar days after notice of such action is sent to such owner by certified mail.

Should you have any questions, please feel free to contact David Nishida at (757) 518-2181, david.nishida@deq.virginia.gov, or at the above address.

Sincerely,

Bert W. Parolari, Jr.
Virginia Water Protection Permit Manager

Enclosures: (1)

cc: Justin Worrell, Virginia Marine Resources Commission

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
TIDEWATER REGIONAL OFFICE
5636 Southern Boulevard, Virginia Beach, Virginia 23462
(757) 518-2000 Fax (757) 518-2009
www.deq.virginia.gov

Doug Domenech
Secretary of Natural Resources

David K. Paylor
Director

Francis L. Daniel
Regional Director

VWP Individual Permit Number 09-1686
Effective Date: June 10, 2010
Expiration Date: June 9, 2025

VIRGINIA WATER PROTECTION PERMIT
ISSUED PURSUANT TO THE STATE WATER CONTROL LAW
AND SECTION 401 OF THE CLEAN WATER ACT

Based upon an examination of the information submitted by the owner, and in compliance with § 401 of the Clean Water Act as amended (33 USC 1341) and the State Water Control Law and regulations adopted pursuant thereto, the State Water Control Board (board) has determined that there is a reasonable assurance that the activity authorized by this permit, if conducted in accordance with the conditions set forth herein, will protect instream beneficial uses and will not violate applicable water quality standards. The board finds that the effect of the impact, together with other existing or proposed impacts to surface waters, will not cause or contribute to a significant impairment to state waters or fish and wildlife resources.

Permittees:	U.S. Army Corps of Engineers Planning and Policy Branch Attn: Mr. Mark Mansfield	City of Virginia Beach Department of Public Works Attn: Mr. Philip J. Roehrs
Addresses:	803 Front Street Norfolk, Virginia 23510	Municipal Center, Bldg. 2, Rm. 340 2405 Courthouse Drive Virginia Beach, Virginia 23456-9031

Activity Location: Sandbridge Beach oceanfront in the 5 mile long by 125 foot wide area between the US Naval Fleet Anti-Air Warfare Training Center at Dam Neck and Back Bay National Wildlife Refuge in Virginia Beach, Virginia.

Activity Description: The permittee is authorized to impact 95.8 acres of non-vegetated intertidal beach and subaqueous bottom to conduct beach nourishment activities at the Sandbridge Beach oceanfront with 1.5 to 2.0 million cubic yards of beach quality sand obtained from Sandbridge Shoals, located beyond the limits of Virginia's territorial sea. The anticipated beach nourishment cycle is approximately every 3 years.

The permitted activity shall be in accordance with this Permit Cover Page, Part I - Special Conditions, and Part II - General Conditions.

Maria R. Nold

Maria R. Nold
Deputy Regional Director

June 10, 2010

Date

Part I - Special Conditions

Authorized Activities and Permit Term

A. ***Authorized Activities***

This permit authorizes impacts to 95.8 acres of non-vegetated intertidal beach and subaqueous bottom at the Sandbridge Beach oceanfront between the US Naval Fleet Anti-Air Warfare Training Center at Dam Neck and Back Bay National Wildlife Refuge as indicated in the application received by DEQ on December 1, 2009 and supplemental materials, revisions, and clarifications received through March 2, 2010. The beach nourishment location is depicted in detail on Sheets 1 - 7 of 7 on the undated plans titled "Sandbridge Beach 2009 Hurricane Protection, Sand Replenishment Project, Permit Application", received by DEQ on December 1, 2009. The beach nourishment cross-sections are depicted on the six undated sheets titled "Sandbridge Sand Replenishment, Typical Beach Fill Cross Section", produced by the Norfolk District, U.S. Army Corps of Engineers, and received by DEQ on December 1, 2009.

The offshore dredging locations are depicted on the plan titled "Sandbridge Beach, Erosion Control and Hurricane Protection Project", dated November 2009, prepared by the Norfolk District, U.S. Army Corps of Engineers, and received by DEQ on December 1, 2009. These dredging activities will occur beyond the limits of Virginia's territorial sea, and are therefore not subject to DEQ regulatory authority. However, as noted by the Virginia Department of Game and Inland Fisheries, those activities should be conducted in accordance with the terms and conditions, and reasonable and prudent measures (RPM) described in the 1993 Biological Opinion and 2001 Incidental Take Statement prepared by the National Marine Fisheries Service found in Appendix A of the "Final Environmental Assessment, Sandbridge Beach Erosion Control and Hurricane Protection Project, Virginia Beach, Virginia", prepared by the U.S. Army Corps of Engineers in June of 2009.

B. ***Permit Term***

This permit is valid for **15 years** from the date of issuance. A new permit may be necessary for the continuance of the authorized activities or any permit requirement that has not been completed, including compensation provisions. The permit term, including any granted extensions, shall not exceed 15 years.

Project Construction at Impact Site

C. ***Standard Project Conditions***

1. The activities authorized by this permit shall be executed in such a manner that any impacts to stream beneficial uses are minimized. As defined in § 62.1-10(b) of the Code, "beneficial use" means both instream and offstream uses. Instream beneficial uses include, but are not limited to, the protection of fish and wildlife habitat, maintenance of waste assimilation, recreation, navigation, and cultural and aesthetic values. Offstream beneficial uses include, but are not limited to, domestic (including public water supply), agricultural, electric power

generation, commercial, and industrial uses. Public water supply uses for human consumption shall be considered the highest priority.

2. No activity shall substantially disrupt the movement of aquatic life indigenous to the water body, including those species that normally migrate through the area, unless the primary purpose of the activity is to impound water.

3. No activity shall cause more than minimal adverse effect on navigation.

4. Beach nourishment activities authorized by this permit shall be conducted in accordance with any Time-of-Year restriction(s) as recommended by the Department of Game and Inland Fisheries or the Virginia Marine Resources Commission. The permittee shall retain a copy of the agency correspondence concerning the Time-of-Year restriction(s), or the lack thereof, for the duration of the construction phase of the project.

5. All excavation, dredging, or filling in surface waters shall be accomplished in a manner that minimizes bottom disturbance and turbidity.

6. All construction, construction access, and demolition activities associated with this project shall be accomplished in a manner that minimizes construction materials or waste materials from entering surface waters, unless authorized by this permit. Wet, excess, or waste concrete shall be prohibited from entering surface waters.

7. All fill material placed in surface waters shall be clean and free of contaminants in toxic concentrations or amounts in accordance with all applicable laws and regulations.

8. Stormwater runoff shall be prohibited from directly discharging into any surface waters. Best management practices (BMP) designed, installed, and maintained, as described in the Virginia Erosion and Sediment Control Handbook (Third Edition, 1992, or the most recent version in effect at the time of construction) and the Virginia Stormwater Management Handbook (First Edition, 1999, or the most recent version in effect at the time of construction), shall be deemed suitable treatment prior to discharge into surface waters. Installation of alternative practices not described in these references shall be submitted to DEQ for approval prior to beginning construction.

9. Measures shall be employed at all times to prevent and contain spills of fuels, lubricants, or other pollutants into surface waters.

10. Virginia Water Quality Standards shall not be violated in any surface waters as a result of the project activities.

11. Erosion and sedimentation controls shall be designed in accordance with the Virginia Erosion and Sediment Control Handbook, Third Edition, 1992, or the most recent version in effect at the time of construction. These controls shall be placed prior to clearing and grading activities and shall be maintained in good working order, to minimize impacts to surface

waters. These controls shall remain in place only until clearing and grading activities cease and these areas have been stabilized.

12. All required notifications and submittals shall be submitted to the DEQ office stated below, to the attention of the VWP permit manager, unless directed in writing by DEQ subsequent to the issuance of this permit:

    Virginia Department of Environmental Quality
    Tidewater Regional Office
    5636 Southern Boulevard
    Virginia Beach, Virginia 23462
    Attention: David Nishida

13. All reports required by this permit and other information requested by DEQ shall be signed by the permittee or a person acting in the permittee's behalf, with the authority to bind the permittee. A person is a duly authorized representative only if *both* criteria below are met. If a representative authorization is no longer valid because of a change in responsibility for the overall operation of the facility, a new authorization shall be immediately submitted to DEQ.

    a. The authorization is made in writing by the permittee.

    b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, superintendent, or position of equivalent responsibility. A duly authorized representative may thus be either a named individual or any individual occupying a named position.

14. All submittals shall contain the following signed certification statement:

    "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

15. Any fish kills or spills of fuels or oils shall be reported to DEQ immediately upon discovery at (757) 518-2000. If DEQ cannot be reached, the spill shall be reported to the Virginia Department of Emergency Management (DEM) at 1-800-468-8892 or the National Response Center (NRC) at 1-800-424-8802.

16. DEQ shall be notified in writing within **24 hours or as soon as possible on the next business day** when potential environmentally threatening conditions are encountered which require debris removal or involve potentially toxic substances. Measures to remove the obstruction,

material, or toxic substance or to change the location of any structure are prohibited until approved by DEQ.

17. The permittee shall notify the DEQ of any additional impacts to surface waters, including wetlands; and of any change to the type of surface water impacts associated with this project. Any additional impacts, modifications, or changes shall be subject to individual permit review and/or modification of this permit. Compensation may be required.

D. *Projects Involving Beach Nourishment Activities*

1. The permittee is authorized to conduct beach nourishment activities at the Sandbridge Beach oceanfront in the 5 mile long by 125 foot wide area between the US Naval Fleet Anti-Air Warfare Training Center at Dam Neck and Back Bay National Wildlife Refuge. The permitees propose to utilize either a hydraulic cutterhead suction dredge or a trailing suction hopper dredge to obtain 1.5 to 2.0 million cubic yards of beach quality sand from Sandbridge Shoals, located greater than 3 miles from the shoreline, outside the limits of Virginia's territorial sea. The material will be transported from the shoals to a pump out buoy located offshore. The material will then be pumped through a discharge pipeline, which will run along the ocean floor, and up onto the beach where bulldozers and graders will distribute the material. The permitees propose to perform the nourishment cycle approximately every 3 years.

2. The double handling of dredged material in State surface waters shall not be permitted.

3. All dredged materials pumped by hydraulic method via pipeline to the beach nourishment area will be done in such a manner as to prevent leakage or discharge of liquids or solids into surface waters. In the event of a ruptured pipeline, dredging/disposal operations shall immediately cease until repairs are accomplished.

4. During transport, dredge material shall be handled in accordance with the transport operation's spill prevention plan. In the event of a spill, the response portions of the plan shall be implemented immediately.

5. Transport of dredged material shall be conducted in such a manner as to prevent any overflow of dredged material.

6. Dredged material shall be pumped via pipeline to the beach above mean high water for dewatering. Dredged material will then be graded on the beach into the authorized impact areas for beach nourishment purposes.

E. *Project Monitoring and Submittals*

Pre – Beach Nourishment Submittals

1. Beach nourishment activities shall be performed in accordance with the construction plans referenced in Part I.A of this permit. Any changes to the plans for permitted areas shall be

submitted to DEQ immediately upon determination that changes are necessary. DEQ approval shall be required prior to implementing the changes.

2. The permittee shall submit written notification at least **ten calendar days** prior to the initiation of each beach nourishment cycle. The notification shall include a projected schedule for initiating and completing the cycle.

Beach Nourishment Monitoring

3. The permittee shall conduct photographic monitoring of beach nourishment activities to document that the permitted activities are in compliance with permit conditions, and to document any events that are not in compliance with the construction-related permit conditions. Enumerated photo stations shall be established at locations along the beach at intervals sufficient to document progress of beach nourishment activities authorized by this permit and shall document conditions in the permitted impact areas before, during and after beach nourishment activities. Photo stations may be established either on the beach or via water craft or temporary floating structures. If the ongoing beach nourishment activities, such as the pumping of the slurry onto the beach and the grading operation, are not be visible from one of the established photo stations at the time of a particular monitoring event, in addition to the photographic monitoring that shall occur at each established photo station, the permittee shall conduct photographic monitoring at the ongoing beach nourishment location to document the during beach nourishment conditions. Each photograph shall be labeled with the permit number, the location of photograph, the photo station number (where applicable), the photograph orientation, the date and time of the photograph, the name of the person taking the photograph, and a brief description of the photograph subject.

4. Photographic monitoring during beach nourishment shall be conducted once per month unless unusual circumstances call for additional documentation. Each monthly set of photographs shall encompass the entire project area and shall be submitted with the monitoring reports as detailed in Part I.E.5.

Beach Nourishment Monitoring Reports

5. Beach Nourishment Monitoring Reports shall be submitted to DEQ **monthly** during beach nourishment activities. The reports shall be submitted by the **10th calendar day** of the month **after** the **month** in which monitoring takes place. The reports shall include the following, as appropriate:

    a. A written narrative describing work that was performed during the monitoring period in each permitted impact area. The narrative shall include a description of the work performed, when the work was initiated, and the expected date of completion.

    b. A summary of activities conducted to comply with the permit conditions, including items associated with meeting specific permit conditions and a description of erosion and sediment controls used to protect water quality and any maintenance performed on the controls.

c. A written summary, including photographs, of non-compliance events or problems encountered, any corrective actions taken, and any subsequent notifications to DEQ.

d. A labeled site map depicting photo stations locations.

e. Photographs labeled as described in Part I.E.3.

Post – Beach Nourishment Submittals

6. The permittee shall submit written notification within **30 calendar days** after the completion of each beach nourishment cycle authorized under this permit.

7. A post-construction survey depicting the extent of beach nourishment activities between the US Naval Fleet Anti-Air Warfare Training Center at Dam Neck and Back Bay National Wildlife Refuge shall be submitted to DEQ within **60 calendar days** following completion of each beach nourishment cycle.

Part II – General Conditions

A. Duty to Comply

The permittee shall comply with all conditions of the VWP permit. Nothing in the VWP permit regulations shall be construed to relieve the permittee of the duty to comply with all applicable federal and state statutes, regulations and prohibitions. Any VWP permit violation is a violation of the law, and is grounds for enforcement action, VWP permit termination, revocation, modification, or denial of an application for a VWP permit extension or reissuance.

B. Duty to Cease or Confine Activity

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the activity for which a VWP permit has been granted in order to maintain compliance with the conditions of the VWP permit.

C. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any impacts in violation of the permit which may have a reasonable likelihood of adversely affecting human health or the environment.

D. VWP Permit Action

1. A VWP permit may be modified, revoked and reissued, or terminated as set forth in 9 VAC 25-210 et seq.

2. If a permittee files a request for VWP permit modification, revocation, or termination, or files a notification of planned changes, or anticipated noncompliance, the VWP permit terms and conditions shall remain effective until the request is acted upon by the board. This provision shall not be used to extend the expiration date of the effective VWP permit. If the permittee wishes to continue an activity regulated by the VWP permit after the expiration date of the VWP permit, the permittee must apply for and obtain a new VWP permit or comply with the provisions of 9 VAC 25-210-185 (VWP Permit Extension).

3. VWP permits may be modified, revoked and reissued or terminated upon the request of the permittee or other person at the board's discretion, or upon board initiative to reflect the requirements of any changes in the statutes or regulations, or as a result of VWP permit noncompliance as indicated in the Duty to Comply subsection above, or for other reasons listed in 9 VAC 25-210-180 (Rules for Modification, Revocation and Reissuance, and Termination of VWP permits).

E. Inspection and Entry

Upon presentation of credentials, any duly authorized agent of the board may, at reasonable times and under reasonable circumstances:

1. Enter upon any permittee's property, public or private, and have access to, inspect and copy any records that must be kept as part of the VWP permit conditions;

2. Inspect any facilities, operations or practices (including monitoring and control equipment) regulated or required under the VWP permit; and

3. Sample or monitor any substance, parameter or activity for the purpose of ensuring compliance with the conditions of the VWP permit or as otherwise authorized by law.

F. Duty to Provide Information

1. The permittee shall furnish to the board any information which the board may request to determine whether cause exists for modifying, revoking, reissuing or terminating the VWP permit, or to determine compliance with the VWP permit. The permittee shall also furnish to the board, upon request, copies of records required to be kept by the permittee.

2. Plans, specifications, maps, conceptual reports and other relevant information shall be submitted as required by the board prior to commencing construction.

G. Monitoring and Records Requirements

1. Monitoring of parameters, other than pollutants, shall be conducted according to approved analytical methods as specified in the VWP permit. Analysis of pollutants will be conducted according to 40 CFR Part 136 (2000), Guidelines Establishing Test Procedures for the Analysis of Pollutants.

2. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

3. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart or electronic recordings for continuous monitoring instrumentation, copies of all reports required by the VWP permit, and records of all data used to complete the application for the VWP permit, for a period of at least three years from the date of the expiration of a granted VWP permit. This period may be extended by request of the board at any time.

4. Records of monitoring information shall include:

    a. The date, exact place and time of sampling or measurements;

    b. The name of the individuals who performed the sampling or measurements;

    c. The date and time the analyses were performed;

    d. The name of the individuals who performed the analyses;

    e. The analytical techniques or methods supporting the information such as observations, readings, calculations and bench data used;

    f. The results of such analyses; and

    g. Chain of custody documentation.

H. Transferability

This VWP permit may be transferred to a new permittee only by modification to reflect the transfer, by revoking and reissuing the permit, or by automatic transfer. Automatic transfer to a new permittee shall occur if:

1. The current permittee notifies the board within 30 days of the proposed transfer of the title to the facility or property;

2. The notice to the board includes a written agreement between the existing and proposed permittee containing a specific date of transfer of VWP permit responsibility, coverage and liability to the new permittee, or that the existing permittee will retain such responsibility, coverage, or liability, including liability for compliance with the requirements of any enforcement activities related to the permitted activity; and

3. The board does not within the 30-day time period notify the existing permittee and the new permittee of its intent to modify or revoke and reissue the VWP permit.

I. Property rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize injury to private property or any invasion of personal rights or any infringement of federal, state or local law or regulation.

J. Reopener

Each VWP permit shall have a condition allowing the reopening of the VWP permit for the purpose of modifying the conditions of the VWP permit to meet new regulatory standards duly adopted by the board. Cause for reopening VWP permits includes, but is not limited to when the circumstances on which the previous VWP permit was based have materially and substantially changed, or special studies conducted by the board or the permittee show material and substantial change, since the time the VWP permit was issued and thereby constitute cause for VWP permit modification or revocation and reissuance.

K. Compliance with State and Federal Law

Compliance with this VWP permit constitutes compliance with the VWP permit requirements of the State Water Control Law. Nothing in this VWP permit shall be construed to preclude the institution of any legal action under or relieve the permittee from any responsibilities, liabilities, or other penalties established pursuant to any other state law or regulation or under the authority preserved by § 510 of the Clean Water Act.

L. Severability

The provisions of this VWP permit are severable.

M. Permit Modification

A VWP permit may be modified, but not revoked and reissued except when the permittee agrees or requests, when any of the following developments occur:

1. When additions or alterations have been made to the affected facility or activity which require the application of VWP permit conditions that differ from those of the existing VWP permit or are absent from it;

2. When new information becomes available about the operation or activity covered by the VWP permit which was not available at VWP permit issuance and would have justified the application of different VWP permit conditions at the time of VWP permit issuance;

3. When a change is made in the promulgated standards or regulations on which the VWP permit was based;

4. When it becomes necessary to change final dates in schedules due to circumstances over which the permittee has little or no control such as acts of God, materials shortages, etc. However, in no case may a compliance schedule be modified to extend beyond any applicable statutory deadline of the Act;

5. When changes occur which are subject to "reopener clauses" in the VWP permit; or

6. When the board determines that minimum instream flow levels resulting from the permittee's withdrawal of water are detrimental to the instream beneficial use and the withdrawal of water should be subject to further net limitations or when an area is declared a Surface Water Management Area pursuant to §§ 62.1-242 through 62.1-253 of the Code of Virginia, during the term of the VWP permit.

N. Permit Termination

After notice and opportunity for a formal hearing pursuant to Procedural Rule No. 1 (9 VAC 25-230-100) a VWP permit can be terminated for cause. Causes for termination are as follows:

1. Noncompliance by the permittee with any condition of the VWP permit;

2. The permittee's failure in the application or during the VWP permit issuance process to disclose fully all relevant facts or the permittee's misrepresentation of any relevant facts at any time;

3. The permittee's violation of a special or judicial order;

4. A determination by the board that the permitted activity endangers human health or the environment and can be regulated to acceptable levels by VWP permit modification or termination;

5. A change in any condition that requires either a temporary or permanent reduction or elimination of any activity controlled by the VWP permit; and

6. A determination that the permitted activity has ceased and that the compensatory mitigation for unavoidable adverse impacts has been successfully completed.

O. Civil and Criminal Liability

Nothing in this VWP permit shall be construed to relieve the permittee from civil and criminal penalties for noncompliance.

P. Oil and Hazardous Substance Liability

Nothing in this VWP permit shall be construed to preclude the institution of legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under § 311 of the Clean Water Act or §§ 62.1-44.34:14 through 62.1-44.34:23 of the State Water Control Law.

Q. Unauthorized Discharge of Pollutants

Except in compliance with this VWP permit, it shall be unlawful for the permittee to:

1. Discharge into state waters sewage, industrial wastes, other wastes, or any noxious or deleterious substances;

2. Excavate in a wetland;

3. Otherwise alter the physical, chemical, or biological properties of state waters and make them detrimental to the public health, to animal or aquatic life, to the uses of such waters for domestic or industrial consumption, for recreation, or for other uses;

4. On or after October 1, 2001 conduct the following activities in a wetland:

   a. New activities to cause draining that significantly alters or degrades existing wetland acreage or functions;

   b. Filling or dumping;

   c. Permanent flooding or impounding;

   d. New activities that cause significant alteration or degradation of existing wetland acreage or functions.

R. Permit Extension

Any permittee with an effective VWP permit for an activity that is expected to continue after the expiration date of the VWP permit, without any change in the activity authorized by the VWP permit, shall submit written notification requesting an extension. The permittee must file the request prior to the expiration date of the VWP permit. Under no circumstances will the extension be granted for more than 15 years beyond the original effective date of the VWP permit. If the request for extension is denied, the VWP permit will still expire on its original date and, therefore, care should be taken to allow for sufficient time for the board to evaluate the extension request and to process a full VWP permit modification, if required.

COMMONWEALTH of VIRGINIA

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

Douglas W. Domenech
Secretary of Natural Resources

Steven G. Bowman
Commissioner

August 23, 2010

City of Virginia Beach, et al
Attn: Philip J. Roehrs
2405 Courthouse Drive
Virginia Beach Municipal Center
Building 2, Room 340
Virginia Beach, VA 23456

RE: VMRC #09-1686

Dear Mr. Roehrs:

Enclosed is the Marine Resources Commission permit for your proposal to place approximately 2 million cubic yards of beach-quality sand along the 5 mile stretch of Sandbridge Beach, situated along the Atlantic Ocean in Virginia Beach. Beach nourishment will include sand hydraulically pumped from the Sandbridge Shoals borrow area, located approximately 3 nautical miles offshore, to the beach area between the Navy's Dam Neck Fleet Training Center to the north and the Back Bay National Wildlife Refuge to the south.

A yellow placard is also enclosed. This placard reflects the authorized activities for inspection purposes and <u>must</u> be conspicuously displayed at the work site throughout the construction phase. Failure to properly post the placard in a prominent location will be considered a violation of your permit conditions.

YOU ARE REMINDED THAT ANY DEVIATION FROM THE PERMIT OR ATTACHED DRAWINGS REQUIRES PRIOR AUTHORIZATION FROM THE MARINE RESOURCES COMMISSION. FAILURE TO OBTAIN THE NECESSARY MODIFICATION WILL BE CONSIDERED A VIOLATION AND COULD SUBJECT YOU TO CIVIL CHARGES IN AMOUNTS NOT TO EXCEED $10,000 PER VIOLATION.

The work authorized by this permit is to be completed by July 31, 2015. Please note that in conformance with Special Condition 17 of your permit you are to notify the Commission prior to commencement of your permitted project. The enclosed self-addressed, stamped post card is to be used for this purpose. All other conditions of the permit will remain in effect.

Please be advised that you may also require issuance of a U. S. Army Corps of Engineers permit before you begin work on this project. You may wish to contact them directly to verify any permitting requirements.

Sincerely,

Tony Watkinson
Chief, Habitat Management

TW/and
HM
cc: Virginia Beach Wetlands Board

MRC 30-317

VMRC# 09-1686
Applicant: City of Virginia Beach, et al

COMMONWEALTH OF VIRGINIA
MARINE RESOURCES COMMISSION
PERMIT

The Commonwealth of Virginia, Marine Resources Commission, hereinafter referred to as the Commission, on this 27th day of July, 2010, hereby grants unto:

City of Virginia Beach, et al
Attn: Philip J. Roehrs
2405 Courthouse Drive
Virginia Beach Municipal Center
Building 2, Room 340
Virginia Beach, VA 23456

hereinafter referred to as the Permittee, permission to:

_x_ Encroach in, on, or over State-owned subaqueous bottoms pursuant to Chapter 12, Subtitle III, of Title 28.2 of the Code of Virginia.

____ Use or develop tidal wetlands pursuant to Chapter 13, Subtitle III, of Title 28.2 of the Code of Virginia.

Permittee is hereby authorized to place approximately 2 million cubic yards of beach-quality sand along the 5 mile stretch of Sandbridge Beach, situated along the Atlantic Ocean in Virginia Beach. Beach nourishment will include sand hydraulically pumped from the Sandbridge Shoals borrow area, located approximately 3 nautical miles offshore, to the beach area between the Navy's Dam Neck Fleet Training Center to the north and the Back Bay National Wildlife Refuge to the south. All activities authorized herein shall be accomplished in conformance with the plans and drawings dated received November 24, 2009, which are attached and made a part of this permit.

This permit is granted subject to the following conditions:

(1) The work authorized by this permit shall be completed by **July 31, 2015**. The Permittee shall notify the Commission when the project is completed. The completion date may be extended by the Commission in its discretion. Any such application for extension of time shall be in writing prior to the above completion date and shall specify the reason for such extension and the expected date of completion of construction. All other conditions remain in effect until revoked by the Commission or the General Assembly.

(2) This permit grants no authority to the Permittee to encroach upon the property rights, including riparian rights, of others.

(3) The duly authorized agents of the Commission shall have the right to enter upon the premises at reasonable times, for the purpose of inspecting the work being done pursuant to this permit.

(4) The Permittee shall comply with the water quality standards as established by the Department of Environmental Quality, Water Division, and all other applicable laws, ordinances, rules and regulations affecting the conduct of the project. The granting of this permit shall not relieve the Permittee of the responsibility of obtaining any and all other permits or authority for the projects.

(5) This permit shall not be transferred without written consent of the Commissioner.

(6) This permit shall not affect or interfere with the right vouchsafed to the people of Virginia concerning fishing, fowling and the catching of and taking of oysters and other shellfish in and from the bottom of acres and waters not included within the terms of this permit.

(7) The Permittee shall, to the greatest extent practicable, minimize the adverse effects of the project upon adjacent properties and wetlands and upon the natural resources of the Commonwealth.

(8) This permit may be revoked at any time by the Commission upon the failure of the Permittee to comply with any of the terms and conditions hereof or at the will of the General Assembly of Virginia.

(9) There is expressly excluded from the permit any portion of the waters within the boundaries of the Baylor Survey.

(10) This permit is subject to any lease of oyster planting ground in effect on the date of this permit. Nothing in this permit shall be construed as allowing the Permittee to encroach on any lease without the consent of the leaseholder. The Permittee shall be liable for any damages to such lease.

(11) The issuance of this permit does not confer upon the Permittee any interest or title to the beds of the waters.

(12) All structures authorized by this permit, which are not maintained in good repair, shall be completely removed from State-owned bottom within three (3) months after notification by the Commission.

(13) The Permittee agrees to comply with all of the terms and conditions as set forth in this permit and that the project will be accomplished within the boundaries as outlined in the plans attached hereto. Any encroachment beyond the limits of this permit shall constitute a Class 1 misdemeanor.

(14) This permit authorizes no claim to archaeological artifacts that may be encountered during the course of construction. If, however, archaeological remains are encountered, the Permittee agrees to notify the Commission, who will, in turn notify the Department of Historic Resources. The Permittee further agrees to cooperate with agencies of the Commonwealth in the recovery of archaeological remains if deemed necessary.

(15) The Permittee agrees to indemnify and save harmless the Commonwealth of Virginia from any liability arising from the establishment, operation or maintenance of said project.

The following special conditions are imposed on this permit:

(16) The yellow placard accompanying this permit document must be conspicuously displayed at the work site throughout the construction phase of the authorized activity.

(17) Permittee agrees to notify the Commission a minimum of 15 days prior to the start of each nourishment cycle authorized by this permit.

(18) Prior to nourishment, permittee agrees to provide the Commission with the entire sheet set of plan-view drawings and profiles of the Sandbridge Beach project limits.

(19) Permitte agrees to contact the U.S. Coast Guard prior to nourishment activities regarding a Private Aids to Navigation application.

(20) Within thirty (30) days of completion of the nourishment activities, a mean low water survey shall be performed and submitted to the Commission.

VMRC # 09-1686

A permit issuing fee of: $100.00

and a royalty of: NA

for a total of **$100.00** This permit consists of 20 sheets.

PERMITTEE

Permittee's signature is affixed hereto as evidence of acceptance of all of the terms and conditions herein.

In cases where the Permittee is a corporation, agency or political jurisdiction, please assure that the individual who signs for the Permittee has proper authorization to bind the organization to the financial and performance obligations which result from activity authorized by this permit.

PERMITTEE [signature]

Accepted for

day of AUGUST 20, 2010 By Phillip J. Roehrs, ENV V
(Name) (Title)

State of Virginia
City (or County) of Virginia Beach, to-wit:
I, Tami D. Jones a Notary Public in and for said City (or County) and State hereby certify that Phillip J. Roehrs, Permittee, whose name is signed to the foregoing, has acknowledged the same before me in my City (or County) and State aforesaid.
Given under my hand this 20th day of August, 2010
My Commission Expires: July 31, 2012

TAMI D. JONES
Notary Public
Commonwealth of Virginia
346900
My Commission Expires Jul 31, 2012

Notary Public Tami D. Jones

COMMISSION

IN WITNESS WHEREOF, the Commonwealth of Virginia, Marine Resources Commission has caused these presents to be executed in its behalf by TONY WATKINSON, CHIEF HABITAT MANAGEMENT
(Name) (Title) Marine Resources Commission

23rd day of AUGUST, 2010 by Tony Watt

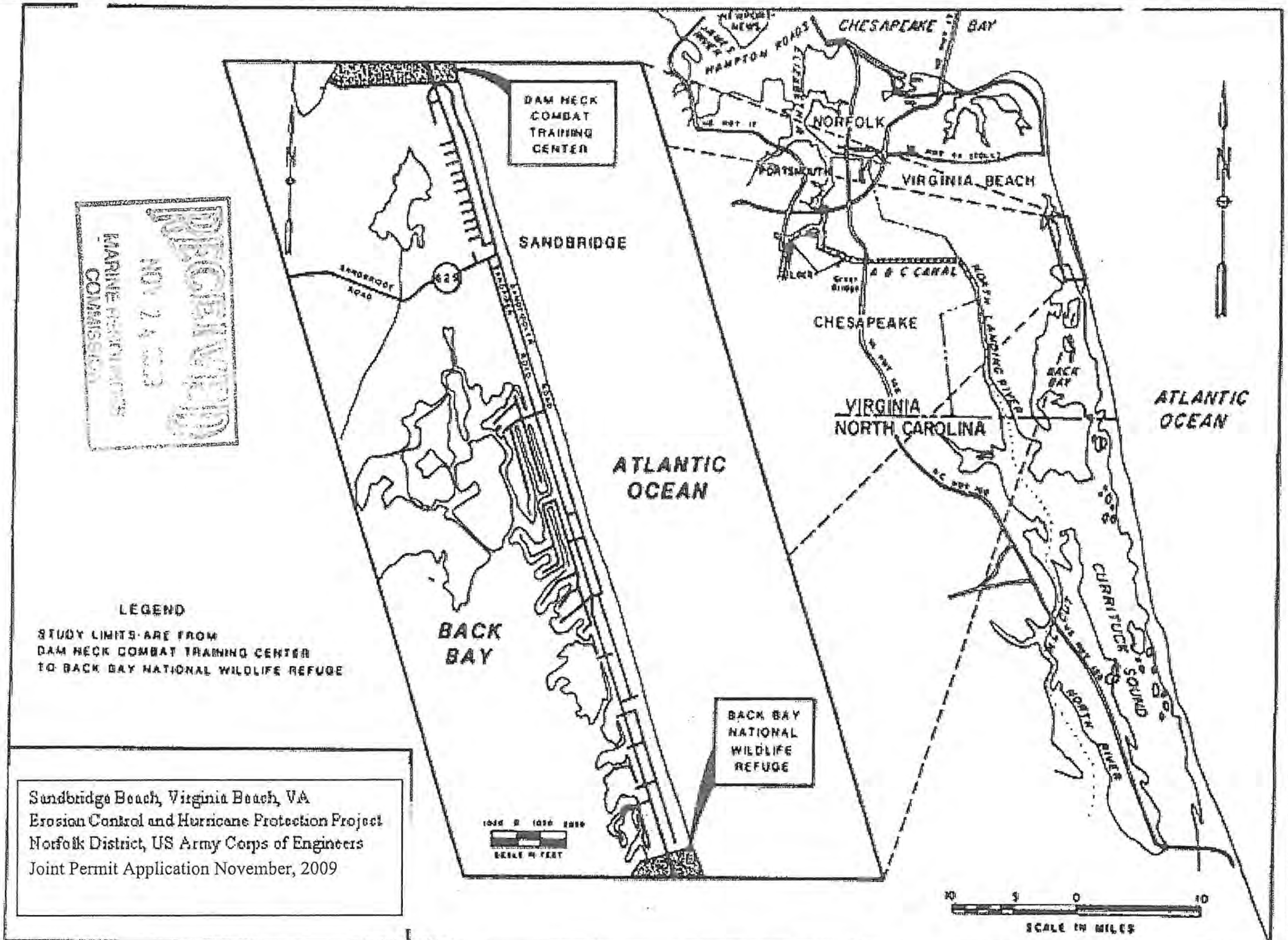
MOLLY O. SHACKELFORD
NOTARY PUBLIC
REG. #234864
MY COMMISSION EXPIRES 7/31/2011
COMMONWEALTH OF VIRGINIA

State of Virginia
City of Newport News, to wit:

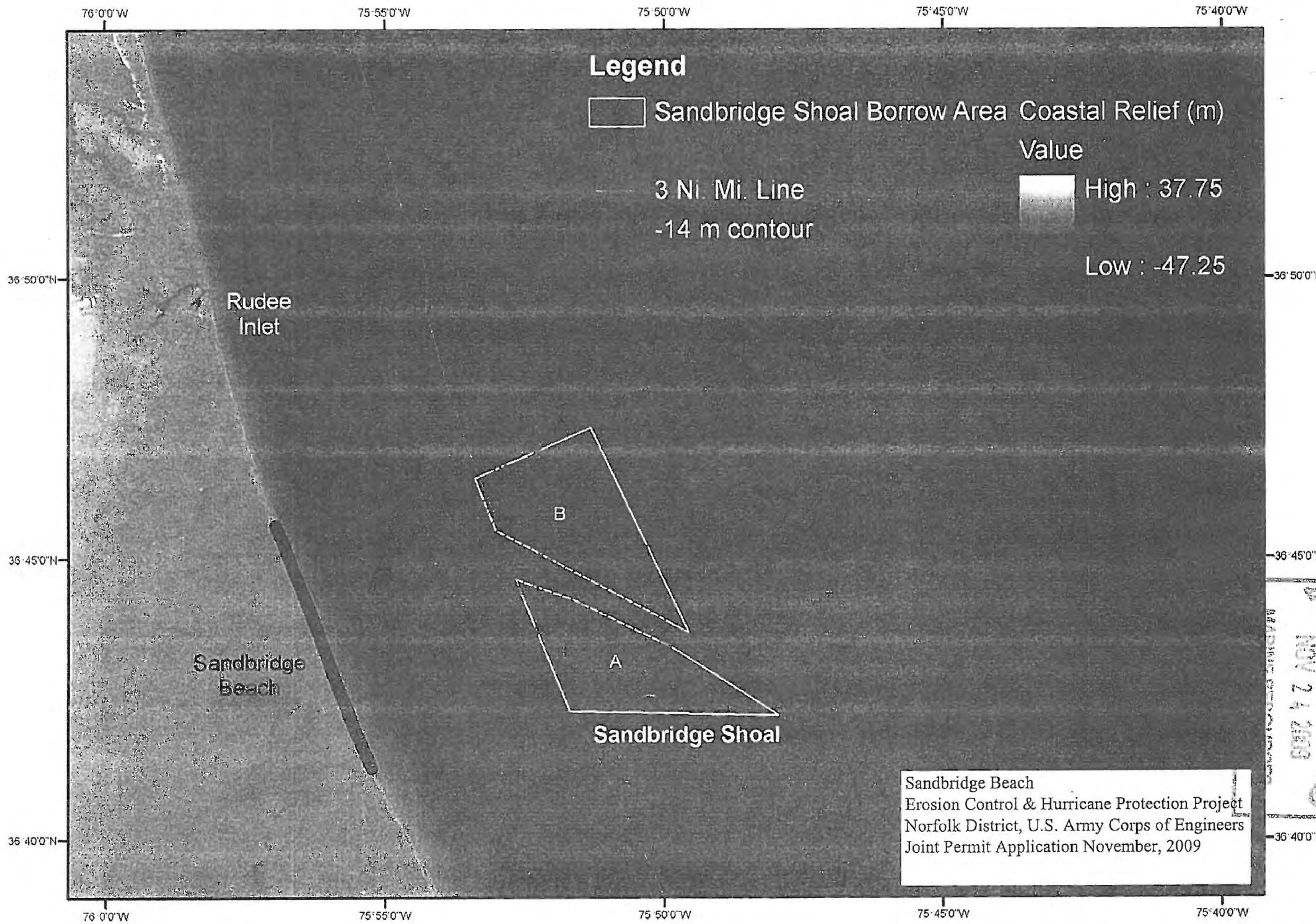
N I, MOLLY O. SHACKELFORD, a Notary Public within and for said City, State of Virginia, hereby certify that TONY WATKINSON, whose name is signed to the foregoing, bearing the 27th day of July 2010, has acknowledged the same before me in City aforesaid.
Given under my hand this 23rd day of AUGUST, 2010
My Commission Expires:

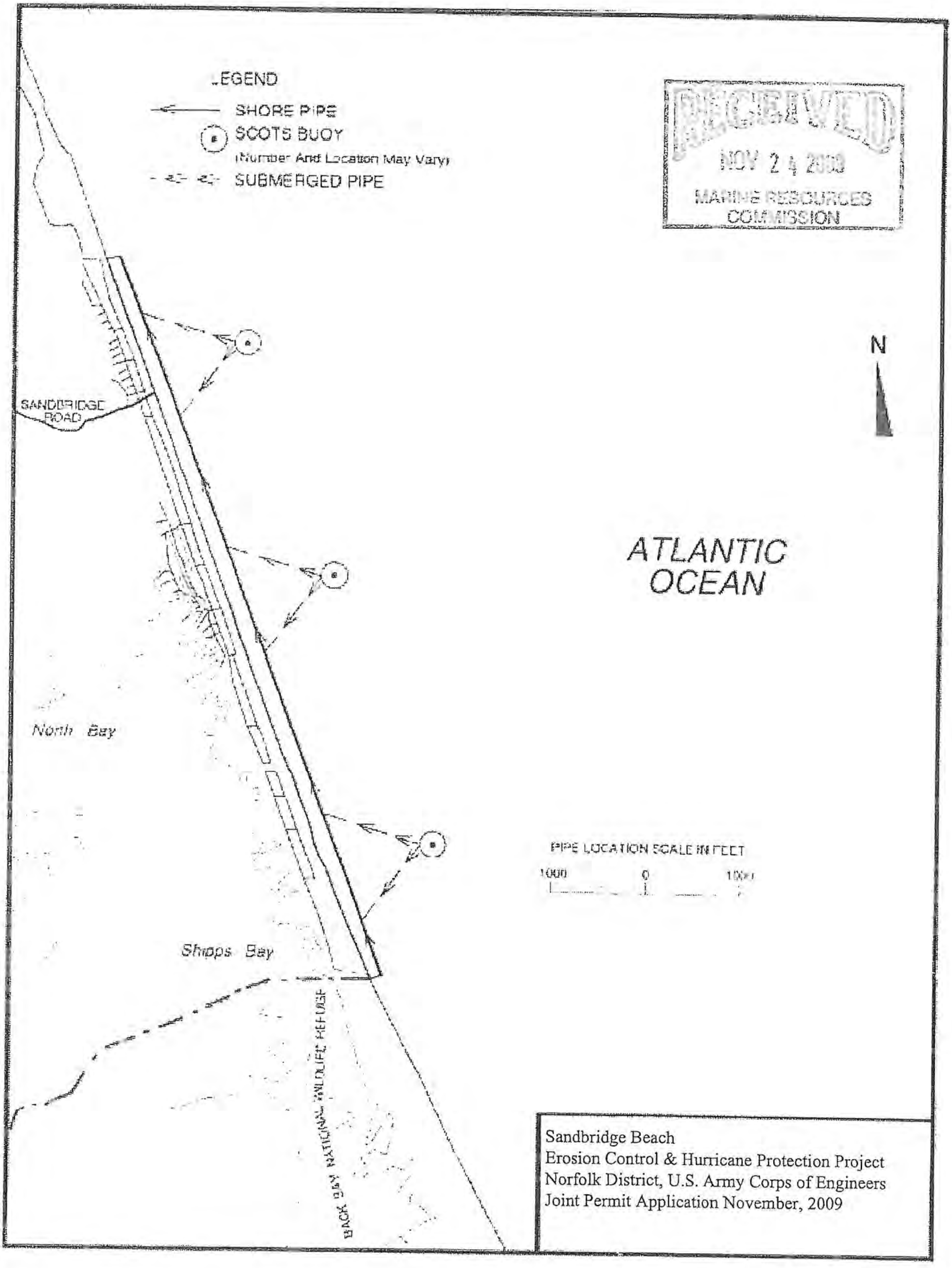
JULY 31, 2011

Notary Public Molly O. Shackelford



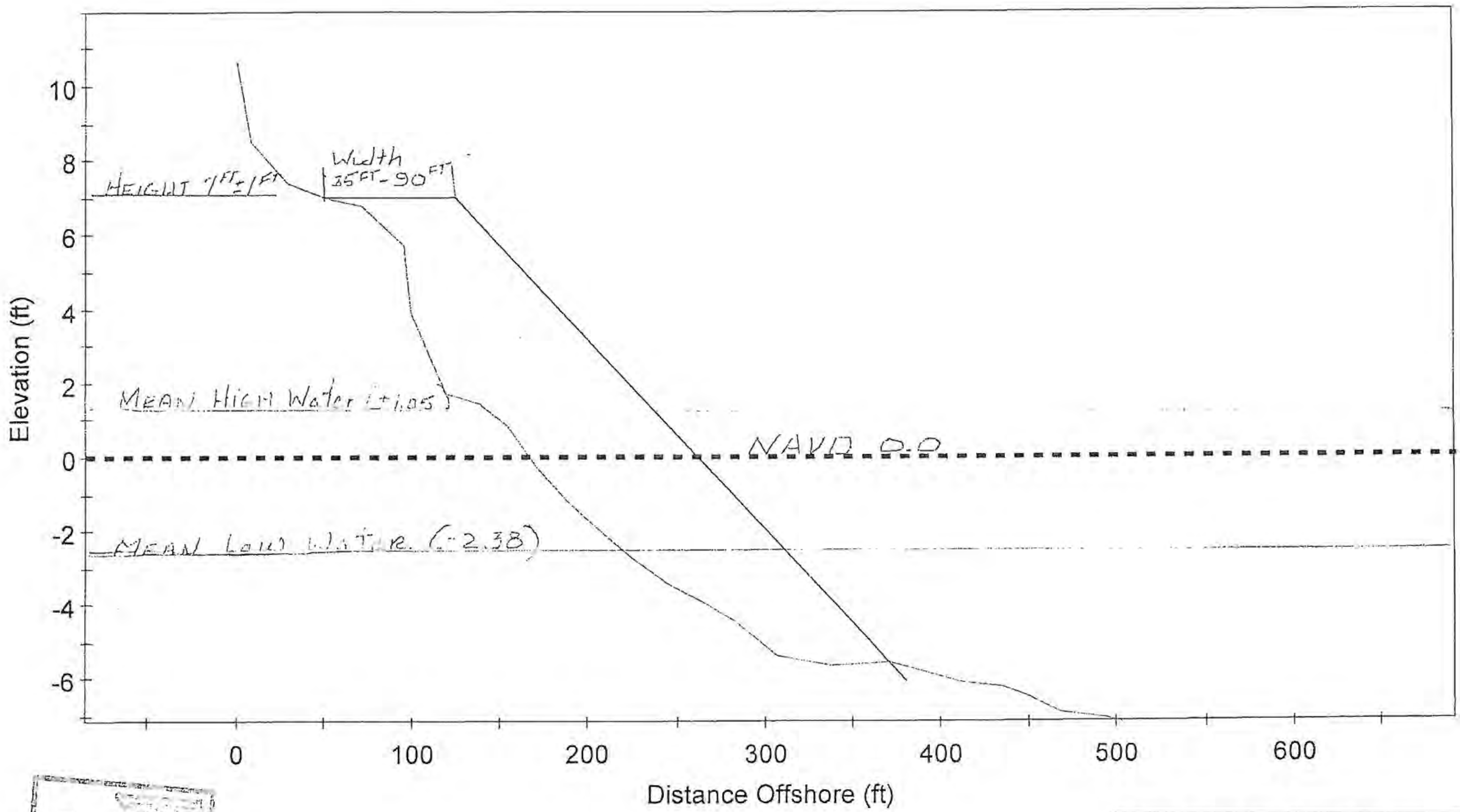
Sandbridge Beach, Virginia Beach, VA
Erosion Control and Hurricane Protection Project
Norfolk District, US Army Corps of Engineers
Joint Permit Application November, 2009


76°0'0"W
75°55'0"W
75°50'0"W
75°45'0"W
75°40'0"W
36°50'0"N
36°45'0"N
36°40'0"N
Legend
Sandbridge Shoal Borrow Area
3 Ni. Mi. Line
-14 m contour
Coastal Relief (m)
Value
High : 37.75
Low : -47.25
Rudee Inlet
Sandbridge Beach
B
A
Sandbridge Shoal
Sandbridge Beach
Erosion Control & Hurricane Protection Project
Norfolk District, U.S. Army Corps of Engineers
Joint Permit Application November, 2009



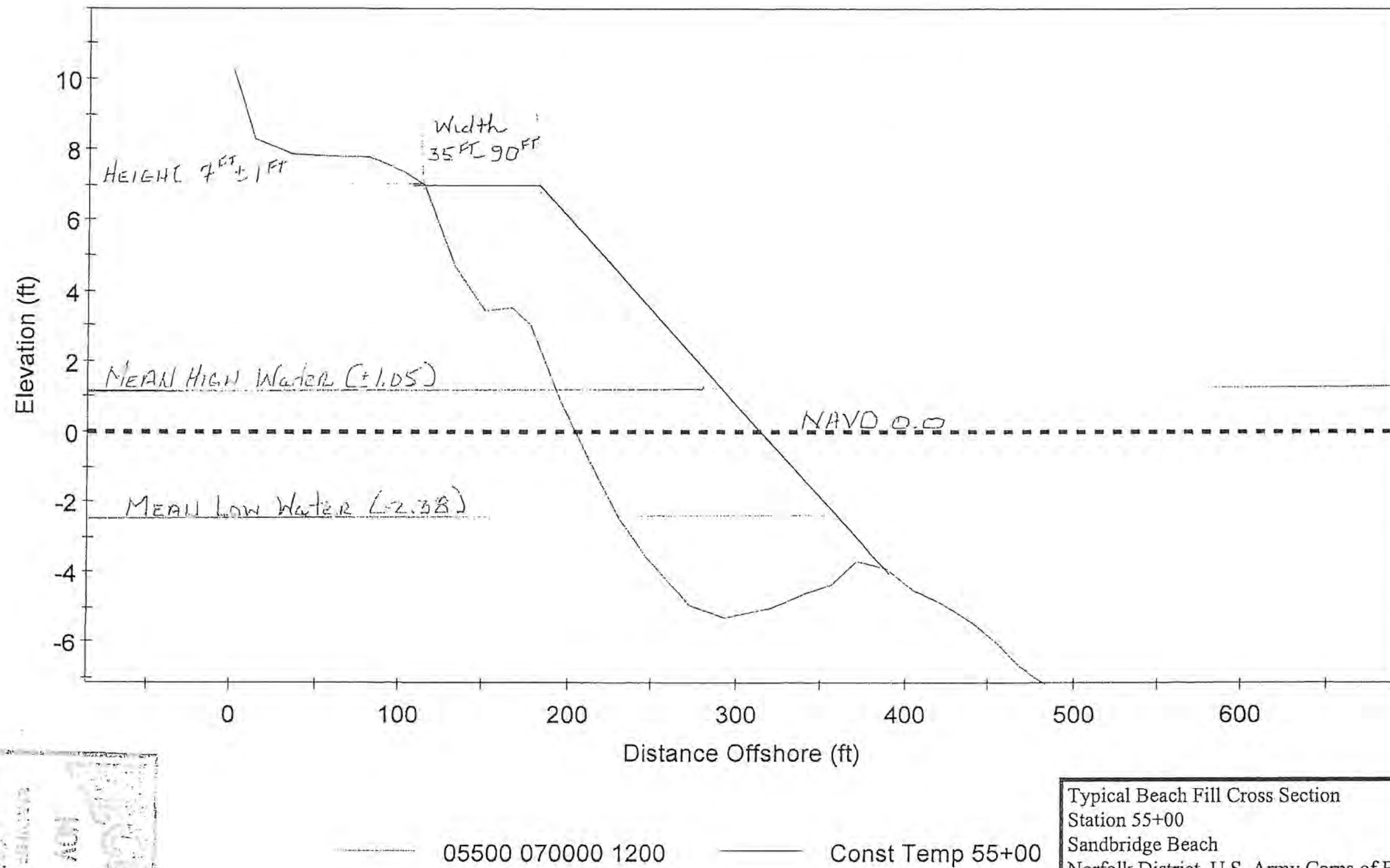
Sandbridge Beach
Erosion Control & Hurricane Protection Project
Norfolk District, U.S. Army Corps of Engineers
Joint Permit Application November, 2009

Sandbridge Sand Replenishment



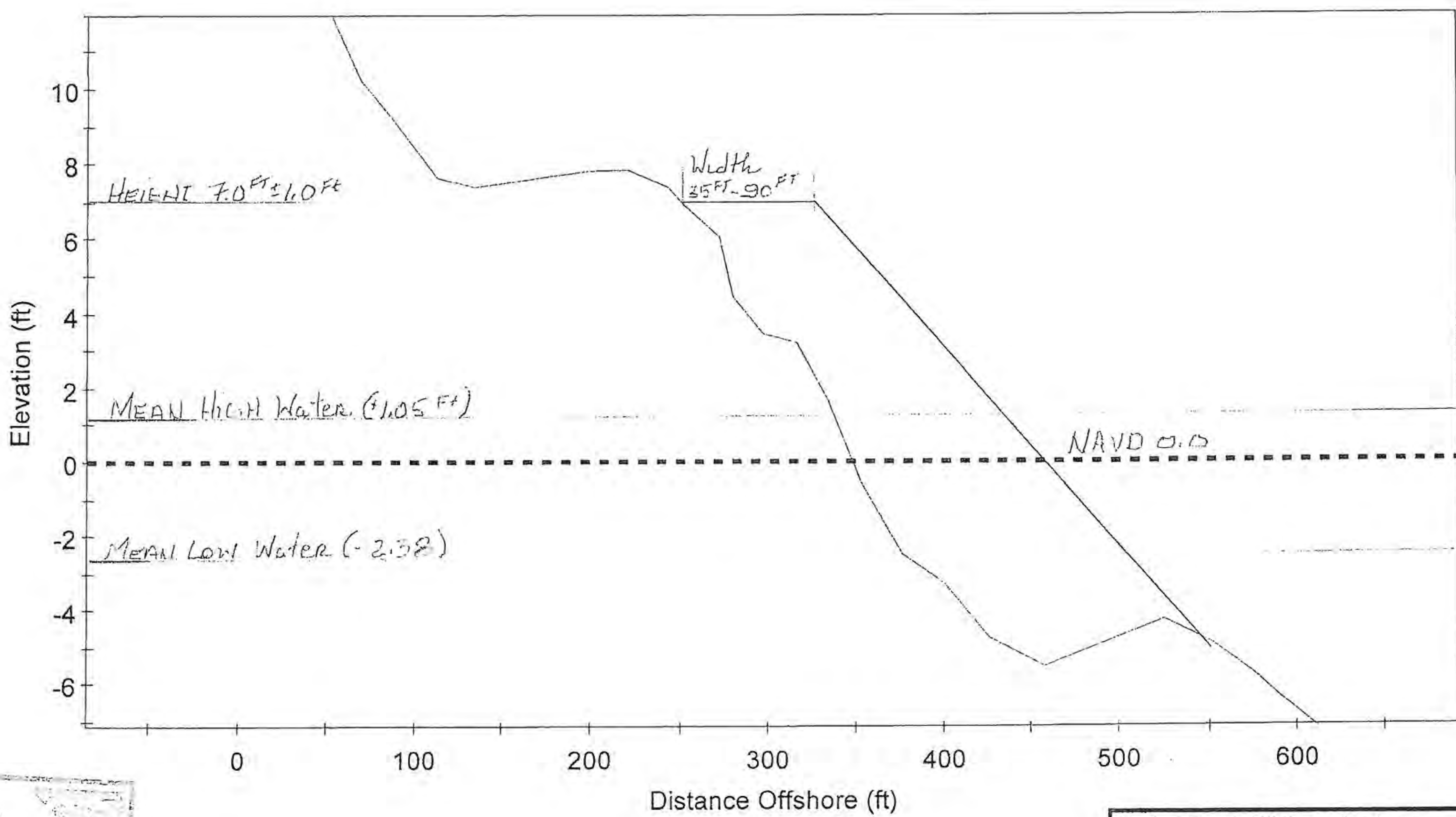
Typical Beach Fill Cross Section
Station 0+00
Sandbridge Beach
Norfolk District, U.S. Army Corps of Engineers
Joint Permit Application November, 2009

Sandbridge Sand Replenishment



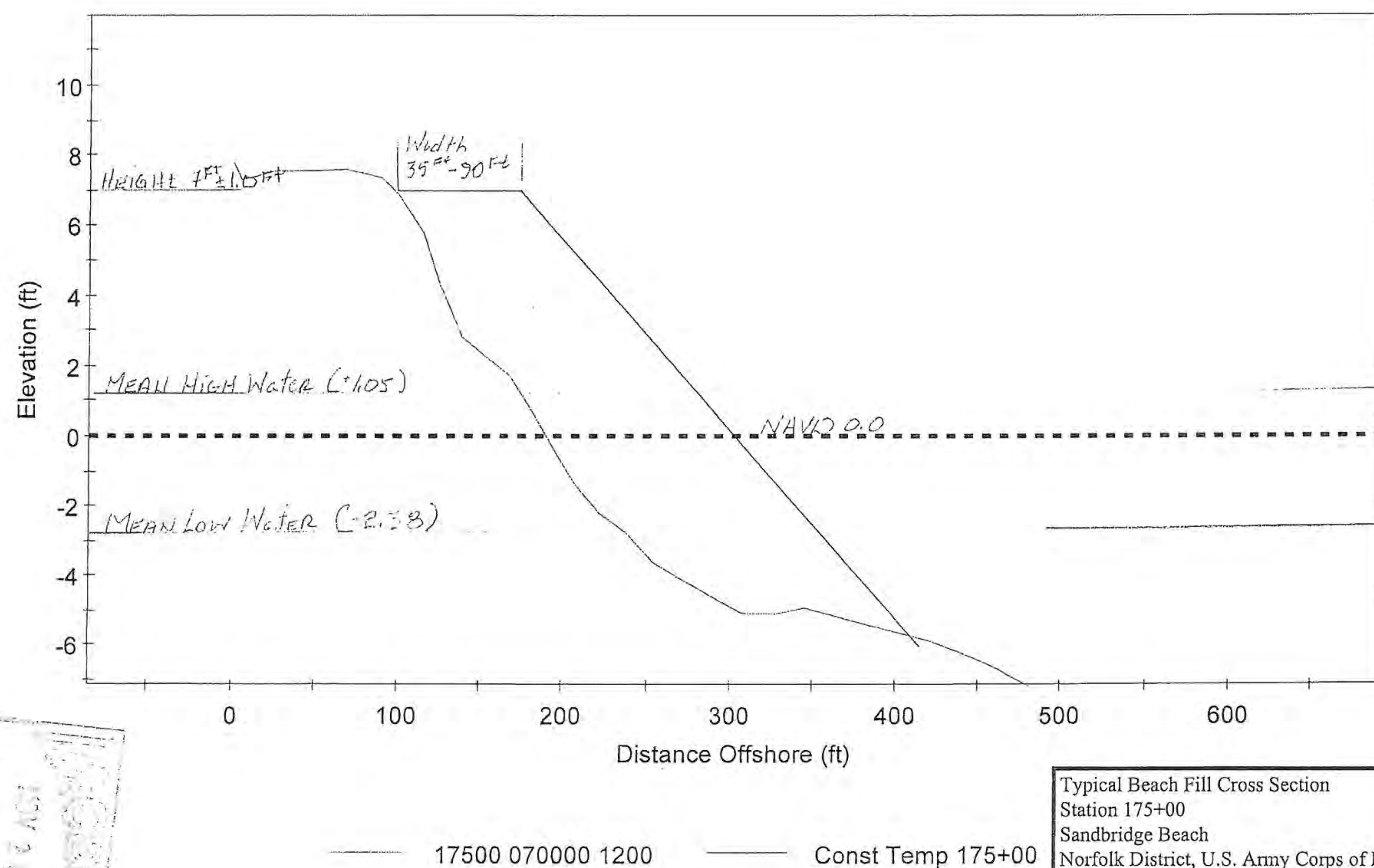
Typical Beach Fill Cross Section
Station 55+00
Sandbridge Beach
Norfolk District, U.S. Army Corps of Engineers
Joint Permit Application November, 2009

Sandbridge Sand Replenishment



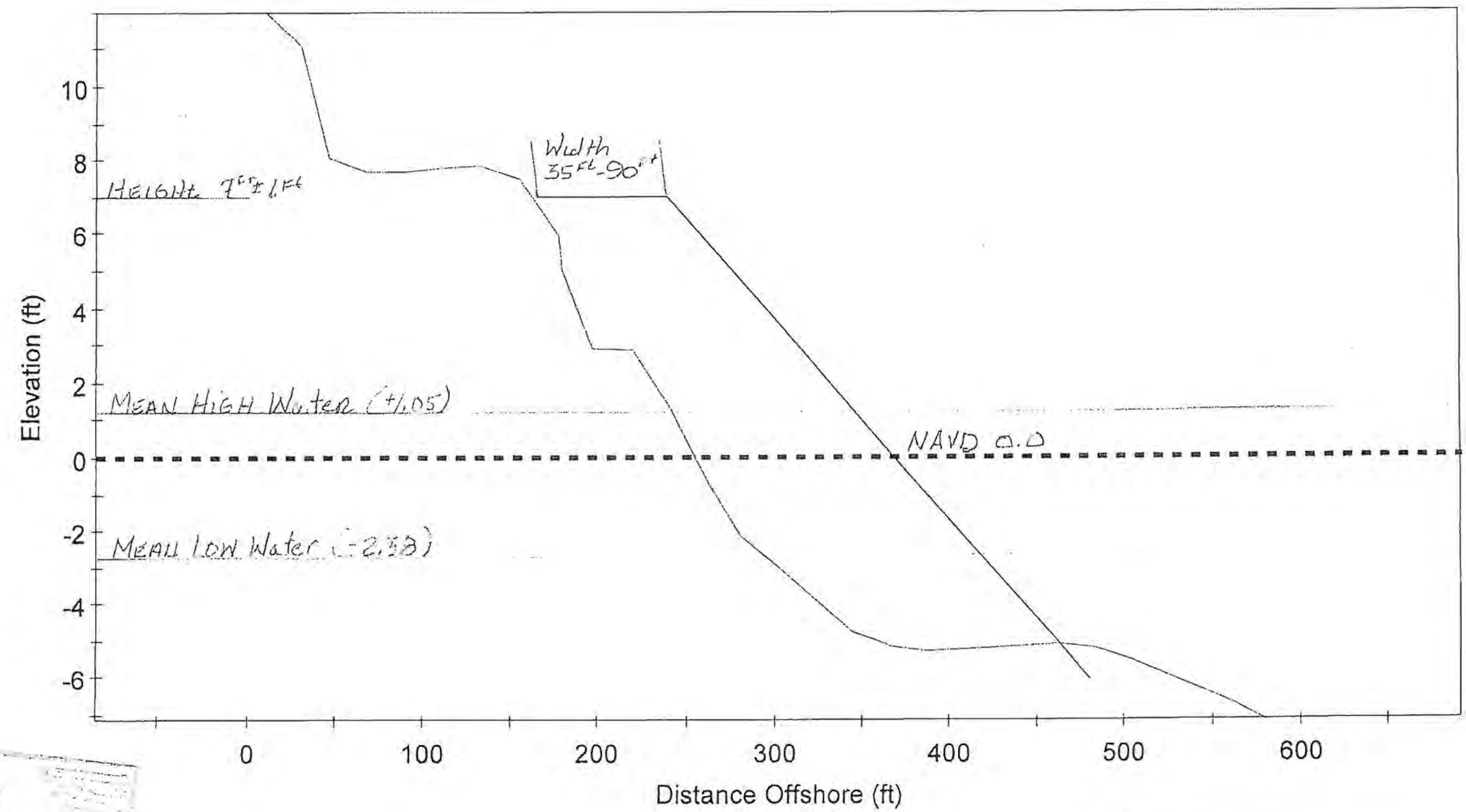
Typical Beach Fill Cross Section
Station 115+00
Sandbridge Beach
Norfolk District, U.S. Army Corps of Engineers
Joint Permit Application November, 2009

Sandbridge Sand Replenishment



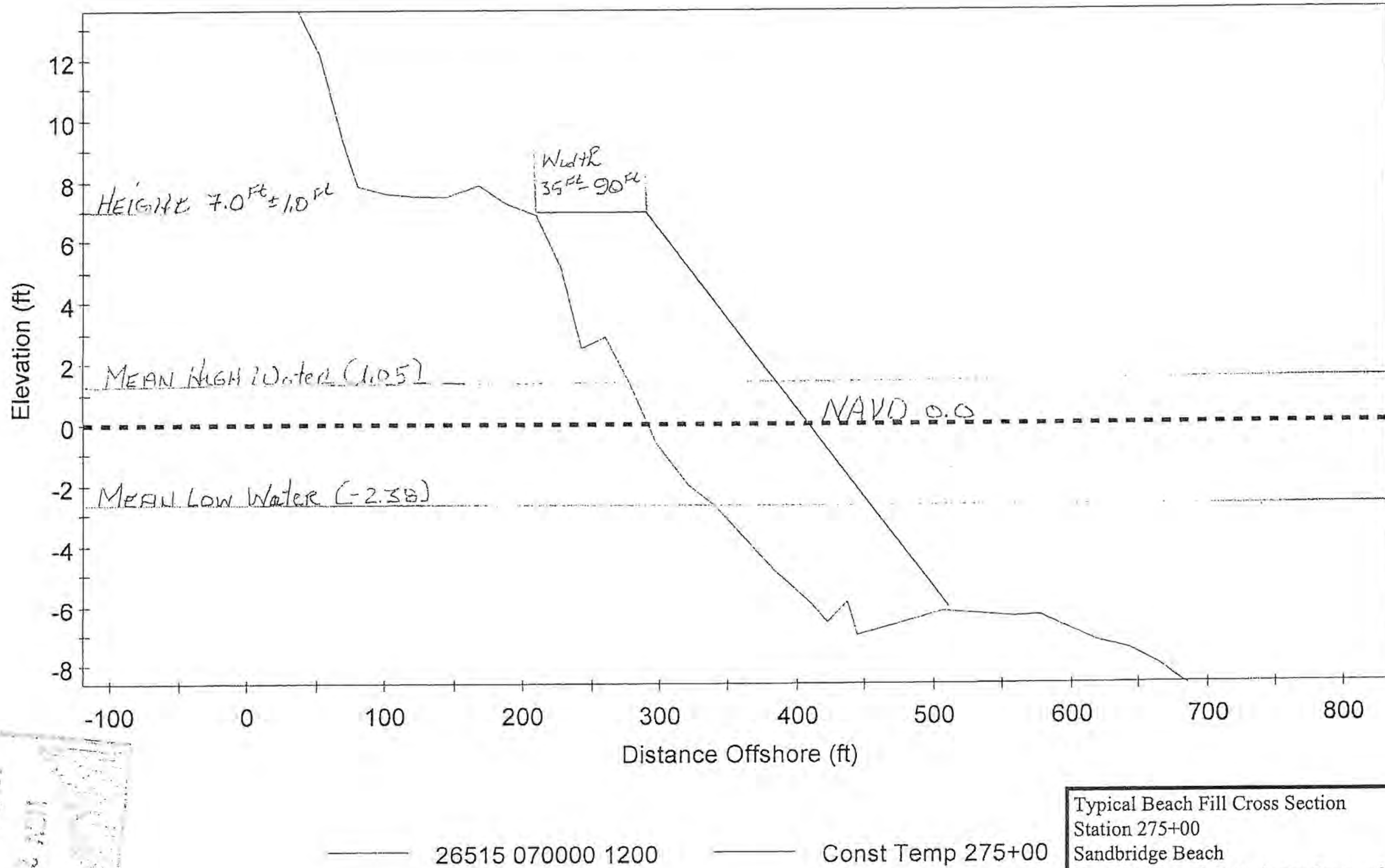
Typical Beach Fill Cross Section
Station 175+00
Sandbridge Beach
Norfolk District, U.S. Army Corps of Engineers
Joint Permit Application November, 2009

Sandbridge Sand Replenishment

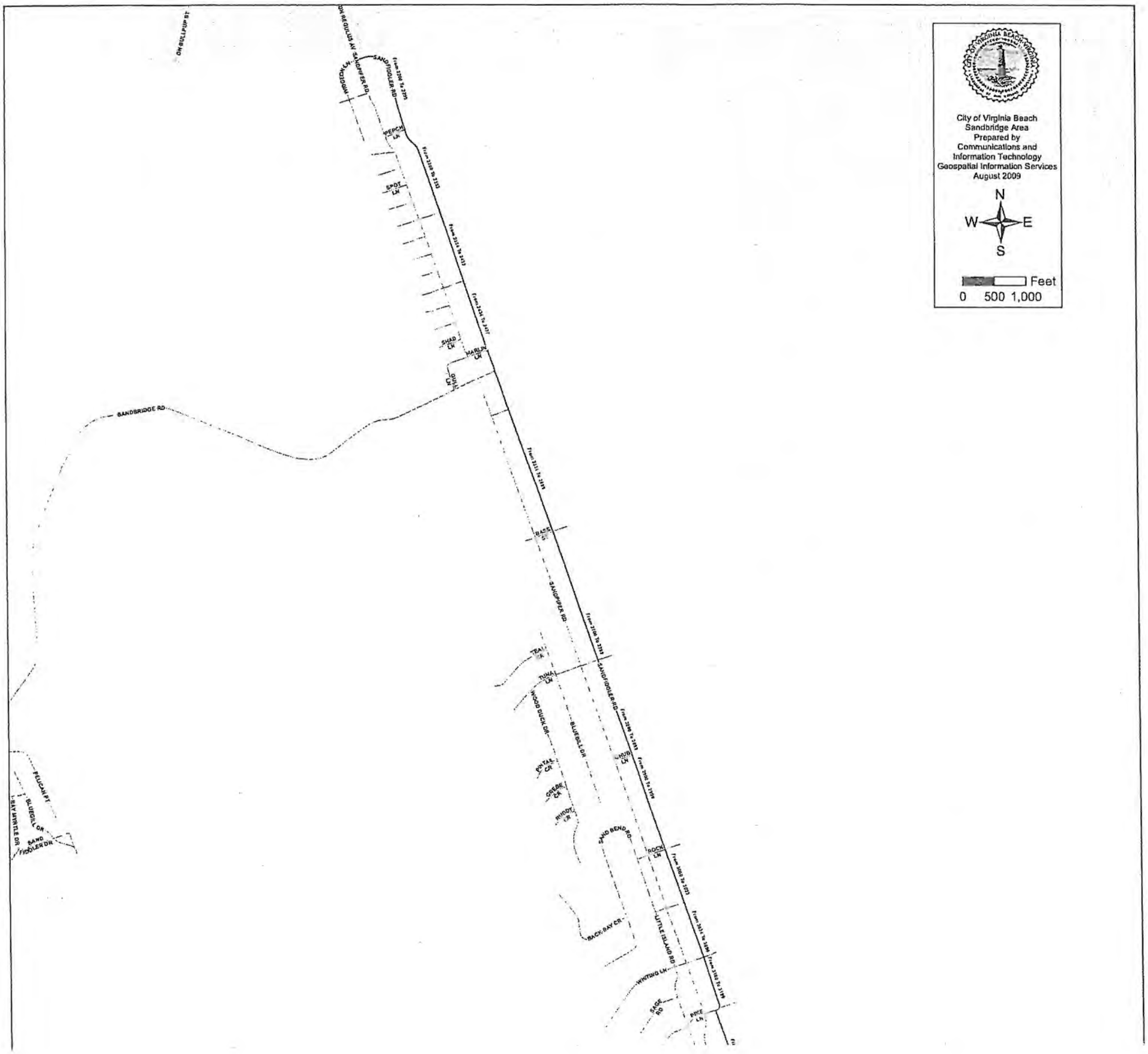


Typical Beach Fill Cross Section
Station 235+00
Sandbridge Beach
Norfolk District, U.S. Army Corps of Engineers
Joint Permit Application November, 2009

Sandbridge Sand Replenishment



Typical Beach Fill Cross Section
Station 275+00
Sandbridge Beach
Norfolk District, U.S. Army Corps of Engineers
Joint Permit Application November, 2009


City of Virginia Beach
Sandbridge Area
Prepared by
Communications and
Information Technology
Geospatial Information Services
August 2009
N
W
E
S
Feet
0 500 1,000
SANDBRIDGE RD
SANDPIPER RD
SANDFIDDLER RD
LITTLE ISLAND RD
BACK BAY CR
SAND BEND RD
WOOD DUCK DR
BLUEGILL DR
PELICAN PT
WHITING LN

09-1686

Permit # ________

Commonwealth of Virginia
Marine Resources Commission
Authorization

A Permit has been issued to:

City of Virginia Beach, et al
Philip J. Roehrs
2405 Courthouse Drive
Virginia Beach Municipal Center
Building 2, Room 340
Virginia Beach, VA 23456

The Permittee is hereby authorized to:

Place approximately 2 million cubic yards of beach-quality sand along the 5 mile stretch of Sandbridge Beach, situated along the Atlantic Ocean in Virginia Beach. Beach nourishment will include sand hydraulically pumped from the Sandbridge Shoals borrow area, located approximately 3 nautical miles offshore, to the beach area between the Navy's Dam Neck Fleet Training Center to the north and the Back Bay National Wildlife Refuge to the south.

Issuance Date: July 27, 2010 Expiration Date: July 31, 2015

Tony Watkinson

Commissioner or Designee

This Notice Must Be Conspicuously Displayed At Site Of Work

SANDBRIDGE BEACH 2009 HURRICANE PROTECTION SAND REPLENISHMENT PROJECT

PERMIT APPLICATION

SURVEY NOTES

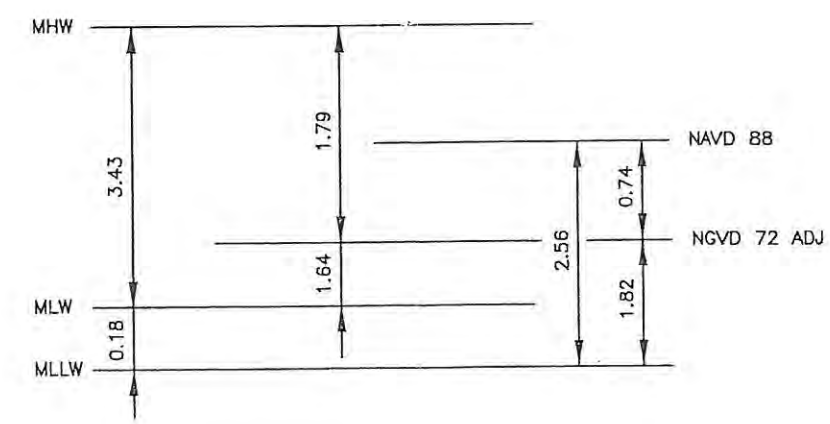
TOPOGRAPHIC INFORMATION SHOWN REFLECTS THE CONDITIONS EXISTING AT THE TIME OF THE SURVEY. TOPOGRAPHY AND CONDITIONS HAVE CHANGED CONSIDERABLY SINCE THE SURVEY WAS CONDUCTED.

PLANIMETRIC AND TOPOGRAPHIC MAPPING NOTES:

INFORMATION COMPILED (JUN–AUG 1995) BY WILLIAM C. OVERMAN ASSOCIATES, P.C., VIRGINIA BEACH, VIRGINIA.

SURVEY DATUM

1. COORDINATES ARE IN U.S. SURVEY FOOT REFERRED TO THE VIRGINIA STATE GRID (SOUTH ZONE) AND ARE BASED ON NAD 83 HORIZONTAL DATUM.
2. ELEVATIONS ARE IN FEET REFERRED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
3. APPROXIMATELY 4,172,250 SQUARE FEET DUNE/BEACH WILL BE IMPACTED ≈ 96 ACRES.
4. ASSUMING 2 MILLION CUBIC YARD PLACEMENT ≈ 800.000 CUBIC YARDS SHALL BE PLACED BELOW MEAN HIGH WATER.



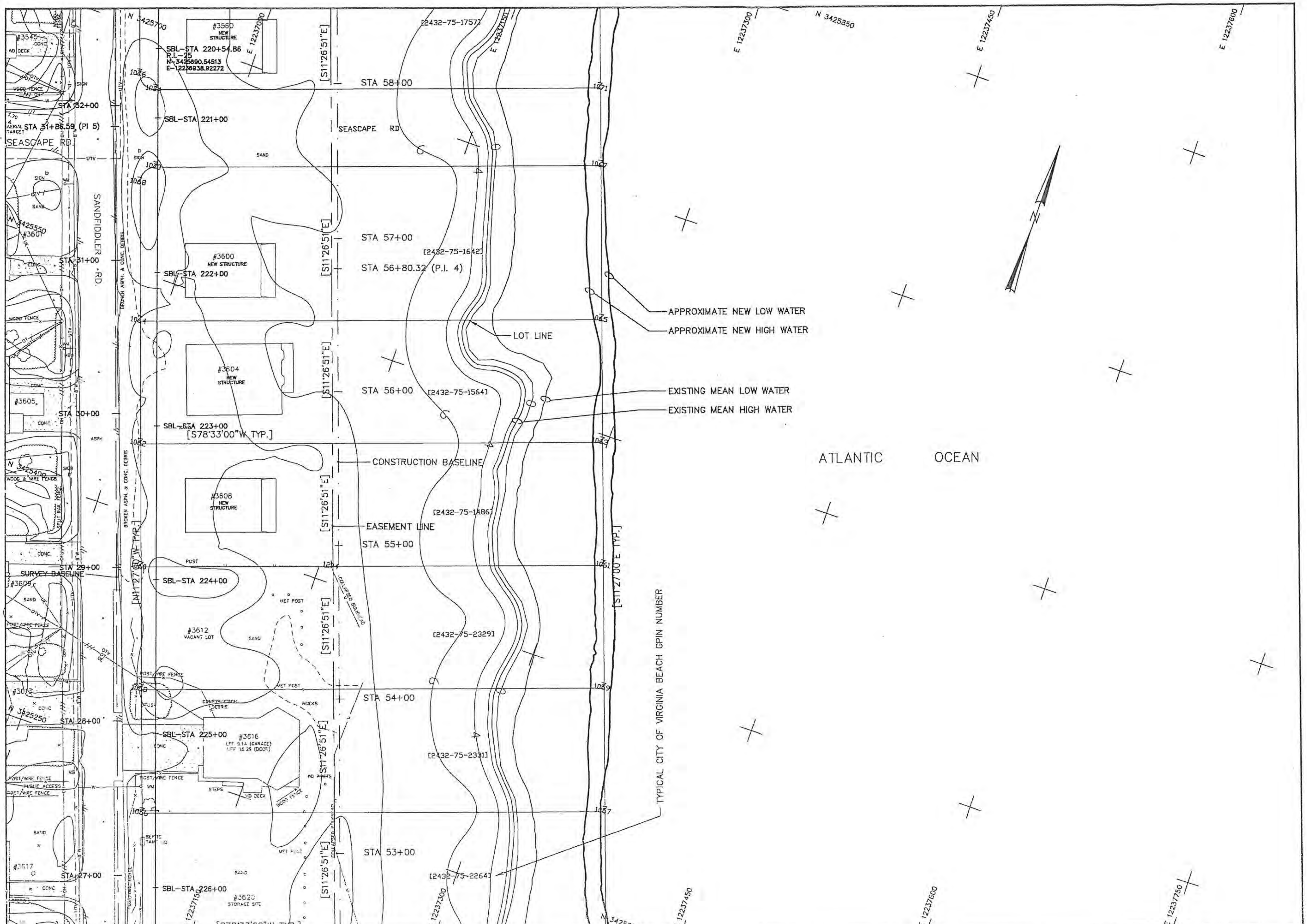
SANDBRIDGE TIDAL DATUM
NOT TO SCALE

NOTE: NOS MEAN LOWER LOW WATER (MLLW) IS BASED ON THE NATIONAL TIDAL DATUM EPOCH (NTDE) OF 1960 – 1978.

SANDBRIDGE BEACH
HURRICANE PROTECTION
SAND REPLENISHMENT PROJECT
PERMIT APPLICATION
PLAN VIEWS
Sht. 1 of 7

1" = 30'

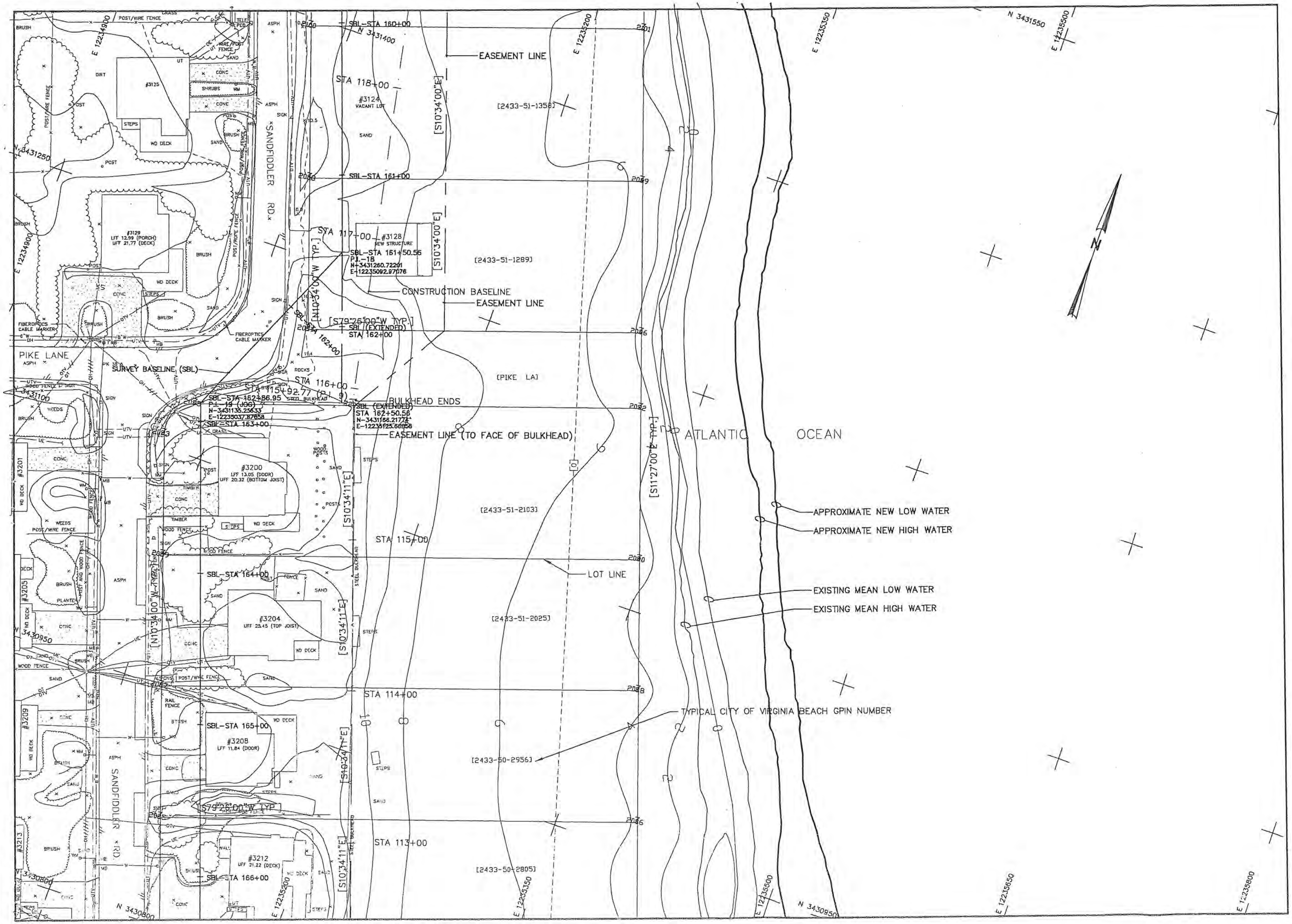
SANDBRIDGE BEACH
HURRICANE PROTECTION
SAND REPLENISHMENT PROJECT
PERMIT APPLICATION
PLAN VIEWS
Sht. 2 of 7



RECEIVED
NOV 24 2003
MARINE RESOURCES COMMISSION

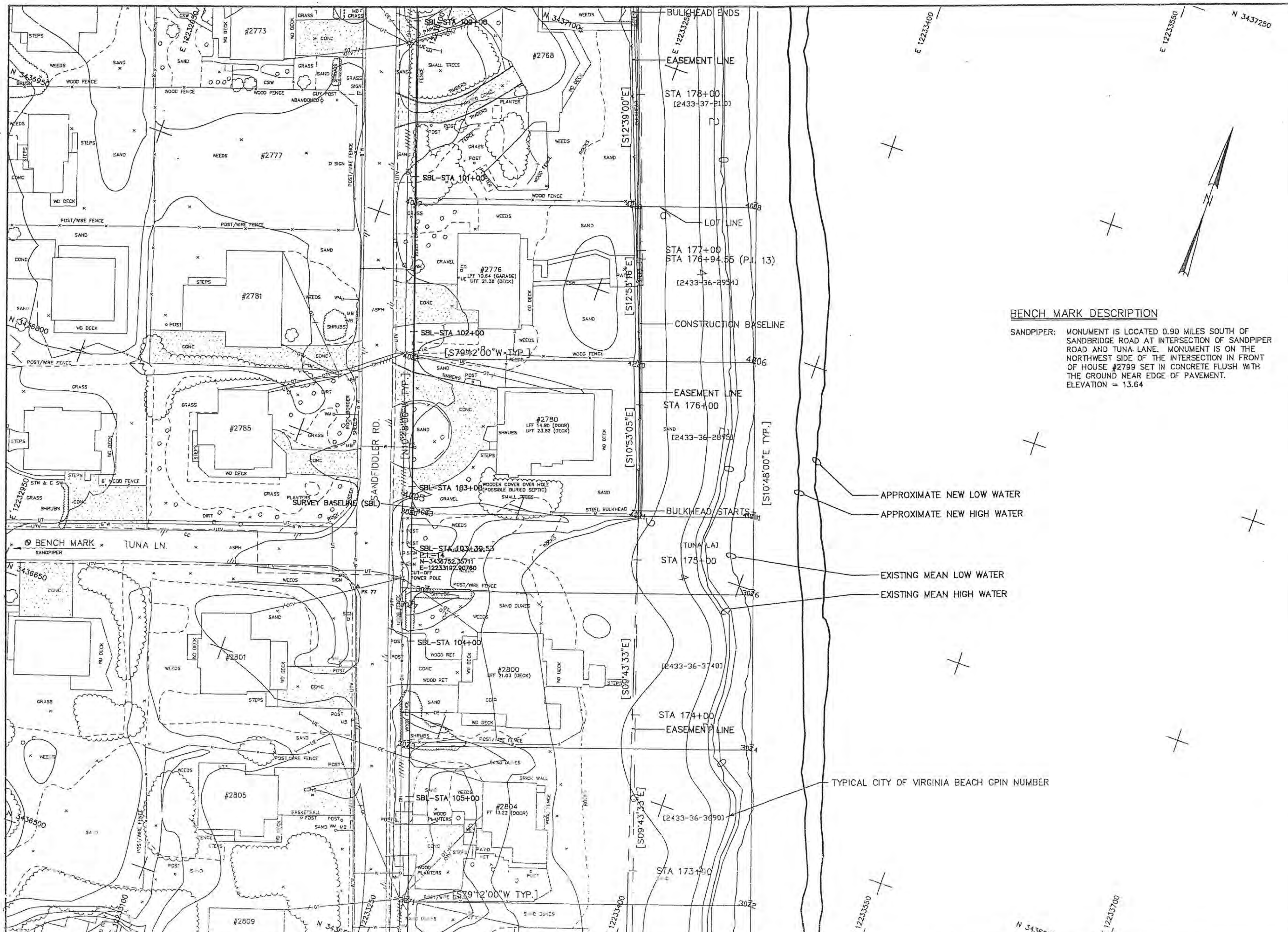
1" = 30'

SANDBRIDGE BEACH
HURRICANE PROTECTION
SAND REPLENISHMENT PROJECT
PERMIT APPLICATION
PLAN VIEWS
Sht. 3 of 7



1" = 30'

SANDBRIDGE BEACH
HURRICANE PROTECTION
SAND REPLENISHMENT PROJECT
PERMIT APPLICATION
PLAN VIEWS
Sht. 4 of 7



BENCH MARK DESCRIPTION

SANDPIPER: MONUMENT IS LOCATED 0.90 MILES SOUTH OF SANDBRIDGE ROAD AT INTERSECTION OF SANDPIPER ROAD AND TUNA LANE. MONUMENT IS ON THE NORTHWEST SIDE OF THE INTERSECTION IN FRONT OF HOUSE #2799 SET IN CONCRETE FLUSH WITH THE GROUND NEAR EDGE OF PAVEMENT. ELEVATION = 13.64

1" = 30'

SANDBRIDGE BEACH
HURRICANE PROTECTION
SAND REPLENISHMENT PROJECT
PERMIT APPLICATION
PLAN VIEWS
Sht. 5 of 7

1" = 30'

SANDBRIDGE BEACH
HURRICANE PROTECTION
SAND REPLENISHMENT PROJECT
PERMIT APPLICATION
PLAN VIEWS
Sht. 7 of 7

From: Armstrong, Jennifer R. NAO <Jennifer.R.Armstrong@usace.army.mil>
Sent: Thursday, June 14, 2012 2:28 PM
To: Culbertson, Jennifer; Wikel, Geoffrey L; Richardson, Trent M; Finnegan, Colleen R.
Cc: Conner, Susan L. NAO; Underwood, Martin K. NAO; Hudgins, Mark H NAO; Rommel B. Tamayo
Subject: USACE Discussions with Navy about use of Sandbridge Shoal (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Good afternoon,

In follow up to our earlier teleconference, USACE met with the Navy yesterday to discuss upcoming scheduled dredge work and use of the Sandbridge Shoal. The Navy indicated that although they intend to award this year, they will not be in the area during the same time as us because they will not have the NEPA coordination/environmental compliance completed in time. In addition, we discussed consideration for the use of a cutterhead dredge. If anything changes to this outlook, they said they will give us a heads up. We will also be having quarterly follow-up meetings to monitor the situation.

Thanks again for the call today and working so closely with us to streamline the process. We look forward to our follow-up discussion in a couple of week, meeting invitation is forthcoming. If you need any additional information or have any questions or concerns until then, please do not hesitate to contact me.

Have a great afternoon,

Jen Armstrong
Project Manager
Norfolk District, U.S. Army Corps of Engineers
Office: 757-201-7704

-----Original Message-----
From: Person, Renee M CTR FACSFAC VACAPES
[mailto:leslie.person.ctr@navy.mil] On Behalf Of FFAECC
Sent: Wednesday, August 22, 2012 8:09 AM
To: Reid, Andrew J NAO
Subject: RE: Sandbridge Beach Nourishment Project: Navy Firing Range
(204.52) (UNCLASSIFIED)

Please let us know how we can assist.

V/r
Renee Person
Airspace Coordinator
Fleet Forces Atlantic Exercise Coordination Center Wyle Laboratories, Inc.
Office: 757-425-XXXX, DSN: 433-1299,
FAX: 757-425-XXXX, Cell: 757-292-XXXX

-----Original Message-----
From: Reid, Andrew J NAO [mailto:Andrew.J.Reid@usace.army.mil]
Sent: Tuesday, August 21, 2012 11:27 AM
To: FFAECC
Cc: Martin, Doug NAO; Hudgins, Mark H NAO; Armstrong, Jennifer R. NAO;
Anderson, Michael L NAO; Lockwood, Keith B NAO
Subject: Sandbridge Beach Nourishment Project: Navy Firing Range (204.52)
(UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Renee Person,
This is to confirm our conversation regarding the Corps of Engineers upcoming beach nourishment project at Sandbridge Beach. The dredging and sand placement work is scheduled to begin on or about December 1, 2012 and must be completed NLT May 8, 2013. The dredge(s) will be borrowing material from the Sandbridge borrow site which is located within firing area 204.52. The contract for this work should be awarded NLT November 1, 2012. On orabout November 15, 2012, we will convene a pre-construction meeting with the contractor and invite you or your colleagues. As on previous Sandbridge projects, our contract requires that our contractor coordinate their water borne activity with FFAECC. We wish to keep you in the loop during the duration of this project. Should you have any questions on the above please call me at 757-201-XXXX. Thanks and I look forward to meeting you.

Andy

Appendix D

Agency Comments & Recommendations to the Draft EA
USACE & MMS Response

Appendix D -Sandbridge Beach - Agency Comments & Recommendations to the Draft EA - USACE & MMS

Agency	Recommendations/Comments	Response
Virginia Marine Resources Commission *Justin Worrell*	• As we have permitted a similar project in the past, proposed beach nourishment efforts along the Sandbridge Beach shoreline in Virginia Beach will require the submittal of a JPA and a permit from the Virginia Marine Resources Commission. • The Fisheries Management Division of the VMRC states that there would be no significant impact to blue crabs as long as there is no sediment placement in the offshore waters. Run off from the beach should not have an impact on the blue crab.	Receipt of all necessary permits will be acquired before the project begins. Noted– no additional response
Virginia Department of Historic Resources *Ronald Grayson*	• With the understanding that anomalies and an identified pale0-channel will be avoided, and our previous determination stated in letter dated July 17, 2008, it is our opinion that no historic properties will be adversely affected by this action. In the event that previously unrecorded historic properties are discovered during project activities, stop work in the area and contact DHR immediately.	Noted– no additional response
Virginia Department of Conservation & Recreation Division of Natural Heritage *Robert S. Munson*	• Follow the FWS and NMFS guidelines for beach nourishment found in the draft EA, Appendix A. • Contact DCR-DNH (telephone, (804) 786-7951) if a significant amount of time passes before the project is implemented, since new and updated information is continually added to Biotics.	Noted– no additional response Noted– no additional response

Virginia Department of Conservation & Recreation Division Chesapeake Bay Local Assistance	• The proposed activity lies outside of the City of Virginia Beach's designated Chesapeake Bay Preservation Areas, as Sandbridge Beach is located along the shoreline of the Atlantic Ocean and therefore outside of the Chesapeake Bay watershed. As such, there are no requirements under the Chesapeake Bay Preservation Act.	Noted– no additional response
Virginia Department of Environmental Quality	• A VWP permit (water quality certification) must be obtained from DEQ prior to project implementation. • According to the DEQ Air Quality Division, the project area is located in an Ozone (O_3) maintenance area and emission control area for the volatile organic compounds (VOCs) and oxides of Nitrogen (NO_x), which are contributors to ozone pollution. Therefore, the applicant should take all reasonable precautions to limit emissions of VOCs and NO_x principally by controlling or limiting the burning of fossils fuels. • During project activities, fugitive dust must be kept to a minimum by using control methods as outlined in 9 VAC 5-50-60 *et seq*. of the Regulations for the Control and Abatement of Air Pollution. The	In accordance with the CZMA and the approved Coastal Zone Management Program of Virginia, the proposed project has been evaluated for consistency with the coastal development policies. A permit will be applied for and a consistency determination will be submitted VMRC and VDEQ. Receipt of all necessary permits including a VWP permit, will be acquired before the project begins. The proposed action would result in small, localized, temporary increases in concentrations of nitrogen dioxide (NO2), SO2, CO, VOC, and PM. The total increases are relatively minor in context of the existing nonpoint and mobile source emissions in the Virginia Beach region. Based on the analysis in the EA, projected emissions from the project would not adversely impact air quality given the relatively low level of emissions and the prevailing offshore winds. With the proposed action, the criteria pollutant levels would be well within the national ambient air quality standards. Fugitive dust is indirectly related to the offshore dredging and transport, during which sediment is wet and fugitive dust will generally not be a problem. Fugitive dust may be a concern related to

	precautions include covering open equipment when conveying materials. • An Air permit may be required for any fuel-burning equipment.	placement and construction activities therefore, fugitive dust from construction would be kept to a minimum by using control methods in accordance with the Regulations for the Control & Abatement of Air Pollution (9 VAC 5-50-60 et seq). No adverse impacts to air quality are anticipated. It has not been determined that an Air permit is required for this project.
Department of Game & Inland Fisheries *Amy Ewing*	• Address possible impacts upon the West Indian Manatee in the final EA. • Coordinate with the NMFS regarding the protection of loggerhead sea turtles, other sea turtles, and sea mammals know from the project area.	The West Indian manatee is Federally listed, but is not included in the list as a species that occurs in Virginia. Manatees are typically found in the temperate and equatorial waters of the southeastern U.S. and the Caribbean; Virginia is the extreme northern range for this species. It is highly unlikely that a manatee would occur in the project area. Therefore, no additional consultation would be necessary unless FWS obtains new information indicating their presence in or near the project area. The Corps and MMS have completed coordination with NMFS regarding threatened and endangered species. NMFS responded by letter that the current ITS and BO remain valid for the upcoming dredging and beach nourishment operations provided Norfolk District adheres to all reasonable and prudent measures and terms and conditions as outlined in the ITS and BO. The NMFS concluded that the proposed project was likely to adversely affect sea turtles, but not likely to jeopardize the continued existence of the species.

Department of Game & Inland Fisheries Cont..	• Adhere to the requirements outlined in the incidental take statement and biological opinion previously issued by NMFS for this project. • Coordinate with the FWS regarding possible impacts upon Federally listed species and for information about whether this project will result in adverse impacts upon Back Bay National Wildlife refuge. • Match all fill materials in color, grain size, and composition to native materials as closely as possible. • Adhere to the requirements for sea turtle protection (such as time of year restrictions, matching of beach fill materials to native materials, hopper dredge retrofitting, use of observers, routine monitoring, etc.) outlined in the incidental take statement and biological opinion.	Noted – no additional response The Corps and MMS have completed coordination with FWS regarding threatened and endangered species. The FWS stated if the mentioned protective measures are followed, the proposed action is not likely to adversely affect Federally listed or proposed species or their critical habitat. Mean grain size at the placement site ranges between 0.23 mm on the berm and 0.26 mm on the foreshore. The mean grain size at Sandbridge Shoal is 0.25 mm. The dredged material closely matches the existing beach material (in color, grain size, etc), thus sea turtles should not be affected by the type of material used for beach placement. There is no time of year restriction for this project. The Norfolk District will adhere to all reasonable and prudent measures and terms and conditions as outlined in the ITS and BO.
National Marine Fisheries Service Habitat Conservation Division *David O'Brien*	•What is the size (in acreage) of Borrow Area A and Borrow Area B? • Essential Fish Habitat Recommendations. The NMFS supports incorporation of best management practices into the project and the following mitigative measures: Use of a predredge vibracore surveys to identify shoal areas of beach quality sand; Following the existing bottom contours to the maximum extent	Area B is approximately 3,519 acres and Area A is approximately 2,325 acres. The Corps and MMS will follow the conservation recommendations. The currently planned project is expected to impact a relatively small fraction of the site, approximately 150-300 acres. The impact can be minimized temporally by rotating borrow areas and disallowing repeated dredging in the same

National Marine Fisheries Service Habitat Conservation Division Cont..	practicable to maintain seafloor ridge and swale heterogeneity; Use of rotational dredging to the maximum extent practicable to preclude the mining of the same sand ridge during sequential dredging projects and to minimize the footprint and time over which the dredge operates; conduct pre and post dredging bathymetric surveys across those portions of the borrow area where dredging will occur. • Coordinate with NOAA fisheries Service to develop a long term strategy and management plan that identifies rotation dredging criteria and an advance schedule for the mining of sand from specific shoals.	locale. Areas of the shoal where sediment grain-size is incompatible with nourishment grain size requirements, as well as other no-dredge areas such as the Navy submarine cable zone, will also remain intact and undisturbed, serving as feeder zone for benthic recolonization. Additionally, since borrow areas are not typically dredged perfectly flat relative to the adjacent seafloor, a portion of the dredge areas will remain morphologically intact. Given the potential for cumulative effects associated with past and future beach nourishment projects, the Corps and MMS have discussed developing a borrow area management plan for Sandbridge Shoal. Provided that the Corps receives future funding, additional investigations and analysis will be preformed to support a long term strategy and management plan, and the Corps will continue to coordinate with MMS and NMFS regarding its future development.
Virginia Institute of Marine Science	• The draft EA is not clear concerning the volume of sand within Sandbridge Shoal. Based on statements from pages 39 and 40, the volume is defined as both ~30x106 million cubic yards (m3) or 20% less than ~30x106 m3. • Bulrush (*Scirpus validus*) has been renamed *Schoenoplectus tabernaemontani*, and southern bayberry (*Myrica cerifera var. cerifera*) has been renamed *Morella cerifera*. This should be corrected in the final EA.	To date, approximately ~6x106 m3 of OCS sand has been excavated from Sandbridge Shoal (resource evaluations suggest the Shoal may contain between 17-80 x106 m3 of sand). Concur - will edit EA

Virginia Institute of Marine Science Cont..	• As stated in the EA (pg39), “given the likelihood of future dredging at Sandbridge Shoal, it is important to consider the potential impacts of continued dredging.” VIMS has concerns that competing interests for the sand on the shoal (Virginia Beach, Navy, others), it is unclear if the shoal can continue to support its proposed uses over the next 40 years.	The original resource evaluation research provides a conservative estimate of the volume of sand that may be available in the main shoal body and larger shoal complex (Kimball & Dame, 1989; Kimball et al., 1991). The volume of sand that is actually compatible with the native beach material at Sandbridge has been qualitatively accessed from numerous vibracores collected in 1995 and 1996. Further research is necessary to determine the overall volume of compatible sand remaining in the shoal complex. The Corps is aware that the Navy also utilizes the shoal for the restoration of Dam Neck Beach, albeit less frequently but is unaware of any additional users for the same purpose at this time. The Corps anticipates that the shoal will provide enough sand resources for continued maintenance of Sandbridge Beach over the next 40 years: 13 maintenance cycles (40 yrs / 3 yr interval) x 2x106 cubic yards per cycle = 26 million cy It is not clear if this proposed effort will exhaust the shoal of beach compatible sand, but the general relief of the shoal complex relative to adjacent seafloor will remain. The original geotechnical surveys may need to be supplemented in order to fully confirm this potential. In addition, The Corps and MMS have discussed developing a borrow area management plan for Sandbridge Shoal to address these concerns in more detail.
	• Research on the direct effects on and recovery of, the benthic community and cascading impacts on the pelagic and demersal fishes and crustaceans in the borrow area should continue in order to improve understanding of the impacts on ecosystem resources.	Noted– no additional response

	• The consistency determination should be revised to address impacts to beaches. The FCD references dunes management enforceable policy, but based upon Virginia Code §28.2 1400 et seq., the enforceable policy also addresses beaches.	Concur - will edit EA