ENVIRONMENTAL ASSESSMENT

DARE COUNTY MULTI-TOWN SHORE PROTECTION PROJECT

Prepared for:

The Town of Duck
The Town of Southern Shores
The Town of Kitty Hawk
The Town of Kill Devil Hills

and

The U.S. Army Corps of Engineers and Bureau of Ocean Energy Management

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1.0 Introduction

The towns of Duck, Southern Shores, Kitty Hawk and Kill Devil Hills are seeking permits and authorizations allowing for a one-time renourishment event along their oceanfront shorelines. This proposed nourishment event, scheduled for construction during the summer of 2022, follows the initial 2017 project during which a total of 3,926,669 cubic yards (cy) of material was placed within the confines of these four municipalities. Prior to the 2017 nourishment event, the state of the shorelines within these jurisdictions had not historically provided an adequate level of storm protection, leaving the human and natural environments vulnerable to damage and erosion from coastal storms. Since the 2017 nourishment event, the town's shorelines have continued to erode due to chronic long-term erosion rates along with impacts associated with passing storms including Hurricane Dorian in September 2019.

The federal government first began evaluating the need for erosion mitigation and storm damage reduction along the northern Dare County shoreline following a resolution adopted by the U.S. House of Representatives in 1990 (USACE, 2000). The U.S. Army Corps of Engineers (USACE) was authorized to study the state of shoreline conditions within portions of Dare County. The USACE published a Final Feasibility Report and Environmental Impact Statement on Hurricane Protection and Beach Erosion Control in 2000, which recommended a nourishment project for 14.2 miles of coastline along Dare County (USACE, 2000). The towns of Nags Head, Kill Devil Hills, and Kitty Hawk were originally included in the federally authorized Dare County Storm Damage Reduction Project (Bodie Island Portion). However, due to difficulties and delays in securing funds for the federal Dare County Beaches Project, the project was never constructed.

In 2013, the towns of Kitty Hawk and Kill Devil Hills decided to pursue the construction of their own storm damage reduction projects without any federal cost sharing. Although not part of the initial federal project, the towns of Duck and Southern Shores also decided to pursue a non-federal nourishment project to manage erosion along portions of their respective oceanfront shorelines and to provide storm damage reduction. In 2017, the four towns cost-shared and implemented a beach nourishment project that involved the placement of approximately 3.9 million (M) cubic yards of material over nearly 8.3 miles of oceanfront shoreline. Material used for the project was obtained from two offshore borrow areas within the Outer Continental Shelf (OCS) in federal waters. Great Lakes Dredge and Dock performed the dredging work in 153 days using three (3) hopper dredges; the Liberty Island, Dodge Island and Padre Island. Dredging began on May 23, 2017, placing material at the Town of Duck and was concluded on October 23, 2017 with nourishment at the Town of Kitty Hawk. A description of each town's component of the 2017 multi-town beach nourishment project, as constructed, is as follows:

Town of Duck: The beach fill design for the Town of Duck included a 20-foot wide dune at elevation +20.0 feet NAVD fronted by a variable width berm at elevation +6.0 feet NAVD. A main fill section was constructed covering 7,915 feet of shoreline beginning on the north at profile station D-10, which is located near 140 Skimmer Way, and ending on the south near station D-19 which is located at the south property line of 137 Spindrift Lane. A five hundred (500) foot taper was construction on the north end of the fill to provide a gradual merger of the project shoreline

with the existing shoreline. Collectively, 1,263,181 cubic yards of material was placed within this domain. Due to concerns with possible damage to sensitive instruments buried on its property, the USACE Field Research Facility requested no material be deposited directly along its shoreline. As a result, a taper was not provided at the south end of the project, rather, the volume of material originally included in the south taper was distributed along the southern extends of the main fill.

Town of Kitty Hawk and Town of Southern Shores: The beach fill design for the Town of Kitty Hawk included a 10-foot wide dune at elevation +12.0 feet NAVD fronted by a 60-foot wide berm at elevation +6.0 feet NAVD. A main fill section was constructed covering 18,989 feet of shoreline beginning on the north at profile station 0+00, which is located approximately 120 feet north of the pier at the Hilton Garden Inn, and ending on the south near station 189+87, which is located between East Sibbern Drive and East Arch Street. Since the Kitty Hawk project was constructed in conjunction with Kill Devil Hills, only one taper on the north end of the main fill was constructed. Originally, the north taper was designed to extend 1,000 ft. into the Town of Southern Shores. In January 2017, the Town of Southern Shores initiated the process to include the southern 1,500 ft. of its shoreline into the Kitty Hawk Project. Subsequently, an additional taper was added to the northern end of the Southern Shores portion of the project. Thus, the Kitty Hawk with Southern Shores extension project included a total of 21,489 feet of shoreline and included the placement of 1,765,619 cy of material within the Town of Kitty Hawk and 80,510 cy of material within the Town of Southern Shores.

Town of Kill Devil Hills: The beach fill design for the Town of Kill Devil Hills included a 20-foot wide dune at elevation +15.0 feet NAVD fronted by a 40-foot wide berm at elevation +6.0 feet NAVD. SBEACH results and topographic data review suggested that no dune construction was required between 240+42 and 269+49 and south of 304+82 to achieve the design level of storm damage reduction. A main fill section was constructed covering 12,501 feet of shoreline beginning on the north at profile 189+87, which is located at the north Town limit, and ending on the south near station 314+88 which is located at Windsong Way. Since the Kill Devil Hills project was constructed in conjunction with Kitty Hawk, only one taper on the south end of the main fill was constructed. The south taper measured 1,009 feet and ended just north of the Prospect Avenue public access at station 324+97. Collectively, 817,359 cubic yards of material was placed within this domain.

Pursuant to the National Environmental Policy Act (NEPA), the USACE and BOEM described the affected environment, evaluated potential environmental impacts and considered alternatives for the 2017 nourishment event in three separate 2015 Environmental Assessments (EAs). Specifically, these include EAs prepared for the Town of Duck (Appendix A), the Town of Kitty Hawk (CPE-NC, 2015a), and the Town of Kill Devil Hills (CPE-NC, 2015b). Because the proposed action will serve as a renourishment of the 2017 event, this EA supplements and summarizes the information included within the three 2015 EAs with respect to the environmental conditions and anticipated impacts and will be referenced throughout this document; one of the EAs is provided as an appendix for convenience. This EA will be utilized to determine if the

proposed action and alternatives, in light of new information, would have any significant effect on the human environment and whether an Environmental Impact Statement (EIS) is needed. Although the proposed action is similar to what was constructed in 2017, there are several aspects of the proposed project, including a substantially larger beach fill area along Southern Shores oceanfront shoreline, which differ to the 2017 project and will be expanded upon in detail within the following sections below.

Considering that the project area includes both terrestrial and marine areas within state waters, as well as marine areas within federal waters, it was decided the Bureau of Ocean Energy Management (BOEM) and the USACE would concurrently act as lead agency for the proposed project. BOEM will lead the coordination efforts with NMFS regarding the resources within the federal offshore borrow areas (i.e., beyond 3 nautical miles [nm]), and the USACE will lead the coordination efforts with NMFS in marine areas within the state of North Carolina's jurisdiction and USFWS regarding lands. Each of the four towns involved with the proposed project will utilize this EA to support their federal consultation efforts and support their respective permitting and leasing efforts with the USACE and BOEM.

1.1. Project Location

The towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills are located along the Atlantic coast of the Outer Banks within Dare County, North Carolina (Figure 1). Placement of fill material will occur along the entirety of the Towns of Southern Shores and Kitty Hawk's oceanfront shoreline and along a portion of the Town of Duck and Kill Devil Hill's oceanfront shoreline. The material used for this renourishment event will be obtained from a borrow area known as "Borrow Area A" located within the Outer Continental Shelf (OCS) in federal waters offshore of Dare County (**Error! Reference source not found.**). Borrow Area A is located between 5.0 and 6.5 miles offshore the town of Kill Devil Hills, NC.

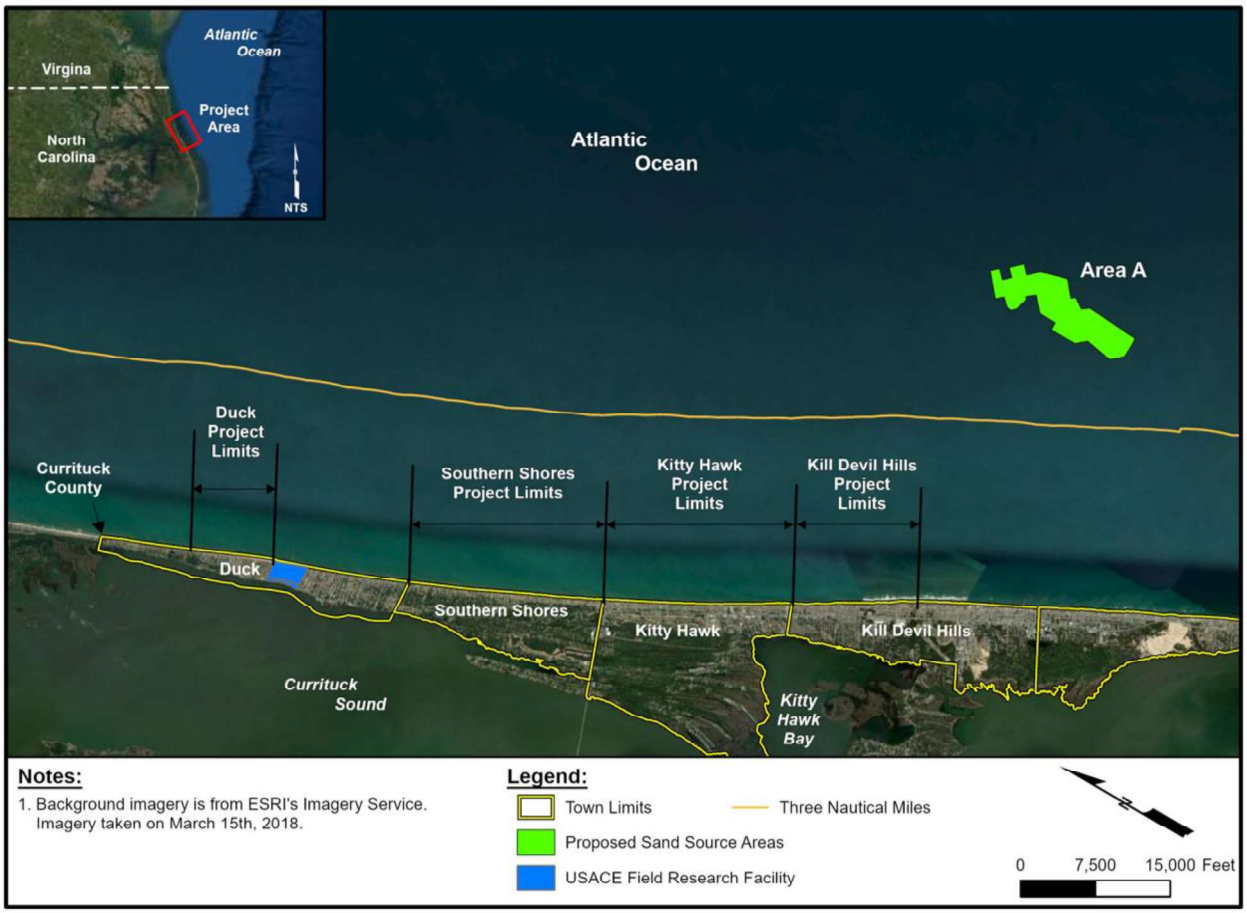

Figure 1. Project location map.

1.2. The Proposed Action

The proposed action will include a one-time sand placement event along an 11.65 mile section of oceanfront shoreline within the Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills utilizing up to 6,589,633 cubic yards of material, including proposed taper sections (**Error! Reference source not found.**). Beach quality sand will be obtained from an offshore borrow area (Borrow Area A) via a self-contained ocean-certified hopper dredge and/or a hydraulic cutterhead pipeline dredge. Placement onto the beach would be accomplished via submerged pipeline with direct pump-out. The type and number of dredges needed will be determined by the contractor. Should a cutterhead dredge be used, dredged material would be transported to the recipient beach via submerged pipeline. In the event a hopper dredge is used, pump-out stations will be implemented, and material will be transported to the beach via submerged pipeline. The specific locations of pipeline corridors and pump-out locations have not been determined at this time but will also be determined by the contractor and in compliance with environmental regulations. Once discharged, the sand will be shaped and graded according to the design template using earth-moving equipment such as bulldozers and excavators. The towns are proposing a year-round construction schedule such that dredging and placement may occur whenever it is deemed safest and most efficient by the contractor. The proposed borrow area for the project is located in federal waters approximately 5.0 to -6.5 miles offshore from the Town of Kill Devil Hills, NC. Details of the proposed project are discussed in Section 0.

1.3. Purpose and Need

Each of the four beach towns (Duck, Southern Shores, Kitty Hawk, and Southern Shores) are focused on sustaining their respective beaches that support a significant portion of their local economies and maintains the towns' tax bases. Infrastructure protection, storm damage mitigation and rapid recovery from storm events are important considerations for each of the four towns. The Town of Kitty Hawk is also particularly concerned with the effects of flooding and are seeking a program that will serve to 1) reduce the vulnerability of public infrastructure including NC 12, town roads between NC 12 and U.S. Highway 158, and utilities to storm-induced erosion; 2) reduce flooding in many non-oceanfront areas throughout the Town during ocean overwash conditions, including portions of Highway NC 12 and U.S. Highway 158; and 3) reduce the vulnerability of homes within the Town that front the Atlantic Ocean and are exposed to wave events during nor'easters and other large storm events as well as natural trends.

In order to accomplish these stated goals, the towns are taking steps to maintain their oceanfront beaches and dunes to a configuration that 1) provides a reasonable level of storm damage reduction (and flood reduction at Kitty Hawk) to public and private development; 2) mitigates long-term erosion that could threaten public and private development as well as recreational opportunities and biological resources; and 3) maintains a healthy beach habitat that supports valuable shorebird and sea turtle nesting habitat.

The current purpose and need call for a one-time beach nourishment event along the oceanfront shoreline of each town. The towns will regularly monitor and re-evaluate the level of storm damage reduction and erosion mitigation that the existing beach provides on 5-year intervals. Should the data indicate that the proposed project requires maintenance nourishment, the towns may seek new permits or permit modification to perform future maintenance work.

The BOEM is not undertaking nor is responsible for the proposed dredge-and-fill work, and therefore has a separate proposed action and purpose and need. The BOEM proposed action is to issue a lease for OCS sand to use in the proposed project (under the authority granted to the Department of the Interior by the Outer Continental Shelf Lands Act [OCSLA]). The proposed action is necessary because the Secretary of the Interior delegates the authority granted in the OCSLA to the BOEM for authorizing use of OCS sand resources for the purpose of shore protection and beach restoration.

1.4 Scoping and Consultation History

On September 14, 2011, the Town of Kill Devil Hills held an interagency scoping meeting in Washington, NC with representatives from various state and federal agencies including the North Carolina Division of Coastal Management (DCM), North Carolina Wildlife Resources Commission (NCWRC), United State Army Corps of Engineers (USACE), US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). The purpose of the meeting was to present the scope of a proposed locally sponsored shoreline protection project and to develop an agreed upon permitting approach and scope for the required environmental

documentation. One outcome of the meeting was the decision to develop a "Project Information Document" that would provide the USACE with a summary of the relevant existing environmental documentation and biological data that pertains to the proposed Kill Devil Hills Shore Protection Project. The information provided within the document was to be used to assist the USACE in determining the appropriate environmental documenting requirements. Following the submittal of the document, the USACE responded that due to the likelihood of determining a Finding of No Significant Impacts (FONSI), an Environmental Assessment (EA) would be the recommended approach regarding the required environmental documentation. The meeting minutes from the September 14, 2011 interagency scoping meeting are found within Appendix B.

Following the 2011 interagency meeting, two other beach towns in Dare County (Kitty Hawk and Duck) expressed interest in pursuing their own shoreline protection projects in light of continued erosion on their respective shorelines. Considering that all three towns were proceeding with similar nourishment projects, constructing these projects within the same year, either concurrently or sequentially, would reduce mobilization costs to the towns. Subsequently, an additional interagency meeting was held on June 19, 2013 with representatives from many of the same agencies to discuss proposed permitting and environmental documentation approaches for all three towns, (Kill Devil Hills, Kitty Hawk and Duck). During the meeting it was determined that each town should apply for their own set of permits and develop their own separate EAs. However, representatives from the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) agreed that while individual EAs could be drafted for each of the three proposed projects, a single regional EFH assessment and a single batched Biological Assessment (BA) could be submitted to satisfy consultation requirements with NMFS and USFWS (i.e., under the Magnuson-Stevens Act and Endangered Species Act, respectively) for the Towns of Duck, Kitty Hawk, and Kill Devil Hills. The meeting minutes from the June 19, 2013 scoping meeting are found within Appendix B.

Because the project involved the use of an OCS borrow area, which fall under the Bureau of Ocean Energy Management (BOEM) jurisdiction, and placement of material on the beach, which falls under the USACE's jurisdiction, it was determined that BOEM and the USACE would act as joint-lead agencies for NEPA purposes and would prepare joint NEPA documents. BOEM and the USACE agreed to participate in the required Endangered Species Act (ESA) Section 7 consultations; the Magnuson-Stevens Fishery and Conservation Management Act Essential Fish Habitat (EFH) consultation (Section 305); the National Historic Preservation Act Section (NHPA) Section 106 process; and the Coastal Zone Management Act (CZMA) Section 307 consistency process.

In a letter from BOEM to the USACE dated December 2, 2014, the environmental documentation and permitting approach as described above was codified. It stated that lead agency in Endangered Species Act (ESA) Section 7 consultation for potential impacts on protected species would be determined by jurisdiction. The BOEM was determined to be the lead agency and would consult with NMFS concerning potential effects from dredging activities for species under their purview (i.e. swimming turtles and whales). The USACE was determined to be the lead agency and consult with UFWS concerning effects from placement activities for species under their purview (i.e. nesting sea turtles). BOEM and the USACE consulted jointly with NMFS Habitat Conservation

Division on EFH and requested NMFS to assign conservation recommendations by jurisdiction. The USACE was the lead agency for the National Historic Preservation Act (NHPA) Section 106 and notified the State Historic Preservation Office (SHPO) and relevant Tribal Historic Preservation Offices (THPO). The USACE and BOEM worked together with the North Carolina Department of Environmental and Natural Resources (NCDENR), to ensure compliance with Section 307 of the Coastal Zone Management Act (CZMA).

Following the submittal of the three EAs, Department of Army (DA) Individual Permits were issued to each of the three towns for the 2017 beach nourishment event (SAW-2014-02202, SAW-2014-02203, and SAW-2014-02204). Consultations with NMFS Protected Resource Division concluded with the issuance of Biological Opinion on May 16, 2016. Consultations with USFWS concluded with the issuance of a Biological Opinion on November 4, 2015, respectively (Appendix C). Consultation with NMFS Habitat Conservation Division in regard to EFH concerns resulted in a "no staffing" email with one recommendation. DCM issued Major Permits to each town as well (Town of Duck, #132-15; Town of Kitty Hawk, #133-15; and Town of Kill Devil Hills, #134-15).

An additional interagency scoping meeting convened on January 31, 2017 to discuss the Town of Southern Shore's desire to place beach fill material within a limited area of the Town's oceanfront shoreline (Appendix A). Due to the project's proximity to Kitty Hawk and their intention to construct the project in tandem with the other three beach town projects, regulatory agencies determined the applicant would apply for their own separate CAMA Major permit and modify Kitty Hawk's existing DA Individual permit. During consultation with the federal partners, the batched BA was also amended to include Southern Shore's project-specific information. DCM subsequently issued a CAMA Major Permit #59-17 to the Town of Southern Shores while the DA issued a modification of the Town of Kitty Hawk's Individual Permit SAW-2014-02204.

Subsequent the completion of the 2017 nourishment event and based on interest expressed by all four beach towns to pursue an additional nourishment event in the future, an interagency meeting convened on April 29, 2020 to discuss the permitting and environmental documentation approach that would be required for the future project (Appendix B). During the meeting, it was decided that each town would pursue their own respective set of permits. In order to satisfy NEPA documentation requirements, however, it was decided that one collective EA would be developed and would be inclusive of site-specific information for all four beach towns. It was also determined that the project-related actions, as presented during the scoping meeting, should be covered by the 2020 South Atlantic Regional Opinion (SARBO) and the 2017 North Carolina Coastal Beach Sand Placement Statewide Programmatic Biological Opinion. As such, the issuance of a new biological opinion as part of the federal consultation process with NMFS and USFWS are not anticipated.

2.0 DESCRIPTION OF ALTERNATIVES

This section describes the alternatives evaluated for responding to the risk of long-term erosion and storm damage to existing structures and infrastructure within the towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills. These alternatives were also evaluated to assess the problems associated with the protection of NC Highway 12 and inland portions within the Town

of Kitty Hawk between NC Highway 12 and US Route 158 (N. Croatan Highway) against flooding caused by wave and storm surge overwash.

The effectiveness of the various alternatives to meet the project's purpose and need was initially determined through analyses previously conducted and presented in the 2015 EAs. The primary tools used for these analyses included the examination of LiDAR surveys, NC Division of Coastal Management (DCM) 2011 Shoreline Change Update, SBEACH model, GENESIS model, and Wave Overtopping analysis (Table 1). A brief description of each of these tools are provided below and can be found in greater detail within the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

Table 1. Tools used to evaluate each Town's alternatives in the 2015 EAs

	Duck	Kitty Hawk	Kill Devil Hills
LiDAR Surveys	X	X	X
DCM 2011 Shoreline Change Update	X	X	X
SBEACH Model	X	X	X
GENESIS Model	X		
Wave Overtopping Analysis		X	

- **LiDAR Surveys**
  Shoreline changes along the Towns of Duck, Kitty Hawk, and Kill Devil Hills were evaluated using LiDAR (Light Detection and Ranging) data collected by USACE JALBTCX (Joint Airborne LiDAR Bathymetry Technical Center of Expertise), USGS (U.S. Geological Survey), NASA (National Aeronautics and Space Administration) and NOAA (National Oceanographic and Atmospheric Administration). LiDAR is an optical remote sensing technology that measures the ground elevation or seafloor at relatively high spatial resolutions. LiDAR data are better suited for surveying sub-aerial platforms since light penetration may be restricted by water clarity. For this analysis, only elevations collected along the dry beach were evaluated.

- **GENESIS Model**
  The GENEralized Model for Simulating Shoreline Change (GENESIS) developed by Hanson & Kraus was used to evaluate the most desirable length of taper or transition sections on each end of the proposed beach nourishment area within the Town of Duck. GENESIS was also used to evaluate the alignment of the shoreline following an initial year of adjustment following the sand placement.

- **NC Division of Coastal Management (DCM) 2011 Shoreline Change Update**
  The NC DCM periodically updates shoreline change rates for the entire state for purposes of computing ocean hazard setback factors. DCM computes shoreline change rates using the "end point" method that measures the difference in position of an "early shoreline" with the shoreline shown on a more recent set of aerial photographs.

- **SBEACH Model**

Storm erosion modeling for the Towns of Duck, Kitty Hawk, and Kill Devil Hills were conducted using the **S**torm Induced BEAch CHange Model (Larson and Kraus, 1989). SBEACH simulates the beach profile changes due to storm generated waves and water levels over the duration of the storm.

- **Wave Overtopping Analysis**
  An assessment of the potential reduction in wave overtopping that could be achieved through the construction of the Kitty Hawk beach nourishment project was based on theoretical wave run-up elevations computed using the De Waal and Van der Meer (1992) method.

Two alternatives have been evaluated within this EA. These include:

- Alternative 1 – No New Action
- Alternative 2 – Applicant's Preferred Alternative – Beach Nourishment from an Offshore Borrow Area within BOEM Waters

2.1 Alternative 1 - No New Action

Alternative 1 is defined as a continuation of the various actions the Towns have historically taken to protect their oceanfront shoreline and infrastructure from storm events and chronic erosion. These measures include town sponsored programs to install sand fencing along vulnerable sections of its shoreline in an attempt to rebuild dunes and actions by individual property owners to rebuild storm damaged dunes through the use of beach scraping (bulldozing). In addition, a limited number of individual property owners have installed temporary sandbag revetments to protect imminently threatened structures. Alternative 1 does not include maintenance of the 2017 nourishment project. With Alternative 1, BOEM would not issue a lease to access an OCS borrow area. Similarly, USACE would not permit any beach nourishment activities.

As discussed above, several tools were previously used to determine the impacts to the towns' oceanfront structures and infrastructure in response to long-term erosion and storm events (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b). Since the 2017 nourishment event, significant erosion has occurred along each of the four beach towns oceanfront shorelines. Much of the erosion can be attributed to the loss of the advanced fill placed during the 2017 project. At the Town of Duck, a June 2020 survey indicated that 271,000 cubic yards of material had eroded from the project area since the December 2017 post-construction survey. This equates to a rate of -12.4 cy/ft./yr. when annualized. As of June 2020, the analysis indicates that the Town of Duck beach nourishment project had approximately 72% of the initial fill volume remaining as measured above the -24-foot NAVD88 contour (CPE-NC, 2020a). Comparison of beach profile data from December 2017 and June 2020 indicated the volume of beach fill remaining within the Southern Shores project area as of June 2020 was 47.5% (CPE-NC, 2020b). Profile-based volumetric analyses indicated that between December 2017 and June 2020, the Kitty Hawk and Kill Devil Hills project areas lost approximately 901,600 cubic yards and 349,100 cubic yards, respectively. The volumetric losses indicate the volume of beach fill remaining within both projects as of June 2020 was 57.5% for Kitty Hawk and 58.6% for Kill Devil Hills (CPE-NC, 2020c). Without maintenance of the 2017 project, erosion is anticipated to continue along the shorelines of these four towns.

2.2 Alternative #2: Applicant's Preferred Alternative - Beach Nourishment from an Offshore Borrow Area within Federal Waters

Under Alternative 2, the four towns propose a one-time renourishment of the 2017 beach placement project for the areas determined to be at-risk for both long-term erosion and storm damage. This follows the initial beach nourishment project that occurred in 2017 within each of the four towns and encompassed the placement of 3,926,669 cubic yards (cy) of material along 8.3 miles of oceanfront shoreline. The 2017 project included the nourishment of the existing beach and dunes within the project area configured to an engineered design that met the town's purpose and needs. The project also included an additional 5 years of advanced fill. The material utilized for the 2017 project was obtained from two offshore borrow areas located in federal waters. Details regarding the engineered design for the 2017 project can be found within the previously drafted EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

Alternative 2, the applicant's preferred alternative, will seek to renourish the beach berms and dunes within the project area at all four beach towns utilizing material obtained from an offshore borrow area located in federal waters. Therefore, BOEM's proposed action under Alternative 2 is to issue a lease for Borrow Area A, located in federal waters while the USACE's proposed action is to issue an Individual Permit. This alternative has been designed to renourish the 2017 design template and provide an additional 5 years of advanced fill while integrating additional stretches of shoreline, primarily located within the Town of Southern Shores, into the project area. The geographic extent, design configuration, and fill volumes of the 2017 nourishment project were previously described for each town in Section 1.0 above. Through the analysis of annual monitoring data and additional modeling efforts, some aspects of that initial project have been modified to ensure that Alternative 2 will serve to meet the purpose and needs of this proposed project.

In preparation of the proposed project, additional engineering efforts have been performed to evaluate design adaptations aimed at improving the performance of the 2017 beach nourishment project. For the Towns of Duck, Kitty Hawk, and Kill Devil Hills, these efforts focused on mitigating erosive "hot spots", assessing the amount of advanced fill, and assessing the berm height elevation. In addition, recent engineering work has focused on evaluating the cost and efficiency of bolstering the dune design to provide additional storm damage reduction to public infrastructure and private development for the Town of Kitty Hawk. Engineering efforts for the Town of Southern Shores were limited for the 2017 project considering that only 1,500' of shoreline within the town limits received fill. Therefore, in order to develop a design for the Town's beach nourishment project, subsequent engineering efforts have entailed 1) conducting detailed design analysis focused on finalizing the established beach design, 2) optimizing fill distribution along the project area, and 3) updating advanced fill quantities based on the latest beach profile data.

All four towns have conducted annual monitoring surveys of the town's oceanfront shorelines since 2017. These data have been used to evaluate the design recommendations described in the following paragraphs. In general, the following analyses have been implemented to determine the finalized project design:

- **Beach Fill Performance Evaluation and Modeling**
  In order to further evaluate the beach nourishment design alternatives and lateral diffusion losses, the highly advanced process-based model Delft3D has been employed. Delft3D is a world leading 3D modeling suite used to investigate hydrodynamics, sediment transport and morphology (beach and dune erosion) and water quality for coastal environments. A regional wave and flow model t utilized by all four of the towns has been developed to evaluate project specific engineering alternatives. After model calibration and following consultation with the towns, the Delft3D model was used to estimate nourishment volume losses for different nourishment designs. Four (4) beach re-nourishment design configurations aimed at optimizing project performance were simulated. These alternatives included variations in nourishment volume density (cy per length of shoreline) and various taper configurations. These alternatives were simulated using the Delft3D model for periods of one (1) year and five (5) years. The results of the model were evaluated in terms of annual volumetric losses from the project area.

- **Advanced Fill Volume Analysis**
  A key component of a beach fill design is an assessment of periodic nourishment requirements needed to maintain the design profile during the interim period between nourishment events. This quantity of fill placed to maintain the design fill during the interim period between nourishment cycles is referred to as advanced fill. Evaluations of the volumetric change rates measured since the 2017 beach nourishment project as well as previously reported historic shoreline and volumetric changes have been determined. Engineers also used the results of the numerical modeling to better resolve expected diffusion losses. Through these analyses, volumes for advanced fill have been calculated

- **Berm Height Elevation Analysis**
  The initial beach fill design for the projects constructed at Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills in 2017 called for a variable width berm constructed at +6.0 ft. NAVD88. During construction of the projects, the constructed berm was overtopped during several high-water events. Water that overtopped the berm infiltrated the sand as water levels subsided, and eventually, the wave climate re-shaped the beach profile into a more natural configuration.

  Engineers have evaluated the various beach profile data sets collected since the projects were constructed to determine if the +6.0 ft. NAVD88 elevation is the optimal elevation to construct the berm for the proposed project. When a beach project is constructed with a berm elevation that is too low, there is a risk that frequent overtopping of the berm can result in ponding of water on the berm, which can impact recreational users of the beach. Furthermore, if a berm is constructed at too high an elevation, increased and more severe

scarping can occur as the profile is evolving in response to wave forces. The analysis has focused on optimizing the berm elevation to minimize both the risk of ponding and the risk of scarping.

- **Dune Design Analysis**
  During the initial design of the Kitty Hawk project, the lack of dune seaward of many of the ocean front houses combined with budgetary constraints precluded the design and construction of a robust dune aimed at providing specific storm damage reduction. The design for the 2017 Kitty Hawk project entailed a 60-foot wide dune and the establishment of a "starter dune". The starter dune was constructed, and sand fencing was placed on the dune to continue to trap sand. Recent observations of the starter dune show that it has grown both vertically and horizontally and is providing both flood mitigation and storm damage reduction. SBEACH, a profile-based storm simulation model, was used to evaluate the existing level of storm protection. Alternative dune designs were also evaluated to determine the increased volume of sand necessary to achieve a similar level of storm damage reduction designed for the projects in Duck and Kill Devil Hills.

- **Storm Vulnerability Analysis**
  In addition to the Delft3D modeling conducted to evaluate long term fill volume losses (lateral losses), SBEACH, a cross-shore storm response model, was utilized to evaluate the ability of various beach fill profile designs to mitigate for the predicted impact of the design storm (Hurricane Isabel) at Southern Shores. The existing cross-shore model calibration using FRF data in the vicinity of the project area was utilized. The wave boundary conditions for the cross-shore model were obtained from the calibrated regional Delft3D model. The cross-shore model was used to evaluate the ability of various beach fill profile designs to mitigate for the predicted impact of the design storm. The beach fill designs included beach fills with variable width berms and elevations, as well as design profiles that include both berms and variable width and elevation of dunes. Each design profile was then evaluated using the same design storm(s) used for the without project condition.

Results of these analyses have resulted in a project design for each of the four beach towns oceanfront shorelines. Collectively, the volume of fill material needed to construct the beach fill within each of the four towns amounts to 4,393,088 cubic yards to rebuild the design template and provide five (5) years of advanced nourishment (Table 2). Table 2 also depicts the fill extent and volumes of fill that were placed within each of the four towns during the 2017 nourishment project to serve as a comparison to this proposed project. The actual dredge volume for the proposed project could vary and be 15 to 20 % higher than the fill volume, dependent upon the loss rate. The borrow area post-construction survey following the 2017 project revealed that approximately 3,543,800 cubic yards were removed from the offshore Borrow Area A during the project and 1,042,900 from offshore Borrow Area C. The difference between the as-built volumes measured in place on the beach and the volume removed from the borrow areas represents a retention rate of over 85%. Along with accounting for the losses anticipated during dredging, the BOEM lease

request for excavating material from within Borrow Area A will include additional volume in the unlikely event a storm eroded the Towns' shorelines prior to the construction of the project. In total, the amount of material that could be excavated from the borrow area would be 6,589,633 cy, or 50% more than the 4,393,088 cy of fill required by the preferred designs with advanced fill.

The proposed project within each town will not include the construction of additional dunes with the exceptions of those areas where portions of the designed dune has been lost since the 2017 event. In these areas, the towns will install sand fencing along the portions of the dune that were re-constructed in accordance with either 15A NCAC 07K .0212 or 15A NAC 07H .0311(c). If sand fencing is to be installed under 15A NAC 07H .0311(c), the towns will limit fencing installation to the face of the constructed dune and will complete the installation after October 31.

Table 2. Fill extents volumes along each beach town for the 2017 event and the proposed project

	2017 Fill Extent (linear feet)	Proposed Fill Extent (linear feet)	2017 Fill Volume (cubic yards)	Proposed Fill Volume (cubic yards)
Town of Duck	8,415	8,415	1,263,181	806,500
Town of Southern Shores	2,500	21,625	80,510	1,216,208
Town of Kitty Hawk	18,989	20,970	1,765,619	1,521,645
Town of Kill Devil Hills	13,510	14,464	817,359	848,735
TOTAL	**43,469**	**65,474**	**3,926,669**	**4,393,088**

Note: Proposed fill extent and volumes includes taper sections- if each of component of the project is constructed in tandem, some tapers will not be needed. Proposed fill volumes are representative of the beach design and advanced fill volumes plus 50% additional volume to account for losses during dredging and additional volume required if a storm event occurs prior to the proposed project.

2.2.1 Town of Duck Beach Nourishment Design

The proposed action is a one-time beach nourishment event that will include sand placement along a 1.6-mile section of the Town's oceanfront shoreline using dredged material from within Borrow Area A. The proposed design consists of a 20-foot-wide dune at elevation +20 feet NAVD88, with a seaward slope of 1V:5H, fronted by a variable width berm at elevation +6 feet NAVD88. The main placement area begins near the northern property boundary of 140 Skimmer Way and extends approximately 7,914 feet southward, terminating in the middle of the parcel at 137 Spindrift Lane. Additionally, there is one 500-foot taper on the north end of the main fill, that extends from the northern boundary of the main placement to the property line between 126 and 128 Skimmer Way. The total linear extent of sand placement is approximately 8,414 feet (1.6 miles) (Figure 2). Plan views and cross sections of the design template are shown in Appendix D. Each cross-section corresponds with profiles with approximately 1,000-foot spacing. The total fill area below MHW is 3,023,609 square feet (69.41 acres), and the total fill area above MHW is 1,488,346 square feet (34.17 acres), for a total disturbed area of 4,511955 square feet (103.58 acres).

Construction of the preferred design along with 5 years of advanced fill would require 806,500 cubic yards of fill material obtained from Borrow Area A. Actual volume dredged from the borrow area will likely require up to an additional 20% to account for losses during dredging; therefore, the total estimated dredge volume is 967,800 cubic yards. The BOEM lease request for excavating material from within Borrow Area A will include additional volume in the unlikely event a storm eroded the Towns' shoreline prior to the construction of the project. In total, the amount of material that could be excavated from the borrow area would be 1,209,750 cy, or 50% more than the 806,500 cy of fill required by the preferred design and advanced fill. Following the construction of the 2017 project, an after-dredge survey revealed that Borrow Area A still contained 12,829,500 cy of material, therefore this borrow area contains enough volume for this project along with the other three towns' proposed projects.

There are five proposed staging areas for this project. One is located at the USACE Field Research Facility, approximately 1,500 feet south of the southern extent of the project limits. This staging area would consist of an existing paved lot encompassing approximately 0.28 acres, and an associated dirt road would be used as a 1,060 linear feet construction access to the beach. Two other staging areas are located along Trinitie Drive and Duck Rd. The two staging areas on or in proximity to Trinitie Drive encompass approximately 0.06 and 0.08 acres, respectively. The construction access to the beach measures 286 feet. The staging area along Sound Sea Ave is approximately 0.27 acres with its construction access to the beach measuring approximately 352 linear feet. The last staging area, located on Acorn Oak Ave. The staging area on Acorn Oak Ave. encompasses 0.16 acres with a construction corridor measuring 3018 feet. Collectively, these five staging areas encompass a total of 0.97 acres. No impervious surfaces or alterations to the dunes will be required for use of these areas.

Figure 2. Plan view for the proposed project within the Town of Duck including the including the project limits, main placement area, and tapers

2.2.2 Town of Southern Shores Beach Nourishment Design

The portion of the proposed project occurring within the town limits of Southern Shores will include placement of up to 1,824,312 cubic yards of material obtained from within Borrow Area A along 21,625 linear feet of shoreline. This includes two ~1,000-foot taper sections; one extending to the north and the other extending to the south (if the project is constructed with the Town of Kitty Hawk receiving fill as well, the southern taper section will not be needed) (Figure 3). The proposed construction template consists of an approximate 25-100-foot-wide berm at an elevation of +6 feet NAVD88. Dunes that require reshaping will be constructed at an elevation no higher than +15.0 feet NAVD88 with a dune crest width of 24.0 feet NAVD88. Plan views and cross sections of the design template are shown in Appendix E.

Construction of the preferred design along with 5 years of advanced fill would require 1,216,208 cubic yards of fill material obtained from Borrow Area A. Actual volume dredged from the borrow area will likely require up to an additional 20% to account for losses during dredging; therefore, the total estimated dredge volume is 1,459,450 cubic yards. The BOEM lease request for excavating material from within Borrow Area A will include additional volume in the unlikely event a storm eroded the Towns' shoreline prior to the construction of the project. In total, the amount of material that could be excavated from the borrow area would be 1,824,312 cy, or 50% more than the 1,216,208 cy of fill required by the preferred design and advanced fill. The total fill

area below MHW is 4,809,633 square feet (110.4 acres), and the total fill area above MHW is 1,098,007 square feet (25.2 acres), for a total disturbed area of 6,798,640 square feet (156.1 acres).

Three staging areas will be established for this project. The first staging area is located within the public parking lot at Byrd Street in the Town of Kitty Hawk. This parking lot, which abuts the beach, will also include a construction corridor by which machinery can access the beach (Appendix E, sheet 3). Two additional staging areas will be in proximity to Hilcrest Drive within a grassy area and a volleyball court (Appendix E, sheet 10). These two staging areas will include a construction corridor as well. Finally, an additional construction access point will be located just north of the Kitty Hawk pier, extending from the public parking lot at the Hilton Garden Inn onto the beach (Appendix E, sheet 3). No impervious surfaces or alterations to the dunes will be required for use of these areas.

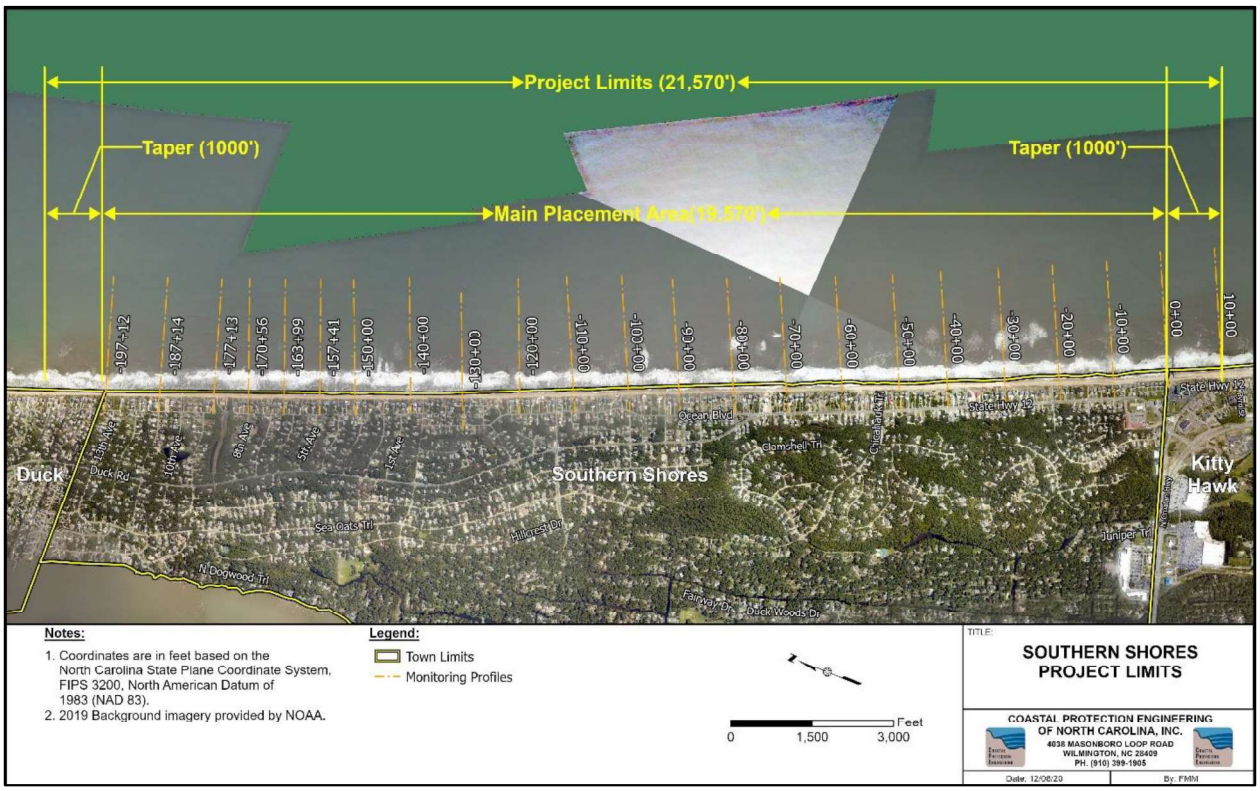

Figure 3. Plan view for the proposed project within the Town of Southern Shores including the including the project limits, main placement area, and tapers

2.2.3 Town of Kitty Hawk Beach Nourishment Design

The proposed action is a one-time beach nourishment project that would include sand placement along a total of 20,970 feet (3.97 miles) of oceanfront shoreline. The main placement area of the proposed project begins at the north town limit (baseline station 0+00) which is approximately 120 feet north of the Kitty Hawk Pier located at the Hilton Garden Inn. The main placement area extends 18,964 feet along the entire length of the Kitty Hawk ocean shoreline ending at

approximately the Kitty Hawk/Kill Devil Hills town limits (baseline station 189+00). If the Kitty Hawk project is constructed as a stand-alone project, two taper sections would be included: a 1,000-foot taper on the north end and a 1,006-foot taper on the south end. The north taper would extend into the Town of Southern Shores, terminating at 8 Sea Bass Circle. The south taper would end at E. Helga Street in Kill Devil Hills, which is located at baseline station 199+00 (Figure 4). Plan views and cross sections of the design template are shown in Appendix E.

The total fill area below MHW is 5,177,410 square feet (118.86 acres), and the total fill area above MHW is 3,065,462 square feet (70.37 acres), for a total disturbed area of 8,242,872 square feet (189.23 acres). The proposed design template consists of a 60-foot-wide berm at elevation +6 feet NAVD88. A dune with a crest elevation of +18 feet NAVD88 and width of 25 feet will be provided landward of the constructed berm along the entire length of the project by pushing some of the material into a pile. Complete plan view and cross-sectional drawings of the proposed project are provided in Appendix F.

Construction of the preferred design along with 5 years of advanced fill would require 1,521,645 cubic yards of fill material obtained from Borrow Area A. Actual volume dredged from the borrow area will likely require up to an additional 20% to account for losses during dredging; therefore, the total estimated dredge volume is 1,614,426 cubic yards. The BOEM lease request for excavating material from within Borrow Area A will include additional volume in the unlikely event a storm eroded the Towns' shoreline prior to the construction of the project. In total, the amount of material that could be excavated from the borrow area would be 2,282,468 cy, or 50% more than the 1,521,645 cy of fill required by the preferred design and advanced fill. Following the construction of the 2017 project, an after-dredge survey revealed that Borrow Area A still contained 12,829,500 cy of material, therefore this borrow area contains enough volume for this project along with the other three towns' proposed projects.

Depending on several variables, including whether the project is constructed as a stand-alone project, available funding, time or contractor constraints, or any unforeseen limitations, the applicant may build all (20,970 linear feet and 2,282,468 cubic yards) or a portion of the proposed project. Currently, the adjacent Town of Kill Devil Hills is also seeking permits to allow the construction of a beach project along the Town’s entire shoreline (See Section 2.2.4 below). Consequently, there is a possibility both the Kitty Hawk and Kill Devil Hills projects could be constructed concurrently, which would eliminate the need for the south taper of the Kitty Hawk project.

There are three staging areas proposed for the project. and a construction corridor by which machinery can access the beach. These staging areas include the existing paved parking lots at Perry Street and Byrd Street and include a construction access corridor to the beach (Appendix A, Sheets 5 and 10). The third staging area at Helga Street is located adjacent to the beach (Appendix A, Sheet 3). One additional construction access corridor will be located just north of

the Kitty Hawk pier at Station 0+00 extending from the public parking lot at the Hilton Garden Inn onto the beach (Appendix F).

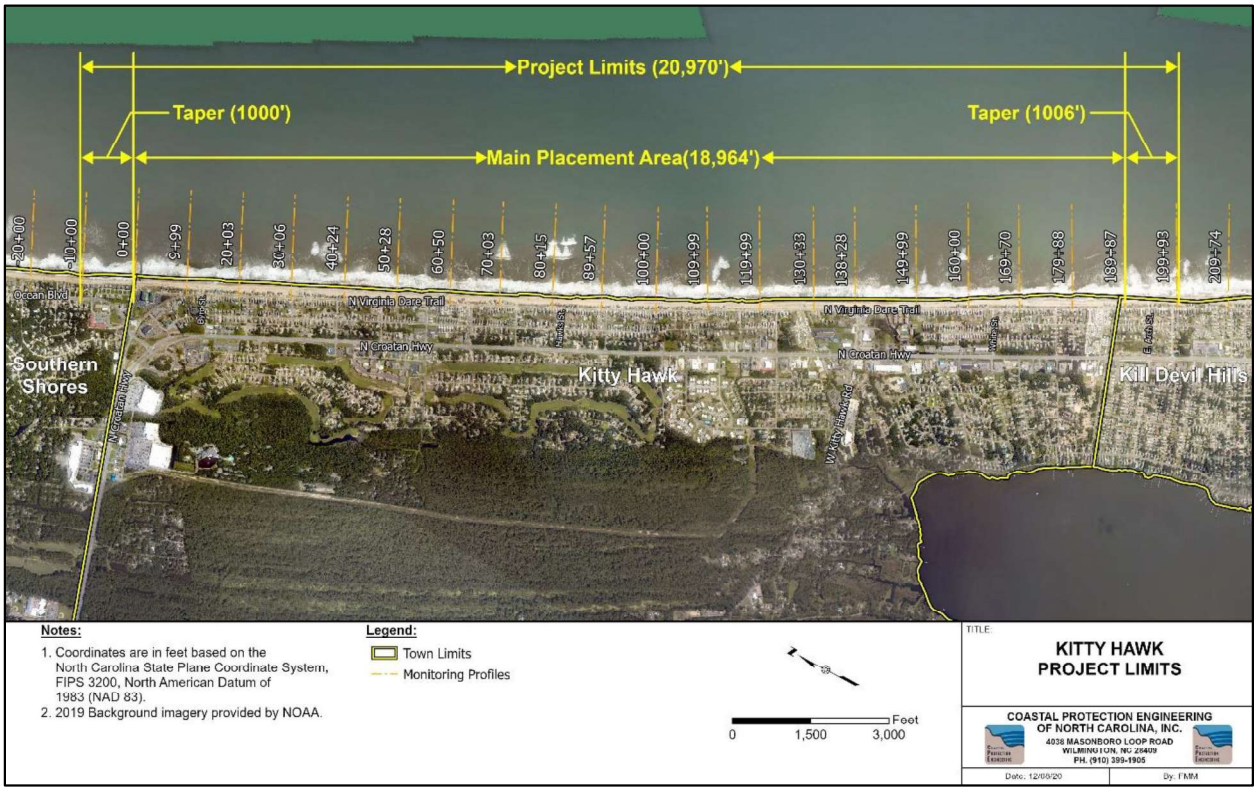

Figure 4. Plan view for the proposed project within the Town of Kitty Hawk including the including the project limits, main placement area, and tapers

2.2.4 Town of Kill Devil Hills Beach Nourishment Design

The proposed action is a one-time beach nourishment event that will include sand placement along a 2.73-mile section of oceanfront shoreline. The main fill portion of the proposed project (excluding tapers) begins at the north town limit (baseline station 189+00) and extends south to Windsong Way located near baseline station 314+88. The length of the main portion of nourished shoreline, excluding the tapers, is 12,500 feet. If the Kill Devil Hills project is constructed as a stand-alone project, two taper sections would be included, one on the south end and the other on the north end of the main placement area. The north taper would extend 933.2 feet into the Town of Kitty Hawk, terminating just south of Tateway Road at station 179+88. The south taper would extend 1,031 feet, ending at the Prospect Avenue public access at station 324+97. Thus, the maximum extents of the Kill Devil Hills project would include 14,464 feet (2.73 mi.) of shoreline (Figure 5). The proposed design includes a 20-foot wide dune at elevation +15.0 feet NAVD fronted by a 40 ft. berm. Modeling results and topographic data indicate that no design dune is required between stations 240+42 and 269+49, and south of 304+82; therefore, only a 40-foot wide berm will be constructed in these areas. The square footage of fill to be

placed below MHW (1.2 ft. NAVD88) to the seaward tow of fill is 3,174,234 square feet (42.69 acres), and the total fill area above MHW is 1,859,831 square feet (72.87 acres), for a total disturbed area of 5,034,065 square feet (115.57 acres).

Construction of the preferred design along with 5 years of advanced fill would require 848,735 cubic yards of fill material obtained from Borrow Area A. Actual volume dredged from the borrow area will likely require up to an additional 20% to account for losses during dredging; therefore, the total estimated dredge volume is 1,018,482 cubic yards. The BOEM lease request for excavating material from within Borrow Area A will include additional volume in the unlikely event a storm eroded the Towns' shoreline prior to the construction of the project. In total, the amount of material that could be excavated from the borrow area would be 1,273,103 cy, or 50% more than the 848,735 cy of fill required by the preferred design and advanced fill. Following the construction of the 2017 project, an after-dredge survey revealed that Borrow Area A still contained 12,829,500 cy of material, therefore this borrow area contains enough volume for this project along with the other three towns' proposed projects.

As discussed above, the Town of Kitty Hawk is also seeking permits to allow the construction of a shore protection project along its entire oceanfront shoreline. Consequently, there is a possibility both the Kill Devil Hills and Kitty Hawk projects could be constructed concurrently, which would eliminate the need for the north taper section of the Kill Devil Hills project. Dependent upon several variables, including whether the project is constructed as a stand-alone project, available funding, time or contractor constraints, or any unforeseen limitations, the applicant may build all or a portion of the proposed project.

There are thee proposed staging areas for this project. The staging area along the beach front at Helga Street encompassing approximately 0.54 ac. (23,495 sq ft) and has an associated 70' long construction corridor to the beach. The second staging area is located along 5th Street and encompasses approximately 0.02 ac. (1,030 sq ft) and has an associated 277' long construction corridor to the beach. The third staging areas is located at the Ashville Drive beach access. This staging area encompasses 0.04 ac (1,652 sq ft) and has an associated 285' construction corridor to the beach. Cumulatively, these staging areas encompass 0.60 ac (26,177 sq ft). No impervious surfaces or alterations to the dunes will be required for use of these areas.

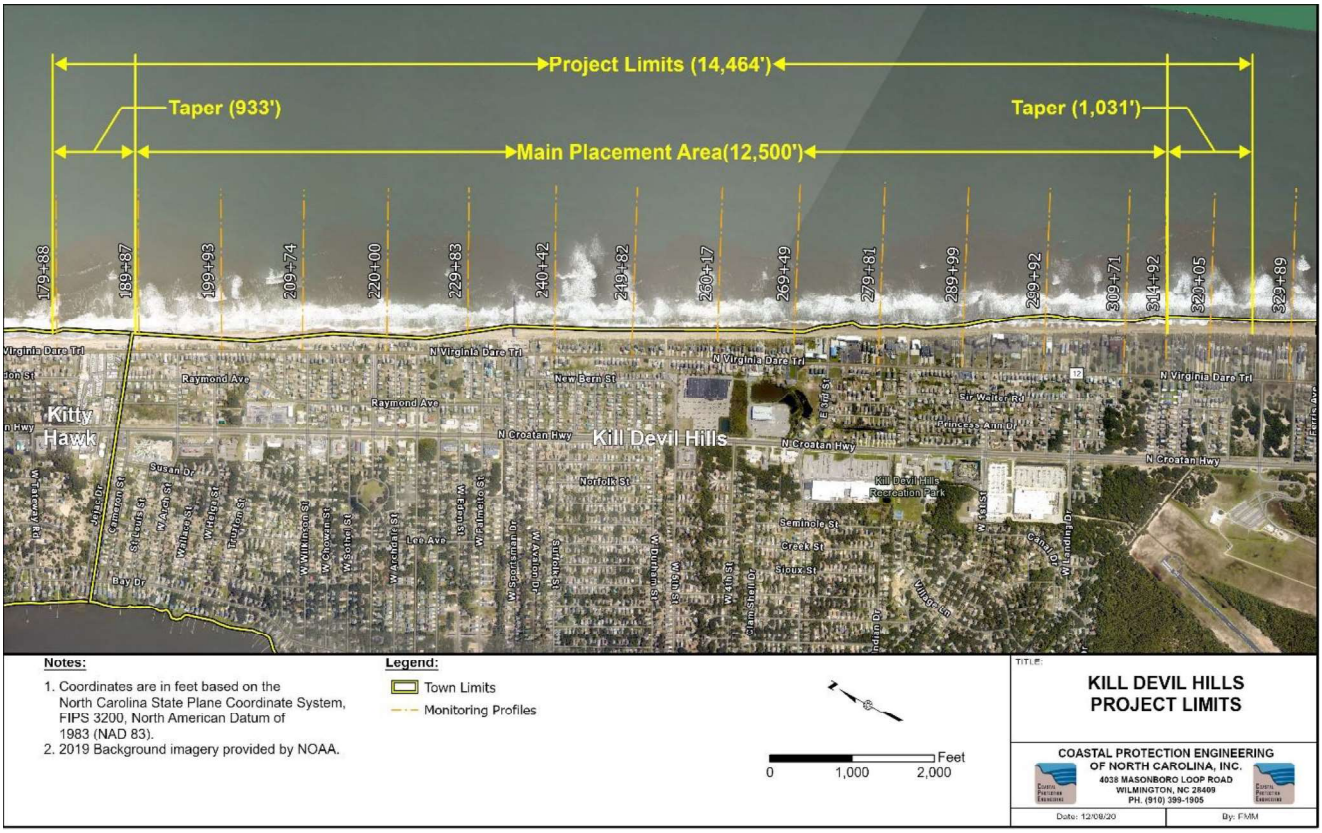

Figure 5. Plan view for the proposed project within the Town of Kill Devil Hills project including the project limits, main placement area and tapers.

2.2.5 Borrow Area Design

The estimated 6,589,633 cy of material needed to construct the project would be obtained from Borrow Area A as shown in **Error! Reference source not found.**. The borrow area is located entirely within federal waters, i.e., seaward of the Three Nautical Mile Line, placing them under the jurisdiction of BOEM. Although two borrow areas (Borrow Area A and Borrow Area C) were used for the 2017 project, this proposed project will not utilize Borrow Area C as the remaining volume is insufficient.

As described in the 2015 EAs, in order to identify and characterize sand source material, CPE-NC used a systematic approach to marine sand searches developed by Finkl, Khalil and Andrews (1997), Finkl, Andrews and Benedet (2003), Finkl, Benedet and Andrews (2005), and Finkl and Khalil (2005). This methodology was used again for this proposed project when assessing the characteristics of the material within Borrow Area A. Proposed Borrow Area A is located on the Outer Continental Shelf between 5.0 and 6.5 miles offshore the Towns of Kill Devil Hills and Nags Head in water depths between 50 and 60 feet and encompasses 1,173 acres. Prior to the construction of the 2017 project, survey data indicated that the Borrow Area A contained 16,373,400 cubic yards of material. The post-construction survey of the borrow area showed that approximately 3,543,900 was removed from the site during the 2017 operation. The post-

construction volume remaining within Borrow Area A was determined in the fall of 2017 to be 12,829,500 cubic yards of material. No additional surveys have been performed within the borrow area since that time, however, it can be assumed that there has been some infilling within the dredge cuts.

Borrow Area A has been divided into seven different design cuts with cut depths ranging from -58.5 to -68.0 ft. (Figure 6). The sediment compatibility analysis, as discussed in section 3.1.2 and 3.1.3, determined that the offshore borrow material in Borrow Area A meets the compatibility requirements established by the North Carolina Coastal Resources Commission (CRC) prior to the 2017 nourishment event. It is the position of the applicants engineering consultant that the previous sediment compatibility analysis (Table 3) remains valid for Borrow Area A. Through correspondence with Division of Coastal Management staff, the applicant was notified that DCM has some concerns about the compatibility of the material in areas previously dredged. Cuts A3, A4, and A5 have been identified as portions of the borrow area not previously dredged during the 2017 construction project. Collectively these three cuts contain 5,153,700 cy of material. Given concerns expressed by DCM staff regarding sediment compatibility of portions of the borrow area previously dredged, the applicant requests DCM consider conditioning the permit to require the applicant to conduct updated bathymetric surveys and sediment sampling of portions of the borrow area previously dredged (Cuts A1, A2, A6, and A7) to evaluate the potential for infilling and sediment compatibility, prior to construction of the project. The additional bathymetric surveys and sediment sampling would need to demonstrate sediment compatibility of any sediment that has infilled previously dredged areas. It is the applicant's intent to conduct such surveys and sediment sampling/analysis during the months of April and May of 2020. In order to maintain the project schedule, the applicant has determined that permit decisions need to be made prior to August 2021. The recommended course of action would allow for DCM to continue its permit review while providing the applicant time to conduct the further investigations, which would be incorporated into bidding documents prior to the project being advertised for bid.

The cultural resource surveys identified three targets within Borrow Area A; therefore, "cultural resource buffers (no work zones)" were developed around the targets and are incorporated into the design (Figure). Further details regarding the cultural resource surveys within Borrow Area A are provided in section 4.7.

The sediment compatibility analysis (discussed in Section 3.1.2 and 3.1.3) determined the material in the offshore borrow area meets the compatibility requirements established by the North Carolina Coastal Resources Commission (CRC). Results of the sand compatibility analyses are discussed further in sections 3.1.2 and 3.1.3.

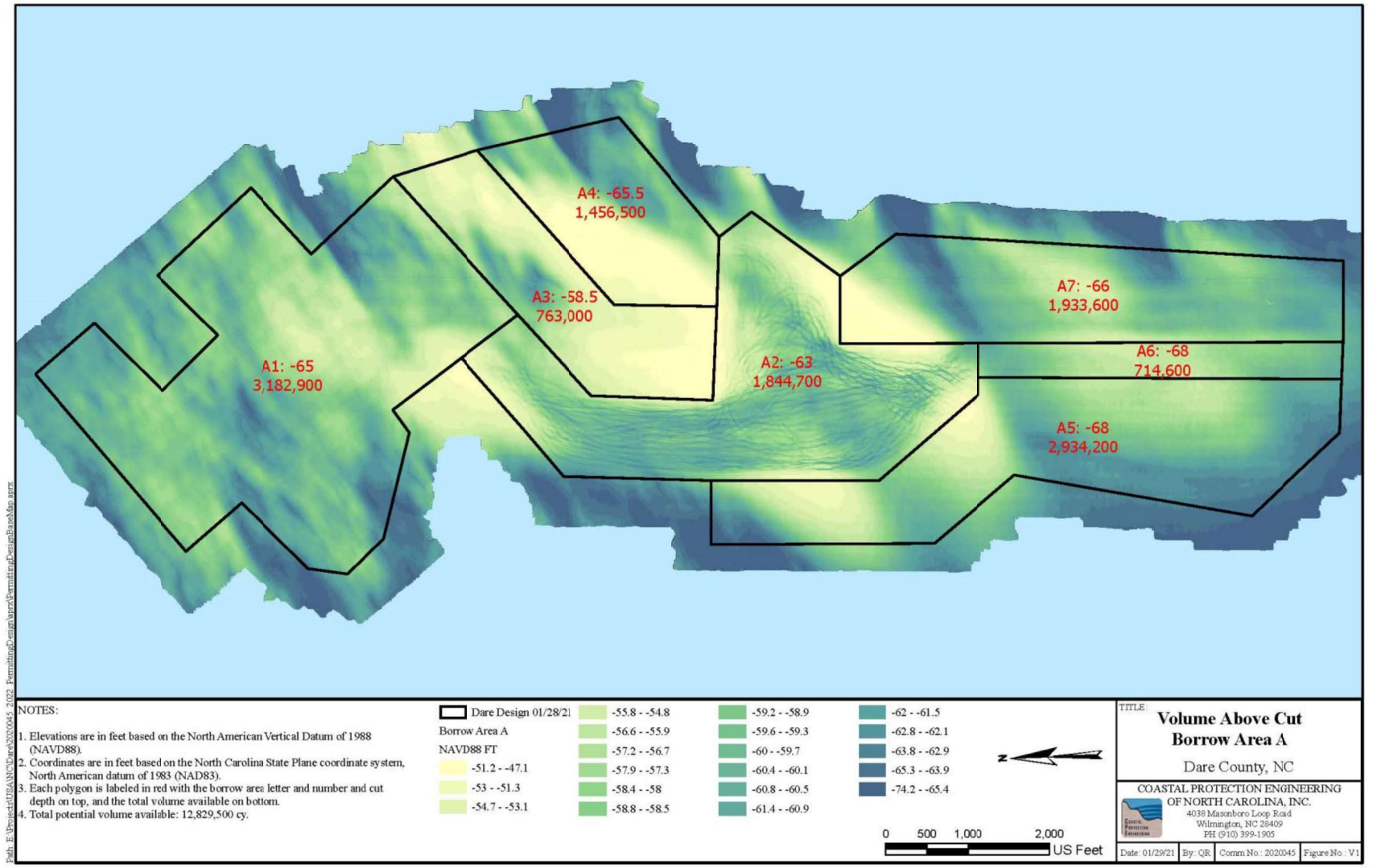

Figure 6. Map of Borrow Area A, showing preliminary design cuts and estimated volumes.

2.2.6 Construction Methods

To obtain material from the borrow area, the Applicant proposes to use either an ocean-certified, self-contained hopper dredge with direct pump-out, a cutterhead suction dredge, or a combination of the two. The attributes of these dredge types are discussed in detail within the EAs developed for the 2017 nourishment project (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b). The dredge types utilized will depend on many factors, including competition in the bid process, pumping or haul distance, and depth and extent of dredging.

The towns aim to complete the project in the shortest time practicable, during a safe operating period and with the least environmental impact possible. Weather and sea-state conditions play a crucial role in the safety and efficiency of offshore dredging projects, particularly during the winter. The wave climate in the northern Outer Banks is reportedly among the most inclement on the U.S. eastern coast (Leffler *et al.,* 1996; Appendix A, CPE-NC, 2015a, CPE-NC, 2015b). Accordingly, the towns propose a year-round construction schedule with a high likelihood that construction would occur during the calmer and safer summer months, just as the 2017 nourishment project was. The ability to perform construction year-round would provide the contractor the most flexibility and provide a safer and more economical work environment for offshore dredging activities in the northern Outer Banks. To allow for the greatest scheduling flexibility, no start and end date will be specified; rather, this will be up to the contractor and based on equipment availability and weather conditions. Based on the production rates experienced during the 2017 nourishment event, the project will likely require approximately 5 months to complete, although this could vary depending on whether the construction of each of the four town's components would be performed concurrently or independently. The maximum time anticipated for completion of the four components is 9 months; however, the contractor could utilize multiple pieces of equipment and construct the projects concurrently, leading to a minimum construction time of 3.5 months. These timeframes are based on the production rates for hopper dredges achieved during the 2017 nourishment project.

Should hopper dredges be utilized, the proposed project may employ relocation trawling as a means to reduce the potential for entrainment of protected species, such as sea turtles and Atlantic sturgeon. Although the 2020 South Atlantic Biological Opinion (SARBO) does not require employing this method to reduce the risk of takes, relocation trawling has been employed in select USACE dredging projects since the 1980's, and has proved to be a successful method for temporary displacement of sea turtles from a project area when hopper dredging was ongoing (Bargo *et al.,* 2009). More information regarding the protocols and techniques which will be employed for relocation trawling efforts are included within the previously drafted 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

Once the material is discharged from the pipe onto the beach, onshore construction crews will shape the material into the desired construction template. The material is typically managed in a

way that reduces turbidity by constructing shore parallel berms along which the water from the slurry will run, allowing additional time for material to settle out of suspension before the seawater returns to the ocean. Equipment such as bulldozers and front-end-loaders are typically used to shape sand on the beach and move pipes as necessary. At the location where the submerged pipeline comes ashore, the slurry flow is typically diverted with a 90-degree elbow to direct the flow towards the project area. As portions of the project are constructed, the pipeline is extended to allow for the next section of beach to be constructed.

3.0 AFFECTED ENVIRONMENT

In July of 2020, the Council on Environmental Quality (CEQ) updated its NEPA regulations and stated the Affected Environment section of an EA should succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration, including the reasonably foreseeable environmental trends and planned actions in the area(s). The Affected Environment within the proposed project area, as described below includes the fact that future berm and/or dune maintenance may occur on a regular basis in the future as a result of the proposed project. Impacts specific to the two alternatives considered are in Section 5.

Details regarding the affected environment associated with the 2017 nourishment project was provided in detail within the three 2015 EAs (Appendix A, CPE-NC 2015a, CPE-NC 2015b). Because the proposed project would affect many of the same resources assessed in what was discussed within the 2015 EAs, the following section will serve to update and supplement the information already available in the 2015 EAs.

3.1 Physical Environment

The four towns included within this proposed project are on the Outer Banks, a coastal barrier island system along the Atlantic coastline of northeastern North Carolina. The natural habitats within these towns follow a profile typical of a coastal barrier island system, transitioning east to west from open ocean to island shoreline, dune, over-wash (mud flat), salt marsh and finally, marine sound. The Project Area is defined as the boundary of where direct effects will occur and is inclusive of the area of nourishment along the shoreline and the OCS borrow area.

3.1.1 Geology and Geomorphology

The geomorphology of the North Carolina coastal environment has been described in detail within the 2015 EAs. In general, it is geographically divided into northern and southern zones by the paleotopographic high referred to as the Cape Lookout High. The region north of Cape Lookout lies within a structural basin known as the Albemarle Embayment and consists of a 90 m thick Quaternary stratigraphic record (Mallinson *et al.*, 2009). The northern zone has been shaped by

multiple cycles of deposition and erosion related to global sea-level cycles during the Pleistocene epoch. Sea level rise during the present geological epoch (Holocene) has resulted in non-uniform deposition of coastal sediments over the eroded Pleistocene embayments. The modern North Carolina barrier island system is therefore superimposed upon multiple irregular, partially preserved and highly dissected geological strata and consists of sediments ranging from peat and mud to unconsolidated or semi-unconsolidated sands, gravel and shell beds.

The inner continental shelf of the Albemarle Embayment is characterized by abundant sediment deposition reflected in large shoal structures, as well as shoreface attached ridges and sorted bedforms (Thieler *et al.,* 2014). Sorted bedforms are subtle, large-scale regions of coarse sand with gravel and shell hash that trend obliquely to the coast. In a 2014 study, Thieler *et al.* identified large-scale bedforms present over broad areas of the inner shelf within Raleigh Bay in the Outer Banks. The bedforms begin about 500 m to approximately 11 km off the coast and span an area over 1000 km^2 between Cape Hatteras and Cape Lookout. These features, also called rippled scour depressions, consist of coarser sediment in the troughs and finer sediments in the ridges (Thieler *et al.*, 2014).

The portion of the Albemarle Embayment extending south from the Town of Kitty Hawk to Cape Hatteras is characterized by a pattern of large, sediment rich, shoal structures (Thieler et al., 2014). A shoal is a natural, underwater ridge, bank or bar consisting of sedimentary deposits, typically sand or gravel dominated, with bathymetric relief of 3 feet or greater and providing potentially important habitat. Major shoal features in this area include Oregon shoal, Platt Shoals, Wimble Shoals, Kinnakeet Shoals, and Diamond shoals (Figure 7). Borrow Area A also falls within this region, and is located in proximity of Oregon shoal – a triangular shaped shoal 15 km long and 3 km wide. The Oregon shoal spans approximately 34 km^2 and lies in 10 to 19 m water depth. This shoal merges with Oregon shoal in a series of large sand waves, and is covered with 1 to 1.5 m high sand waves with wavelengths of 400 m to 1,000 m.

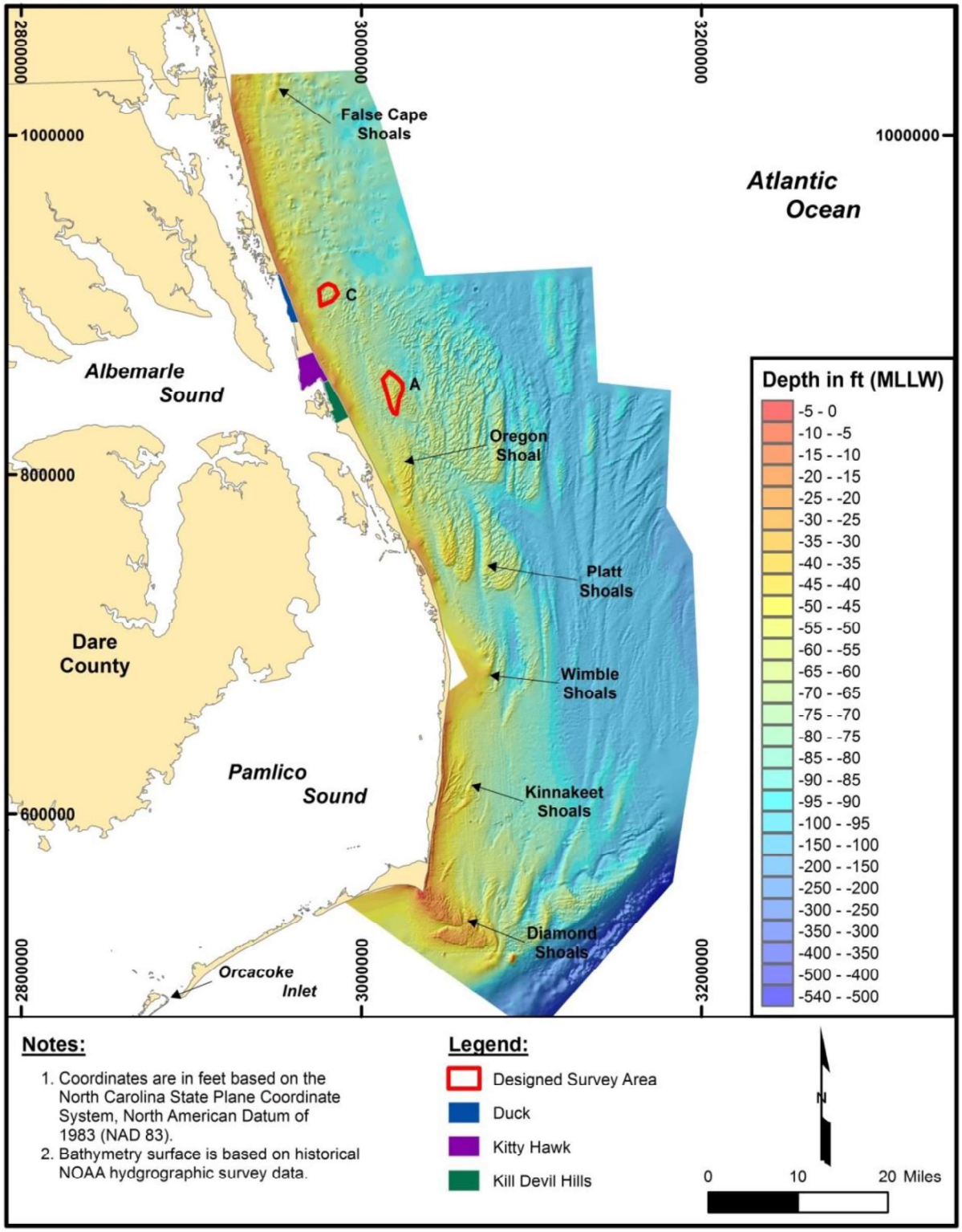

Figure 7. Regional bathymetry with potential borrow area and major shoal features. Note: Borrow Area C will not be utilized for this proposed project.

3.1.2 Native Beach Sand Quality and Composition

Regional sediment composition, sediment size and sediment shape are among the many variables affecting a coastline's morphology. Barrier islands in the Outer Banks are primarily composed of unconsolidated fine- to medium-sized quartz and shell (calcium carbonate) material (McNinch, 2004).

Taking material from offshore and placing it onto the beach has the potential to alter the physical characteristics of the native beach. To minimize the risk of such alterations, projects are designed to use similar sediment with regards to sorting, mean grain size, median grain size, and sediment composition. Furthermore, the North Carolina State Sediment Criteria Rule (15A NCAC 07H .0312) sets state standards for nourishment projects to prevent the disposal of incompatible material on the native beach. More information regarding the North Carolina State Sediment Criteria Rule can be found within the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

Native beach material was collected and analyzed for the towns of Duck, Kitty Hawk, and Kill Devil Hills prior to the construction of the 2017 beach nourishment event to ensure that the borrow material would be compatible. The details of the native beach sampling protocols are provided in the 2015 EAs with the results depicted in Table 3. In June 2020, samples of the Southern Shores native beach material were collected from 5 transects with 13 samples collected at each transect. Sampling began at the dune and extended seaward to the -20-foot NAVD contour. In keeping with the state standards, six of the samples were collected landward of mean low water, six seaward of mean low water and one at mean low water. The results of the characterization of the Southern Shores samples, as well as allowable limits for offshore borrow area material as determined by the State Sediment Criteria, are provided in Table.

Table 3. Characteristics of the native beach material for each town. The State sediment criteria allowances are displayed for each parameter.

Parameter	Duck	Southern Shores	Kitty Hawk	Kill Devil Hills	State Standard Allowance
Mean Grain Size	0.33	0.44	0.38	0.36	n/a
Munsell Color (Wet/Dry)	5/6	6/7	5/7	5/7	n/a
% Silt	1.01	1.23	0.94	0.90	Native + 5%
% Granular	3.89	6.03	6.38	5.15	Native + 5%
% Gravel	2.00	2.17	1.64	1.62	Native + 5%
% Carbonate	2.0	2.0	2.0	2.0	Native + 15%

Note: There are no state standard allowances for mean grain size or Munsell color.

Along with ensuring compatibility of the sand characteristics, the State Sediment Criteria also require quantification of clasts (rocks and shell) greater than 3-inches in diameter present on the native beach. As such, scientists conducted a pre-construction survey to determine the background levels of clasts (rocks) greater than 3-inches that exist along each of the four towns' beaches. Per the updated State Sediment Criteria language, the number of 3-inch clasts were quantified within five (5) 10,000 sq ft.[2] sections within each of these native beaches. Results identified 267, 65, 16, and 37 clasts greater than 3-inches within the survey areas at Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills, respectively. The criteria stipulate that borrow area material greater than 3-inches in diameter that is placed in the project area is considered incompatible if it is more than twice the background level that existed on the native beach before the project began. Since the June 2020 survey, the State has updated their guidance again and now also require a survey, using the same methodology described above, to determine the total number of sediments greater than or equal to one inch in diameter. Although this additional survey has not been conducted at this time, the Towns will perform it prior to the implementation of the proposed project.

3.1.3 Borrow Area Sand Quality and Composition

Analysis of sediment characteristics from within Borrow Area A, suggests that the material within meets or exceeds the standards for the each of the native beach at all four towns, per the State Sediment Criteria are presented in Table . This material was placed along the oceanfront shorelines of Southern Shores, Kitty Hawk, and Kill Devil Hills during the 2017 nourishment event. As the beach was constructed, sediment samples were collected and visually inspected along the entire project area at approximately 100 ft. intervals in order to verify the compatibility of the material in terms of visual estimates of shell percentage, silt/clay content, grain size, and color. Additional information pertaining to the geotechnical and geophysical efforts that were performed during the borrow area investigation are included within the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

Table 4. Composite summary sediment characteristics of the offshore borrow area within BOEM jurisdiction.

Parameter	Borrow Area A
Mean Grain Size (mm)	0.36
Sorting (Phi)	1.47
Wet/Dry Munsell Color	5/6
Fines (%)	0.83
Granular (%)	1.42
Gravel (%)	0.47
Carbonate (%)	1.0

3.2 Littoral Processes

The four beach towns included within this proposed project are subject to littoral processes typical of the barrier islands that line the North Carolina coast. The islands are subject to winds, rising sea levels and strong storms that gradually push sand from the ocean side of the islands to the land side. The project area includes the intertidal and subtidal unconsolidated bottoms, as well as the offshore sand shoals within the borrow area. Coastal salinity is maintained at approximately 35 ppt year-round and water temperatures range from 49ºF in January to 80ºF in August. This coastline experiences semi-diurnal tides with an average tidal range of approximately 3 ft. Net water movement is from north to the south via a longshore current that veers toward the southeast in the summer and toward the southwest in the winter (Inman and Dolan, 1989).

The predominant wave direction in the northern Outer Banks comes from the south to southeast in the spring and summer and from the north to northeast in the fall and winter. Annually, the wave heights typically range from 1.6 to 4.9 ft., with a mean wave height of about 3.3 ft. (USACE, 2006). Highest waves are generally associated with tropical storms and may occur in phase with hurricane surges which typically occur between the months of June and October. According to the USACE (2006), this area can experience waves in excess of 15 ft. during tropical storms, although they occur sporadically. These waves contribute to coastal erosion impacting both the beach berm and dunes. The National Oceanographic and Atmospheric Administration (NOAA) has maintained a tide observation station at Duck, North Carolina called Tide Station 8651370 since 1978 (NOAA, 2020). The mean sea level trend for Duck is estimated at 4.77 mm/year, based on monthly mean tidal data recorded by Tide Station 8651370 from 1978 to 2019 (NOAA, 2020).

According to the International Panel on Climate Change (IPCC), global mean sea level has been rising and will continue to do so during the 21st century. Climate models predict that rates of sea level rise will increase due to increased ocean warming and melting glaciers and ice sheets (IPCC, 2013).

3.3 Water Quality

The North Carolina Department of Natural Resources (NCDENR) Division of Marine Fisheries (DMF) maintains water quality sampling sites throughout the state. Six sampling sites are located near the project area. These include station N5A (beach access at Springtail Drive at Duck), N7 (Hillcrest Drive at Southern Shores), N7A (1.5 miles north of Kitty Hawk Pier in Southern Shores), N12 (SR 1206 in Kitty Hawk), N12A (Sportsman Dr. in Kill Devil Hills), and N12B (3rd Street in Kill Devil Hills). The 2015 EAs indicated that these sampling sites maintained good water quality in terms of *Enterococci* bacteria (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b). Between 2016 and 2020, there were only two sampling dates that contained elevated *Enterococci* levels above EPA standards. The remaining samples collected during this time period contained

acceptable levels of bacterial indicating that these sampling sites continue to have generally good water quality levels in terms of *Enterococci*.

3.4 Air Quality

Ambient air quality standards are based on six common pollutants: particulate matter less than 2.5 m (PM-2.5); particulate matter 2.5 to 10 m (PM-10); carbon monoxide (CO); ozone (O_3); sulfur dioxide (SO_2); nitrogen dioxide (NO_2); and lead (Pb). According to the EPA, a geographic area that meets or is within the national ambient air quality standard is deemed an "attainment area"; an area that does not meet this standard is called a nonattainment area. Dare County as a whole is designated as an attainment area (USEPA, 2020).

3.5 Noise

Ambient noise levels within the project area are relatively low as the oceanfront shorelines are primarily surrounded by residential homes and commercial properties. Please refer to the 2015 EAs for more details and information regarding the source of noise and ambient sound levels (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

3.6 Natural Setting

Natural habitats found within the project area include dry beaches, dunes and foredunes. Additional natural habitats that are designated as Essential Fish Habitat are discussed in Section 3.7 below. The construction of the 2017 nourishment project modified aspects of the natural setting and are addressed accordingly below.

3.6.1 Beach and Dune

The beach and dune community within the project area is limited in extent due to development and a coastline that is receding due to storm events and beach erosion (Leatherman *et al.,* 2000). A description of these habitat types is provided in detail within the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b). The 2017 nourishment project modified the conditions of the dunes and beaches within the towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills. The project involved the placement of 1,263,181 cubic yards of sand along 1.6 miles of shoreline in the Town of Duck; 1,765,619 cubic yards along 3.8 miles of shoreline in the Town of Kitty Hawk; 80,510 cubic yards along 1,500 feet of shoreline in Southern Shores; and 817,359 cubic yards along 2.6 miles of the Kill Devil Hills shoreline. The fill placed within the Town of Duck included a 20-foot-wide dune with a beach berm constructed at a variable width. The fill design at Kitty Hawk included a 10-foot-wide dune fronted by a 60-foot beach berm. While no dune was constructed at Southern Shores, a beach berm was constructed. At Kill Devil Hills, a 20-foot-wide

dune was constructed along with a design for a 40-foot beach berm. Additional material was placed on the beach berm along each town's shoreline to serve as advanced fill. Post-construction surveys were conducted in December (several months after the completion of the project) to determine the fill volume, fill density, and beach berm width as-built fill density along each town's shoreline as the material equilibrated. This information is depicted in Table 5.

Table 5. Distance of shorelines where sand placement occurred, post-construction volumes, and fill densities associated with the 2017 nourishment project.

	Distance of Shoreline (feet)	Pre-Construction to Dec. 2017 Volume [1] (cubic yards)	As-Built Fill Density (cubic yards/foot)	Pre-Construction to Dec. 2017 Beach Width Change[2]
Town of Duck	8,358	966,300	151.1	110.9 ft.
Town of Southern Shores	1,500	121,713	53.7	60.1 ft.
Town of Kitty Hawk	19,989	2,120,195	88.3	97.8 ft.
Town of Kill Devil Hills	13,577	895,413	60.2	37.1 ft.

[1] Volume change computed along the portion of the profile where AD and BD surveys overlap.
[2] Width of the beach at the Mean High Water (+1.2' NAVD88) Shoreline.

Since 2017, additional post-construction surveys have been completed in 2018, 2019, and 2020. As of the June 2020 survey, the project area within Duck had lost a total of 271,000 cubic yards, or 40% of initial fill volume measured above the -24-foot NAVD88 contour. Between December 2017 and May 2020, profile surveys indicate that the beach fill project area of Southern Shores lost approximately 92,100 cubic yards or about 44% of the fill initially measured within the project area as of December 2017. Between the same time period, the Kitty Hawk and Kill Devil Hills project areas lost approximately 787,200 cubic yards and 246,800 cubic yards, respectively. The volumetric losses indicate the volume of beach fill remaining within both projects as of June 2020 was 63% for Kitty Hawk and 71% for Kill Devil Hills.

3.7 Essential Fish Habitat

The term "essential fish habitat" or EFH is defined under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and refers to waters and substrate necessary for fish to spawn, breed, feed or grow to maturity. Essential fish habitats are those necessary to maintain fish production consistent with a sustainable fishery and the managed species' contribution to a healthy ecosystem. The MSA provides for conservation and management of Federal fisheries and requires Federal fishery management plans to describe and identify essential fish habitat for managed fish species, to minimize to the extent practicable adverse effects on such habitat caused by fishing, and to identify other actions to encourage the conservation and enhancement of such habitat. A separate Essential Fish Habitat assessment document (Appendix C) has been developed

to satisfy the MSA's consultation requirements with NMFS. The following sections, however, provide information regarding EFH within the project area.

3.7.1 Fishery Management

The MSFCMA of 1976, amended in October 1996 and also referred to as the Sustainable Fisheries Act, was enacted by the U.S. Congress to protect marine fish stocks and their habitat, prevent overfishing while achieving optimal yield and minimize bycatch to the extent practicable. Congress defined Essential Fish Habitat as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." The MSFCMA requires that EFH be identified for all fish species federally managed by the Fishery Management Councils (FMC) and the National Marine Fisheries Service (NMFS).

Eight FMC were established under the MSFCMA to manage living marine resources within federal waters and are required to describe and identify EFH designations in their respective regions. Each of these councils is responsible for developing Fishery Management Plans (FMP) to achieve specified management goals for fisheries. The FMP includes data, guidelines for harvest, analyses, and management measures for a fishery. Each FMP must describe the affected fishery, analyze the condition of the fishery, and describe and identify relevant EFH.

In close coordination, both the South Atlantic Fisheries Management Council (SAFMC) and the Mid-Atlantic Fisheries Management Council (MAFMC) manage marine fisheries in the federal waters off the North Carolina coast. Federal water limits off the North Carolina coast extend from 3 nautical miles to 200 nautical miles. In addition, the Atlantic States Marine Fisheries Commission (ASMFC) manages fisheries in the state waters of all 15 Atlantic coast states from Maine to Florida. The ASMFC manages fish stocks within the state waters of North Carolina from the coastline to three nautical miles offshore. NMFS manages highly migratory species (HMS).

The SAFMC is responsible for the conservation and management of fish stocks within the federal 200-mile limit of the Atlantic off the coasts of North Carolina, South Carolina, Georgia and east Florida to Key West. The seven states that comprise the MAFMC are New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia and North Carolina (North Carolina is also on the South Atlantic Council). The MAFMC also works with the ASMFC to manage summer flounder, scup, black sea bass, bluefish, and spiny dogfish. The SAFMC broadly defines EFH habitats for all of its managed fisheries in a generic management plan amendment that contains life stage based EFH information for each of the federally managed species. The SAFMC currently manages eight fisheries that include coastal migratory pelagics, coral and live bottom habitat, dolphin and wahoo, golden crab, shrimp, snapper grouper, spiny lobster and Sargassum. Of these eight fisheries, only the snapper grouper complex contains species that are considered overfished. Both the recreational and commercial snapper grouper fisheries are highly regulated and progress continues to be made as more species are removed from the overfished list each year. The other fisheries are expected to continue into the future at productive sustainable levels (SAFMC, 2020).

The MAFMC is responsible for the conservation and management of fish stocks in the federal waters off the coasts of New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia and North Carolina. They have prepared multiple FMPs with amendments to identify EFH for each life stage (eggs, larvae, juvenile and adults) of its managed fisheries. The MAFMC identifies several broad areas designated as EFH in estuarine and marine environments. The six FMPs developed by the council are the golden tilefish; summer flounder, scup, black sea bass; dogfish; surf clam and ocean quahog; Atlantic mackerel, squid, and butterfish; and bluefish (MAFMC, 2020).

NMFS has also prepared multiple FMPs with amendments to identify EFH within its authority. Four fisheries (billfish, swordfish, tuna and sharks) are managed under the FMPs of NMFS and are classified as Highly Migratory Species (HMS). NMFS geographically defines EFH for each HMS along the Atlantic coast. The defined EFH areas are species-specific and include shallow coastal waters, offshore waters inside the exclusive economic zone (EEZ), offshore waters outside the EEZ and inshore waters along the Atlantic coast (NMFS, 2010).

The North Carolina Marine Fisheries Commission (NCMFC) manages commercially, and recreationally significant species of fisheries found in state marine or estuarine environments. The NCMFC designates Primary Nursery Areas (PNA) that are included as EFH by the SAFMC.

Table 4 in Appendix C depicts the EFH species and lifestages for these species that overlap the proposed borrow area with high impact potential.

3.7.2 Habitats Designated as EFH

Aside from the life-stage based EFH defined for managed fish species, the SAFMC and MAFMC have designated eight habitats as EFH. Of those habitat types, only the marine water column is found within the Project Area. There are no estuarine areas located within the Project Area. Also, as determined from sidescan sonar data acquired during geophysical surveys of the borrow area (discussed in section 3.1.1), there are no hardbottom habitats within or in the vicinity of the project area. There are also no coral and coral reefs, artificial/manmade reefs or Sargassum essential fish habitat marine areas located with the Project Area. There are no potential impacts for these EFH categories and they will not be discussed further.

The marine water column will be temporarily affected by an increase in turbidity, and potentially by a decrease in dissolved oxygen (DO), as a result of dredging in the offshore borrow area and by the placement of sand onto the beach. Additionally, transient indirect effects to the marine water column, surf zone, offshore shoals and managed species are expected due to benthic resources being temporarily effected by the removal of sediment within the offshore borrow area and through burial with sand placement along the oceanfront shoreline. Brief descriptions of the marine water column, offshore shoals and managed species present within the Project Area are continued below.

3.7.2.1 Marine Water Column

The SAFMC and MAFMC designate the marine water column as an EFH. The marine water column is divided into oceanographic zones that are defined by physical parameters of the water column such as temperature, salinity, density and others. Three oceanographic zones are defined for the North Carolina area including outer shelf (131 to 230 ft.), mid-shelf (66 to 131 ft.) and inner shelf (0 to 66 ft.). These zones are influenced by the Gulf Stream, winds, tides and freshwater runoff (SAFMC, 1998).

Marine water column environments in proximity to the Project Area include the inner shelf waters associated with the proposed borrow area and the surf zone waters associated with the placement of sand on the oceanfront shorelines of the Towns. Managed fish species that utilize marine water column EFH in North Carolina waters are managed by the ASMFC, NCDMF, NMFS, SAFMC and MAFMC and are discussed in Section 0 above.

3.7.2.2 Offshore Shoals

Although not identified as Essential Fish Habitat in the FMP Amendments of the South Atlantic and Mid-Atlantic FMC's (NMFS, 2010), offshore shoal environments are utilized by many fish species and NMFS has identified shoal complexes as EFH for Coastal Migratory Pelagics and Highly Migratory Species (SAFMC, 1998; NMFS, 2009). A physical description of the shoal features in vicinity of the project area is provided in section 3.1.1. The functional value shoals provide for fishes has been described to include spawning, shelter and foraging habitat (CSA, Inc *et al.,* 2009). Multiple life stages of a number of fish species have been documented in shoal and ridge/trough complexes. These features may serve as refuge for juveniles and schooling planktivores, habitat for species that serve as prey for demersal fishes, and spawning sites for some demersal fishes and schooling planktivores.

3.7.2.3 Habitat Areas of Particular Concern

Habitat Areas of Particular Concern (HAPC) are subsets of designated EFH and are defined as rare, particularly susceptible to human-induced degradation, especially ecologically important or located in an environmentally stressed area. The SAFMC and the MAFMC have designated HAPC areas to focus conservation priorities on specific habitat areas that play a particularly important role in the life cycles of federally managed fish species. HAPC may include high value intertidal and estuarine habitats, offshore areas of high habitat value or vertical relief and habitats used for migration, spawning and rearing of fish and shellfish (NMFS, 2004). No HAPCs are located within the project area.

3.7.2.4 Nursery Areas

The North Carolina Division of Marine Fisheries (NCDMF) has designated three categories of nursery areas, Primary, Secondary and Special Secondary Nursery Areas. Primary Nursery Areas

(PNAs) encompass approximately 80,000 acres throughout North Carolina. PNAs are typically shallow with soft muddy bottoms and surrounded by marshes and wetlands. They are found in the upper portions of bays and creeks, where the low salinity and abundance of food is ideal for young fish and shellfish. To protect juveniles, many commercial fishing activities are prohibited in these waters. Secondary Nursery Areas (SNAs) are located in the lower portion of bays and creeks. As juvenile fish and shellfish develop, primarily blue crabs and shrimp, they move into these waters. Trawling is prohibited in SNAs. Special SNAs are found adjacent to SNAs, but closer to the open waters of sounds and the ocean. These waters are closed for a majority of the year when juvenile species are abundant (Deaten *et al.*, 2010). There are no NCDMF designated PNAs in the proposed Project Area.

3.7.2.5 Significant Natural Heritage Areas

The North Carolina Natural Heritage Program (NCNHP) serves as an information clearinghouse in support of conservation of the rarest and most outstanding elements of natural diversity in the state. These elements of natural diversity include plants and animals that are so rare or natural communities that are so significant that they merit special consideration in land-use decisions. There are no anticipated direct or indirect impacts to significant natural heritage or managed areas associated with the proposed Project Area.

3.7.3 Managed Species

Managed species that have the marine water column or shoals listed as an EFH and that may be present in the Project Area include coastal migratory pelagics, highly migratory species; snapper grouper complex; shrimp; summer flounder, scup and black seabass; red drum; bluefish and spiny dogfish. Section 3.3 in Appendix C includes detailed information regarding these species.

3.8 Threatened and Endangered Species

This section includes a description the threatened and endangered species that could be present within the project area based upon their geographic range (Table 6). However, the actual occurrence of a species in the project area would depend upon the availability of suitable habitat, the seasonality of occurrence, migratory habits and other factors. The project area is defined by the stretch of shoreline receiving beach nourishment, the borrow area, temporary pipeline corridors, and the surrounding waters.

Table 6. Federally threatened, endangered or proposed listed species, and designated critical habitats, that may occur in the vicinity of the project area.

Common Name	Scientific Name	Federal Status	Likelihood of Occurrence

Mammals			
West Indian Manatee	*Trichechus manatus*	Endangered	Low
North Atlantic Right Whale	*Eubalaena glacialis*	Endangered	Low
Sei Whale	*Balaenoptera borealis*	Endangered	Low
Sperm Whale	*Physeter macrocephalus*	Endangered	Low
Fin Whale	*Balaenoptera physalus*	Endangered	Low
Blue Whale	*Balaenoptera musculus*	Endangered	Low
Reptiles			
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Low
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	Low
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Endangered	High
Loggerhead Sea Turtle	*Caretta caretta*	Threatened (NWA DPS)	High
Green Sea Turtle	*Chelonia mydas*	Endangered	High
Fish			
Shortnose Sturgeon	*Acipenser brevirostrum*	Endangered	Low
Atlantic Sturgeon	*Acipenser oxyrinchus*	Endangered (Carolina DPS)	Moderate
Vascular Plants			
Seabeach Amaranth	*Amaranthus pumilus*	Threatened	Low
Birds			
Piping Plover	*Charadrius melodus*	Threatened	Low
Roseate Tern	*Sterna dougallii dougallii*	Endangered	Low
Rufa Red Knot	*Calidris canutus rufa*	Threatened	Low
Critical Habitat			
Loggerhead Unit LOGG-N-1 (NMFS)		Designated	

3.8.1 West Indian Manatee

The West Indian manatee is listed as a federally protected species under the Endangered Species Act of 1973 (ESA) and the Marine Mammal Protection Act of 1972 (MMPA). Sightings and stranding data suggest the Florida manatee regularly occurs within inland and coastal waters of North Carolina, and they have been sighted most frequently from June through October when water temperatures are warmest (above 71.6º F [22º C]) (USFWS, 2003a; USFWS, 2014a). Manatees may also overwinter in North Carolina where the discharge from power plants supports the warm water temperatures (USFWS, 2008). The USFWS has reported manatee sightings in the last 20 years in the counties of Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Pitt,

Tyrrell and Washington. After compiling state-wide manatee sighting and stranding reports from 1991 to 2012, Cummings *et al.* (2014) reported there have been 99 manatee sightings in North Carolina. Sighting records varied between years and ranged from 0 to a peak of 30 sightings in 2012. Sightings were reported throughout North Carolina, although most were concentrated around the heavily populated coastal areas of Beaufort and Wilmington. Manatees were least commonly sighted in the open ocean and around marinas. With these factors in mind, the number of manatees potentially occurring in the project area is presumed to be low with the greatest likelihood of occurrence during the warmer months, in particular June through October. For more information regarding the West Indian manatee, please refer to the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

3.8.2 Whales

All whales are protected under the MMPA and are under NMFS jurisdiction. There are five species of whales also listed as endangered under the ESA that are known to occur in the Western North Atlantic. These species include the blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), North Atlantic right whale (*Eubalaena glacialis*), sei whale *(B. borealis)* and sperm whale (*Physeter macrocephalus*).

Until 2015, NMFS managed the endangered humpbacks as one global population. In September 2016, NMFS revised the ESA listing for the humpback whale to identify 14 Distinct Population Segments (DPS), list one as threatened, four as endangered, and identify nine others as not warranted for listing (81 FR 62259). With this decision, NMFS established that the health of one stock should be considered apart from other stocks. Today, within U.S. jurisdiction, there are three listed DPSs; the Central America, Mexico, and Western North Pacific (DPSs are named by the breeding waters they return to in the winter months). The humpback whales that migrate through the waters of the project area are part of the West Indies DPS which have been de-listed.

The North Atlantic right whale population ranges primarily from calving and nursing grounds in coastal waters off the southeastern United States to summer feeding and mating grounds that include New England waters, the Bay of Fundy, Scotian Shelf and Gulf of St. Lawrence. Wintering grounds include waters off the southeastern United States where females give birth from December to March (NMFS, 2013a), as well as Cape Cod Bay (Brown and Marx, 1998). Between 2015 through September 2020, NOAA Fisheries has recorded one observation of right whales within the project area. On November 19, 2017, a mother and calf was observed swimming offshore from Kitty Hawk (NMFS, 2020).

Right Whale Slow Zones is a program that notifies vessel operators of areas where maintaining speeds of 10 knots or less can help protect right whales from vessel collisions.

Right Whale Slow Zones, a program that notifies vessel operators of areas where maintaining speeds of 10 knots or less to help protect right whales from vessel collisions, are established around

areas where right whales have been recently seen or heard. These areas are identical to Dynamic Management Areas (DMA) when triggered by right whale visual sightings but, they will also be established when right whale detections are confirmed from acoustic receivers. Under this program, NOAA Fisheries provides maps and coordinates to vessel operators indicating areas where right whales have been detected. Mariners are encouraged to avoid these areas or reduce speeds to 10 knots or less while transiting through these areas for 15 days.

No right whale critical habitat is designated within the project area.

The blue, fin, sei and sperm whales are considered oceanic whales and rarely venture into the shelf waters offshore North Carolina (Kenny and Winn, 1987; NMFS, 1998a). Therefore, these species are considered unlikely to occur within the project area. For more information regarding whales, please refer to the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

3.8.3 Sea Turtles

There are five species of sea turtles that can be found nesting on the beaches of North Carolina, swimming in offshore waters, or both. These species include the leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), green sea turtle (*Chelonia mydas*), and the loggerhead sea turtle (*Carretta carretta*).

The loggerhead sea turtle, which occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans, was federally listed worldwide as a threatened species on July 28, 1978 (43 FR 32800). On September 22, 2011, the loggerhead sea turtle's listing under the Act was revised from a single threatened species to nine distinct population segments (DPS) listed as either threatened or endangered. Loggerhead sea turtles found in proximity to the project area are part of the Northwest Atlantic Ocean DPS which is listed as threatened. Critical habitat for the Northwest Atlantic Ocean DPS has been established by both the USFWS and NMFS. While none of the USFWS designated critical habitat areas for the loggerhead sea turtle is found within the project area, NMFS's critical habitat area "Unit LOGG-N-01" extends into the waters off the southernmost portion of Kill Devil Hills. In addition, Borrow Area A is within this critical habitat unit.

The green sea turtle was federally listed on July 28, 1978 (43 FR 32800). Breeding populations of the green turtle in Florida and along the Pacific Coast of Mexico are listed as endangered; all 97 other populations are listed as threatened. The leatherback sea turtle was federally listed as an endangered species on June 2, 1970 (35 FR 8491). Leatherbacks have the widest distribution of the sea turtles with nonbreeding animals recorded as far north as the British Isles and the Maritime Provinces of Canada and as far south as Argentina and the Cape of Good Hope (Pritchard, 1992). The hawksbill sea turtle was Federally listed as endangered on June 2, 1970 (35 FR 8491). The

hawksbill is found in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean. The Kemp's ridley sea turtle was federally listed as endangered on December 2, 1970 (35 FR 18320). The Kemp's ridley has the most geographically restricted distribution of any sea turtle species. The range of the Kemp's ridley includes the Gulf coasts of Mexico and the U.S., and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland.

Detailed information regarding each of these species' ecology and lifecycles may be found within the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

3.8.3.1 Sea Turtle Nesting Activity

Data provided by the North Carolina Wildlife Resources Commission (NCWRC) for the period from 2009 to 2013 show the leatherback, Kemp's ridley, green and loggerhead sea turtles have been documented nesting along the Northern Outer Banks (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b). Between 2015 and 2020, only Kemp's ridley and loggerhead sea turtle nests were documented nesting within the project area. In North Carolina, sea turtle nesting season starts May 1 and ends August 31, although turtles have been documented nesting outside of these dates in the past. Between 2015 and 2019, a total of 52 sea turtle nests were documented along the shorelines of Duck, Southern Shores, Kitty Hawk, and Duck (Godfrey, pers. comm., June 25, 2020) (Table 7). Fifty were identified as loggerhead nests while two were identified as Kemp's ridley nests. An analysis regarding the trends of documented sea turtle nesting and hatchling emergence dates from throughout the state of North Carolina and specifically within the Outer Banks between 2009 and 2013 was presented in detail within the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

Table 7. Sea turtle nests documented between 2015-2019 within the project area.

Year	Duck	Southern Shores	Kitty Hawk	Kill Devil Hills
2015	3	2	2	2
2016	4	3	5	3
2017	1	2	0	3
2018	1	1	3	3
2019	3	4	6	1

During the 2017 nourishment project, turtle monitoring was conducted in accordance with the conservation measures, reasonable and prudent measures, and terms and conditions detailed in the U.S. Fish and Wildlife Service Biological Opinion (BO) dated November 4, 2015. The turtle monitoring commenced on the night of May 23, 2017. The monitoring was conducted on a daily basis until September 15, 2017 by sea turtle monitors from the Network for Endangered Sea Turtles (NEST). In the early mornings at/or immediately after sunrise, additional volunteer sea turtle

monitor(s) would conduct morning nesting activity surveys and drive the limits of the entire project area to look for any sea turtle crawl activity (i.e. false crawl or nesting). One loggerhead sea turtle nest was relocated during the project on July 6, 2017 near 4th Street in Kill Devil Hills.

3.8.3.2 Swimming Sea Turtles Offshore North Carolina

Numerous studies have shown that the Mid-Atlantic and South-Atlantic Bight, particularly the waters from North Carolina to New Jersey, provide important seasonal and migratory habitat for sea turtles, especially juvenile and adult loggerheads from the Northern U.S population. The Mid-Atlantic Bight (MAB) includes oceanic waters from Cape Cod, Massachusetts to Cape Hatteras, NC; and the South Atlantic Bight (SAB) includes oceanic waters from Cape Hatteras, NC to Cape Canaveral, Florida. In a study spanning ten years (1998-2008), 68 female loggerhead sea turtles (*Caretta caretta*) were tagged following nesting on the beaches of North Carolina (NC), South Carolina (SC), and Georgia (GA) (Griffin *et al.*, 2013). Using satellite tags, their movements were tracked in order to document where the turtles spend their time while at sea. Tagging data indicated that these turtles migrated to areas offshore Cape Hatteras, NC to northern New Jersey (NJ) to forage and recover from the stresses of reproduction and nesting (Griffin *et al.*, 2013). The majority of the turtles (42 of 68) used migration routes over the continental shelf off Cape Hatteras, NC moving south to the South Atlantic Bight from mid-September through November, and north to the Mid-Atlantic Bight in from April through June (Griffin *et al.*, 2013). The width of the migratory corridor used by the turtles was constricted off Cape Hatteras, NC and was used over seven months of the year (Griffin *et al.*, 2013). This indicates that it is an important high-use area for female loggerheads and this should be considered when conducting activities there.

Although loggerheads are the most common turtle occurring offshore of North Carolina, the state's marine waters also provide important habitat for green and Kemp's ridley sea turtles. A review of sightings reports obtained from commercial and recreational fishermen and the public indicate that sea turtles are present offshore North Carolina year-round. There were two seasonal peaks: one in spring (April to June) off the entire North Carolina coast, and one in late fall (October through December) off the northern North Carolina coast (Epperly *et al.*, 1995).

The Sea Turtle Stranding and Salvage Network (STSSN) is a national network of volunteers that document sea turtles that are found stranded in the U.S. A stranded sea turtle is one that is located washed ashore or floating, alive or dead. If it is alive, it is generally in a weakened condition and may be sick or injured. The North Carolina STSSN has documented 2,461 stranded sea turtles offshore of Dare County between the 2015 and 2019 (Table 8). The overwhelming majority of these turtles were identified as green sea turtles followed by loggerhead and Kemp's ridley. Additional sea turtle stranding data from previous years were included in the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

Table 8. Number of stranded sea turtles observed offshore Dare County between 2015-2019.

	Loggerhead	Green	Kemp's Ridley	Leatherback	Hawksbill	Unidentified
2015	64	203	55	3	0	1
2016	87	975	69	1	0	4
2017	157	284	88	12	0	4
2018	57	72	41	2	0	1
2019	47	197	31	1	0	5
TOTAL	412	1,731	284	19	0	15

In accordance with the Biological Opinion issued by NMFS for the 2017 project, trawling to determine relative abundance of sea turtles in the area, was required five days prior to the commencement of hopper dredging if SST is above 10°C. An abundance of a minimum of one turtle captured during preliminary abundance trawling would trigger the need for relocation trawling to be employed during the remainder of the dredging operation. Figure 15 shows a view of the trawler from the bridge of the Padre Island Dredge. On May 22, 2017, a loggerhead turtle was captured during preliminary abundance trawling. Therefore, relocation trawling was required during the remainder of the dredging operation. Once relocation trawling was required, it continued simultaneous with dredging operations. Relocation trawling occurred ahead of the dredges throughout the duration of dredging. During relocation trawling, 1 trawling vessel operated in tandem with each dredge actively digging in the borrow area. A total of 74 sea turtles were relocated during the construction of the project, 47 loggerheads and 9 leatherbacks from Borrow area A and 1 leatherback, 15 loggerheads, and 2 Kemp's ridley relocated from Borrow area C. Turtles captured during relocation trawling were photographed, measured, biopsied for genetics, scanned for tags, and if necessary, PIT or Inconel tagged. They were relocated at least 3 nautical miles (nmi) away from the dredging area. All sea turtles captured by relocation trawling were flipper-tagged prior to release. Two (2) lethal takes of loggerhead turtles occurred during the entire project. Both takes occurred as a result of entrainment in the dredge's draghead. As required by the permit, BOEM was notified via phone and the incidental take form was provided to the USACE. Trawlers were onsite and operational during the lethal takes.

3.8.4 Shortnose Sturgeon

The shortnose sturgeon (*Acipenser brevirostrum*) was listed as endangered on March 11, 1967 under the Endangered Species Preservation Act of 1966 (a predecessor to the Endangered Species Act of 1973). NMFS later assumed jurisdiction for shortnose sturgeon under a 1974 government reorganization plan (38 FR 41370). Aside from seasonal migrations to estuarine waters, this species rarely occurs in the marine environment (NMFS, 1998b; Keiffer and Kynard, 1993). There are accounts of shortnose sturgeons occurring in the Atlantic Ocean offshore of NC (Holland and Yelverton, 1973; Dadswell *et al.,* 1984), however, these records are not well substantiated and there is speculation as to whether they were misidentified juvenile Atlantic sturgeon (Shortnose

Sturgeon Status Review Team, 2010). Those shortnose sturgeon captured in the ocean are usually taken close to shore, in low salinity environments; there are no records of shortnose sturgeon in the NMFS database for the northeast offshore bottom trawl survey (NMFS, 1998b). This species is therefore considered highly unlikely to occur in the project area. Additional information regarding the ecology of shortnose sturgeons is included in the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

4.8.5 Atlantic Sturgeon

In 2009, the Natural Resources Defense Council (NRDC) petitioned NMFS to list the Atlantic sturgeon (*Acipenser oxyrinchus*) under the Endangered Species Act of 1973 (ESA). As a result of the petition, four Distinct Population Segments were listed as endangered on February 6, 2012, including the South Atlantic DPS, the Carolina DPS, the Chesapeake Bay DPS and the New York Bight DPS. The project area falls within the range of the Carolina DPS.

Records from federal, private and state surveys also show that Atlantic sturgeon have been documented within nearshore Atlantic Ocean habitats from the North/South Carolina state line to off the mouth of Chesapeake Bay (Moser *et al.* 1998). Coastal North Carolina is considered one of several concentration areas along the northeastern U.S. where sturgeon have been shown to aggregate, and Stein *et al.* (2004) found the fish were often associated with inlets of the Outer Banks. An acoustic array deployed offshore Cape Hatteras has collected data on acoustically-tagged Atlantic sturgeon (tagged by members of the Atlantic Cooperative Telemetry network) from February 2012 to May 2014. Data has been collected for 123 individual Atlantic sturgeon and indicate the highest numbers of detections have occurred during the months of November and March (Charles Bangley, *pers. comm*, 2014). In general, few acoustically tagged Atlantic sturgeon were recorded passing the array during the summer months.

A study conducted by Laney *et al.* (2007) also provides some insight into spatial distribution of Atlantic sturgeon in the marine waters offshore Virginia and North Carolina, based on incidental captures in winter tagging cruises conducted between 1988 and 2006. The surveys included sampling in and near extensive sand shoals adjacent to Oregon Inlet and Cape Hatteras. During the months of January and February from 1998 through 2006, investigations by bottom trawling captured 146 juvenile Atlantic sturgeons in depths from 9.1 to 21.3 m. (29.9 to 69.9 ft.) (Laney *et al.,* 2007). Captures typically occurred near shore at depths less than 18 m.

Additional information regarding the ecology of Atlantic sturgeons is included in the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

3.8.6 Seabeach Amaranth

Seabeach amaranth (*Amaranthus pumilus*) is an annual plant that is native to Atlantic Ocean barrier island beaches. The USFWS listed the species as threatened on April 7, 1993 under the Endangered Species Act of 1973.

Annual seabeach amaranth surveys performed between 1992 and 2009 by the U.S. Army Corps of Engineers, Wilmington District throughout various locations throughout Dare County, including Bodie Island, Pea Island, Rodanthe, Avon, Buxton, Frisco to Hatteras, and Hatteras to the Hatteras Inlet revealed no occurrences. The National Park Service (NPS) has conducted annual surveys within the Cape Hatteras National Seashore (CAHA). At CAHA, seabeach amaranth populations fluctuated greatly from 1985 to 2004. No plants have been observed since 2005 and the plant is currently thought to possibly be extirpated from CAHA (NPS, 2016). The USFWS has no records of the species on the Pea Island National Wildlife Refuge (PINWR) but suitable habitat for this species does exist near Bonner Bridge. The nearest known population is at Cape Point, approximately 40 miles south of the inlet (USACE, 2000).

Previous beach nourishment projects have rebuilt habitat for seabeach amaranth and encouraged growth of some populations, as seen in Bogue Inlet (Dale Suiter, *pers.comm.,* 2007) and Wrightsville Beach (USFWS, 1996a). For example, historically, seabeach amaranth had been recorded on Wrightsville Beach, but after severe erosion and lack of nourishment during the 1970's no plants were recorded in surveys from 1980 – 1987. After two nourishment projects in 1980-81 and 1986, surveys in 1988 recorded nearly 3,000 plants. According to the USFWS (1996a), Wrightsville Beach had become one of the largest and least variable populations of seabeach amaranth known and had apparently reestablished itself (whether from a seedbank or from colonization is not known) on this renourished beach. However, surveys performed by the USACE have not recorded the species on Wrightsville Beach since 2011, when only two plants were observed. Prior to 2011, no plants had been recorded since 2008 (USACE, 2013a). This suggests the ephemeral nature of even well-established populations of seabeach amaranth. Another population displaying this ephemeral behavior is located in Bogue Banks, Carteret County, NC. Prior to 2001, the area surveyed between Fort Macon and Atlantic Beach supported substantial populations of seabeach amaranth, with plant counts numbering in the thousands some years. In 2001, the number of plants had fallen to 20. After nourishment, seabeach amaranth increased to over 5,000 plants in 2002, 2003 and 2004. In 2010, plant counts fell below 100 and by 2013, only one plant was found in the entire area surveyed within Carteret County (USACE, 2013a).

Additional information regarding the ecology of seabeach amaranth is included in the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

3.8.7 Piping Plover

The piping plover (*Charadrius melodus*) was federally listed in 1986 under the Endangered Species Act of 1973, as amended, and three separate breeding populations were identified in North America: 1) the Atlantic Coast population (threatened), 2) the Northern Great Plains population (threatened) and 3) the Great Lakes population (endangered). Piping plovers are also listed as threatened throughout their wintering range (USFWS, 1996a). The Atlantic Coast population breeds along the east coast of North America from the Canadian Maritime Provinces to North Carolina. The Northern Great Plains population can be found breeding from southern Alberta to Manitoba and south to Nebraska. The Great Lakes population breeds along the shorelines of the Great Lakes. All three populations migrate to the coastal shorelines of the South Atlantic, Gulf of Mexico and the beaches of the Caribbean Islands to winter (USFWS, 2012).

On July 10, 2002, the USFWS published a final rule to list 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas as Critical Habitat for wintering populations of piping plovers (66 FR 36038). The Critical Habitat closest to the project area is Unit NC-1. The northern boundary of NC-1 is approximately 24 km (15 mi) south of Kill Devil Hills, the southernmost of the four towns considered in this assessment. There is no critical habitat unit within the project area.

According to the USFWS, the piping plover may be found within all eight coastal counties of North Carolina (USFWS, 2014a). However, no piping plovers have been documented within the project area within at least the last five (5) years (Maria Dunn, pers. comm. June 19, 2020, eBird, 2020). Additional information regarding the population dynamics and ecology of piping plovers is included in the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

3.8.8 Rufa Red Knot

On December 11, 2014, the final rule listing the *rufa* red knot as threatened was published in the Federal Register (79 FR 238).

Although the Delaware Bay and coastal Virginia represent the largest stopover concentration of migrating *rufa* red knots, coastal North Carolina does support the birds during their spring and fall migrations. Surveys for the *rufa* red knots have been performed throughout the state and the data is maintained by the North Carolina Wildlife Resources Commission (NCWRC). Data NCWRC database was summarized within the 2015 EAs to determine total *rufa* red knot observations per month throughout the state from 1985 to 2013. This data shows that beaches in the vicinity of Dare County have historically supported roughly 10% of red knot occurrences from the northern region and 8% of statewide occurrences. However, the highly developed nature of the oceanfront shoreline likely deters any red knots from utilizing habitats within the project area. These four beach towns have narrow, heavily utilized beaches with dogs, pedestrians and vehicular traffic that discourages use by shorebirds (Sara Schweitzer, *pers. comm.,* August 29, 2013). Therefore, while

the birds may be present elsewhere within the county, it is not likely that red knots will occur within the project area. No observations of *rufa* red knots have been documented within the project area within at least the last five (5) years (Maria Dunn, pers. comm. June 19, 2020; eBird, 2020). Additional information regarding the population dynamics and ecology of red knots is included in the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

3.8.9 Roseate Tern

On November 2, 1987, the USFWS listed two populations of the Roseate tern (*Sterna dougallii dougallii*) as endangered and threatened. The population that nests in northeastern North America was determined to be endangered, while the Caribbean population (including nesting birds in the U.S. Virgin Islands, Puerto Rico and Florida) were listed as threatened. The roseate tern is a rare occurrence in North Carolina and is not listed as one of the bird species prioritized for conservation in the North Carolina Wildlife Resources Commission's Wildlife Action Plan (Sara Schweitzer, *pers. comm.,* July 9, 2014). This species is primarily observed south of Cape Hatteras, particularly at Cape Point within Cape Hatteras National Seashore during the months of June through August. According to eBird, there have been opportunistic sightings of the roseate tern in Dare County; however, these occurrences have been rare. There are no records of the species nesting in the proposed project area (USFWS, 1999; eBird, 2020). Additional information regarding the ecology of roseate terns is included in the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

3.9 Cultural Resources

It is necessary to determine if any cultural resources, such as archaeological or historic artifacts and structures, exist within the Project Area and if they are eligible for listing on the National Register of Historic Places. The federal statutes associated with these actions include Section 106 of the National Historic Preservation Act of 1966, as amended (PL 89-665); the National Environmental Policy Act of 1969; the Archaeological Resources Protection Act of 1987; the Advisory Council on Historic Preservation Procedures for the Protection of Historic and Cultural Properties (36 CFR Part 800); and the Abandoned Shipwreck Act of 1987.

The National Register of Historic Places was queried to identify any historic sites potentially present within the area of sand placement. Of the twenty-seven sites in Dare County that are listed in the National Register of Historic Places database, several were found to be within the project area (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

In October 2014 remote-sensing surveys were performed by Tidewater Atlantic Research (TAR) to identify whether any cultural resources exist within the borrow areas used for the 2017 project (Borrow Area A and Borrow Area C). Analyses of survey results identified nine magnetic anomalies in Area A, four of which were considered potentially significant and recommended for

avoidance and buffering. These buffers were implemented and were incorporated into the final borrow area design for the 2017 project.

Borrow Area A is located just over 11 miles to the southeast from a Formerly Used Defense Site (FUDS) referred to as the Former Duck Target Facility Munitions Response Site (MRS) (Figure 8). A FUDS refers to a property that was owned by, leased to, or otherwise possessed by the United States and under the jurisdiction of the Department of Defense (DoD), that was transferred from DoD control prior to October 17, 1986. The Duck Target Facility MRS was used from 1941 to 1965 as a practice bombing and rocket target range, and numerous types of rockets and practice bombs were used. Although over 1,000 tons of munitions have been removed or inspected at the site, these investigations have so far determined that all munitions present are munitions debris and scrap metal. During the construction of the 2017 project, two munitions were recovered in the dredge's screen box during dredging from within Borrow area A. The munitions were sucked up through the drag arm, passed through the dredge pump, and were recovered in the screener basket after the hopper was filled. Explosive Ordnance Disposal (EOD) staff from Joint Expeditionary Base Little Creek, Virginia, initially indicated that the rounds did not appear volatile and that they believed it was safe to discharge the load and to continue dredging. In the interim, the dredge operator was asked by EOD to stow the munitions in a safe place on the boat and EOD would retrieve them the next day which it did. In addition to these two MECs, a testing cartridge was recovered by the dredge from within Borrow Area A. The testing cartridge was sucked up through the drag arm, passed through the dredge pump, and was recovered in the screener basket. EOD master tech out of Little Creek, Virginia, was immediately notified and soon stated that it was safe for work to continue and that it was not a hazard.

Additional information regarding cultural resources is included in the 2015 EAs (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b).

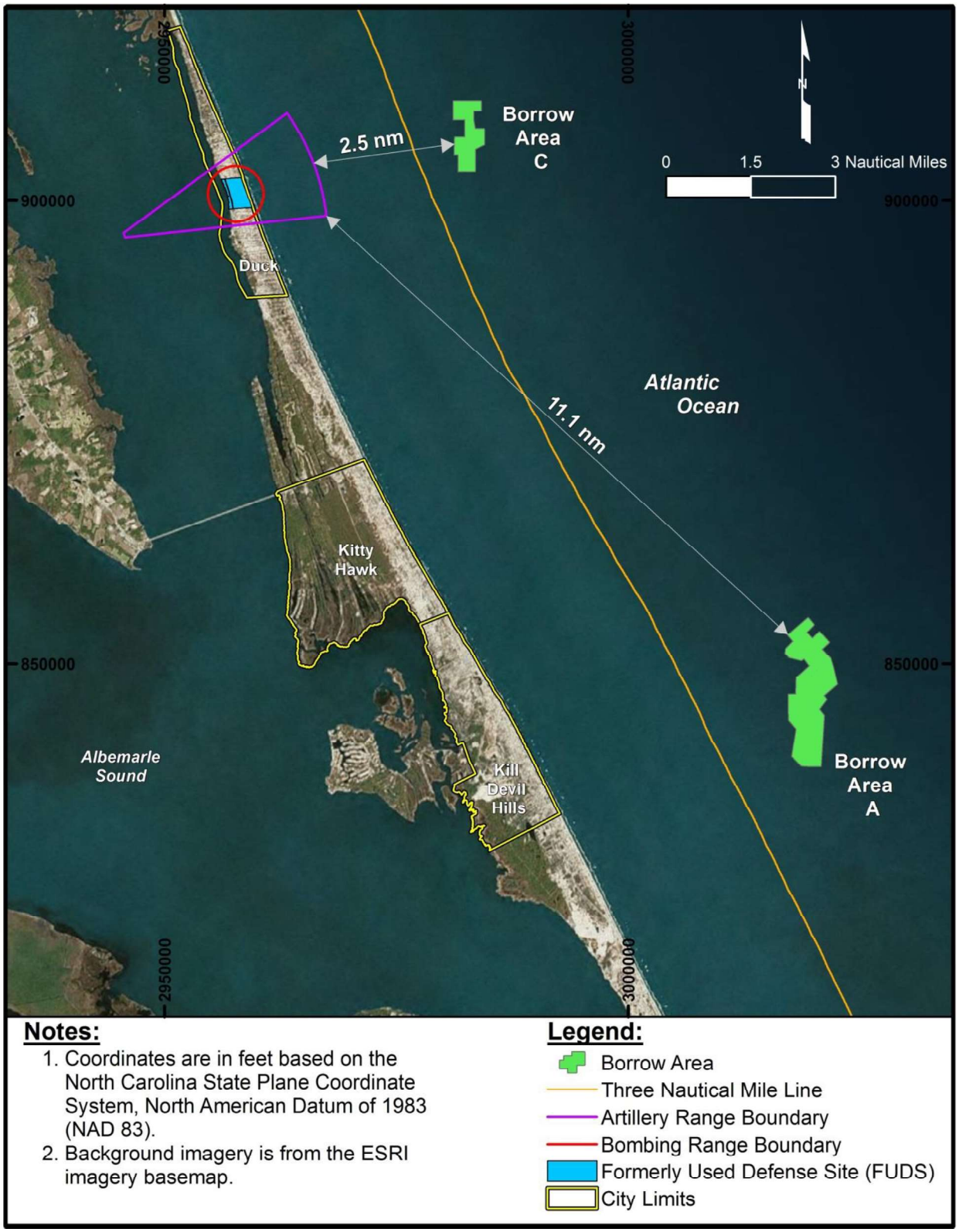

Figure 8. The location of the Duck Target Facility Munitions Response Site. Note: Borrow Area C will not

be utilized for this proposed project.

3.10 Socioeconomic Resources

Tourism is the main economic driver in Dare County, as the area provides many recreational and scenic resources. In 2019, visitor spending brought in $1.27 billion and also supported 13,880 jobs within the local economies within Dare County (Outer Banks Visitors Bureau, 2020). Annual Dare County tourism generates more than $116.5 million in state and local tax revenue. In 2017, the median household income in Duck, Southern Shores, and Kitty Hawk was $58,329, $101,596, and $64,997, respectively. At Kill Devil Hills, the median household income in 2017 was $53,358 (City Data, 2020).

3.11 Recreational and Scenic Resources

Dare County spans 110 miles of oceanfront shoreline that provides access to millions of residents and visitors each year. As a tourist destination, Duck has many recreational venues that include surf shops, kayak rental shops, bicycle rental shops, fishing rental shops, charter boat fishing, beach tours and bird watching. Other water related recreational services provided are kite surfing, jet ski rentals and dive charters in the area. The Outer Banks are also known as a surfer's destination. Recreational fishing is also a major draw for tourists and locals alike. In-shore anglers, pier fishing, surf fishing and boat fishing collectively draw in revenue through fishing enthusiasts' hotel accommodations, rentals, dining and permits.

4.0 IMPACTS ASSOCIATED WITH THE APPLICANT'S PREFERRED ALTERNATIVE

The Council on Environmental Quality (CEQ) regulations (40 CFR §§ 1508) were updated in July of 2020. The new regulations no longer distinguish between direct, indirect, and cumulative effects. Effects, or impacts, are now defined by the CEQ as "changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance from the proposed action or alternatives".

Beach nourishment affects the infrastructural and economic aspects of the human environment. It can also have considerable positive and negative biological impacts on the many components of the beach ecosystem including terrestrial arthropods, marine zoobenthos, microphytobentos, shorebirds, vascular plants, nesting sea turtles and swimming marine fauna. Negative impacts dominate in short term, while long-term impacts depend on the ecological recovery of the system, which is influenced by the project timing, project size and location, techniques employed, sand quality and quantity and conditions prior to nourishment (Speybroeck *et al.*., 2006). In general, positive impacts include protection of upland structures and infrastructure, restoration of eroded beach and dune habitat for wildlife nesting and roosting, and potential benefits to local economies due to increased recreational opportunities. Table 9 provides a summary of the impact to the

various resources that were determined for the actions associated with the 2017 nourishment project which still apply to the proposed project. Additional information regarding these impacts can be found in Appendix A and in the other 2015 EAs (CPE-NC, 2015a, CPE-NC, 2015b).

Table 9. Comparison of potential impacts for each resource resulting from the two alternatives as summarized in the 2015 EAs for the 2017 project.

Resource	Potential Impacts	
	No New Action	**Proposed Action**
Water Quality	No impacts.	Temporary turbidity increase at borrow area; temporary increase of turbidity in the nearshore waters at the fill site; impacts to benthic communities through light reduction and clogging of filter feeders.
Air Quality	No impacts.	Temporary and localized reduction in air quality due to emissions from construction equipment and dredging vessels.
Noise	Temporary increases due to construction associated with demolition or relocation efforts. Additional temporary and sporadic increase in noise levels due to use of construction equipment used for beach scraping or sandbag placement.	Temporary increase at beach fill site due to construction equipment and activities; temporary increase in marine sound at borrow areas from dredging; higher peak sound pressure levels produced by hopper dredges may be detrimental to marine life.
Beach and Dune Habitat	Continued loss of beach/dune in some areas due to long-term erosion and storms. Further habitat degradation from beach scraping and/or sandbag placement.	Increase in beach/dune habitat; temporary elimination of infaunal benthic community due to burial. May bury beach or dune vegetation present in the Project Area.
EFH – Marine Water Column	No impacts.	Temporary elevated turbidity levels at borrow site (mid-and inner-shelf) and fill site (surf zone) may cause adverse impacts to fish physiology and behavior.
EFH – Offshore Shoals	No impacts.	Removal of benthic organisms due to sand excavation; alteration of seabed topography may alter habitat value temporarily.
T&E Species	Loss of beach/dune habitat potentially utilized by sea turtles (nesting), red knots (foraging, roosting), piping plovers (nesting, foraging, roosting), seabeach amaranth (germination, growth); degradation of same habitats due to potential use of sand fencing, beach scraping, sandbags. Unabated erosion may cause continued reduction of habitat for sea turtles, red knots, piping plovers; removal of development from shoreline may reduce human disturbance to sea turtles, red knots, piping plovers.	Adverse impacts include: Possibility of entrainment of swimming sea turtles; Noise harassment to sea turtles; Burial of beach/subtidal infaunal prey species; Harassment/injury to nesting and hatchling sea turtles from construction lighting and activities; Alteration of sea turtle nesting habitat; Disruption of foraging and roosting activity for piping plovers and red knots during active construction Positive impacts include: Increased beach habitat for sea turtles (nesting), red knots (foraging, roosting), piping plovers (nesting, foraging, roosting), seabeach amaranth (germination, growth).
Cultural Resources	No impact.	Potential for disturbance to unanticipated cultural resources not documented within the borrow areas,

		pipeline corridors, and pump-out locations, and sand placement areas.
Socioeconomics	Loss of recreational beach from storms would decrease tourism revenue; Eventual removal of at-risk residential structures from tax base if damaged beyond repair; Reduction of lot value if structures damaged; temporary impact to habitability of at-risk commercial structure due to storm damages.	Temporary reduction in tourism and associated revenue due to construction activity and temporary closure of actively constructed beach sections; post-project increased tourism due to wider recreational beach; maintains the tax base of homes in the project area by reducing storm vulnerability.
Recreational and Scenic Resources	Loss of recreational beach from storm-induced erosion, Reduced aesthetics from beach scraping or sandbag projects, in the long term: reduced aesthetics from derelict structures. If structures are abandoned, storm-induced erosion may reduce amount of recreational opportunities afforded by the beach; deterioration of abandoned property will temporarily reduce aesthetic value of beach, reduce safety and usage of beach until demolition occurred. Relocation of structure may allow establishment of natural beach/dune communities, improved aesthetics.	Temporary reduction in tourism due to construction activity and temporary closure of actively constructed beach sections; Closure of areas in proximity to the offshore borrow areas to recreational boat traffic; reduced aesthetics due to construction equipment and offshore dredges; increased beach width supports more recreational activity and creates a more aesthetically pleasing beach.

In addition to the impacts as described in Table 9 above for the No Action Alternative and the Proposed Action Alternative for the 2017 project, shoreline erosion rates and SBEACH numerical model results were used to also determine the number of ocean front structures that would be imminently threatened over a 30 year time horizon along the shorelines of Duck, Kitty Hawk, and Kill Devil Hills (Appendix A, CPE-NC, 2015a, CPE-NC, 2015b). The SBEACH analysis incorporated the impacts associated with Hurricane Isabel which brought 26.7-foot waves with a 15.4 second period along with a storm surge of 4.4 feet. Collectively, 170 structures were determined to be at risk from long-term erosion while 245 were determined to be at-risk due to storm damage (Table 10).

Table 10. Number of structures to be impacted as a result of long-term erosion or storm damage over a 30-year period under Alternative 1

Town	Number structures at-risk of long-term erosion	Number structures at-risk of storm damage
Duck	54*	83
Kitty Hawk	100	122
Kill Devil Hills	16	40

TOTAL	**170**	**245**

***20 swimming pools would be impacted in addition to this number of structures**

At the present time, the number of structures currently at-risk due to long-term erosion and storm damage is considerably lower due to the fact that much of the material placed along the shorelines of these three beach towns remains in place today and continue to afford protection. While this analysis was not performed for the Town of Southern Shores prior to its beach fill project in 2017, it can be deduced that today less structures would be at-risk compared to prior to the construction of the 2017 project as well.

The proposed project differs from the 2017 beach nourishment project in several ways. First, while the extent of the fill has expanded (most notably within the town limits at Southern Shores), the volume and fill density of material to be placed on the beach has been reduced. In addition, this project will only include the utilization of one borrow area: Borrow Area A. Due to these changes, the proposed project additional impacts beyond those summarized in Table 10 may be realized. These impacts are associated with the beach and dune habitat, EFH offshore shoals, threatened and endangered species (including nesting sea turtles, piping plovers, red knots, roseate terns, and seabeach amaranth), and cultural resources.

4.1 Effects on Beach and Dune Habitat

Sand placement and dune construction would contribute to development of a stable beach and dune habitat that may prove beneficial for many plant and animal species. This beneficial effect will occur along 8,414 linear feet along the Town of Duck, 19,570 linear feet along the Town of Southern Shores, 20,970 linear feet along the Town of Kitty Hawk, and 14,464 linear feet along the Town of Kill Devil Hills (including taper sections). Collectively, this represents an additional 18,470 linear feet of beach berm and dunes compared to the 2017 nourishment event. In consideration of this additional spatial coverage, greater impacts to the infaunal community that inhabits the intertidal and subtidal beach (e.g. polychaetes, amphipods, crustaceans, gastropods) as well as the biological community that depend on them such as ghost crabs, fish and a variety of seabirds and shorebirds will be incurred. However, numerous studies have demonstrated that nourishment does not prevent recolonization of the beach by infaunal organisms when performed properly and responsibly. An example of short-term recovery of beach infauna can be seen in the 2011 nourishment project at Nags Head Beach, North Carolina. The Town of Nags Head constructed a beach nourishment project from March through November 2011, and placed material along approximately 10 miles of oceanfront shoreline. Results from post-construction benthic monitoring have confirmed that the area impacted by sand placement on Nags Head beach has regained a viable assemblage of benthic organisms that is similar to non-impacted beaches both one year post-construction (CZR Incorporated and CSE, Inc., 2013) and two years post-construction (CZR Incorporated and CSE, Inc., 2014). The year-2 post-construction surveys

showed no significant differences between the nourished beach in Nags Head from the control beaches in the study in terms of mean difference of taxa richness and sand grain size. On the nourished beach, wintertime abundance was significantly higher two years post nourishment than pre-nourishment (CZR Incorporated and CSE, Inc., 2014).

4.2 Effects on Offshore Shoals EFH

Dredging at offshore shoals may result in effects associated with shoal morphology, benthic abundance and elevated turbidity. The proposed maximum extents of the borrow area encompass 1,173 acres or approximately 1.83 square miles. Relative to the extent of shoals in the region, the proposed project only has the potential to affect a comparably small area.

Potential long-term physical and biological impacts could occur if dredging significantly changes the physiography of the shoals. Sediment removal has the potential to alter seabed topography, particularly if sediment removal in the borrow area results in a deep hole. A borrow area located in an active shoal area will likely be in-filled, while an un-active area will not. In instances where in-filling does not occur, the hydrology and hydrodynamics that drive benthic recolonization and recovery can subsequently be affected. The potential for creation of deeper holes is higher with a cutterhead than a hopper dredge. Prior to the construction of the 2017 project, survey data indicated that the Borrow Area A contained 16,373,400 cubic yards of material. The post-construction survey of the borrow area indicated that 12,829,500 cy remained indicating that 3,543,800 was removed from the site during the 2017 operation.

Benthic resources within offshore borrow area will be affected during project construction by the removal of sediment. Benthic invertebrates that inhabit sand shoals provide structural fish habitat via the development of worm tubes, burrows and depressions. In addition, these invertebrates provide a foraging base for demersal feeders. Recolonization by opportunistic benthic species would be expected to begin soon after project construction ceases. Because of the opportunistic nature of the species, rapid recovery would be expected to occur from the migration of benthic organisms from adjacent areas and larval transport. Benthos found in sand bottoms of high-energy environments, such as those within the project borrow area, tend to recover more quickly than those occurring in lower-energy environments with a higher percentage of fine particles (Normandeau Associates Inc., 2014). Faster recovery in shallow high-energy environments may reflect the adaptation of communities that occur in these habitats to frequent disturbance from episodic storm events (Normandeau Associates Inc., 2014). Monitoring studies of post-dredging effects and recovery rates of borrow areas indicate that most borrow areas usually show significant recovery by benthic organisms approximately 1 to 2 years after dredging and greater inter-annual variability than differences from the effects of dredging (USACE, 2013b). Burlas *et al.* (2001) monitored borrow sites with bathymetric high points off northern New Jersey and found that essentially all infaunal assemblage patterns recovered within 1 year after dredging disturbance,

except recovery of average sand dollar weight and biomass composition, which required 2.5 years. With the expected relatively quick recovery of infaunal communities, the project is not expected to result in significant long-term impacts to benthic prey resources.

The potential for EFH turbidity effects are limited by the borrow source's low percentage of fines and rapid fallout during removal. Although turbidity plumes associated with dredging often are short-lived and affect relatively small areas (Cronin *et al.*, 1970; Nichols *et al.*, 1990), re-suspension and re-dispersion of dredged sediments by subsequent currents and waves can propagate dredge-related turbidity for extended periods after dredging ends (Onuf, 1994). Biological responses to turbidity depend on these physical factors, coupled with the type of organism, geographic location, and the time of the year. In the case of sand dredging from offshore shoals for beach nourishment, turbidity plumes at the borrow site are virtually nonexistent due to rapid settling of sand-sized particles, resulting in minimal, if any, sedimentation impacts relative to background transport processes (Louis Berger Group, 1999). Additionally, in an analysis of potential biological and physical impacts of dredging on offshore ridge and shoal features, CSA *et al.* (2009) confirmed that turbidity plumes and their effects are expected to be less important in unprotected offshore areas. This is due to sand settling more rapidly than clay and silt and offshore shoals tend to be coarser than inshore deposits (CSA et. al., 2009).

4.3 Effects on Threatened and Endangered Species

Several of the federally listed species that may occur within the project area could be impacted as a result of the proposed project. Although these impacts were described in detail for the 2017 nourishment project (see Appendix A, CPE-NC, 2015a, CPE-NC, 2015b), several aspects of the proposed project may result in slightly different impacts for several of these species. Specifically, due to the increased extent of fill placed along the oceanfront shoreline, the impacts discussed in the 2015 EAs for nesting sea turtles, seabeach amaranth, piping plovers, and rufa red knots may be exacerbated. During the 2017 event, 3.9M cubic yards of material was placed over nearly 8.3 miles of oceanfront shoreline. The proposed project has been formulated to include the placement of 6,589,633 cy, however this volume is extremely conservative as it contains 50% more volume than the design and advanced fill currently calls for to account for volumetric losses during dredging and the potential for storm-induced erosion between the permitting effort and construction. Ultimately, this material will be spread over 11.65 miles of oceanfront shoreline.

<u>Nesting Sea Turtles</u>

Characteristics of the borrow material placed on the beach (including sand compaction, beach moisture content, sand color, sand grain size and shape, and sand grain mineral content) may alter sea turtle nesting behavior (Crain *et al.*, 1995). Nest site selection and digging behavior of the female can be altered, or deterred, if she finds the beach unsuitable. Additionally, escarpments may develop on nourished beaches and can prevent sea turtles from accessing the dry beach causing the female to return to the water without nesting. This is energetically wasteful to the

female and may result in overall decreased reproductive success. If unable to reach preferable nesting sites, females may also choose to deposit nests in unfavorable areas seaward of the escarpment making them vulnerable to washout (Crain *et al.*, 1995).

Projects that utilize fill material that is similar in grain size and composition to the nourishment area may prevent or reduce some of the adverse effects associated with nourishment efforts (Crain *et al.*, 1995). In April 2008, the North Carolina Coastal Resources Commission (CRC) adopted State Sediment Criteria Rule Language (15A NCAC 07H .0312) for borrow material aimed at preventing the disposal of incompatible material on the beach. The material proposed for use in the nourishment of the four towns will meet these criteria (Table) and consequently reduces many of the potential impacts to nesting and hatchling sea turtles. Despite the increased extent of fill that is proposed for this project, the use of compatible material will reduce the likelihood of any additional impacts to nesting sea turtles.

Seabeach Amaranth

Burial of seabeach amaranth plants present within the project footprint during sand placement is a potential direct impact to the species. Additionally, seabeach amaranth grows in dynamic coastal environments such as overwash areas and dune blowouts; therefore, stabilization of these areas through nourishment actually degrades the primary habitat. The nourishment portion of the proposed project could result in adverse effects as seed burial may deter germination the following season, depending upon the depth of disposal material (USFWS, 1993). Although seabeach amaranth seeds are accustomed to becoming wholly or partially buried by winter sand movement (USFWS, 1996a), if seeds become deeply buried due to nourishment activity, populations could be negatively affected (USFWS, 2002; 2010). Studies have shown that seedlings do not emerge from a depth of more than 1 or 2 cm (USFWS, 2010a). Burial of the seed bank may be particularly detrimental to isolated populations, as no nearby seed sources would be available to re-colonize the nourished site, contributing to fragmentation (USFWS, 2002). USFWS biologist Dale Suiter suggested it is likely that burial would delay germination of seeds, not prevent germination entirely (*pers. comm.*, 2007). The extent of the potential effects of burial relies on the nature of seabeach amaranth's seed bank and the importance of long distance and water dispersal of seeds; however, these topics need further study (USFWS, 1996a). In contrast, the restoration of the eroded shoreline may provide suitable habitat and encourage colonization post-nourishment, as has been observed following other nourishment projects. It should also be noted that while the above impacts may occur to seabeach amaranth, no recent (i.e. post-2009) surveys have been performed in the area; therefore, it is not known if any plants exist there currently. Therefore, despite the increase of fill extent for the proposed project compared to the 2017 project, no additional impacts to seabeach amaranth are anticipated.

Piping Plovers and Rufa Red Knots

Infaunal prey density has been shown to affect habitat use in shorebirds (Peterson *et al.,* 2006). The direct placement of sand will result in the burial and nearly complete mortality of benthic infauna along the beach and shallow water surf zones at the project nourishment locations. This

would indirectly affect any adult and flightless chicks attempting to forage in the ocean intertidal zone within the 11.26-mile fill area which is a larger extent compared to the 8.3 mile fill area associated with the 2017 nourishment event. A wider and more stable beach following project construction may both positively and negatively affect both piping plovers and red knots. While it may provide a more consistent buffer between important bird habitat areas and upland development and associated human activities, it may also encourage more development and recreational use of the beach, further degrading habitat. The increase in beach width from beach nourishment activities should increase the amount of available roosting habitat, and eventually increase the amount of suitable foraging habitat after benthic invertebrates repopulate the nourished area.

4.4 Effects on Cultural Resources

Excavation of the borrow area could unearth, crush, or otherwise damage any archaeological resources present within the path of the dredge or in an anchoring location. Cultural resource surveys identified a number of anomalies within Borrow Area A that are potentially culturally significant. The locations of potential pipeline corridors have not been identified at this time therefore no specific surveys have been performed. Pipeline corridors will be established by the contractor, and clearance surveys will be performed within the corridors prior to laying of pipe. The clearance surveys will be performed at the site of any submerged pipeline locations in advance of operations in or along the Outer Continental Shelf (shore-ward of the Three Nautical Mile Limit) and will consist of magnetometer and side scan sonar surveys.

Due to the extensive surveys and establishment of buffer zones around identified potential cultural resources within the borrow area, dredging activities are not expected to impact cultural resources within this area. Additionally, remote sensing surveys will be performed within portions of the pipeline corridors to ensure the corridors are free of, and avoid, potential cultural resources. Furthermore, according to the National Register of Historic Places, there are no historic or culturally significant sites documented within the Project Area. It is therefore concluded that the proposed dredging and sand placement activities will not affect cultural resources.

5.0 CONSERVATION AND MONITORING MEASURES

The following describes the actions and measures incorporated into the design and implementation of the Applicant's Preferred Alternative.

A wide range of conservation and monitoring measures were established for the 2017 project. Due to the similarity of the proposed project, those measures, summarized below in Table 11 and described in greater detail within Appendix A, will be also be employed as part of the proposed four-town nourishment project. These measures are included to avoid and minimize potential project related impacts to the resources found within the project area. Several conservation measures included within Table 11 refers to the 1995 and 1997 SARBO. Because the SARBO

was recently updated in 2020, this proposed project replaces those measures cited within the previous SARBO documents with the updated version.

Table 11. Summary of conservation and monitoring measures employed during the 2017 nourishment project.

	Conservation/Monitoring Measure
Borrow Area Design	The size and shape of the borrow areas have been designed such that a minimum number of turns will be required by the hopper dredge, which increases dredge efficiency and reduces the potential for sea turtle entrainment.
Dredge Type	Construction of the project will be accomplished using cutterhead suction dredges, trailing suction hopper dredges, or a combination of the two. To minimize impacts from hopper dredging, the project will follow the standard hopper dredging conditions outline in the 1995 and 1997 South Atlantic Regional Biological Opinion.
Dredge Positioning	Navigation and positioning software will be used by the contractor to accurately track the dredge location. The software will provide real-time dredge positioning and digging functions to allow color display of dredge shape, physical feature data as found in background Computer Aided Design (CAD) charts and color contour matrix files from hydrographic data collection software described above. The software will also provide a display of theoretical volume quantities removed during actual dredging operations. Dredge anchors will not be placed any further than 200 feet from the edge of the areas to be dredged. The dredge contractor will be required to verify the location of the anchors with real time positioning each and every time the anchors are relocated.
Pipeline Positioning	The pipeline alignment along the beach will be placed to avoid potential piping plover habitat or sea turtle nests. The alignment will be coordinated with, and approved by, the USACE. As-built positions of the pipeline will be recorded using GPS technology and included in the final construction observation report.
Pipeline Observations	Observations and assessments of the pipeline during construction will be performed to avoid pressurized leaks from the pipeline couplings or other equipment that may result in sediment plumes, siltation and/or elevated turbidity levels. The Towns, along with the associated engineer, will coordinate with the dredgers and have in place a mechanism to cease dredge and fill activities in the event that a substantial leak is detected In the event that a substantial leak is detected (leaks resulting in turbidity that exceed state water quality standards). The contractor will cease dredge and placement activities until an appropriate repair of the affected equipment has been completed.
Construction Observations	Several initiatives will be undertaken by the Towns, the Engineer, or his duly authorized representative to monitor construction practices. Construction observation and contract administration will be periodically performed seven days/week, approximately twelve hours/day during periods of active construction. Most observations will be during daylight hours; however, random nighttime observations may be conducted. The Towns, the Engineer, or his duly authorized representative will provide onsite observation by an individual with training or experience in beach nourishment and construction observation and testing, and that is knowledgeable of the project design and permit conditions. The project manager will coordinate with the field observer. Multiple daily observations of the pump-out location will be made for quality assessment and quality control (QA/QC) of the material being placed on the beach. The construction contractor will provide observations 24 hours per day during construction.
Sediment Compatibility	The Sediment Criteria Rule provides beneficial guidelines for both grain size and percent weight of calcium carbonate. However, other important characteristics such as organic content, heavy mineral content and color are not addressed. These aspects of the beach material will be considered. Maintaining adherence to this sediment criteria rule for material

	placed on the beach will reduce adverse impacts to the beach invertebrate community and would also reduce effects to sea turtle nest construction and incubation of the eggs. Multiple daily observations of the active placement locations will be made for QA/QC of the material being placed on the beach. The individual will collect a representative sub-surface (6 in. below grade) grab sediment sample at not less than 200-foot intervals along the newly constructed berm to visually assess grain size, wet Munsell color, granular, gravel, and silt content. Each sample will be archived with the date, time, and location of the sample. Samples will be collected during beach observations. The sample will be visually compared to the acceptable sand criteria. If determined necessary by the Engineer, or his duly authorized representative, quantitative assessments of the sand will be conducted for grain size, wet Munsell color, and content of gravel, granular and silt. A record of these sand evaluations will be provided within the Engineer's daily inspection reports and submitted to USACE and DCM for verification. Following construction, compaction of placed fill material will be inspected by the Towns, the Engineer or his duly authorized representative in coordination with the DCM and USACE. Compaction monitoring will begin after the material has been graded and dressed to the final slope and a period of time will be allowed for finer particles to be washed away and final settling of the material to occur prior to compaction monitoring. If the fill material appears to have a higher degree of compaction than that which is acceptable additional testing such as cone penetration testing will be considered. After subsequent testing, if it is determined that tilling is necessary to reduce compaction based on consultation with the appropriate agencies, the contractor will till the beach to a minimum depth of 36 inches throughout the constructed portion of the beach to loosen the compaction of the placed material. Beach tilling will only be performed as a result of an identified compaction problem based on agency consultation. Beach compaction monitoring and, if necessary, tilling would ensure that project impacts on sea turtle nesting are minimized.
Escarpments	Visual surveys of escarpments will be made along the beach fill area immediately after completion of construction. Escarpments in the newly placed beach fill that exceed 18 inches for greater than 100 ft. shall be graded to match adjacent grades on the beach. Removal of any escarpments during the sea turtle hatching season (May 1 through November 15) shall be coordinated with the NCWRC, USFWS and the USACE. The likelihood of escarpment formation can be reduced by incorporating a beach design that closely resembles the native beach in terms of berm elevation, sediment size, and sediment sorting characteristics. The proposed project will be designed with a berm elevation of +6 ft. NAVD88, and sediment characteristics that fall within the ranges required by the North Carolina State Sediment Criteria.
Water Quality	During construction, shore parallel berms will be constructed on the beach to reduce nearshore turbidity impacts. These berms are designed such that the slurry will run parallel to shore, allowing sediment to settle out before the water is returned to the ocean. Turbidity monitoring during construction will be managed by the contractor. The contractor will be responsible for notifying the construction engineer in the event that turbidity levels exceed the state water quality standards. Measures that could be taken to subsequently reduce turbidity include moving the dredge to a different location, or asking the contractor to extend the berm, which would allow more time for fines to settle out before the water flows back into the ocean.
West Indian Manatee and Whale Monitoring	During construction or dredging activities, the contractor will adhere to the "Guidelines for Avoiding Impacts to the West Indian Manatee" created by the USFWS. Full-time NMFS-certified endangered species observers will be present on the hopper dredge(s) to alert dredge operators of any whales or manatees in the area. In the event a whale or manatee is spotted, the ship's captain will make proper maneuvers to avoid collisions or injury to the marine mammals. Vessel operators will abide by the 10 kt (18.5 km/h) speed restrictions in any Dynamic Management Areas (DMAs) that may be established while underway. Operators will abide by NMFS Southeast Region marine mammal viewing guidelines and maintain 50 yds. from sea turtles and dolphins and 100 yds. from whales. Vessel operators will also follow

	the restricted vessel approach of 500 yds. established for North Atlantic right whales. Participation in the Right Whale Early Warning System is required; therefore, dredging within right whale critical habitat from December through March will follow the protocol established within the Early Warning System (NMFS, 1995).
Sea Turtle Monitoring and Relocation Trawling	Risk of entrainment will be reduced by use of a sea turtle deflector on the dredge's draghead. Every effort will be made to keep the dredge pumps disengaged when the hopper dredge dragheads are not firmly on the bottom. Also, the rotating cutterhead will not be lifted from the sediment surface during operations. Additionally, full-time NMFS-certified protected species observers will be present on the hopper dredge to document any sea turtle activity and monitor turtle takes through screening of inflow and/or outflow. Dredging operations will abide by the terms and conditions deemed necessary to minimize hopper dredging impacts to sea turtles set forth in the 1995 and 1997 South Atlantic Regional Biological Opinion (SARBO). On the beach, artificial lighting used during nighttime construction activities will be angled or shielded to reduce deterrence of sea turtle nesting and hatchling disorientation. A sea turtle nest monitoring and avoidance/relocation plan will be implemented through coordination with USFWS and NCWRC. This monitoring will be performed by trained individuals knowledgeable of the beach construction operations. Should hopper dredges be utilized, the proposed project may employ relocation trawling as a means to reduce the potential for entrainment. If relocation trawling is implemented, standard relocation trawling conditions will be observed as set forth by NMFS, including specification for trawl time, handling, holding conditions, take and release and any tagging, etc. A sea turtle nest monitoring plan will be implemented through coordination with USFWS and NCWRC. Dare County is included in surveys conducted by Network for Endangered Sea Turtles (N.E.S.T), the volunteer organization which performs systematic surveys of the northern Outer Banks from the Virginia border to the southern tip of Nags Head. Surveys are performed throughout the nesting season (May through August), and include daily morning patrols to mark and protect newly laid nests, as well as monitoring during incubation period and emergence. These surveys have been performed since 1981. Because the proposed project includes nourishment during the summer months (nesting season), monitoring will be needed to identify, and subsequently avoid burial or excavation of, existing nests during construction. This monitoring will be performed by trained individuals knowledgeable of the beach construction operations. In addition to monitoring surveys, nest relocation will be implemented by highly trained individuals and in coordination with the appropriate agencies.
Bird Monitoring	Although a project-specific bird monitoring plan will not be developed, existing programs established by the State, Cape Hatteras National Seashore, and other entities are anticipated to continue monitoring piping plovers, *rufa* red knots, and other bird species along portions of the Outer Banks in Dare County. In addition, all personnel involved in the construction process along the beach will be trained to recognize the presence of piping plovers and red knots prior to the initiation of beach construction. Personnel will be provided photos of each species, which will be required to be kept at the construction site for quick reference. A contractor representative authorized to stop or redirect work will conduct a shorebird survey prior to 9:00 am each day of sand placement activities. The survey will cover the work area and any locations where equipment is expected to travel. The contractor will note any observance of red knots or piping plovers and submit observations to the USACE Wilmington District Office the next calendar day.

The avoidance and minimization measures as described above will be implemented as part of the proposed action. Based on these measures, no significant impacts are anticipated and therefore a Finding of No Significance is warranted.

6.0 References

Bargo, T., J. Glass, T. Fitzpatrick, D. Oullette. 2005. Sea turtle relocation trawling: Is it effective? REMSA, Inc. 5 pp.

Brown, M.W. and M.K. Marx. 1998. Surveillance, Monitoring and Management of North Atlantic Right Whales, Eubalaena glacialis, in Cape Cod Bay, Massachusetts: January to Mid-May, 1998. Final report submitted to the Division of Marine Fisheries, Commonwealth of Massachusetts, October 1998, Contract No. SCFWE3000-8365027.

Burlas, M., Ray, G.L., Clarke, D. 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 Corps of Engineers, Vicksburg, Mississippi.
Turtles, CRC Press, New York, 10: 168-170, 16: 255-273

City Data. 2020. Median household income in municipalities in Dare County. Online at: http://www.city-data.com/city/Kill-Devil-Hills-North-Carolina.html. Last visited September 11, 2020.

CPE-NC (Coastal Planning & Engineering of North Carolina, Inc.), 2015a. Town of Duck Shoreline Protection Project Environmental Assessment. Pp 173.

CPE-NC (Coastal Planning & Engineering of North Carolina, Inc.), 2015b. Town of Kitty Hawk Shoreline Protection Project Environmental Assessment. Pp 183.

CPE-NC (Coastal Planning & Engineering of North Carolina, Inc.), 2015c. Town of Kill Devil Hills Shoreline Protection Project Environmental Assessment. Pp 175.

CPE-NC (Coastal Planning & Engineering of North Carolina, Inc.), 2020a. Town of Duck North Carolina 2020 Shoreline & Volume Change Monitoring Report. Pp 23.

CPE-NC (Coastal Planning & Engineering of North Carolina, Inc.), 2020b. Town of Southern Shores North Carolina 2020 Beach Assessment Report. Pp 37.

CPE-NC (Coastal Planning & Engineering of North Carolina, Inc.), 2020c. Towns of Kitty Hawk & Kill Devil Hills North Carolina 2020 Shoreline & Volume Change Monitoring Report. Pp 23.

Crain, D.A., Bolten, A.B., and Bjorndal, K.A., 1995. Effects of beach nourishment on sea turtles: review and research initiatires, Restoration Ecology, p. 3, 2, 95-104

Cronin, E.L., R.B. Biggs, D.A. Flemer, G.T. Pfitzmeyer, F. Goodwin, Jr., W.L. Dovel, and D.E. Richie, Jr. 1970. Gross physical and biological effects of overboard spoil disposal in Upper Chesapeake Bay. University of Maryland, Chesapeake Biological Laboratory, Natural Resources Institute Special Report Number 3. 66 pp.

CSA International, Inc., Applied Coastal Research and Enginnering, Inc., Barry A. Vittor & Associates, Inc., C.F. Bean, L.L.C., and Florida Institute of Technology. 2009. Analysis of Potential Biological and Physical Impacts of Dredging on Offshore Ridge and Shoal Features. Prepared by CSA International, Inc. in cooperation with Applied Coastal Research and Engineering, Inc., Barry A. Vittor & Associates, Inc., C.F. Bean, L.L.C., and the Florida Institute of Technology for the U.S. Department of the Interior, Minerals Management Service, Leasing Division, Marine Minerals Branch, Herndon, VA. OCS Study MMS 2010-010. 160 pp. + apps.

Cummings, E.W., D.A Pabts, J.E. Blum, S.G. Barco, S.J. Davis, V.G. Thayer, N. Adimey, and W.A. McLellan. 2014. Spatial and Temporal Patterns fo habitat use and mortality of the Florida manatee (*Trichechus manatus latirostris*) in the Mid-Atlantic States of North Carolina and Virginia from 1991 – 2012. *Aquatic mammals* 40(2): 126-139.

CZR Incorporated and CSE, Inc. 2013. Nags Head Beach 2011 Nourishment Project: Post-Year 1 Report. Town of Nags Head, Dare County, NC. 45 pp.

CZR Incorporated and CSE, Inc. 2014. Nags Head Beach 2011 Nourishment Project: Post-Year 2 Report. Town of Nags Head, Dare County, NC. 40 pp. + Appendices.

Dadswell. M.J., B.D. Taubert, T.W. Squiers, D. Marchette, J. Buckley. 1984. Status of the shortnose sturgeon, *Acipenser brevirostrum*, in Canada. Canadian Field-Naturalist 98:75-79.

Deaton, A.S., W.S. Chappell, K. Hart, J. O'Neal, B. Boutin. 2010. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources. Division of Marine Fisheries, NC.

De Waal, J. P., Van der Meer, J. W. 1992: Wave run-up and overtopping on coastal structures. Proceedings of the 23th International Conference on Coastal Engineering. pp. 1758-1771. Venice, Italy.

eBird. 2020 An online database of bird distribution and abundance (web application). eBird, Ithaca, New York. Available: http://ebird.org/content/ebird/ Accessed: 6/26/2020

Epperly, S.P., J. Braun, and A. Veishlow. 1995. Sea turtles in North Carolina waters. *Conservation Biology.* 9(2): 384-394.

Griffin DB, Murphy SR, Frick MG, Broderick AC, Coker JW, Coyne MS, Dodd MG, Godfrey MH, Godley BJ, Hawkes LA, Murphy TM, Williams KL, Witt MJ. 2013. Foraging habitats and migration corridors utilized by a recovering subpopulation of adult female loggerhead sea turtles: implications for conservation. *Ma.r Biol.* 160:3071-3086

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, 368 Division of Commercial and Sports Fisheries, Morehead City. Special Scientific Report 24:1-132

Inman, D.L and R. Dolan. 1989. The Outer Banks of North Carolina: budget of sediment and inlet dynamics along a migrating barrier system. *Journal of Coastal Research* 5(2): 193-297.

IPCC (Intergovernmental Panel on Climate Change). 2013: Summary for policymakers. In: Climate change 2013: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdon and New York, NY, USA.

Keiffer, 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(6): 1088-1103.

Kenney, R. D., and H. E. Winn. 1987. Cetacean biomass densities near submarine canyons compared to adjacent shelf/slope areas. Continental Shelf Research 7(2):107-114.

Laney, R. W.; Hightower, J. E.; Versak, B. R.; Mangold, M. F.; Cole, W. W., Jr; Winslow, S. E., 2007: Distribution, habitat use, and size of Atlantic sturgeon captured during cooperative winter tagging cruises, 1988–2006. Am. Fish. Soc. Symp. 56, 167–182.

Larson, M. and N. Kraus. 1989. SBEACH: Numerical model for simulating storm-induced beach change; Report 1: Empirical Foundation and Model Development. Report 1. Technical Report CERC-89-9. USAEWES, Coastal Engineering Research Center. 267 pp.

Leatherman, S.P., K. Zhang, and B.C. Douglas. 2000. Sea level rise shown to drive coastal erosion. EOS, Transactions American Geophysical Union 81(6):55-57.

Leffler, M, C Baron, B Scarborough, K Hathaway, P Hodges, and C Townsend. 1996. Annual data summary for 1994 CERC Field Research Facility (2 volumes). USACE-WES, Coastal Engineering Research Center, Vicksburg, MS, Tech Rept CERC-96-6.

Louis Berger Group. 1999. 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, OCS Study MMS 99-0036. 355 pp

MAFMC. 2014. Fishery Management Plans & Amendments. http://www.mafmc.org/fishery-management-plans. Last visited September 2020.

Mallinson, D.J., S.R. Riggs, S.J. Culver, D. Ames, B.P. Horton, A.C. Kemp. 2009. The North Carolina Outer Banks barrier islands: A field trip guide to the geology, geomorphology, and processes.

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

Moser, M. L., J. B. Bichey, and S. B. Roberts. 1998. Sturgeon distribution in North Carolina. Center for Marine Science Research, Wilmington, North Carolina. Final Report to U.S. Army Corps of Engineers, Wilmington District.

Nichols, M., R.J. Diaz, and L.C. Shaffner. 1990. Effects of hopper dredging and sediment dispersion, Chesapeake Bay. Environ. Geol. Water Sci. 15:31-43

NMFS (National Marine Fisheries Service). 1998a. 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 theNational Marine Fisheries Service, Silver Spring, MD. 42 pp.

NMFS (National Marine Fisheries Service). 1998b. 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.

NMFS (National Marine Fisheries Service). 2004. Endangered Species Act Section 7 Consultation on Dredging of Gulf of Mexico Navigation Channels and Sand Mining ("Borrow") Areas Using Hopper Dredges by COE Galveston, New Orleans, Mobile, and Jacksonville Districts (Consultation Number F/SER/2000/01287), 119 pp

NMFS (National Marine Fisheries Service). 2009. Final Amendment 1 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan, Essential Fish Habitat. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. Public Document. 395pp.

NMFS (National Marine Fisheries Service). 2010. Essential fish habitat: A marine fish habitat conservation mandate for federal agencies. South Atlantic Region. National Marine Fisheries Service. St. Petersburg, FL. 14 pp.

NMFS (National Marine Fisheries Service). 2013a. North Atlantic right whales (*Eubalaena glacialis*. NOAA Office of Protected Resources. Online at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/rightwhale_northatlantic.htm Accessed: May 28, 2014.

NMFS (National Marine Fisheries Service). 2020. NOAA Right Whale Sighting Advisory System. Online at: https://apps-nefsc.fisheries.noaa.gov/psb/surveys/MapperiframeWithText.html

NOAA (National Oceanic and Atmospheric Administration). 2020. Website on mean sea level trend, 8651370 Duck, North Carolina. Online at: https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8651370 Accessed: August 28, 2020.

Normandeau Associates, Inc. 2014. Understanding the Habitat Value and Function of Shoal/Ridge/Trough Complexes to Fish and Fisheries on the Atlantic and Gulf of Mexico Outer Continental Shelf. Draft Literature Synthesis for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Contract # M12PS00031. 116pp.

Onuf, C.P. 1994. Seagrasses, dredging, and light in Laguna Madre, Texas, U.S.A. Est. Coast. Shelf Sci. 39:75-91

Outer Banks Visitors Bureau, 2020. https://www.outerbanks.org/about-us/. Last visited 10/11/20.

Peterson, C.H., M.J. Bishop, G.A. Johnson, L.M. D'Anna, and L.M. Manning. 2006. Exploiting beach filling as an unaffordable experiment: Benthic intertidal impacts propagating upwards to shorebirds. *Journal of Experimental Marine Biology and Ecology* 338:205-221.

Pritchard, P.C.H. 1992. Leatherback turtle Dermochelys coriacea. Pages 214-218 in Moler, P.E. (editor). Rare and Endangered Biota of Florida, Volume III. University Press of Florida; Gainesville, Florida.

SAFMC (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. The Shrimp Fishery Management Plan, The Red Drum Fishery Management Plan, The Snapper Grouper Fishery Management Plan, The Coastal

Migratory Pelagics Fishery Management Plan, The Golden Crab Fishery Management Plan, The Spiny Lobster Fishery Management Plan, The Coral, Coral Reefs, and Live/Hardbottom Habitat Fishery Management Plan, The Sargassum Habitat Fishery Management Plan, and The Calico Scallop Fishery Management Plan. Prepared by the South Atlantic Fishery Management Council, Charleston, South Carolina, October 1998.

SAFMC (South Atlantic Fishery Management Council). 2014. http://www.safmc.net/. Last visited October 2020.

Shortnose Sturgeon Status Review Team. 2010. A biological assessment of shortnose sturgeon (*Acipenser brevirostrum*). Report to National Marine Fisheries Service, Northeast Regional Office. November 1, 2010. 417 pp.

Speybroeck, J., D. Bronte, W. Courtens, T. Gheskiere, P. Grootaert, J. Maelfait, M. Mathys, S. Provoost, K. Sabbe, E.W.M Stienen, V. Van Lancker, M. Vincx and S. Degraer. 2006. Beach nourishment: An Ecologically Sound Coastal Defense Alternative? A review. *Aquatic Conservation: Marine and Freshwater Ecosystems* 16:419-435.

Stein, A.B., K.D. Friedland, and M. Sutherland. 2004. Sturgeon marine distribution and habitat use along the northeast coast of the United States. Transactions of the American Fisheries Society 133:527–537

Thieler, E.R., D.S. Foster, E.A. Himmelstoss, 2014. Geological framework of the northern North Carolina, USA inner continental shelf and its influence on coastal evolution. *Marine Geology* 348: 112-130.

USACE (United States Army Corps of Engineers). 2000. Final feasibility report and environmental impact statement on hurricane protection and beach erosion control: Dare County beaches (Bodie Island portion), Dare County, North Carolina. Vol I and Vol II, US Army Corps of Engineers, Wilmington District, South Atlantic Division.

USACE (U.S. Army Corps of Engineers). 2006. Appendix I - Biological Assessment. In: Draft General Reevaluation Report and Environmental Impact statement on hurricane protection and beach erosion control: West Onlsow Beach and New River Inlet (Topsail Beach), North Carolina. USACE, pp. I1-I28.

USACE (United States Army Corps of Engineers, Wilmington District). 2013a. 2013 Seabeach amaranth (*Amaranthus pumilus*) survey. U.S. Army Corps of Engineers Wilmington District. 53 pp

USACE (U.S. Army Corps of Engineers). 2013b. Integrated Feasibility Report and Draft Environmental Impact Statement. Coastal Storm Damage Reduction. Bogue Banks, Carteret County, North Carolina. Draft Report

USFWS (U.S. Fish and Wildlife Service). 1993. Formal Conference Report Regarding Seabeach Amaranth, *In:* 1993 Biological Opinion Concerning Beach Nourishment Projects as Masonboro Island, Wrightsville Beach, Topsail Beach and West Onslow Beach. 22 pp

USFWS (U.S. Fish and Wildlife Service). 1996a. Recovery Plan for Seabeach Amaranth *(Amaranthus pumilus)* Rafinesque. Atlanta, Georgia

USFWS (U.S. Fish and Wildlife Service). 1996b. Piping Plover (*Charadrius melodus*), Atlantic Coast Population, Revised Recovery Plan. Hadley, Massachusetts. 258 pp

USFWS (U.S. Fish and Wildlife Service). 1999. Northern Dare County storm damage reduction project, Dare County, North Carolina. Raleigh Field Office, Raleigh, NC, 202 pp + appendices.

USFWS (U.S. Fish and Wildlife Service). 2002. Biological Opinion on the effects of an interim beach fill at the critical zone and south beach areas of the sandy hook unit of gateway national recreation area, Monmouth County, New Jersey on the piping plover (*Charadrius melodus*) and seabeach amaranth (*Amaranthus pumilus*). National Park Service, Fort Hancock, NJ. 111 pp.

USFWS (U.S. Fish and Wildlife Service). 2003a. Guidelines for Avoiding Impacts to the West Indian Manatee, Precautionary Measures For Construction Activities In North Carolina Waters, http://www.fws.gov/nc-es/mammal/manatee_guidelines.pdf Last visited December 4, 2013.

USFWS (U.S. Fish and Wildlife Service). 2008. West Indian manatee, (*Trichechus manatus*). https://www.fws.gov/endangered/esa-library/pdf/manatee.pdf. Last visited March 18, 2014.

USFWS (U.S. Fish and Wildlife Service). 2010a. Biological opinion for expansion of Wallops Flight Facility and ongoing operations, Accomack County, Virginia, Project #2010-F-0105.

USFWS (U.S. Fish and Wildlife Service). 2012. Piping Plover Critical Habitat. http://www.fws.gov/raleigh/species/es_piplch.html Accessed March 26, 2014

USFWS (U.S. Fish and Wildlife Service). 2014a. West Indian Manatees in North Carolina, http://www.fws.gov/nc-es/mammal/manatee.html. Accessed: March 18, 2014.