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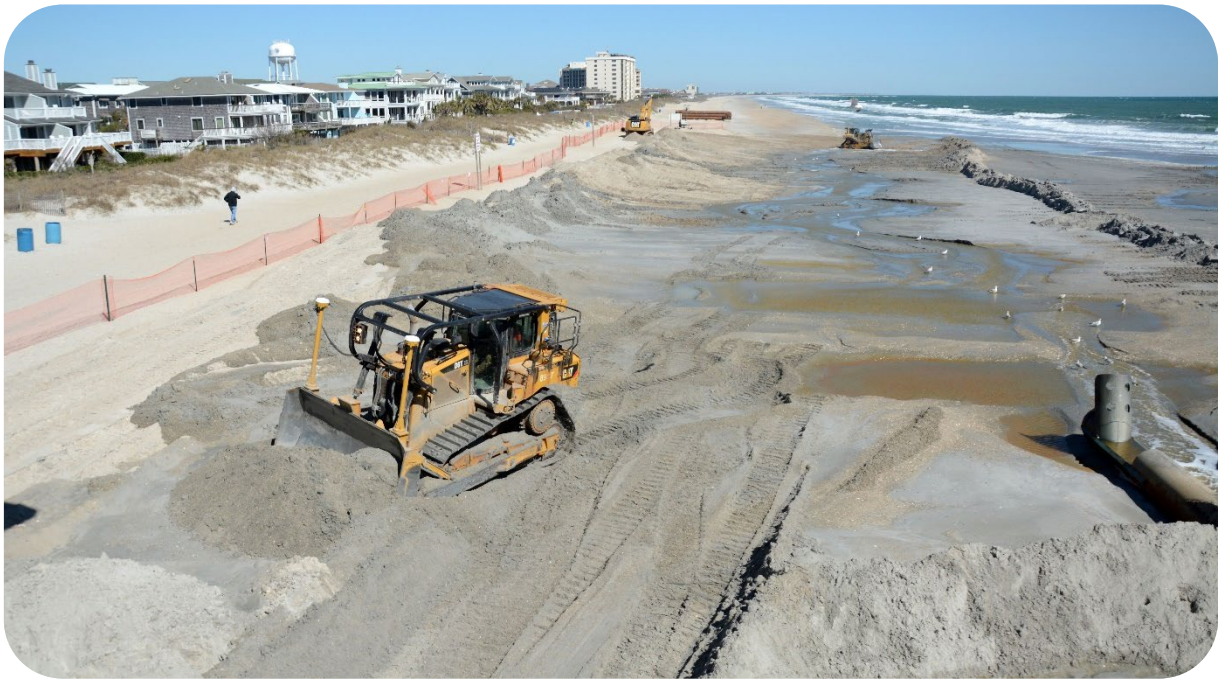
US Army Corps of Engineers ®
Wilmington District

WRIGHTSVILLE BEACH, NC

VALIDATION STUDY



June 2019

Wilmington District – U.S. Army Corps of Engineers

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Executive Summary

Wrightsville Beach, NC

Validation Study

The purpose of this action is to determine Federal interest for increasing the total maximum project cost limit, established by Section 902 of the Water Resources Development Act (WRDA) of 1986, to continue Coastal Storm Risk Management (CSRM) through periodic renourishment on the Wrightsville Beach, NC CSRM project through FY 2036, the end of currently authorized Federal participation in periodic renourishment. The latest estimate of current total project costs through FY 2036 is projected to exceed the Section 902 limit. With a determination of Federal interest, obtaining authorization in WRDA 2020 would avoid delays in impacting the next scheduled cost-shared periodic renourishment in FY 2022. This Validation Study is being conducted under the existing project authority and is a cost-shared effort with the Town of Wrightsville Beach as the non-Federal sponsor. The United States Army Corps of Engineers (USACE) is the lead agency, with the Bureau of Ocean Energy Management (BOEM) as a cooperating agency. Project Delivery Team (PDT) representatives included members of the Wilmington, Jacksonville and Savannah Districts with participation by the Town of Wrightsville Beach (sponsor), New Hanover County and other Federal and State agencies.

Wrightsville Beach is located about 15 miles east of Wilmington, North Carolina in New Hanover County. The community is located on a barrier island fronted by the Atlantic Ocean on the east, Banks and Motts Channels and the Atlantic lntracoastal Waterway on the west, Masons Inlet on the north, and Masonboro Inlet on the south. The area along the shoreline within the project footprint is approximately three miles in length and is fully developed with a mix of homes, motels, hotels and commercial establishments.

Since the purpose of this Validation Study is to increase the total maximum project costs and Section 902 limit, no investigations to reformulate/modify the physical characteristics of this project were conducted.

Construction of the Wrightsville Beach CSRM project was inititated in FY 1965 with Masonboro Inlet/Banks Channel being the historic borrow source for material placed on Wrightsville Beach. Current engineering analysis of this borrow source indicates that there may not be a sufficient quantity of sand to provide borrow material for four additional renourishments required through FY 2036. Also, all of Masonboro Inlet and about half of the Banks Channel borrow source is located within a Coastal Barrier Resources System (CBRS) unit. The Coastal Barrier Resources Act (CBRA) was enacted in 1982 and contains restrictions on Federal spending within undeveloped coastal barriers. Due to this identified risk, the PDT has identified a new potential offshore area, not located within a CBRS unit, for beach quality borrow material investigations in the event that the sand borrow source of Masonboro Inlet/Banks Channel is not sufficient or

useable in the future. It's anticipated that an offshore borrow source may be needed for at least one of the four required renourishments.

Additional investigations and technical analyses will be required to determine the quality and quantity of a potential offshore borrow source including geomorphic, geophysical, environmental and cultural surveys. These investigations would occur during the preconstruction engineering and design phase after project authorization and before an offshore borrow source is used for placement of sand on Wrightsville Beach through FY 2036.

The Recommended Plan is the National Economic Development (NED) plan, which is a continuation of the existing Wrightsville Beach CSRM project. If authorized, the Recommended Plan would increase the total maximum/Section 902 project cost limit, so Federal participation in periodic renourishment can continue on Wrightsville Beach through FY 2036. The current authorized project consists of the following: A dune having a crown width of 25 feet at 12.5 feet North American Vertical Datum of 1988 (NAVD88), together with a beach berm, having a crown width of 50 feet at 9.5 feet NAVD88, and a construction berm, having a crown width of 205 feet at 5.0 feet NAVD88. The dune and berms extend north 13,670 feet from the Masonboro Inlet north jetty. In addition to the main fill, the project includes a 2,000-foot-long transition on the north end. The total project length (including transitions) would be 15,650 feet. The periodic renourishment interval for the project remains at four years. Dredged material for the beach fill would be obtained from Masonboro Inlet/Banks Channel as the primary borrow source in combination with an offshore source, to the extent required, through FY 2036. Continued use of the Masonboro Inlet and about half of the Banks Channel borrow source would require an exemption from the provisions of CBRA. Use of an offshore source would not require an exemption from the provisions of CBRA.

Utilizing existing information about the inlet borrow source and information gathered about the offshore borrow source, the use of the Masonboro Inlet/Banks Channel as the primary borrow source is environmentally preferable to exclusively using an offshore borrow source, and would conserve Federal and non-Federal funds. Consequently, there is the explicit understanding that CBRA would prohibit the use of the inlet as a borrow source unless Congressional re-authorization of the project allows for the use of Federal funds to work within this borrow area, notwithstanding the financial restrictions of CBRA.

While USACE does not typically consider alternatives that are outside the scope of current Congressional authority, the National Environmental Policy Act specifically allows for this type of consideration. Given the environmental benefits associated with continued use of the inlet borrow source, the Recommended Plan includes the Masonboro Inlet/Banks Channel as the primary borrow source for this project notwithstanding the restrictions of CBRA.

As noted earlier, the Recommended Plan is environmentally preferable. Coordination with resource agency representatives was initiated early in the study and appropriate avoidance and minimization measures (i.e. environmental windows, beach placement activities, borrow source

selection and use, etc.) were developed and integrated into the project alternatives during the Validation Study process in order to reduce project impacts. These measures reduced significant direct impacts; however, incidental impacts were still documented with respect to specific species and their associated habitat requirements, including listed species such as piping plovers and sea turtles.

This report is a fully Integrated Validation Study and Environmental Assessment that complies with the National Environmental Policy Act (NEPA) and the USACE's water resources planning process. The Recommended Plan would not result in any significant impacts to federally-listed threatened or endangered species or their designated critical habitat, would have no significant impact to sites listed on or eligible for inclusion on the National Register of Historic Places, and would not significantly affect any wetlands or waters of the U.S., nor any important wildlife habitat. Therefore, no compensatory mitigation is required. Informal Section 7 coordination with the US Fish and Wildlife Service (FWS) has been successfully completed. The FWS and the National Marine Fisheries Service (NMFS) have been actively involved throughout this study and will have additional opportunity to provide input during the 30-day Public Review. The Recommended Plan is covered under the North Carolina Division of Water Resources' March 19, 2017, Water Quality Certification (WQC) No. 4099: General Certification for Projects Eligible for U.S. Army Corps of Engineers Regional General Permit 198000048. All conditions of WQC #4099 will be met. The project will also be in compliance with Section 404 of the Clean Water Act and a Section 404(b)(1) analysis is included as an appendix to this report.

The estimated First Cost of the Recommended Plan is $52,800,000 with October 2018 (FY 2019) price levels or an average of approximately $13,200,000 per periodic renourishment event. Continuation of Federal participation in the project using Masonboro Inlet and Banks Channel in combination with an offshore borrow source would be anticipated to be cost-shared 50 percent Federal ($26,400,000) and 50 percent non-Federal ($26,400,000). Operations and maintenance costs between scheduled periodic renourishment cycles are estimated at $75,000 a year and would be a 100 percent non-Federal responsibility. As stated earlier, the project includes a 4-year renourishment cycle, resulting in four total renourishments through FY 2036. The preliminary benefit cost ratio for the Recommended Plan is 5.2 to 1.

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1 STUDY OVERVIEW AND PURPOSE

The Integrated Validation Study and Environmental Assessment (EA) presents the results of analyses to determine Federal interest in increasing the total maximum/Section 902 project cost limit to continue coastal storm risk management (CSRM) periodic renourishment on the Wrightsville Beach, NC CSRM project through Fiscal Year (FY) 2036, the end of currently authorized Federal participation in periodic renourishment. The latest estimate of current total project costs through FY 2036 is projected to exceed the Section 902 limit as defined in the Water Resources Development Act (WRDA) of 1986, as amended. Cumulative total project costs through FY 2018, $21.7 million, are approximately within $2.8 million of this project's Section 902 limit of $24.5 million, leaving insufficient spending authority to perform a subsequent periodic renourishment. Cumulative total project costs cannot legally exceed the Section 902 limit without prior Congressional authorization. The Town of Wrightsville Beach is the local sponsor. The USACE is the lead Federal agency for this report, and the Bureau of Ocean Energy Management (BOEM) is a cooperating agency.

1.1 Purpose and Need for Action

The last periodic renourishment was completed in March 2018 and the next cost-shared event is scheduled to occur in FY 2022. However, the anticipated cost of this renourishment event would likely cause the Section 902 limit to be exceeded. Therefore, the purpose of this action is to obtain authorization in WRDA 2020 to increase the Section 902 maximum project cost limit to avoid delays in performing scheduled cost-shared periodic renourishment cycles after 2021.

1.2 Study Authority and Scope

The project was authorized by the Flood Control Act of 1962, Public Law (PL) 87-874 as published in House Document 511, 87th Congress, 2nd Session and the Water Resources Development Act of 1986 (PL 99-662). The initial authorization provided for shore and hurricane wave protection along 14,000 feet of ocean shoreline (+ 2,000-foot-long transition) extending north from Masonboro Inlet and included a dune and berm system that protected against hurricane wave action from a 35-year storm. Also included in this authorization was a provision for Federal aid for periodic renourishment for a 10-year trial period to determine the technical viability of periodic renourishment. After the 10-year trial period ended in April 1981, the project was re-evaluated for continued Federal participation in project renourishment. This re-evaluation culminated in a Feasibility Report and Environmental Assessment being completed in September 1982 (Revised February 1983) recommending continued Federal participation in project renourishment for 50 years, which was authorized in the WRDA 1986.

1.3 Study Area

Wrightsville Beach is located about 15 miles east of Wilmington, North Carolina in New Hanover County. The community is located on a barrier island fronted by the Atlantic Ocean on the east, Banks and Motts Channels and the Atlantic lntracoastal Waterway on the west, Masons Inlet on the north, and Masonboro Inlet on the south (Figure 1-1).

Figure 1-1. Location of Study Area

1.4 Study Process

The US Army Corps of Engineers (USACE) studies for water and related land resources follow detailed guidance provided in the Planning Guidance Notebook (Engineer Regulation 1105-2-100). This guidance is based on the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies that were developed pursuant to Section 103 of the Water Resources Planning Act (P.L. 89-80) and Executive Order 11747, which were approved by the U.S. Water Resources Council in 1982 and by the President in 1983. A defined six-step process is used to identify and respond to problems and opportunities associated with the federal objective and specific state and local concerns. The process involves an orderly and systematic approach to making evaluations and decisions at each step so that the public and the decision-makers can be informed of basic assumptions made, the data and information analyzed, risk and uncertainty, the reasons and rationales used, and the significant implications of each alternative plan. The process concludes with the selection of a Recommended Plan.

This Validation Study only presents the results of analyses to determine Federal interest for increasing the total maximum or Section 902 project cost limit to continue coastal storm risk management (CSRM) through periodic renourishment on the Wrightsville Beach, NC CSRM project through FY 2036. Since the purpose of this Validation Study is to increase the total maximum project costs and Section 902 limit, no investigations to reformulate/modify the physical characteristics of this project were conducted. The one exception to this approach was the inclusion of a third alternative in addition to the No Action alternative which incorporated an alternative borrow source (offshore) in lieu of the historical borrow source (Masonboro Inlet/Banks Channel). This approach was taken due to the risk of unavailability of the historical borrow source in the future due to the Coastal Barrier Resources Act (CBRA) (see section 9.3 for details).

Construction of the Wrightsville Beach CSRM project was inititated in FY 1965 with Masonboro Inlet/Banks Channel being the historic borrow source for material placed on Wrightsville Beach. Current engineering analysis of this borrow source indicates that there may not be a sufficient quantity of sand to provide borrow material for four additional renourishments required through FY 2036. Also, all of Masonboro Inlet and about half of the Banks Channel borrow source is located within a Coastal Barrier Resources System (CBRS) unit. The CBRA was enacted in 1982 and contains restrictions on Federal spending within undeveloped coastal barriers. Due to this identified risk, the PDT has identified a new potential offshore area, not located within a CBRS unit, for beach quality borrow material investigations in the event that the sand borrow source of Masonboro Inlet/Banks Channel is not sufficient or useable in the future. It's anticipated that an offshore borrow source may be needed for at least one of the four required renourishments.

Additional investigations and technical analyses will be required for any new offshore source to determine the quality and quantity of available material, including geomorphic, geophysical, environmental and cultural surveys. These investigations would occur during the preconstruction engineering and design (PED) phase after project authorization and before an offshore borrow source is used for placement of sand on Wrightsville Beach.

2 HISTORY OF THE PROJECT

Initial construction of the Wrightsville Beach project was completed in 1965, was nourished with 1.4 million cubic yards (CY) of sand in 1970, and was completely restored between December 1980 and April 1981 under the initial authorization. The 1962 project authorization was amended by the Water Resources Development Act of 1986, which extended periodic renourishment for 50 years to FY 2036, with a 4-year renourishment cycle. To date, eight CSRM periodic renourishment events have been completed since the 1986 authorization, those being performed in 1991, 1994, 1998, 2002, 2006, 2010, 2014 and 2018. The next periodic renourishment is planned for FY 2022, if the project's total maximum project cost or Section 902 limit is increased as proposed within this report, subject to future funding availability. For planning purposes, it is likely the renourishment quantity will be similar to events in the past, which have averaged approximately 780,000 CY per renourishment. Periodic renourishment activities are cost-shared in accordance with the Local Cooperation Agreement signed with the Town of Wrightsville Beach on June 27, 1990.

2.1 Project Description

The Wrightsville Beach CSRM Project, as constructed, covers 15,650 feet of ocean shoreline and fronts the Town of Wrightsville Beach. The project includes the following: A dune having a crown width of 25 feet at 12.5 feet North American Vertical Datum of 1988 (NAVD88), together with a beach berm, having a crown width of 50 feet at 9.5 feet NAVD88, and a construction berm, having a crown width of 205 feet at 5.0 feet NAVD88. The dune and berms extend north 13,670 feet from Masonboro Inlet North Jetty. In addition to the main fill, the project includes a 2,000-foot-long transition on the north end, from Station 140+00 to Station 160+00. The total project length (including transitions) is 15,650 feet. Historically the typical project renourishment extends from Station 70+00 to 140+00 with a 2,000-foot transition to station 160+00 (shown as solid red line in Figure 2-1). To date, the historic borrow area source has been the Masonboro Inlet/Banks Channel borrow area. Maximum borrow depths within Masonboro Inlet vary from -20 to -30 feet over approximately 111 acres while within Banks Channel it varies from -24 to -30 feet over 43 acres.

2.2 Prior Studies and Reports

USACE has conducted a number of prior studies regarding the Wrightsville Beach area and has prepared a number of related engineering, planning, and environmental reports. These studies have addressed coastal storm risk management, as well as navigation needs and are listed below.

- 1980 Wrightsville Beach Section 111 Report
- 1982 Wrightsville Beach Shore and Hurricane Wave Protection EA/FONSI (Revised 1983)
- 1989 Wrightsville Beach Renourishment Report and Supplement to the EA/FONSI
- 1997 Channel Realignment Maintenance Dredging for Masonboro Inlet EA/FONSI

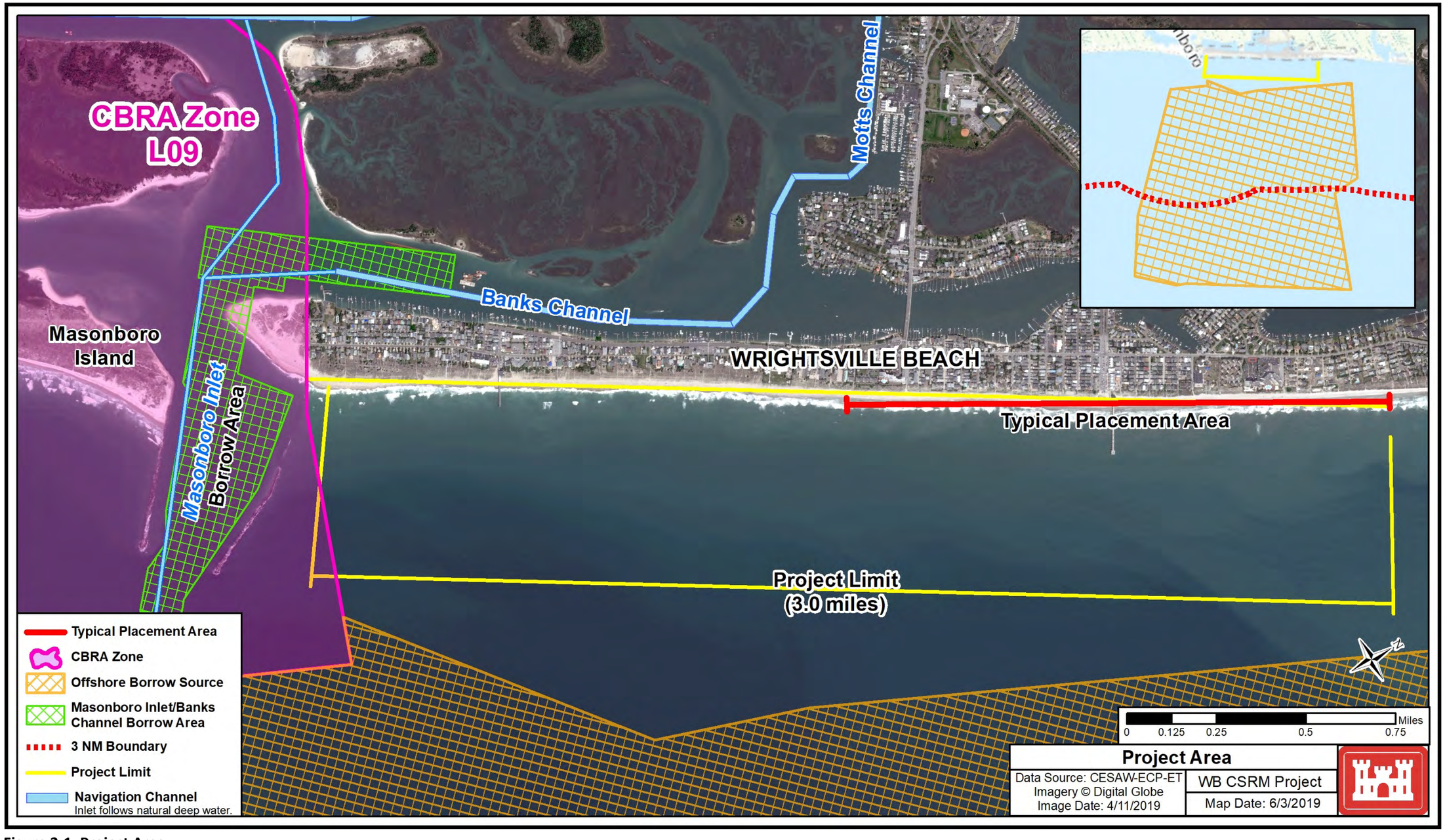


Figure 2-1. Project Area

2.3 Existing Federal Projects in New Hanover County

2.3.1 Coastal Storm Risk Management Projects

The Wrightsville Beach CSRM project is not the only existing Federal coastal storm risk management project in New Hanover County. The Carolina Beach and Vicinity CSRM project, located approximately 10 miles south of Wrightsville Beach, was authorized by the Flood Control Act of 1962. This project includes two separable elements – Carolina Beach and Area South. The Area South portion includes the southern shoreline of Carolina Beach and all of Kure Beach. The historic sand source for the Carolina Beach portion is Carolina Beach Inlet. The Area South portion is immediately adjacent on the south side of the Carolina Beach portion of the project. Since initial construction in 1998, Area South has shared the same three-year renourishment interval with Carolina Beach. The sand source that Area South currently utilizes, referred to as Borrow Area B, is an offshore borrow source.

A Beach Renourishment Evaluation Study is currently being conducted for the Carolina Beach portion under the authority of Section 1037 of the Water Resources Reform and Development Act of 2014, as amended. Authorization for the Carolina Beach CSRM project currently expires at the end of FY 2020. The Beach Renourishment Evaluation Study is investigating the economic feasibility and environmental acceptability in continuing Federal participation in periodic renourishment for an additional 15 years. The resulting report is being prepared for consideration in a potential WRDA 2020 prior to the next scheduled renourishment event in FY 2022.

A map showing locations of the New Hanover County CSRM projects is located in Figure 2-2.

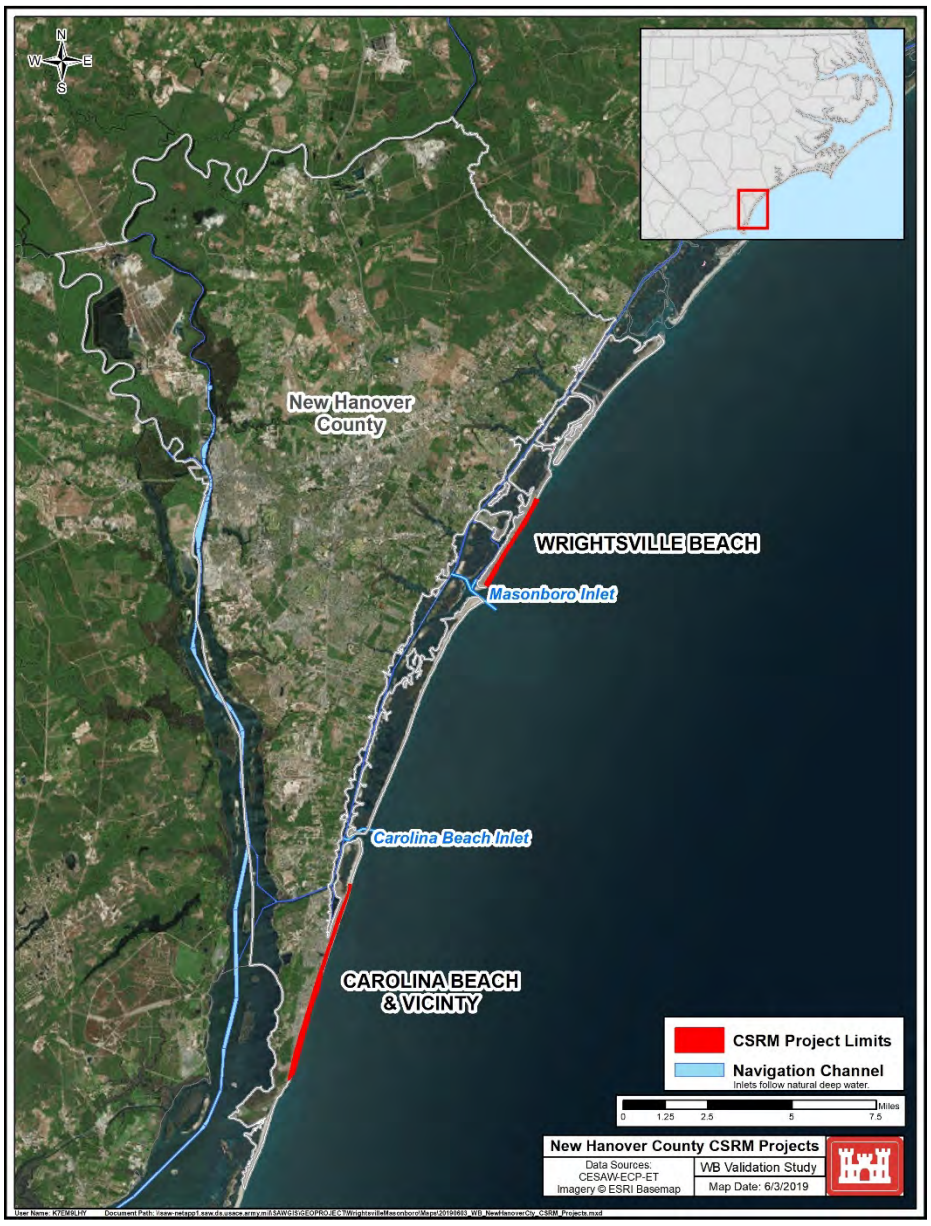


Figure 2-2. New Hanover County CSRM Projects

2.3.2 Atlantic Intracoastal Waterway (AIWW)

The AIWW provides an important inland navigation route from Norfolk, Virginia, to the St. Johns River, Florida. The 308-mile-long North Carolina portion is the state's only north-south commercial navigation thoroughfare. The authorized project includes a navigation channel with a depth of 12 feet and widths varying from 90 feet inland to 300 feet in open waters; side channels and basins at a number of locations; and five highway bridges/AIWW crossings. The Beaufort to Cape Fear River section was authorized by House Document No. 450, 69th Congress, *Inland Waterway, Beaufort – Cape Fear River*. The main channel of the AIWW in North Carolina was completed in 1940, and it has since been maintained by dredging to remove shoals that develop periodically. Some of the dredged material removed during maintenance

activities is beach-quality sand. That material is placed directly on nearby ocean beaches, when practicable; otherwise, it is stockpiled in confined disposal areas near the shoreline of the AIWW.

2.3.3 Masonboro Inlet Navigation Project

The Masonboro Inlet navigation project is an authorized feature of the AIWW and was authorized by the River and Harbor Act of 1950. This project includes a channel across the ocean bar at Masonboro Inlet and a channel through Banks and Motts Channel to the AIWW, a deposition basin and dual jetties providing a connection between the AIWW and the Atlantic Ocean. Banks and Motts Channels have authorized depths of -12 feet and widths of 90 feet.

Construction of a jetty on the north side of Masonboro Inlet took place between July 1965 and June 1966. By the late 1970s, the navigation channel (and northern end of Masonboro Island) had shifted significantly to the north. As a result, the authorized southern jetty was constructed in 1980 and the navigation channel was dredged to -14 feet and centered between the two jetties**.** The width of this navigation channel varies up to 400 feet between the jetties. This inlet, and the southern portion of Banks Channel, requires little or no recurring maintenance dredging due to using this borrow source every 4 years for placement on the Wrightsville Beach CSRM project. The Masonboro Inlet project configuration remains unchanged as of today.

The northern jetty includes a low weir for passing sand into the inlet for future use as borrow material when periodic renourishment of Wrightsville Beach is required. Following completion of the northern jetty, the CSRM project began to suffer an unexpectedly high rate of erosion of the sand fill, particularly along the northern 7,000 feet of the project shoreline. This erosion could not be explained in terms of slope adjustments or sorting action of the fill. Continued severe erosion necessitated the dredging and placement of a substantial quantity of fill on the Wrightsville Beach CSRM project in the spring of 1970, after which the project was considered officially completed and was turned over to the local sponsor. No additional fill was placed on the project until April 1980. At that time, an emergency fill, consisting of approximately 500,000 cubic yards of sand removed from the southern end of Banks Channel, was placed along the northern 7,000 feet of project shoreline under Public Law 84-99 authority. Upon completion of this work in May 1980, the northern half of the project still offered only a portion of the coastal storm risk management protection for which it was designed.

The 1980 Wrightsville Beach Section 111 Report presented an analysis of the shore processes and the principle finding was that the Masonboro Inlet north jetty caused an average annual deficit of 155,000 cubic yards of sand to the adjacent CSRM project by substantially reducing the natural sand bypassing at the inlet.

This investigation recommended mitigation of the shore damages caused by the north jetty. The plan considered most feasible for restoration of the Wrightsville Beach CSRM project involved dredging approximately 1.8 million cubic yards of beach quality sand from the

Masonboro Inlet navigation channel and its adjacent shoals with placement on the beach from Station 70+00 north to Station 140+00 (to the fully authorized dimensions). The Section 111 report documented the Federal responsibility for the jetty-induced erosion and recommended periodic renourishment of 439,000 cubic yards of material to the Wrightsville Beach CSRM project every 4 years.

2.3.4 Wilmington Harbor Navigation Project

Wilmington Harbor is a high use deep draft navigation project located on the southeastern coast of North Carolina in Brunswick and New Hanover counties. The project extends from the Atlantic Ocean to a point just beyond downtown Wilmington, NC, a distance of about 35 miles. The project includes a channel 44 feet deep through the Ocean Bar and 42 feet deep to 800 feet south of the Cape Fear Memorial Bridge in downtown Wilmington. Upstream of this point, the project is 38 feet deep to the Highway 133 bridge; 32 feet deep to the Hilton Railroad Bridge over the Northeast Cape Fear River; and 25 feet deep from the Hilton Railroad Bridge to a point 1-2/3 miles above the bridge. The project also includes a northwestward connecting channel, 12 feet deep, from the Atlantic Intracoastal Waterway at Snow's Cut to the main river channel.

The project mitigation features include a 30 acre tidal embayment and about 700 acres of existing tidal swamp and upland area for habitat preservation to offset losses of wetlands and primary nursery areas. Also, a rock ramp for fish passage at Lock and Dam No. 1 on the Cape Fear River was constructed to address the impacts to anadromous fish and the endangered short-nose sturgeon from rock removal by blasting during the harbor deepening.

3 PROBLEMS AND OPPORTUNITIES, GOALS AND OBJECTIVES

3.1 Problems and Opportunities

A problem is an existing undesirable condition to be changed. An opportunity is a chance to create a future condition that is desirable.

Problems and opportunities have been identified by the Project Delivery Team (PDT) as follows:

Problems

- There is a continuing threat to existing residential and commercial structures and property, and local infrastructure, with future without project average annual damages, including land loss, are approximately $7,983,000.

Opportunities

- There is an opportunity to significantly reduce risk of coastal storm damage by investigating structural and non-structural measures for residential and commercial structures and property in the town of Wrightsville Beach, NC.

3.2 Goals and Objectives

As described in Engineering Regulation 1105-2-100 and as outlined in the 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, the Federal objective in water resources planning is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment. The Federal objective leads to the general overall goal of this study:

Goal: Evaluate continued Federal participation in the existing Wrightsville Beach CSRM project.

Identifying and considering the problems, needs, and opportunities of the study area in the context of Federal authorities, policies, and guidelines resulted in the establishment of the following specific objective:

Objective: Ensure a Federal economically justified role in continued renourishment of the Wrightsville Beach CSRM project.

Achieving the study objective would likely also have positive effects on the environment, such as the preservation of sea turtle and shorebird nesting and foraging habitat, as well as benefits associated with recreational use of the restored beach, and reduced damages to roads and utilities.

3.3 Constraints

As described in Engineering Regulation 1105-2-100, constraints are restrictions that limit the planning process. Constraints, like objectives, are unique to each planning study. Some general types of constraints that need to be considered are resource constraints and legal and policy constraints. Resource constraints are those associated with limits on knowledge, expertise, experience, ability, data, information, money and time. Legal and policy constraints are those defined by law, Corps policy and guidance. Plans should be formulated to meet the study objectives and to avoid violating the constraints.

The following constraints were identified for the study:

Planning Constraints

1. Only an increase in the total maximum Section 902 of WRDA 1986 project cost limit allowing Federal participation in periodic renourishment to continue through FY 2036 will be considered, and no reformulation of the existing project is required.
2. Continued use of the historical borrow source (Masonboro Inlet/Banks Channel) would require an exemption from CBRA in the Congressional Authorization.

3.4 Key Assumptions

The key assumptions made for this study are:

- Current physical and social trends occurring from the present will continue into the future for the 50-year period of analysis.
- Damaging storms will continue to occur with comparable strength and frequency as have occurred in the past.
- Existing structures will be rebuilt after being damaged or destroyed by storms
- No new structures will be built on currently undeveloped lots. This is a conservative approach with regards to benefits since additional structures would result in additional Future Without Project (FWOP) Condition damages, hence increased benefits.
- No other coastal storm risk management project will be constructed in the study area over the period of analysis.
- No new real estate is required.
- The proposed work around for Beach-fx (using a 1 dune/ 1 berm design) will produce similar outputs as expected from the actual authorized project design which includes 1 dune and 2 berms.
- Evaluation of an offshore borrow source is necessary because the project's historic borrow area within Masonboro Inlet and Banks Channel may not be available in the future through FY 2036.

4 DESCRIPTION OF EXISTING AND FUTURE WITHOUT PROJECT CONDITIONS

This section focuses on quantifying the existing and future without project physical shoreline and economic conditions, which form the primary basis for the comparison (FWOP) of benefits of project alternatives. The existing condition of significant environmental resources in the area is described in Section 7 of this report. The FWOP refers to the most likely future that would occur without continued Federal participation in periodic renourishments.

4.1 Existing Conditions

4.1.1 Existing Hurricane and Coastal Storm Damage Conditions

Wrightsville Beach is located in an area of significant hurricane activity. The shoreline of Wrightsville Beach is influenced predominantly by tropical systems that occur during the summer and fall. Northeasters during the late fall, winter and spring also have an effect, but to a lesser degree due to shielding effects of the coastal geography north of the project site. Based on records from the National Hurricane Center, 37 hurricanes and 49 tropical storms have passed within a 50-nautical mile radius of the project site over the 166-year period of record. In recent years, a number of named storms passing within the 50-mile radius have significantly impacted the project area, including Florence (2018), Colin (2016), Hermine (2016), Matthew (2016), Arthur (2014), and Beryl (2012). Damages from these storms, as well as from more distant storms causing indirect impacts, included substantial erosion and damage from winds, waves, and elevated water levels. However, structural damage to buildings from these storms was minimal. Assessments indicate that the project berm and dune absorbed many of the impacts.

4.1.2 Existing Beach Erosion Conditions

Major erosion in the project area is caused by tropical cyclones occurring in the warmer months and northeasters that frequently occur along Wrightsville Beach during the colder months. Erosion rates vary by reach, but average between four and eight feet per year for the majority of the project. Erosion in the project area has been managed by planned sand renourishments on a 4-year interval. More detail on erosion rates is located in Appendix A.

4.1.3 Existing Recreation Conditions

The study area has a fairly robust tourist-oriented commercial industry. Visitors come to enjoy both the developed beach areas and to take advantage of other ocean-based recreational opportunities.

4.1.4 Existing Environmental Conditions

The existing environmental conditions of the area are detailed in Section 7 of this report.

4.1.5 Existing Socioeconomics Conditions

Over the past 35 years Wrightsville Beach has developed rapidly as a family ocean resort community for outdoor recreation. Land use is primarily recreational, residential with many commercial properties, with the highest density along the oceanfront and Inlet. Based on the 2010 census, the permanent, off-season population is about 2,500 residents, but increases vastly in the summer. During the summer months a large portion of the homes within the study area are available as summer rentals to vacationers primarily from inland North Carolina and other locations around the Eastern United States. The current beach plays a large role in the significant revenues generated from tourist-oriented businesses.

For more information about socioeconomics see Section 7.8 of this report.

4.1.6 Existing Public Parking and Access Conditions

ER 1165-2-130 (Federal Participation in Shore Protection) requires reasonable public parking and access to the beach to be provided by the non-Federal sponsor. These requirements ensure that all portions of the project shoreline are available for public use as defined by adequate parking and access facilities. Per ER 1165-2-130, paragraph 6.h.: "Parking should be sufficient to accommodate the lesser of the peak hour demand or the beach capacity", and "public use is construed to be effectively limited to within one-quarter mile from available points of public access to any particular shore. In the event public access points are not within one-half mile of each other, either an item of local cooperation specifying such a requirement and public use throughout the project life must be included in the project recommendations or the cost-sharing must be based on private use." The USACE Wilmington District has further interpreted the policy for adequate parking and access to mean that for participation in coastal storm risk management projects within the District's boundaries of North Carolina, a minimum of 10 public parking spaces need to be located at each access point.

Parking spaces were verified and geolocated visually. Heads-up digitizing of parking space locations was performed using 2016 North Carolina Center for Geographic Information Analysis Aerial Orthophotography imagery as well as Google Earth Imagery (various dates). Point locations were compiled and attributed according to their spatial locations, and cross-referenced against data provided by the Town of Wrightsville Beach. These data were then spatially intersected with a quarter mile buffer from each Coastal Area Management Act (CAMA) beach access as per USACE CSRM Parking and Access Planning policy guidance. Lastly, the quantity of spaces within each quarter mile buffer was aggregated and confirmed.

There are 44 public access points on Wrightsville Beach that range from simple walkovers to accessible dune walkover structures. Each of these access points are clearly marked with signs. Four of the access sites include public parking as well as shower and changing facilities. The estimates of public parking spaces were provided by the Town of Wrightsville Beach Planning and Inspections Department and verified by USACE District staff in December 2018, indicating 44 CAMA access points and 666 parking spaces. The number of marked parking spaces has increased slightly from 2002.

Additional information on Parking and Access can be found in Appendix C.

4.2 Future Without Project (FWOP) Conditions

4.2.1 Future Without Project Coastal Storm Damage Conditions

For purposes of economic analysis, the study area was divided into two economic reaches. An economic reach contains one or more similar, adjacent damageable elements. Economic reaches in the study area vary in length but average approximately 7,100 ft long. Average annual coastal storm damages to the study area were estimated using the Beach-*fx* model.

The estimated average total without project damages over 50 years for each of the economic reaches, based on 300 life-cycles. Damages are fairly comparable across reaches, although there are several notable exceptions. At the fiscal year (FY) 2019 discount rate of 2.875%, total average annual without project structure and content damages are estimated at $6,935,000 per year. Average annual without project damages resulting from land loss (which are calculated based on the erosion rates presented in Appendix B) are estimated at $1,048,000. Thus, the total average annual damages in the study area in the Future Without-Project condition are $7,983,000. Appendix F contains more details on the calculation of land loss value and the determination of structure and content value.

4.2.2 Future Without Project Beach Erosion Conditions

Based on the calculated average erosion rate per year, without continued Federal participation in the project a good portion of the beach will continue to erode from the existing condition back into the dune. Once the beach has eroded back into the dune, escarpments will occur resulting in wave reflection off the escarpment with subsequent increased erosion, scouring, and loss of intertidal beach habitat. The intertidal beach habitat and benthic invertebrate community is a significant resource for feeding shorebirds and surf zone fishes. As the beach and dune complex erode, important habitat for a variety of plants and animals would be endangered, including loss of the dune grasses and associated fauna. Additionally, beach habitat for loafing and nesting shorebirds as well as nesting sea turtles would be degraded or lost as the beach and dune are eroded into the coastal infrastructure. Recreational opportunities associated with the beach would also diminish.

4.2.3 Future Without Project Recreation Conditions

Wrightsville Beach will likely continue to serve as a popular tourist destination in the future, although in the without project condition the recreational value of the area would decline as the beach continues to erode and the beach width available for typical beach-going activities is reduced or eliminated.

4.2.4 Future Without Project Environmental Conditions

The future without project environmental conditions of the area are detailed in Section 7 of this report.

4.2.5 Future Without Project Socioeconomis Conditions

The population of New Hanover County, along with that of the rest of the State of North Carolina, is predicted to increase over the next 15 years. However, in a future without project condition, where the beach is allowed to erode, a large economic impact would likely be felt by the community on the island, as many commercial businesses that are dependent upon the income generated by year-round tourists. Should beach utility drop below a critical level associated with shoreline erosion, the significant revenues gained from tourist-oriented business could be expected to markedly decrease as recreational opportunities and environmental quality diminish.

4.2.6 Future Without Project Sea Level Rise Conditions

Engineering Regulation (ER) 1100-2-8162 and Engineer Technical Letter (ETL) 1100-2-1 provide USACE both a methodology and a procedure for determining a range of sea level change estimates. This guidance is used for incorporating the potential direct and indirect physical effects of projected future sea level change in the engineering, planning, design and management of USACE projects.

Three estimates are required by the guidance, a Low (Baseline) estimate representing the minimum expected sea level change, an Intermediate estimate, and a High estimate representing the maximum expected sea level change. These estimates are referenced to the midpoint of the latest National Tidal Datum epoch, 1992.

Based on historical sea level measurements taken from National Ocean Service gauge 8659084 at Southport, North Carolina, the historic sea level change rate (e+M) was determined using the updated published sea level change extracted from *http://www.corpsclimate.us/ccaceslcurves.cfm*.

Relative vulnerability to flooding during extreme events is consistent between both with and without project conditions. However, adaptation in the form of additional sand volume will be required to maintain project performance. For this analysis, the base/low sea level rise rate curve was used to compare with and without project conditions.

Details of this study's sea level rise analysis are located in Appendix B. A discussion on risk and uncertainty in the sea level rise analysis is located in section 6.9.5 of this report.

5 PLAN FORMULATION AND EVALUATION OF ALTERNATIVES

Typically, a number of alternatives are identified early in the planning process, and their number is reduced by screening, evaluation, and comparison in an iterative sequence in increasing levels of detail to finally identify the selected plan. However, the purpose of this action is to determine Federal interest for increasing the total maximum or Section 902 project cost limit to continue coastal storm risk management (CSRM) through periodic renourishment on the Wrightsville Beach, NC CSRM project through FY 2036. Since the purpose of this Validation Study is to increase the total maximum project costs and Section 902 limit, no investigations to reformulate/modify the physical characteristics of this project were conducted.

The Validation Study process resulted in the identification and evaluation of two preliminary alternatives:

1. The No Action Plan
2. Continuation of Federal participation in periodic renourishments consistent with the currently authorized project by increasing the total maximum/Section 902 project cost limit while using Masonboro Inlet/Banks Channel borrow source through FY 2036.

During the study the PDT identified a study risk concerning the future availability of the historic sand borrow source (Masonboro Inlet/Banks Channel). This risk is associated with the sand borrow source location being situated within a Coastal Barrier Resources System (CBRS) unit, and therefore subject to restrictions on the expenditure of Federal funds. Due to this identified risk, the PDT evaluated offshore borrow sources not located within a CBRS unit. Continued use of Masonboro Inlet/Banks as the borrow source would require an exemption from the provisions of CBRA in the project's final Congressional authorization. Use of offshore borrow sources would not require an exemption from the provisions of CBRA. Details on both borrow source alternatives are located in Appendix A, Geotechnical. **The following is the final array of alternatives:**

1. The No Action Plan
2. Continuation of Federal Participation in Periodic Renourishments consistent with the currently authorized project by increasing the total maximum/Section 902 project cost limit while using the inlet borrow source (requires an exemption from the the provisions of CBRA) and an offshore borrow source, if needed, through FY 2036.
3. Continuation of Federal Participation in Periodic Renourishments consistent with the currently authorized project by increasing the total maximum/Section 902 project cost limit using an offshore borrow source only (does not require an exemption from the provisions of CBRA) through FY 2036.

Since the Masonboro Inlet and a portion of Banks Channel borrow source is located within a CBRS unit, the PDT has identified potential areas of new offshore borrow, not located within a CBRS unit, in the event that the Masonboro Inlet/Banks Channel borrow source is not useable in the future. Also, Alternative 2, which includes continued use of the historic borrow source of Masonboro Inlet/Banks Channel, may require use of an offshore borrow source for at least one of the four renourishments.

Additional investigations and technical analyses are required to determine the quality and quantity of the potential offshore borrow source, including geomorphic, geophysical, environmental and cultural surveys. These investigations would occur during the preconstruction engineering and design phase (PED) after project authorization and before any offshore borrow source is used for placement of sand on Wrightsville Beach as part of this project.

5.1 No Action Plan

The No Action Plan involves no increase of total maximum project costs and would prevent Federal participation in any cost-shared future renourishment under the current Wrightsville Beach CSRM project.

The No Action Plan would result in potential economic losses resulting from damages to structures and their contents due to hurricane and storm activity, loss of beachfront land due to progressive and long-term shoreline erosion and increased risk to life and safety. In addition, periods of severe shoreline recession could adversely affect nesting habitat for endangered and threatened sea turtles and shorebirds, and beach acreage available for recreational opportunities.

5.2 Formulation and Evaluation Criteria

Alternative plans are evaluated by applying numerous, rigorous criteria. Four general planning and guidance (P&G) criteria are considered during alternative plan screening: completeness, effectiveness, efficiency, and acceptability. Analysis of alternatives using the P&G criteria, as well as their definitions are located in section 5.6.2, Tables 5-6 and 5-7.

There are also categories of specific technical criteria related to (1) engineering, (2) economic, (3) environmental, and (4) institutional items. They are as follows:

Engineering Criteria

- The plan must represent a sound, acceptable, and safe engineering solution.

Economic Criteria

- The plan must contribute benefits to National Economic Development (NED).
- Tangible benefits of a plan must exceed economic costs.
- Each separable unit of improvement must provide benefits at least equal to costs.
- Recreation benefits may not be more than 50 percent of the total benefits required for economic justification.

Environmental Criteria

- The plan would fully comply with all relevant environmental laws, regulations, policies, executive orders.
- The plan would represent an appropriate balance between economic benefits and environmental sustainability.
- The plan would be developed in a manner that is consistent with the Corps' Environmental Operating Principles (EOPs).
- Adverse impacts to the environment would be avoided. In cases where adverse effects cannot be avoided, mitigation must be provided to minimize impacts to at least a level of insignificance.

Institutional Criteria

- The plan must satisfactorily address the identified needs and concerns of the public.
- The plan must be implementable with respect to financial and institutional capabilities.
- The plan must be implementable with regard to public support.

5.3 Environmental Operating Principles

The USACE Environmental Operating Principles (Principles) were developed to ensure that USACE missions include totally integrated sustainable environmental practices. The Principles provided corporate direction to ensure the workforce recognized the USACE role in, and responsibility for, sustainable use, stewardship, and restoration of natural resources across the Nation and, through the international reach of its support missions. More information on the Principles can be found here:

http://www.usace.army.mil/Missions/Environmental/EnvironmentalOperatingPrinciples.aspx

Specifically for this project, these Principles were adhered to during the planning process with regards to the screening of potential borrow sources, and the proposed timing of construction activities to avoid impacts to listed species to the maximum extent practicable.

5.4 Identification, Examination and Screening of Measures

A variety of potential measures can be considered and combined when formulating alternative plans for reducing coastal storm damages. These measures generally are categorized as either structural or non-structural. Structural measures are those that directly affect the conditions that cause storm damage – in this case erosion, wave attack and/or flooding. Non-structural measures are those taken to reduce damages without directly affecting those conditions driving project area damages. A No Action Alternative is developed to provide a baseline condition against which to measure comparative plan effectiveness. Under the No Action alternative, FWOP conditions remain in place without implementation of a Federal project.

The structural and non-structural measures associated with the existing project are as follows:

Structural Measures

- ***Beach Fill.*** Beach fill measures consist of berms, dunes, and terminal sections. Measures generally involve variations in dune width, dune height, and berm width. Beach fill measures are considered some of the most appropriate and effective measures, as they mimic the natural environment and can be designed to optimize storm risk management outputs. Although incidental to formulation efforts for this project, beach fill measures that widen the existing berm also provide more recreational benefits than hard structures, and expand the area available for sea turtle nesting and shorebird nesting and foraging. Additionally, a beach fill alternative is naturally adaptable to various sea-level rise scenarios. However, in order to fully realize project outputs, the beach fill template may need to be periodically renourished throughout the life of the project. Figure 5-1 shows an example of a beach fill being constructed.

- ***Vegetation and sand fencing.*** Vegetation and sand fencing help retain windblown sand but do not provide adequate storm damage reduction for moderate to severe storms, and hence are not adequate as a stand-alone measure. However, any dune construction measure would also include appropriate vegetation planting.

Non-Structural Measures

- ***Floodplain and Building Code Regulations.*** Management of the floodplain is a non-Federal responsibility. Regulatory measures include coastal building codes, building construction setbacks, and floodplain regulations. Most regulatory measures have already been instituted at the local level. These regulations provide indirect benefit to storm damage reduction, primarily to new and future construction. They are considered as part of the existing and future without project conditions, and are an integral part of any final project alternatives.

- **Evacuation, Routing and Signage.** Elements of this measure include State evacuation route signage, reverse 911 phone systems, low frequency AM Stations, hurricane risk education and upgrading critical infrastructure and services.

Figure 5-1. Example of Beach Fill Being Constructed

5.5 Identification of Alternative Plans

Three alternatives were identified and evaluated:

5.5.1 Alternative 1: No Action

The No Action Alternative remains in the list of final alternative plans. The No Action Alternative would only be recommended if no other acceptable alternatives produced positive net economic benefits, or if other alternatives had unacceptable and immitigable environmental effects.

5.5.2 Alternative 2: Continuation of Federal Participation in Periodic Renourishments consistent with the currently authorized project by increasing the total maximum/Section 902 project cost limit while using the inlet borrow source (requires an exemption from the provisions of CBRA) and an offshore borrow source, if needed, through FY 2036

This alternative would determine Federal interest in increasing total maximum project costs to allow Federal participation in periodic renourishments for the Wrightsville Beach CSRM project through FY 2036. This alternative would be the same as the current Wrightsville Beach CSRM project, but would have two borrow source options, Masonboro Inlet/Banks Channel and an offshore borrow source. Additional investigations and technical analyses are required to determine the quality and quantity of the potential offshore borrow source, including geomorphic, geophysical, environmental and cultural surveys. These investigations would occur during the preconstruction engineering and design phase (PED) after project authorization and before any offshore borrow source is used for placement of sand on Wrightsville Beach as part of this project.

5.5.3 Alternative 3: Continuation of Federal Participation in Periodic Renourishments consistent with the currently authorized project by increasing the total maximum/Section 902 project cost limit using an offshore borrow source only (does not require an exemption from the provisions of CBRA) through FY 2036

This alternative would determine Federal interest in increasing total maximum project costs to allow Federal participation in periodic renourishments for the Wrightsville Beach CSRM project through FY 2036. This alternative would be the same as the current Wrightsville Beach CSRM project, but would use offshore borrow sources only. Additional investigations and technical analyses are required to determine the quality and quantity of the potential offshore borrow source, including geomorphic, geophysical, environmental and cultural surveys. These investigations would occur during the preconstruction engineering and design phase (PED) after project authorization and before any offshore borrow source is used for placement of sand on Wrightsville Beach as part of this project.

5.5.4 Application of CBRA in using Masonboro Inlet/Banks Channel Borrow Source

Utilizing existing information about the inlet borrow source and information gathered about the offshore borrow source, the use of the Masonboro Inlet/Banks Channel as the primary borrow source is environmentally preferable to using the offshore borrow source (see Section 7), and would conserve Federal and non-Federal funds. Consequently, there is the explicit understanding that CBRA would prohibit the use of the inlet as a borrow source unless the Congressional re-authorization of the project allows for the use of Federal funds to work within this borrow area notwithstanding the financial restrictions of CBRA.

While USACE does not typically consider alternatives that are outside the scope of current Congressional authority, the National Environmental Policy Act specifically allows for this type of consideration. Given the environmental benefits associated with continued use of the inlet

borrow source, Alternative 2 includes the Masonboro Inlet/Banks Channel as the primary borrow source for this project notwithstanding the restrictions of CBRA. For additional information on the application of CBRA for Alternatives 2 and 3, see Section 9.3 of this report.

5.6 Evaluation of Alternative Plans

This section discusses second-tier evaluation of alternative plans.

5.6.1 Beach Fill Alternatives Evaluation

The Beach-fx model was used to produce the benefits and borrow volumes needed for each alternative. Preliminary detailed project costs were ultimately developed, independent of the Beach-fx model, and are presented in this report for Alternatives 2 and 3. A four-year renourishment cycle was specified for all model runs. Results from the Beach-fx model are displayed in Table 5-1.

5.6.2 System of Accounts Analysis

The System of Accounts is the method to organize and track the effects of alternative plans. It is essentially a set of effect categories. The four primary categories considered for impacts in this study are as follows:

1) National Economic Development (NED)

Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units at October 2018 (FY 2019) price levels (Table 5-2).

2) Regional Economic Development (RED)

Contributions to RED are changes in the distribution of regional economic activity that result from the alternative plan (Table 5-3).

3) Environmental Quality (EQ)

EQ is captured as both beneficial effects and adverse effects. Beneficial effects are favorable changes in the ecological, aesthetic, and cultural attributes of natural and cultural resources. Adverse effects are unfavorable changes in the ecological, aesthetic, and cultural attributes of natural and cultural resources (Table 5-4).

4) Other Social Effects (OSE)

The OSE account displays impacts that would not be reflected in the other three accounts (NED, RED and EQ). These additional impacts could include the following: Community impacts; life, health and safety factors; displacement; and long-term productivity (Table 5-5).

The average annual NED costs, benefits, and net benefits of each of the alternatives at October 2018 (FY 2019) price levels are shown in Table 5-1. Alternative 2 provides the highest net benefits by continuing Federal participation in periodic renourishments, consistent with the currently authorized project, by increasing the total maximum/Section 902 project cost limit while using the inlet borrow source for at least three of the four remaining renourishments using a pipeline cutterhead dredge (requires an exemption from the CBRA) and use of an offshore borrow source may be needed for possibly one of the four renourishments using a hopper dredge due to the operating depths and 2 to 5 mile distance from the coastline placement area. As such, the contingency amount for Alternative 2 reflects risk consideration that a new offshore borrow source may be needed in additional to the inlet borrow source over the remaining life of the project through FY 2036.

Table 5-1. Comparison of alternative average annual (AA) costs and benefits, October 2018 (FY 2019) price level, FY 2019 discount rate (2.875 percent). The interest rate used was current at time of analysis.

		Continue Project as Authorized (Interest @ 2.875 percent)	
Item	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
Damage Reduction Benefits	$0	$5,902,000	$5,902,000
Land Loss Benefits	$0	$1,048,000	$1,048,000
Primary Benefits	$0	$6,950,000	$6,950,000
Primary BCR (No Recreation)	N/A	3.4	2.7
Recreational Benefits	$0	$3,475,000	$3,475,000
Total Benefits	$0	$10,425,000	$10,425,000
Total Costs	$0	$2,004,000	$2,539,000
Preliminary BCR	N/A	5.2	4.1

Table 5-2. Comparison of NED Impacts at October 2018 (FY 2019) price levels

Account: NED			
	Alternative		
Item	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
a. Beneficial Impacts			
Average Annual Damages Prevented	$0	$6,950,000	$6,950,000
Emergency Costs Avoided	$0	n/a	n/a
Recreation	$0	$3,475,000	$3,475,000
Total Beneficial Impacts	$0	$10,425,000	$10,425,000
b. Adverse Impacts			
Initial Project Cost, Including Real Estate	$0	$52,800,000	$66,898,000
Interest During Construction	$0	n/a	n/a
Economic Costs for BCR	$0	$52,800,000	$66,898,000
Average Annual First Cost	$0	$2,004,000	$2,539,000
Annual O&M	$0	n/a	n/a
Total Average Annual Costs	$0	$2,004,000	$2,539,000
Benefit-Cost Ratio	n/a	5.2:1	4.1:1
Average Annual Net Benefits	n/a	$8,421,000	$7,886,000

Table 5-3. Comparison of RED Impacts

Account: RED			
Item	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
Sales Volume	Reduced rental market and tourism.	Rental sales and tourism sales preserved or increased.	Same as Alternative 2
Income	Decreased recreation visitation may reduce the income of service industries and rental properties.	Increased recreation visitation may improve the income of service industries and rental properties.	Same as Alternative 2
Employment	Seasonal employment may decrease due to decreased recreation visitation.	Seasonal employment may increase recreation visitation. Temporary increase in employment related to construction activities.	Same as Alternative 2
Tax Changes	Loss of tax base if properties are destroyed and cannot be rebuilt.	Tax base and property values preserved or increased.	Same as Alternative 2

Table 5-4. Comparison of EQ Impacts (Part 1 of 5)

Account: EQ				
Item	**Sub-Item**	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
Physical Resources	**Air Quality**	No effect.	Temporary pollutant increase associated with dredging and heavy equipment during renourishment events.	Temporary pollutant increase associated with dredging and heavy equipment during renourishment events. Slightly larger increase as compared to Recommended Plan due to longer transit time to and from borrow source and use of two dredges vs. one with Recommended Plan.
	Geology and Sediments	Increased quantity of sediments in Masonboro Inlet/Banks Channel. Inlet could migrate or close. Long-term beach erosion.	Reduction of beach quality sediment in the inlet and reduction in downdrift sediments to Masonboro Island; Reduction of beach quality sand offshore due to use for one renourishment event	Increased quantity of sediments in Masonboro Inlet/Banks Channel. Increased shoaling in Masonboro Inlet and possibly Mason's Inlet. Greater reduction of beach quality sediment offshore as compared to Recommended Plan.
	Climate Change	No effect to climate change. Likely increased storm events and sea level rise would cause increased erosion rates.	No effect to climate change. Likely increased storm events and sea level rise would result in increased erosion rates	Same as Alternative 2.
	Sea Level Rise	No effect to sea level rise. Accelerated sea level rise rates would lead to higher storm surges and increased erosion rates.	No effect to sea level rise. Accelerated sea level rise rates would lead to higher storm surges and increased erosion rates.	Same as Alternative 2.

Table 5-4. Comparison of EQ Impacts (Part 2 of 5)

Account: EQ				
Item	**Sub-Item**	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
Water Quality		No effect.	Short-term and localized elevated turbidity and suspended solid levels nearshore, offshore and in the surf zone associated with dredging and beach placement.	Increased short-term and localized elevated turbidity and suspended solid levels offshore and in the surf zone associated with dredging and beach placement due to longer project duration as compared to Alternative 2.
Marine Resources	**Benthic Resources**	Long-term reduction in benthic macro-invertebrate abundance in the beach environment due to erosion and scour of beach habitat. No effect to offshore benthic resources.	Short-term and localized impact to benthic macro-invertebrate community from direct burial and turbidity associated with dredging and beach placement.	Short term and localized impact to benthic macro-invertebrate community from direct burial and turbidity associated with beach placement. Increase over Recommended Plan in short term and localized impact to macro-invertebrate community associated with dredging duration and greater extent of borrow area impacts.
	Surf Zone Fishes and Nekton	No effect.	Short-term effects due to renourishment turbidity. Minor impacts to oceanic nekton. Minor entrainment impacts with use of hopper for one renourishment event.	Increased short term turbidity effects over Recommended Plan due to renourishment duration. Increased impacts to oceanic nekton (Offshore borrow) and greater entrainment impacts due to use of a hopper dredge for all renourishment events.
	Hard Bottoms	No effect.	No effect. All hard bottoms will be buffered and avoided.	Same as Alternative 2.

Table 5-4. Comparison of EQ Impacts (Part 3 of 5)

Account: EQ				
Item	**Sub-Item**	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
Marine Resources	**EFH-HAPC**	No effect.	No significant adverse impacts to EFH or HAPC. Physical and biological impacts to EFH would be short-term and localized on an individual and cumulative effects basis.	No significant adverse impacts to EFH or HAPC. Physical and biological impacts to EFH would be slightly greater than Recommended Plan, but would be short-term and localized on an individual and cumulative effects basis.
Wetlands and Floodplains		Permanent loss of flood plain land area due to erosion.	No effect.	No effect.
Terrestrial Resources	**Vegetation**	Long-term loss of vegetation habitat areas as beach erodes.	Disturbance of some existing vegetation, minimized by post-renourishment dune planting if the dune requires renourishment.	Same as Alternative 2.
	Wildlife	Long-term loss of roosting, foraging, breeding and nesting habitat for mammals, reptiles, amphibians and birds.	Short-term effects to transient species. Temporary effect to roosting and foraging shorebird habitat.	Increased duration of short term effects to transient species and temporary effects to roosting and foraging shorebird habitat due to longer renourishment duration.
Endangered & Threatened Species	**Whales and Manatees**	No effect.	Short-term impacts to foraging habitat and low risk of vessel strikes. No effect to manatees or NARW critical habitat.	Increase of short-term impacts to foraging habitat and increased chance of vessel strikes offshore and during transit. No effect to manatees or NARW critical habitat.

Table 5-4. Comparison of EQ Impacts (Part 4 of 5)

Account: EQ				
Item	**Sub-Item**	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
Endangered & Threatened Species	**Sea Turtles**	Long-term decrease in sea turtle nest success due to beach erosion, scarping and scouring of the dune.	Minor risk to benthic oriented sea turtles due to cutterhead dredge impact. Short-term decrease in sea turtle nesting success associated with changes to the physical characteristics of the beach. Long-term sustainability of sea turtle nesting habitat due to preservation of the beach berm. No effect to loggerhead critical habitat.	Increased risk to benthic oriented sea turtles due to hopper dredge impact. Short-term decrease in sea turtle nesting success associated with changes to the physical characteristics of the beach. Long-term sustainability of sea turtle nesting habitat due to preservation of the beach berm. No effect to loggerhead critical habitat.
	Atlantic and Shortnose Sturgeon	No effect to sturgeon or critical habitat.	No effect to Shortnose Sturgeon. Minor risk of Atlantic sturgeon (AS) entrainment or impacts from hopper dredge (1 renourishment event). Short-term impacts to benthic foraging and refuge habitat and disruption of migratory pathway. No effect to critical habitat.	No effect to Shortnose Sturgeon. Increased risk of Atlantic sturgeon (AS) entrainment or impacts from hopper dredges and increased renourishment time over Alternative 2. Short-term disruption of migratory pathway. No effect to critical habitat.
	Seabeach Amaranth	Long-term loss of seabeach amaranth habitat as beach erodes.	Deep burial of seeds during renourishment may slow germination and population recovery over the short-term. Increased available seabeach amaranth habitat.	Same as Alternative 2.
	Piping Plover and Red Knot	Long-term loss of habitat areas as beach erodes.	Short-term impact to bird foraging, sheltering and roosting areas; longer term enhancement of these areas with beach renourishment. No effect to critical habitat.	Increased short-term impacts to bird foraging, sheltering and roosting areas. Longer term enhancement of these areas with beach renourishment. No effect to critical habitat.

Table 5-4. Comparison of EQ Impacts (Part 5 of 5)

Account: EQ				
Item	**Sub-Item**	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
Socioeconomics	**Demographics, Economics and Income**	Increased potential adverse impacts to the existing tax base, commercial and public entities.	Continued economic growth and minimize damages to residential, public and commercial structures, as well as reduction of damages to critical infrastructure.	Same as Alternative 2.
	Aesthetic Recreational and Resources	Adverse long-term detrimental effect due to beach erosion.	Short-term minor adverse impacts due to renourishment activities. Long-term benefits as a result of beach renourishment and stabilization.	Increased short-term impacts over Recommended Plan to aesthetics and recreational due to beach placement activities. Long-term benefits as a result of beach renourishment and stabilization.
	Commercial and Recreational Fishing	No effect.	Potential temporary delays to boat traffic navigating Masonboro Inlet during renourishment.	No effect.
Cultural Resources		No effect to resources in the Inlet or offshore.	Slight risk of encountering resources associated with beach placement and inlet borrow source dredging. All identified resources during offshore surveys will be avoided. Long-term protection of potential beach resources that would be affected by natural processes.	Slight risk of encountering resources associated with beach placement. All identified resources during offshore surveys will be avoided. Long-term protection of potential beach resources that would be affected by natural processes.
Noise		No effect.	Minor short-term increase in noise during renourishment. No injurious effects to sea turtles, marine mammals and fishes. Minor behavioral impacts to marine mammals.	Short-term increase in noise on beach over Recommended Plan due to increased renourishment time; increase in noise offshore due to use of two hopper dredges and longer duration; somewhat, mitigated by distance dissipation. No injurious effects to sea turtles, marine mammals and fishes. Minor behavioral impacts to marine mammals.
HTRW		No effect.	No effect.	No effect.

Table 5-5. Comparison of OSE Impacts

Account: OSE			
Item	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
Life, Health and Safety	No change. Continued stress during damaging storms. Evacuation would still be required before storm landfall.	Significant reduction in stress related to concern of amount of damage and recovery during and after storms. Evacuation would still be required before storm landfall.	Significant reduction in stress related to concern of amount of damage and recovery during and after storms. Evacuation would still be required before storm landfall.
Community Cohesion	Increased displacements of all permanent residents and visitors.	Periodic displacement of all permanent residents and visitors.	Periodic displacement of all permanent residents and visitors.
Community Growth	Recreation visitation would likely decrease as the beachfront erodes away. Permanent population would likely decrease as lots are abandoned.	Growth trends in population and recreation visitation would continue.	Growth trends in population and recreation visitation would continue.
Traffic and Transportation	Increased risk to streets and highways as the beachfront erodes. Reduction in navigation constraints in inlet due to renourishment.	Reduced damages to streets and highways. Minor, short-term impacts in recreational and commercial boat traffic due to dredging operations during renourishments.	Reduced damages to streets and highways.
Environmental Justice	No Effect.	No Effect.	No Effect.
Socioeconomics	In absence of a project, the probability of damages to existing structures increases, potential adverse impacts to existing tax base and impacts to commercial and public entities.	Continued economic growth in the presence of an authorized project. Minimize damage to residential, public and commercial structures, as well as reduction of damages to critical infrastructure.	Continued economic growth in the presence of an authorized project. Minimize damage to residential, public and commercial structures, as well as reduction of damages to critical infrastructure.

USACE Planning Criteria Evaluation

Alternatives were also evaluated based on the planning criteria of acceptability, completeness, effectiveness, efficiency and with consideration of the planning constraints. General planning criteria definitions are located in Table 5-6 below, with the comparative evaluation following in Table 5-7.

Table 5-6. General Planning Criteria Definitions for Alternatives Screening

Completeness	Completeness is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities. Completeness also includes consideration of real estate issues, operations and maintenance (O&M), monitoring, and sponsorship factors.
Effectiveness	Effectiveness is the extent to which the alternative plans contribute to achieve the planning objectives. The plan must make a significant contribution to the problem or opportunity being addressed.
Efficiency	Efficiency is the extent to which an alternative plan is the most cost effective means of achieving the objectives. The plan outputs cannot be produced more cost-effectively by another plan.
Acceptability	Acceptability is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations and public policies. Appropriate mitigation of adverse effects shall be an integral component of each alternative plan. The project should have evidence of broad-based public support and be acceptable to the non-Federal cost-sharing partner.

Table 5-7. Comparison of P&G Impacts

P&G	Alternative		
Item	**Alternative 1 (No Action)**	**Alternative 2 (Inlet Borrow Source)**	**Alternative 3 (Offshore Borrow Source)**
Acceptability	Would be objectionable to some state and local entities, and will not meet the planning objective, but is compliant with existing laws, regulations and policies.	May not be compliant with the CBRA. Except for CBRA, would continue to be acceptable to Federal, state and local entities and is compliant with existing laws, regulations and policies.	Would be acceptable to Federal, state and local entities and is compliant with existing laws, regulations and policies
Completeness	Not a complete solution because it would not meet the planning objective.	Complete solution.	Complete solution.
Effectiveness	Not effective in achieving the planning objective.	An effective solution because it meets the planning objective.	An effective solution because it meets the planning objective.
Efficiency	Not efficient because it does not contribute to planning objective.	Most efficient alternative for meeting the planning objective.	Meets the planning objective, but not the most efficient alternative due to increased renourishment costs and greater environmental impacts.

5.7 Plan Selection

5.7.1 Identification of NED Plan

Based on the results of the analyses presented in Section 5, Alternative 2 is identified as the NED Plan, as it is the alternative with the highest net benefits. The dimensions of the NED plan, as is the Recommended Plan, are summarized in Section 6.

5.7.2 Identification of a Locally Preferred Plan (LPP)

No Locally Preferred Plan has been identified, as the non-Federal sponsor is in support of moving forward with the NED Plan as the Recommended Plan

5.8 Value Engineering

Value Engineering is required during the Planning-Engineering-Design phase under 41 U.S.C. 1711 and OMB Cir. A-131, and will be applied per ER 11-1-321 on a per nourishment basis. A regional Programmatic Value Study was completed in June 2018 regarding dredging in the South Atlantic region. The resulting report will be referenced in bridging documents to address each nourishment project through FY 2036. If another programmatic value study is conducted, it will be referenced for future projects.

5.9 Independent External Peer Review (IEPR)

IEPR may be required for decision documents under certain circumstances. IEPR is the most independent level of review, and is applied in cases that meet certain criteria where the risk and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted. A risk-informed decision, as described in EC 1165-2-217, is made as to whether IEPR is appropriate. IEPR panels will consist of independent, recognized experts from outside of USACE in the appropriate disciplines, representing a balance of areas of expertise suitable for the review being conducted. There are two types of IEPR:

- Type I IEPR. Type I IEPR reviews are managed outside USACE and are conducted on project studies. Type I IEPR panels assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, economic analysis, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, models used in the evaluation of environmental impacts of proposed projects, and biological opinions of the project study. Type I IEPR will cover the entire decision document or action and will address all underlying engineering, economics, and environmental work, not just one aspect of the study. For decision documents where a Type II IEPR (Safety Assurance Review) is anticipated during project implementation, safety assurance shall also be addressed during the Type I IEPR per EC 1165-2-217.

- Type II IEPR. Type II IEPR, or Safety Assurance Review (SAR), are managed outside USACE and are conducted on design and construction activities for hurricane, storm, and flood risk management projects or other projects where existing and potential hazards pose a significant threat to human life. Type II IEPR panels will conduct reviews of the design and construction activities prior to initiation of physical construction and, until construction activities are completed, periodically thereafter on a regular schedule. The reviews shall consider the adequacy, appropriateness, and acceptability of the design and construction activities in assuring public health safety and welfare.

a. Decision on Type 1 IEPR. As documented in the Review Plan approved by the South Atlantic Division Commander in January 2019, this Validation Study is excluded from a Type 1 IEPR because this project does not involve nor is expected to meet any of the mandatory triggers described in EC 1165-2-217, paragraph 11.d:

A. There is no public safety component of the project.

B. The total project cost is less than $200 million.

C. We do not expect the governor to request IEPR.

D. We do not expect the DCW or the Chief of Engineers to determine this project is controversial due to significant public dispute over the size, nature, or effects of the project or the economic or environmental costs or benefits of the project.

Therefore, this project is excluded from Type I IEPR.

b. Decision on Type II IEPR. Based on the project as currently envisioned, the Wilmington District Chief of Engineering, as the Engineer-In-Responsible-Charge, does not recommend a Type II IEPR Safety Assurance Review of this project at this time. A risk-informed decision concerning the timing and the appropriate level of reviews for the project implementation phase will be prepared and submitted for approval in an updated Review Plan prior to initiation of the design/implementation phase of this project.

Products to Undergo Type I IEPR. Not applicable

Required Type I IEPR Panel Expertise. Not applicable

Documentation of Type I IEPR. Not applicable

6 RECOMMENDED PLAN

The purpose of this report section is to centralize information concerning the Recommended Plan. The Recommended Plan is discussed in terms of features, renourishment, maintenance, monitoring requirements, real estate requirements, economics, accomplishments, and risk and uncertainty.

6.1 Plan Description and Components

The Recommended Plan is Alternative 2 – Continuation of Federal participation in periodic renourishments consistent with the currently authorized project by increasing the total maximum/Section 902 project cost limit while using the inlet borrow source (requires an exemption from the CBRA) and an offshore borrow source (may be needed for possibly one renourishment event), through FY 2036.

The project includes the following: Dune having a crown width of 25 feet at 12.5 feet NAVD88, together with a beach berm, having a crown width of 50 feet at 9.5 feet NAVD88, and a construction berm, having a crown width of 205 feet at 5.0 feet NAVD88. The dune and berms extend north 13,670 feet from Masonboro Inlet North Jetty. Historically the typical project renourishment extends from Station 70+00 to 140+00 with a 2,000-foot transition to station 160+00 (shown as the solid red line on Figure 6-1).

Material for the beach fill would be obtained with a cutterhead dredge from Masonboro Inlet/Banks Channel and, if required, a hopper dredge from the offshore borrow source.

Continued use of the Masonboro Inlet/Banks Channel borrow source would require an exclusion from the provisions of CBRA for this project in the Congressional authorization. The project plan view is illustrated on Figure 6-1.

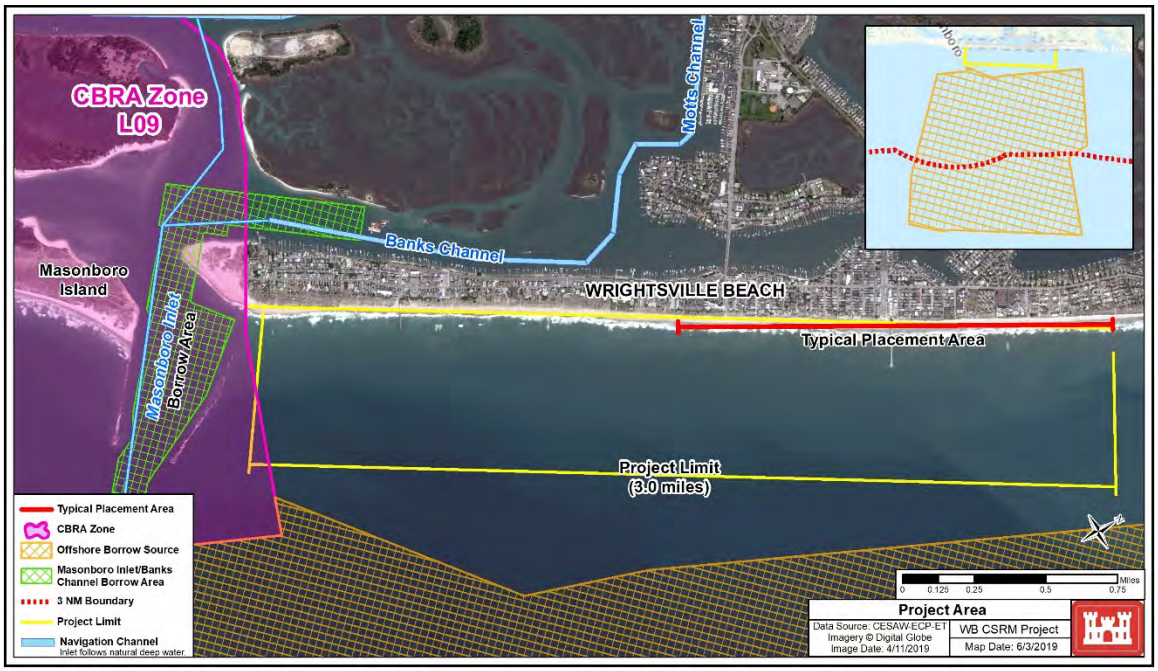


Figure 6-1. Plan View of the Recommended Plan

6.1.1 Beach Fill

The Recommended Plan has a main fill length of 15,650 feet. The dune dimensions listed for the Recommended Plan integrate, and are based on, the existing idealized dune dimensions for those reaches, and represent the existing renourishment template, as described in Section 6.1 of this report.

6.2 Design and Renourishment Considerations

6.2.1 Renourishment

The Recommended Plan will require an estimated 780,000 cubic yards for each renourishment cycle (every 4 years). During the remaining project life (to FY 2036), the four renourishment events would require a total volume of 3.1 million cubic yards of material.

The renourishment material would most likely be pumped to the beach from cutterhead dredges or moved from an offshore borrow source with a hopper dredge. Material would then be shaped on the beach by earth-moving equipment. During renourishment, material between the toe of dune and mean high water line would be tilled to prevent compaction. Due to limitations in the ability of equipment to shape material underwater, the berm is not constructed in the shape of the design berm profile. Instead, the volume of material necessary to create the design berm is pumped out into an initial construction profile (Figure 6-2). Renourishments would place material seaward of the final design berm profile by a variable distance (approximately

100-150 ft) to cover anticipated sand movement during and immediately after renourishment. Once sand distribution along the foreshore occurs (about 6 months), the adjusted profile should resemble the design berm profile. Each renourishment is anticipated to take 45 days using one cutterhead dredge (Masonboro Inlet/Banks Channel) or two hopper dredges (offshore) each concurrently taking 54, or a total of 108 dredging days. Typical plan and cross-section views of the project from selected reaches are shown in Appendix B.

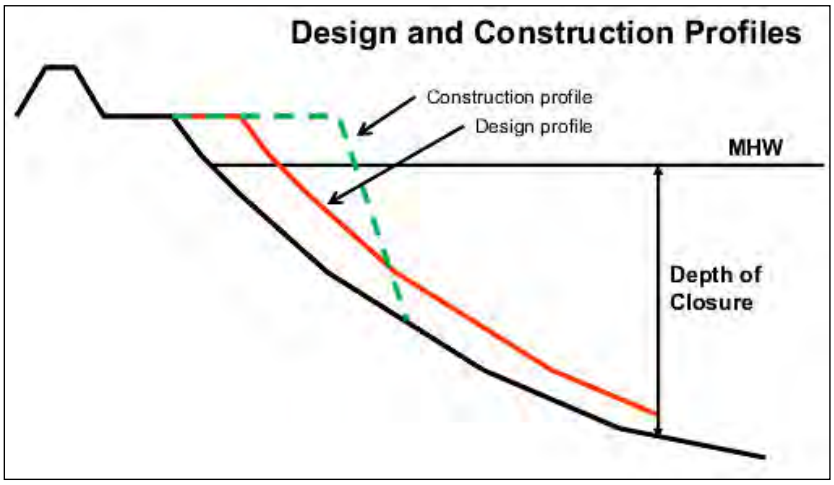


Figure 6-2. Representation of a Berm Construction vs. Design Profile

For cutterhead operations that include the placement of dredged material on the beach, a pipeline route would be extended from the dredge plant to the beach fill placement location. Before each renourishment event, pipeline placement will be coordinated with the appropriate resource agencies. Renourishments would utilize a pipeline route from Masonboro Inlet to the northernmost portion of the project. Prior to the commencement of dredging, shoreline pipe will be mobilized to the beach in segments of varying sizes in length and diameter. The mobilization process usually requires the use of heavy equipment to transport and connect pipe segments from the beach access point to the designated placement area. The placement of shore pipe is generally on the upper beach, away from existing dune vegetation and seaward of the toe of the primary dune.

The width of disturbance area required to construct the pipeline route varies depending on the size of pipe used for the project. Site context and environmental features are considered for each project, so that construction activities are confined to areas with minimal impact to the environment. Once the heavy equipment and pipe is on the beach and the pipes are connected, heavy equipment operation is generally confined to the vicinity of the mean high water line, away from dune vegetation on the upper beach. Within the active placement area, heavy equipment operates throughout the width of the beach in order to manage the outflow of sediment and construct target elevations for the appropriate beach profile.

6.2.2 Dune Vegetation

The dune portions of the project would be stabilized against wind losses by planting appropriate native beach grasses. Sand fencing is not needed since the existing dune is at the appropriate height to provide stabilization without fencing. If the dune is under the design template height or if the dredging contractor damages the dune during a periodic renourishment event, dune stabilization would be accomplished by planting vegetation on the dune during the optimum planting season following dune renourishment. If planting is accomplished by machine, all equipment must be off the beach by close of the environmental window of March 31 to the maximum extent practicable. Planting stocks would consist of a variety of native dune plants including sea oats (*Uniola paniculata*), American beachgrass (*Ammophila breviligulata*), panic grass (*Panicum amarum*), and seaside little bluestem (*Littoralis variety*). The vegetative cover would extend from the landward toe of the dune to the seaward intersection with the berm for the length of the dune. Plant spacing guidelines will follow the recommendations provided by the North Carolina Sea Grant, *The Dune Book* (Rogers and Nash, 2003). Sea oats would be the predominant plant with American beach grass and panic grass as supplemental plants. Seaside little bluestem would be planted on the backside of the dune away from the most extreme environment.

6.2.3 Renourishment Access

Renourishment access to the project is currently available by public roads and rights-of-way. There are sufficient access areas along the beach at the ends of public streets and at public access areas for contractors to move pipe and equipment to the beach, as successfully demonstrated during numerous prior periodic renourishment events.

6.2.4 Borrow Areas

Construction of the Wrightsville Beach CSRM project was inititated in FY 1965 with Masonboro Inlet/Banks Channel being the historic borrow source for material placed on Wrightsville Beach. Current engineering analysis of this borrow source indicates that there may not be a sufficient quantity of sand to provide borrow material for four additional renourishments required through FY 2036. Also, all of Masonboro Inlet and about half of the Banks Channel borrow source is located within a Coastal Barrier Resources System (CBRS) unit. The CBRA was enacted in 1982, and includes restrictions on Federal spending within undeveloped coastal barriers. Due to this identified risk, the PDT has identified a new potential offshore area, not located within a CBRS unit, for beach quality borrow material investigations in the event that the sand borrow source of Masonboro Inlet/Banks Channel is not sufficient or useable in the future. It's anticipated that an offshore borrow source may be needed for at least one of the four required renourishments (Figure 6-3).

Utilizing existing information about the inlet borrow source and information gathered about the offshore borrow source, the use of the Masonboro Inlet/Banks Channel as the primary borrow source is environmentally preferable to exclusively using the offshore borrow source (see Section 7), and would conserve Federal and non-Federal funds. Consequently, there is the explicit understanding that CBRA would prohibit the use of the inlet as a borrow source unless the Congressional re-authorization of the project allows the use of Federal funds to work within this borrow area notwithstanding the financial restrictions of CBRA.

While USACE does not typically consider alternatives that are outside the scope of current Congressional authority, the National Environmental Policy Act specifically allows for this type of consideration. Given the environmental benefits associated with continued use of the inlet borrow source, the Recommended Plan includes the Masonboro Inlet/Banks Channel as the primary borrow source for this project notwithstanding the restrictions of CBRA. For additional information on the application of CBRA to the Recommended Plan, see Section 9.3 of this report.

Additional investigations and technical analyses are required to determine the quality and quantity of the potential offshore borrow source, including geomorphic, geophysical, environmental and cultural surveys. These investigations would occur during the preconstruction engineering and design phase (PED) after project authorization and before any offshore borrow source is used for placement of sand on Wrightsville Beach as part of this project.

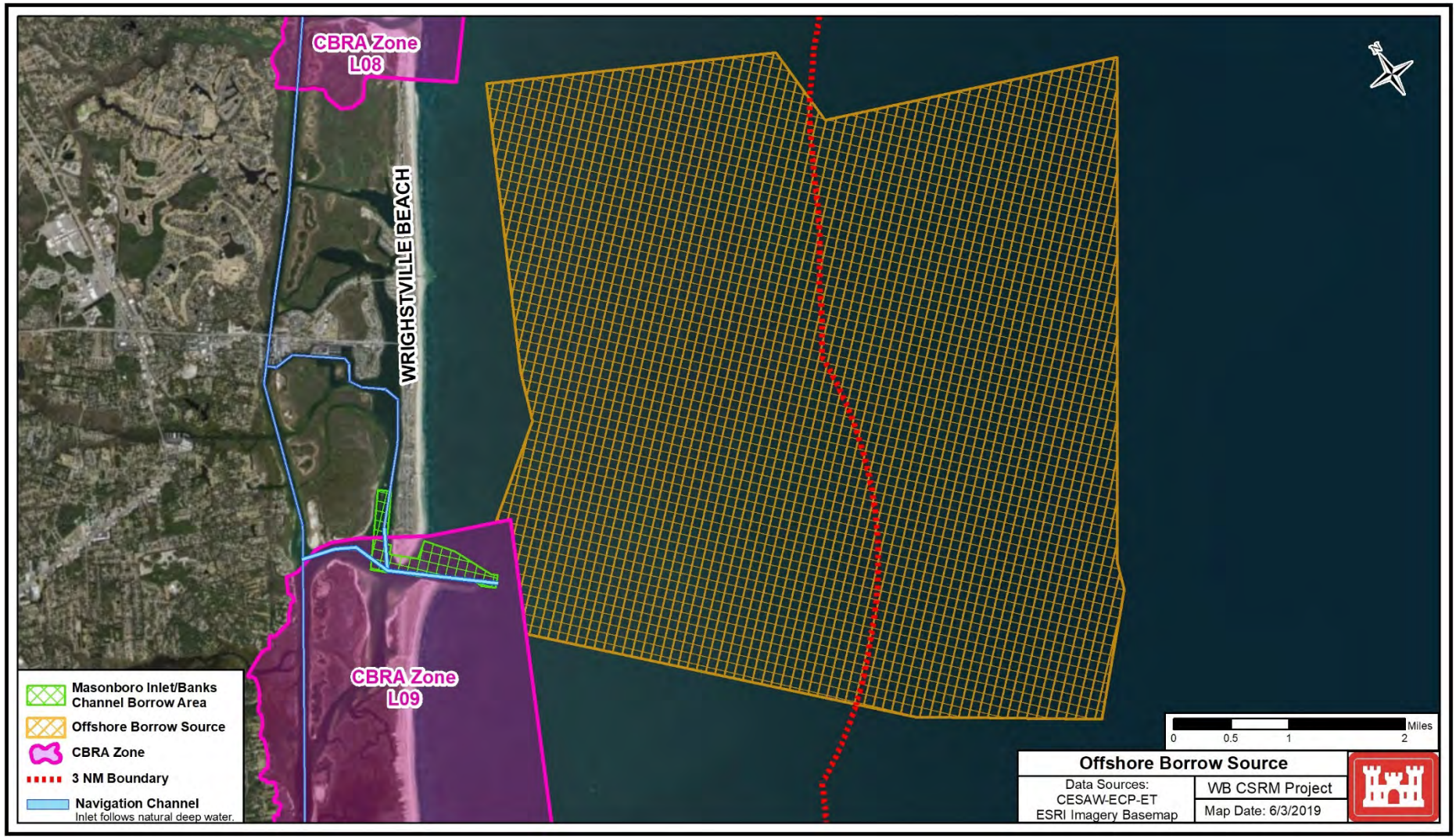


Figure 6-3. Potential Offshore Borrow Sourc

6.2.5 Masonboro Inlet/Banks Channel

Wrightsville Beach renourishment was initially performed using sand dredged from Banks Channel in 1965 and a subsequent renourishment in 1970. Sand has been dredged once every four years from Masonboro Inlet and/or the southern portion of Banks Channel to provide suitable beach fill material to Wrightsville Beach. These renourishment events occurred in 1981, 1986, 1991 and from 1994 through 2018. Borrow area limits constitute a polygonal area of around 154 acres, which ranges in width from 600 ft. to 1,600 ft. with a total length of about 9,000 ft. The Masonboro Inlet/Banks Channel borrow area depths range from -20 feet to -30 feet. MLLW. Water depths and sediment volumes vary, in accordance with dredging, beach renourishment operations, and naturally-occurring sediment entrainment and deposition. Located immediately southwest of the project site, Masonboro Inlet/Banks Channel receives and retains suitable sand via longshore current. As a result, Masonboro Inlet/Banks Channel has historically served as a reliable sand source for the authorized project. However, this historic borrow source may not have sufficient quantity of sand to provide borrow material for all four renourishments required through FY 2036, so an additional borrow source was identified, if needed. It's anticipated that an offshore borrow source may be needed for at least one of the four renourishments.

6.2.6 Offshore Borrow Source

An offshore borrow source located outside of the CBRS unit was evaluated. The specific borrow source to be used for future renourishments will be beyond the -30-foot contour and one to five miles offshore (see Figure 6-3). The final borrow source would be determined and finalized during the PED phase of the study (after project authorization). During PED, additional vibracore borings and environmental surveys of the borrow source will be completed. An offshore borrow source beyond 3 nautical miles is subject to Federal mining requirements of the Bureau of Ocean Energy Management (BOEM). Preliminary analysis indicates that the offshore borrow source to be investigated during PED contains adequate beach quality material for the life of the project (through FY 2036). For further details on the evaluation of the borrow source, refer to Appendix A, Geotechnical.

6.2.7 Dredging Production

Dredging production refers to the average volume transported per day and relates to factors such as plant, material, distance, and weather. This information is used to estimate project cost and renourishment time. Production rates are estimated to average about 21,000 cubic yards/day (dependent on placement location and weather conditions) for cutterhead periodic renourishment and 8,750 cubic yards/day per dredge for a total of 17,500 cubic yards/day for two hopper dredges.

6.2.8 Environmental Window

Cutterhead dredging operations and project-related activity on the oceanfront beach involving renourishment equipment, equipment stockpiling, or sand movement will be restricted to the environmental window of November 16 to March 31. The March 31 date is for the protection of birds that nest, forage and roost on the south end of the beach that could be impacted by the pipeline route from the Masonboro Inlet/Banks Channel borrow area. For hopper dredging, which would not require a pipeline on the south end of the beach, each renourishment event would be accomplished between November 16 and April 15. Hopper dredging operations for the project would be done in accordance with the 1997 National Marine Fisheries Service (NMFS) South Atlantic Regional Biological Opinion (SARBO) for the continued hopper dredging of channels and borrow sources in the Southeastern United States or any superseding SARBO that is prepared by NMFS. Under the 1997 SARBO, the NMFS does not place a window on hopper dredging operations from Pawley's Island, South Carolina, through North Carolina. However, both the USACE South Atlantic Division (SAD) office and South Atlantic Wilmington (SAW) District office have, to the extent practicable, recommended hopper dredging during cold water months when sea turtle abundance is typically low. The Wilmington District traditionally accomplishes all hopper dredging during the coldest water months from December 1 to April 15 due to historically high sea turtle abundance and bird nesting concerns.

6.2.9 Recommended Renourishment Plan

Periodic renourishment would occur every four years during the environmental windows described above and would typically consist of using a cutterhead (pipeline) for a least three of the four nourishment events with material dredged from the Masonboro Inlet/Banks Channel borrow source. Prior to each renourishment event, the USACE will coordinate with the appropriate resource agencies to identify a pipeline route that minimizes impacts to bird habitat on the south end of Wrightsville Beach. If use of an offshore borrow source is required, dredging this source would be accomplished with a cutterhead or hopper dredge. A separate contract would be required for each periodic nourishment cycle.

6.3 Monitoring Requirements

6.3.1 Beach Fill Monitoring

A comprehensive monitoring program in accordance with USACE guidance (EM 1110-2-1100, Part V, Chapter 4) has been, and would be followed, when not budgetarily constrained, for the Wrightsville Beach project to assess and ensure project functionality throughout its design lifetime. Such monitoring supports the design efforts for periodic renourishment and is cost-shared 50 percent Federal and 50 percent non-Federal. Beach fill monitoring would include semiannual beach profile surveys, aerial photography, and an annual monitoring report. Beach fill monitoring is required for

post-construction surveys to confirm the final constructed beach profile after equilibration. Profile equilibration occurs about 6 months after completion of renourishment. If budgetary constraints lengthen the renourishment interval beyond the four years identified in the Recommended Plan, any subsequent beach fill monitoring prior to pre-construction surveys conducted for the next renourishment cycle would be considered a local responsibility.

Beach profile surveys would not only allow assessment of anticipated beach fill performance, but also allow determination of renourishment volume requirements. A geo-rectified aerial photographic record of the project would further facilitate assessment of the beach fill performance. The annual monitoring report would present the data collected and the corresponding analysis of project performance, including recommendations on renourishment requirements.

6.3.2 Environmental Monitoring and Other Commitments

The environmental goal of the project is to avoid and minimize adverse impacts to the environment to the maximum extent practicable. Costs related to the measures that will be taken to minimize impacts are factored into the total project renourishment costs. As part of the North Carolina Sea Turtle Protection Project, and with the help of Federal and local agencies and volunteer groups, annual surveys of sea turtle activity have and continue to occur along Wrightsville Beach. These surveys likely would continue, with or without a project in place.

The placement of material on Wrightsville Beach may have impacts to the threatened seabeach amaranth. The proposed project limits avoid the inlet vicinity at both ends of Wrightsville Beach, which have historically been areas of consistently higher amaranth abundance. Along the beachfront, within the project limits, seabeach amaranth occurs sporadically along the dune face; however, due to high erosion rates and inundation from storm events, available habitat is deteriorating. Beach renourishment would have initial adverse impacts through burial of existing seeds. Plants will not be impacted directly since they are annuals and are not present from November 16 – April 15; however, much of the habitat requirements for seabeach amaranth lost to erosion will be restored.

Seabeach amaranth monitoring, in areas of Wrightsville Beach receiving sand placed by USACE, will include five annual monitoring events following the placement event. In accordance with a 1993 Biological Opinion (USFWS 1993), "The Corps should commit to monitoring the beach disposal areas for at least five years following beach disposal to determine the status of the seabeach amaranth populations in the project areas and the effects that beach disposal has on this species." Given this obligation, and should the Corps continue to place sand on Wrightsville Beach every five years or sooner, annual Seabeach monitoring may be expected to occur in relative perpetuity. Annual Seabeach amaranth monitoring cost is estimated to be approximately $2,600. Annual monitoring

cost includes survey of favorable habitat areas by two individuals to record presence and number of plants, and data recording, compilation, and analysis.

Contractors will be required to monitor and assess the pipeline numerous times each day and night during construction to avoid adverse leaking of dredged material from the pipeline and its couplings that may result in sediment plumes, siltation and/or elevated turbidity levels, as well as erosion of the beach. In the event a leak is discovered, the contractor will be required to either repair the leak immediately or cease dredging and pumping until the leak is repaired.

6.4 Real Estate Considerations

All of the necessary lands, easements and rights-of-way for the Wrightsville Beach project were in place prior to the 1965 initial construction phase. A town building line, located along the ocean shoreline, was established in 1939. All land seaward of this building line is owned by the Town of Wrightsville Beach. In 1967, the building line was extended northward to include Shell Island, which had become attached to Wrightsville Beach when Moore Inlet was closed.

During past renourishment operations, the dredge discharge pipeline has been laid along the beach, seaward of the town building line or floated in Banks Channel to existing cross-island pipeline easements located at Bridger Street (near baseline station 50+00), Chadbourn Street (near baseline station 80+00), and Mallard Street (near baseline station 130+00). These existing pipeline easements are adequate for this and future renourishment operations.

The Masonboro Inlet/Banks Channel borrow source for the Wrightsville Beach CSRM project is located on State-owned submerged lands. The use of this source has previously been approved. All the State and Federal environmental resource agencies are notified prior to each renourishment operation.

If the offshore borrow source is beyond three nautical miles offshore it is subject to Federal mining requirements of the BOEM. A noncompetitive negotiated agreement is required from the BOEM. However, this specific borrow source and corresponding borrow source use plan will be determined and finalized during the PED phase of the study after project authorization. During that phase, additional vibracore boring data in the offshore borrow sources would be collected as needed and if necessary, additional environmental compliance documentation completed for any change in borrow source extent or location.

There will be no additional real estate requirements for Wrightsville Beach associated with this or future renourishment operations as all of these requirements have been satisfied as a result of previous renourishment efforts. In the case of the offshore borrow source, there would be no new real estate requirements.

6.5 Operation and Maintenance Considerations

Operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) requirements of the sponsor consist of project inspections and maintenance between periodic renourishment cycles. The beach fill monitoring actions are different from the non-Federal sponsor's OMRR&R project inspections and surveillance, which consist of assessing dune vegetation, access facilities, dune crest erosion, trash and debris, and unusual conditions such as escarpment formation or excessive erosion. Periodic renourishment and beach fill monitoring (including the annual beach profile surveys) are classified as continuing renourishment, not as OMRR&R. Dune vegetation maintenance includes watering, fertilizing, and replacing dune plantings as needed. Other maintenance includes reshaping of any minor dune damage, repairs to walkover structures and vehicle accesses, and grading any large escarpments. Estimated OMRR&R annual costs are $75,000.

6.6 Public Parking and Access Requirements

The Town of Wrightsville Beach meets the requirements for public parking and access as required by ER 1165-2-130 (Federal Participation in Shore Protection). Refer to Section 4.1.6 for a summary of parking and access at Wrightsville Beach and to Appendix C for an inventory of the existing parking facilities and access points along Wrightsville Beach.

6.7 Economics of the Recommended Plan

6.7.1 Recommended Plan - CSRM Benefits

Table 6-1 presents the applicable economic results at the October 2018 (FY 2019) price level for Recommended Plan at the interest rate of 2.875 percent, resulting in a benefit cost ratio of 5.2 to 1.

Table 6-1. The applicable average annual economic results at the October 2018 (FY 2019) price level for the Recommended Plan at the interest rate of 2.875 percent.

Recommended Plan – Alternative 2 (@ 2.875 percent) – Average Annual	
Damage Reduction Benefits	$5,902,000
Land Loss Benefits	$1,047,000
Primary Benefits	$6,950,000
Primary BCR (No Recreation)	3.4
Recreational Benefits	$3,475,000
Total Benefits	$10,425,000
Total Costs	$2,004,000
Preliminary BCR	5.2

6.7.2 Recommended Plan - Recreation Benefits

Per ER 1105-2-100, the USACE policy on the application of recreation benefits is that "recreation must be incidental in the formulation process and may not be more than fifty percent of the total benefits required for justification. If the criterion for participation is met, then all recreation benefits are included in the benefit to cost analysis." The Recommended Plan is justified based solely on CSRM benefits, therefore all incidental recreation benefits are being claimed for the project.

In order to determine the recreation benefits of the Recommended Plan an economic value must be placed on the recreation experience at Wrightsville Beach. By applying a unit day value to estimated use, an approximation is obtained that will be used to estimate project recreation benefits. For this analysis, general unit day values (UDV) are used to determine the economic value of recreation at Wrightsville Beach. UDV are administratively determined values which represent the NED recreation values for typical types of recreation. Guidance for their use is provided by Engineering Regulation 1105-2-100. The average annual recreation benefit for Recommended Plan (at 2.875 percent interest rate) is $3,475,000.

6.7.3 Recommended Plan - Total Benefits

Combining the CSRM benefits and the recreation benefits yields a total average annual benefit for the Recommended Plan of $10,425,000.

6.7.4 Recommended Plan - Costs

Determining the economic costs of the Recommended Plan consists of four basic steps. First, project First Costs are computed. First Costs include expenditures for project design and initial construction and related costs of supervision and administration. First Costs also typically include the lands, easements, and all rights-of-way, but are not applicable in this report. Total First Cost is estimated to be $52,800,000 at October 2018 (FY 2019) price levels. Details regarding this preliminary cost are contained in Appendix E (Cost Engineering).

Second, Interest during Renourishment is typically added to the project First Cost, but is not applicable to this report given that initial construction has already occurred.

Third, Scheduled Renourishment Costs are computed. Those costs are incurred in the future for each of the 4 planned renourishments. As detailed in Appendix E, the estimated cost is $13,200,000 ($13,040,000 for the FY 2022 renourishment) for each renourishment. Note that this cost includes the cost of the annual beach fill monitoring (see Section 6.4).

Fourth, Expected Annual Costs are computed. Those costs consist of interest and amortization of the Total Investment Cost and the equivalent annual cost of beach fill monitoring and project OMRR&R (see sections 6.3.2 and 6.5). The Expected Annual Costs provide a basis for comparing project costs to expected annual benefits. Expected Annual Costs for the Recommended Plan are estimated to be $2,004,000.

6.7.5 Recommended Plan - Benefit to Cost Ratio

For the Recommended Plan, with the expected annual benefits of $10,425,000 and average annual costs of $2,004,000, the benefit to cost ratio is 5.2 to 1. See Appendix F for an explanation of the calculations.

6.8 Summary of Recommended Plan Accomplishments

The Recommended Plan will reduce coastal storm damages to structures along approximately three miles of beachfront. Additionally, the plan would reduce future land loss over much of the same area. The Recommended Plan would also increase the recreational value and demand of the beach. Additionally, the Recommended Plan would potentially reduce future emergency response costs (although these have not been quantified for this study), and preserve or expand the amount of beach habitat available for sea turtle and shorebird utilization as well as seabeach amaranth. Finally, the Recommended Plan will benefit the regional economy by maintaining the area as a popular year-round destination and supporting the jobs and businesses associated with that industry.

6.9 Evaluation of Risk and Uncertainty

6.9.1 Residual Risks

Residual risk is the risk that remains after the Recommended Plan is implemented.

Beach-fx estimates that average annual residual damages in the Future With Project condition will be $1,033,000. This estimate represents a significant reduction in Future Without Project damages of $7,983,000 and indicates a robust reduction in coastal storm risk throughout Wrightsville Beach.

The proposed project would greatly reduce, but not completely eliminate future storm damages. Coastal storm damages are reduced by approximately 87 percent over the 50 year period of analysis; therefore, the residual damages would be approximately 13 percent. The project is designed to reduce damages from storm waves, direct flooding, and erosion, but would not prevent any damage from back bay flooding; therefore, any ground-level floors of structures, ground-level floor contents, vehicles, landscaping, and property stored outdoors on the ground would still be subject to saltwater flooding that flows in through the inlets and the back bay channels. However, back-bay flooding is a relatively minor issue in the first three rows of the island, which is where the direct benefits of the project are being measured and those damages were not claimed as a project benefit. As the project is also not claiming any benefits beyond the third row of

the island, damages from flooding to structures past the third row were not been calculated. Structures would also continue to be subject to damage from hurricane winds and windblown debris. Even new construction is not immune to damage, especially from these processes.

The proposed beach fill would reduce damages but does not have a specific design level. In other words, the project is not designed to fully withstand a certain category of hurricane or a certain frequency coastal storm ocean event. The project purpose is coastal storm risk management, and the berm-and-dune is not designed to prevent loss of life. Loss of life is prevented by the existing procedures of evacuating the barrier island completely, well before expected hurricane landfall and removing the residents from harm's way. The erratic nature and unpredictability of hurricane path and intensity require early and safe evacuation. That policy should be continued either with or without the coastal storm risk management project.

6.9.2 Risk and Uncertainty in Economics

The Beach-fx model accounts for uncertainty in the economic evaluations through the use of Monte-Carlo simulations to model future damages. The average annual damages reported in this study are based on the damages averaged across 300 life cycles, with each life cycle experiencing a different suite of storms during the period of analysis. Additionally, uncertainty is accounted for in the damage functions that are used to determine the amount of damage incurred to a structure and its contents from a given storm. Each structure type is assigned a minimum, maximum, and most likely damage function, meaning that the amount of damage experienced by a structure due to a specific amount of erosion or water depth can vary between life cycles. An example of one of these damage functions is shown in Figure 6-4 below, the entire suite of damage functions used in this study are contained in Appendix B.

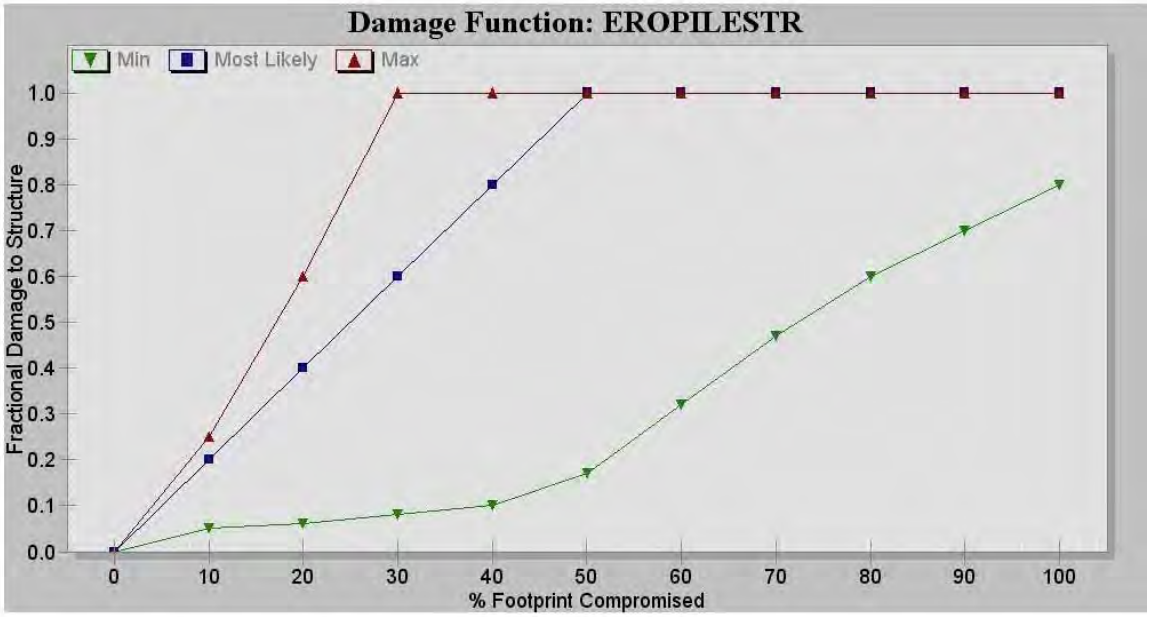


Figure 6-4. Damage Functions used to Measure Erosion Damage to Structures on 8-ft Pile.

6.9.3 Risk and Uncertainty in Project Costs

A Cost and Schedule Risk Analysis CSRA, using Crystal Ball, was performed as a joint effort between the cost engineer and the PDT for all alternatives. The risk analysis evaluated the project for risk elements which may cause a variance to cost, schedule, or both. The contingencies developed for the alternatives range from 25 percent for a cutterhead dredge from Masonboro Inlet/Banks Channel and 29 percent for two hopper dredges from an offshore borrow source.

6.9.4 Risk and Uncertainty in Borrow Availability

Historical boring logs and respective laboratory data indicate that suitable quality beach fill material has been consistently available within the Masonboro Inlet/Banks Channel borrow area. This material appears to be well distributed within the horizontal and vertical confines of the current authorized borrow source. Periodic renourishment efforts have shown that the material available is suitable for beach fill.

Historical bathymetric surveys, geotechnical fence diagrams, and rudimentary sediment budget analysis indicate that natural sedimentation processes provide sand recharge to current project borrow source, though the amount appears to be diminishing. Therefore, the Masonboro Inlet/Banks Channel borrow area most likely cannot provide the volume required for the all four periodic renourishment to FY 2036. The project may likely need to utilize the identified offshore borrow source in addition to the existing primary borrow source, to provide the required beach fill volume.

The only options available to USACE, unless a legislative exemption from the provisions of CBRA is specifically authorized for this project, is to develop the identified offshore borrow source. The cost associated with development and long-term implementation will not be negligible, and results in a lesser benefit-to-cost ratio for the project. Bathymetric surveys and additional confirmatory drilling and sampling will be required to confirm the quality and volume of sand present.

6.9.5 Risk and Uncertainty in Sea Level Rise Assumptions

Relative Sea Level Change was calculated using the USACE Sea Level Change Curve Calculator which is available at: http://www.corpsclimate.us/ccaceslcurves.cfm. This Calculator uses the methodology described in Engineer Regulation (ER) 1100-2-8162, *Incorporating Sea Level Changes in Civil Works Programs*. A full discussion of the accelerated sea level rise rates and how they were calculated for the project area is contained in Appendix B.

Extreme water levels incorporated into the calculator are based on statistical probabilities using recorded historic monthly extreme water level values. *NOAA Technical Report NOS CO*-OPS 067 - *Extreme Water Levels of the United States 1893-2010* describes the methods and data used in the calculation of the exceedance probability levels using a generalized extreme value statistical function (NOAA 2013). The USACE method uses the same NOAA recorded monthly extreme values in a percentile statistical function. Both methods use data recorded and validated by NOAA at the long-term, established tide gauges. The extreme values at the gauge can be significantly different than what may occur at the project site due to differences in site characteristics and complex interactions of physical forces that vary between the locations. The level of confidence in the exceedance probability decreases with longer return periods.

The net benefits reported for the Recommended Plan in section 6.7.1 are based on the intermediate sea level rise rate (.0128 ft/yr) being applied to both the future with and without project conditions. The Recommended Plan was rerun in Beach-fx using both the historic (.0066 ft/yr) and high (.0325 ft/yr) sea level rise rates for both the future with and without project conditions. In the future without project condition, damages increase under accelerated sea level rise scenarios. Under accelerated sea level rise, damages also increase in the with project conditions, but to a lesser degree. Table 6-2 shows a comparison of with and without project damages under the various scenarios.

Table 6-2. Comparison of average annual (AA) with and without project damages and benefits under historical, intermediate accelerated and high accelerated sea level rise scenarios. Benefits include land loss. October 2018 (FY 2019) price levels. Period of analysis – 15 years.

	Future Without Project Damages (AA)	With Project Damages (AA)	AA Benefit
Historical (low)	$2,640,000	$787,000	$2,020,000
Intermediate Rate	$2,763,000	$798,000	$2,135,000
High Rate	$3,392,000	$856,000	$2,747,000

The increases in project costs are relatively minimal under the accelerated sea level rise scenarios. Under assumptions of accelerated sea level rise, project net benefits actually increase and the project remains economically justified. This conclusion supports the concept of beach fill as naturally adaptable to sea level rise fluctuations.

6.9.6 Risk and Uncertainty in Future Beach Placement Activities

Continued dredged material placement from maintenance dredging of local navigation channels cannot be consistently relied upon in the future without project condition. This assumption is due to uncertainties in navigation funding, and also uncertainties associated with timing and placement locations for any dredged material that might become available. In addition, beach placement of dredged material does not provide a consistent or measurable level of damage reduction. As the estimated renourishment volumes for the Recommended Plan are based on the assumption of no future maintenance dredging placement on area beaches, any such placement that did occur would have the effect of reducing the amount of renourishment material needed and therefore reducing the cost of the proposed Federal coastal storm risk management project. In addition, if at the time of renourishment the beach profile is already at or greater than the design template of the Recommended Plan, then no additional material would be placed for the project at that time.

6.9.7 Risk and Uncertainty in Coastal Storms

Beach-fx is an event-driven life-cycle model. USACE guidance requires that coastal storm risk management studies include risk and uncertainty. The Beach-fx model satisfies this requirement by fully incorporating risk and uncertainty throughout the modeling process (input, methodologies, and output). Over the project life-cycle, typically 50 years for new studies and the remaining project life for existing projects, the model estimates shoreline response to a series of historically based storm events applied for each of three USACE sea level change scenarios as required by Engineering Regulation, ER 110-2-8162. These plausible storms, the driving events, are randomly

generated using a Monte-Carlo simulation. The corresponding shoreline evolution includes not only erosion due to the storms, but also allows for storm recovery, post-storm emergency dune and/or shore renourishment, and planned renourishment events throughout the life of the project. Risk-based damages to structures are estimated based on the shoreline response in combination with pre-determined damage functions for all structure types within the project area. Uncertainty is incorporated not only within the input data (storm occurrence and intensity, structural parameters, structure and contents valuations, and damage functions), but also in the applied methodologies (probabilistic seasonal storm generation and multiple iteration, life cycle analysis). Results from the multiple iterations of the life cycle are averaged over a range of possible values. The Beach-fx parameters that dictate storm selection are discussed in Appendix B.

7 AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

Wrightsville Beach is a barrier island approximately 4.5 miles long stretching from Masonboro Inlet in the south to Masons Inlet to the north. The barrier island is separated from the mainland by Banks Channel in the south and Shell Island in the north. Wrightsville Beach is developed and can be accessed by one of two bridges across Banks Channel. Wrightsville Beach includes some hotels but is dominated by private homes. The footprint of the study area includes the marine environment offshore of Wrightsville Beach, the barrier island, and the sub-aerial terrestrial beach.

This section describes the existing conditions and probable consequences (impacts and effects) of the alternatives and associated actions on significant environmental resources within the proposed beach placement locations and within the borrow sources. For comparison purposes, impacts of the No Action Plan (Alternative 1), the Recommended Plan (Alternative 2), and Alternative 3 are described. The most significant differences in impacts associated with Alternatives 2 and 3 are related to the differences in the types of dredge (cutterhead vs hopper), the duration of each renourishment event, borrow area disturbance and pipeline placement. The Recommended Plan (Alternative 2) would include use of a cutterhead dredge for likely three of the four renourishments and a hopper dredge for possibly one of the four renourishments. When using a cutterhead dredge the duration of each renourishment event would be less than Alternative 3, borrow area disturbance would be less than Alternative 3 and the area of disturbance in the borrow area would be a previously disturbed area. For Alternative 3, removal of sand from an offshore borrow source would result in disturbance to a new area with each renourishment event. Alternative 2 would require a pipeline on the south end of Wrightsville Beach when the cutterhead dredge is used, whereas Alternative 3 would not require require a pipeline in the inlet area, since dredged material would come from offshore. The specific impacts for each alternative are addressed below.

7.1 Proposed Action

The Recommended Plan is the continuation of Federal participation in periodic renourishments consistent with the currently authorized project by increasing the total maximum/Section 902 project cost limit while using the inlet borrow source (requires an exemption from the provisions of CBRA) and an offshore borrow source, if needed, through FY 2036.

The Wrightsville Beach Coastal Storm Risk Management Project, as constructed, covers 15,650 feet of ocean shoreline and fronts the Town of Wrightsville Beach. The project includes the following: Dune having a crown width of 25 feet at 12.5 feet NAVD88, together with a beach berm, having a crown width of 50 feet at 9.5 feet NAVD88, and a

construction berm, having a crown width of 205 feet at 5.0 feet NAVD88. The dune and berm extend north 13,670 feet from Masonboro Inlet North Jetty. In addition to the main fill, the project includes a 2,000-foot-long transition on the north end, from Station 140+00 to Station 160+00. The total project length (including transitions) is 15,650 feet. Historically the project renourishment extends from Station 70+00 to 140+00 with a 2000-foot transition to station 160+00 (shown as a solid red line on Figure 6-1). Every four years, each renourishment will require an estimated 780,000 cubic yards. A total of four renourishment events (to FY 2036) would require a total volume of 3.1 million cubic yards.

The Recommended Plan includes two sand borrow sources with use of Masonboro Inlet/Banks Channel as the primary borrow source. The Masonboro Inlet/Banks Channel borrow area depths range from -20 feet to -30 feet. MLLW, and the borrow area limits constitute a polygonal area of around 154 acres, which ranges in width from 600 ft. to 1,600 ft. with a total length of about 9,000 ft. Each renourishment event using the Masonboro Inlet/Banks Channel borrow area will impact previously disturbed areas each time.

The secondary option is a new offshore borrow source. When the offshore borrow source is used, approximately 123 acres of previously undisturbed area will be impacted with each renourishment event. Additional investigations and technical analyses are required to determine the quality and quantity of the potential areas of new offshore borrow source including geomorphic, geophysical, environmental and cultural surveys after authorization for use of any new offshore source. These investigations would occur during the PED phase, after project authorization and before any of offshore borrow area is used.

Renourishment material from Masonboro Inlet/Banks Channel would be pumped to the beach from a cutterhead dredge and shaped on the beach by earth-moving equipment. The pipeline would run from Masonboro Inlet to Wrightsville Beach. Each renourishment event will require about 45 cutterhead dredging days. Dredging and beach placement will be restricted to the environmental window of November 16 to March 31. The March 31 end date would minimize impacts to bird habitat as a result of pipeline placement and occurs before the sea turtle nesting season start date of May 1.

Renourishment material from an offshore borrow source would be pumped to the beach from the hopper dredge directly onto Wrightsville Beach and shaped on the beach by earth-moving equipment. Each renourishment event likely would use two hopper dredges working concurrently for 54 days (each). Dredging and beach placement will be restricted to the environmental window of December 1 to April 15.

The Recommended Plan is the environmentally preferred plan because of the overall impacts are smaller than Alternative 3. These impacts include the following:

- Fewer dredging days with a cutterhead dredge as opposed to two hopper dredges which reduces air emissions, noise, endangered species vessel strikes and entrainment, recreation, aesthetics and other impacts
- Smaller acreage of benthic and water quality impacts and in the same, previously dredged area as opposed to larger and new impacts each dredging event

7.2 Physical Resources

7.2.1 Air Quality

Ozone is North Carolina's most widespread air quality problem, particularly during the warmer months. High ozone levels generally occur on hot sunny days with little wind, when pollutants such as nitrogen oxides and hydrocarbons react in the air. High levels of fine particles are more of a problem in the western Piedmont region but can occur throughout the year, particularly during episodes of stagnant air and wildfires. The project would be constructed outside the ozone season. The air quality in New Hanover County, North Carolina, is designated as an attainment area. North Carolina has a State Implementation Plan approved or promulgated under Section 110 of the Clean Air Act. A conformity determination is not required for this project because it is located in an attainment area,

The ambient air quality for New Hanover County has been determined to be in compliance with the National Ambient Air Quality Standards, and is designated as an attainment area for ozone, fine particulate matter and carbon monoxide and sulfur dioxide is meeting the 75 parts per billion 2010 1-hour standard (www.deq.nc.gov).

Greenhouse gases absorb infrared radiation, thereby trapping heat and making the planet warmer. The most important greenhouse gases directly emitted by humans include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and several other fluorine-containing halogenated substances. Although CO2, CH4, and N2O occur naturally in the atmosphere, human activities have changed their atmospheric concentrations. From the pre-industrial era (i.e., ending about 1750) to 2017, concentrations of these greenhouse gases have increased globally by 45, 164, and 22 percent, respectively.

Gases in the atmosphere can contribute to climate change both directly and indirectly. Direct effects occur when the gas itself absorbs radiation. Indirect radiative forcing occurs when chemical transformations of the substance produce other greenhouse gases, when a gas influences the atmospheric lifetimes of other gases, and/or when a gas affects atmospheric processes that alter the radiative balance of the earth.

In 2017, total gross U.S. greenhouse gas emissions were 6,472.3 MMT, or million metric tons, carbon dioxide. Total U.S. emissions have increased by 1.6 percent from 1990 to 2017, and emissions decreased from 2016 to 2017 by 0.3 percent (Draft Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2017).

Alternative 1 (No Action): This alternative would have no effect on air quality.

Alternative 2 (Recommended Plan): Temporary increases in exhaust emissions from the cutterhead dredge and other renourishment equipment are expected, however, the emissions produced would be similar to that produced by other large pieces of machinery and should be readily dispersed. Each renourishment is expected to take approximately 45 days, 54 days if two concurrent hopper dredges, and would occur during cold weather months. All dredges must comply with the applicable EPA standards. The direct and indirect emissions from this alternative fall below the prescribed de minimis levels, and therefore will have no effect on air quality.

Alternative 3 (Offshore Borrow Source): This alternative would result in an increase in exhaust emissions due to the 54 days dredging time of two concurrent hopper dredges and increased transit time from the offshore borrow source to beach placement as compared to the Recommended Plan. A conformity determination is not required for this project because it is located in an attainment area, the direct and indirect emissions from this alternative fall below the prescribed de minimis levels, and therefore will have no effect on air quality.

7.2.2 Geology and Sediments

Wrightsville Beach is a modern transgressive barrier island that lies along the southwestern side of Onslow Bay, which is bound by Cape Lookout to the north and the Cape Fear to the south (NCGS, 1985). Wrightsville Beach is approximately 4.5 miles long and is bounded by Mason's Inlet to the north, and Masonboro Inlet to the south. Sedimentary strata on the island consists of unlithified Quaternary surficial clastic sediments that unconformably overlie either Oligocene (Synder et al., 1991) or Eocene (Harris and Zullo, 1991) sandy, molluscan-mold and bryozoan-echinoid limestone. Landward, the stratigraphy of the area consists of unconformity bound, offlapping, Pliocene-Pliestocene, Eocene, and Cretaceous variably consolidated or lithified marine sediments that dip gently southeast toward the continental shelf. Offshore of Wrightsville Beach, Onslow Bay is generally a sediment starved environment because it lacks thick modern fluvial deposits, and the physiography of the Carolina coastline limits large-scale littoral sediment exchange (Blackwelder et al., 1982). Offshore of Wrightsville Beach, the seafloor is characterized by the presence of numerous shore normal rippled scour depressions and mobilized coarse sands that lie atop finer-grained shoreface and shelf derived sands. These crosscut older limestone and mud outcrops, coarse lag deposits, and drowned inner shelf dune fields (Thieler et al., 2001).

Prior to construction of the northern jetties, Masonboro Inlet likely received and retained sand-sized quartz grains via longshore current and inlet processes, similar to that described by Ritter (1989) and USACE (1995). Although the direction of the littoral sediment transport is generally in a north-to-south direction in Onslow Bay, the presence of the northern Masonboro jetty has interrupted the natural littoral sediment

migration in the vicinity of the inlet. Introduction of a low water weir, which was built into the northern Masonboro jetty, facilitated the littoral drift of sandy material over the jetty weir, and back into the inlet system. USACE estimates that the amount of material passing over the northern jetty weir is between 251,000 and 298,000 cubic yards/year, which was deemed sufficient to satisfy project requirements for borrow source recharge and mitigation. However, steady southward growth of the sand spit on the southern tip of Wrightsville Beach at the expense of southward migration and erosion of Masonboro Island still continues, and is a result of jetty construction. Current renourishment activities are conducted in an attempt to recreate the littoral transport that was present, and to provide a measure of storm risk management benefits to Wrightsville Beach.

In 2008, a reconnaissance-level investigation was conducted where 79 vibracores were drilled within 2-1/2 to 5 miles offshore of Wrightsville Beach. The investigation area was selected based upon the results of a United States Geological Survey geophysical survey conducted immediately offshore of Wrightsville Beach. Much of the vibracore sampling was conducted farther offshore in Federal waters, seaward of the 3-nautical mile territorial seas limit. Lab testing and compatibility analysis were partially completed, but full delineation of the borrow area extents, dredged material depth and usable volume were not developed. The distribution of potentially suitable beach fill materials shows little discernable pattern with the given information, but further delineation may reveal depositional trends in sandy material that could facilitate future development. More detail on geology and sediments can be found in Appendix A.

Typical USACE contract specifications for renourishment projects generally recognize suitable beach material as Poorly Graded Sand, or Poorly Graded Sand with Silt per the Unified Soil Classification System, as long as the portion of material meets these criteria:

- Less than 10 percent, by weight, material passes #200 sieve over weighted average.
- Less than 10 percent, by weight, material retained on the #4 sieve over weighted average.
- Material retained on the 3/4 inch sieve does not exceed, by percentage or size that found on the native beach.
- Contains no construction debris, toxic material, or other foreign matter. Contains no clasts or lithified rock.

The USACE guideline for beach placement is no more than 10 percent of the material passing the # 200 sieve, i. e., dredged material must be 90 percent sand (coarse-grained). All dredged material that will be placed on Wrightsville Beach meets the USACE guideline and is dredged from either the same inlet that has been used as a

borrow source in the past or from a new offshore borrow source. A full discussion of sediments and geology can be found in Appendix A.

Alternative 1 (No Action): With no action, approximately 780,000 CY of beach quality sand that is removed for periodic renourishments would remain in the Masonboro Inlet/Banks Channel borrow area. Sediments would only be removed for navigation purposes, as needed. This alternative could result in increased shoaling in the inlet and Banks Channel, requiring navigation maintenance dredging. Currently, maintenance dredging is not required to keep the inlet open. This alternative would also result in the long-term erosion of Wrightsville Beach.

Alternative 2 (Recommended Plan): Implementation of the Recommended Plan would temporarily reduce approximately 780,000 CY (dredged from an area of about 154 acres) of beach quality sediment in Masonboro Inlet/Banks Channel every four years, except for one potential offshore renourishment, until FY 2036. For the renourishment event that uses offshore borrow, this alternative would permanently reduce the offshore sand volume by approximately 780,000 CY Removal of sediment from Masonboro Inlet/Banks Channel reduces the amount of down drift sediments that reach Masonboro Island.

Alternative 3 (Offshore Borrow Source): This alternative would result in all four renourishment events permanently removing beach quality sediment from the offshore borrow area. Each event would remove approximately 780,000 CY (123 acres) of beach quality sediment in the offshore borrow source, resulting in a total of 3.1 million CY and an impact to 492 acres. Material in the Masonboro Inlet/Banks Channel borrow area would only be removed for navigation purposes. This alternative could result in increased shoaling in the inlet. Also, the introduction of 780,000 cy of sand every four years into the Beach/Inlet system from an offshore borrow source, may result in increased shoaling in Mason's Inlet (north end of Wrightisville Beach) due to longshore drift.

7.2.3 Climate Change

The global average temperature has increased by more than 1.5°F since the late 1800s. Many factors, both natural and human, can cause changes in Earth's energy balance, including:

- Variations in the sun's energy reaching Earth
- Changes in the reflectivity of Earth's atmosphere and surface
- Changes in the greenhouse effect, which affects the amount of heat retained by Earth's atmosphere

Greenhouse gases come from a variety of human activities, including: burning fossil fuels for heat and energy, clearing forests, fertilizing crops, storing waste in landfills,

raising livestock, and producing some kinds of industrial products (www.epa.gov). Greenhouse gasses are discussed in more detail in Section 7.2.1.

A review of the U.S. Environmental Protection Agency's analysis for climate change for North Carolina titled *What Climate Change Means for North Carolina* (https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-nc.pdf) states:

- Most of North Carolina has warmed 0.5-1.0 degrees Fahrenheit in the last 100 years. The southeastern United States has warmed less than most of the nation.
- Tropical storms and hurricanes have become more intense during the past 20 years. Hurricane wind speeds and rainfall rates are likely to increase as the climate continues to warm.
- Increased rainfall may further exacerbate flooding in some coastal areas. Since 1958, the amount of precipitation during heavy rainstorms has increased by 27 percent in the Southeast, and the trend toward increasingly heavy rainstorms is likely to continue.

Alternative 1 (No Action): This alternative would have no effect on climate change. Climate change would increase the frequency and intensity of storm events which will likely increase erosion rates and the effects of storm surge.

Alternative 2 (Recommended Plan): This alternative will not increase the effects of climate change in the project area; however, the project area is likely to be affected by climate change due to the proximity of the project to the coast where effects of climate change, such as increased storm events and sea level rise, will likely be more dramatic than inland portions of the State. Increased frequency and intensity of storm events will likely increase erosion rates which may increase the need for larger, or more frequent, renourishments to maintain coastal storm risk management benefits.

Alternative 3 (Offshore Borrow Source): Impacts of Alternative 3 would be similar to the Recommended Plan.

7.2.4 Sea Level Rise

Relative sea level refers to the local elevation of the sea with respect to land, including the lowering or rising of land through geologic processes, such as subsidence and glacial rebound. It is anticipated that sea level will rise within the next 100 years. To incorporate the direct and indirect physical effects of projected future sea-level change on design, renourishment, operation, and maintenance of coastal projects, the USACE has provided guidance in EC 1165-2-212 that has been superseded by ER 1100-2-8162 and Engineer Technical Letter 1100-2-1.

In accordance with ER 1100-2-8162, dated 31 December 2013, potential relative sea level change must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence. Based on historical sea level measurements taken from NOS gage 8659084 at Southport, North Carolina, the historic sea level change rate was determined using the *updated published* seal level change fetched from http://www.corpsclimate.us/ccaceslcurves.cfm. The economic analysis period for this study begins with a Beach-fx model start date of 2021 (economic base year of 2022) and extends to the end of the project life in FY 2036. At Gauge 8659084, the mean sea level trend is 2.01 mm/year (0.00659 feet/year) with a 95 percent confidence interval of +/- 0.41 mm/year (0.00134 feet/year) based on monthly mean sea level data over a 74 year record (Figure 7-1) which is equivalent to a change of 0.11 feet over the remaining life of the project (FY 2036). The Intermediate rate was determined to be 3.91 mm/year (0.0128 feet/year). The High rate was determined to be 9.92mm/year (0.0325 feet/year). This results in an Intermediate and High change in sea level between the start year (FY 2021) and the end of the project life (FY 2036) of 0.21 feet and 0.54 feet, respectively. Relative sea level change between 2021 and 2036 is shown graphically in Figure 7-2.

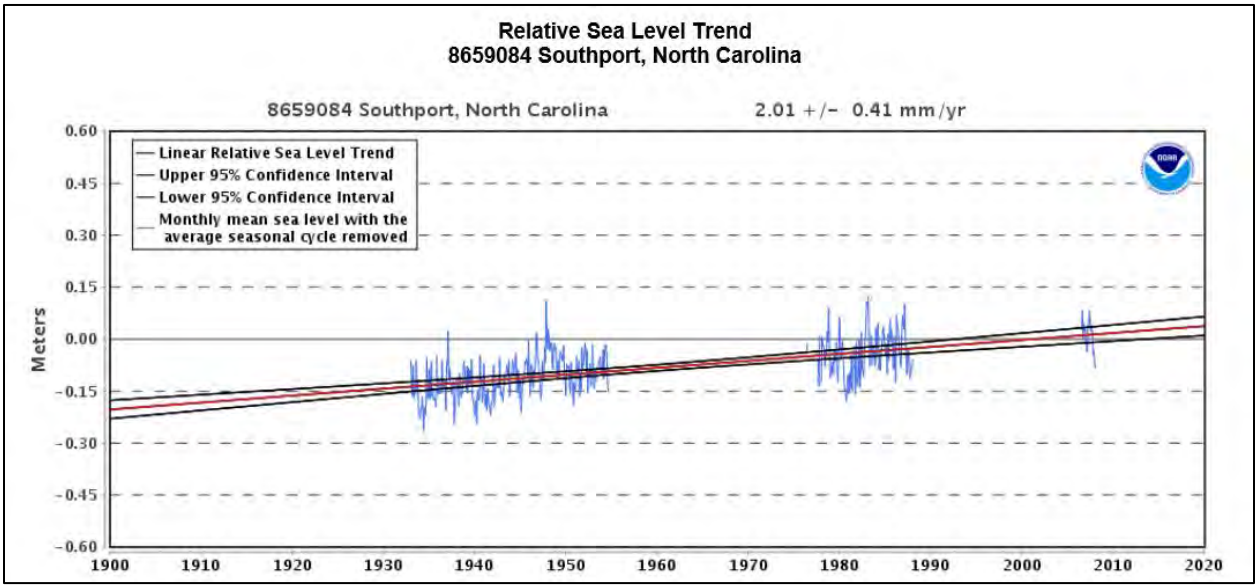


Figure 7-1. Relative Sea Level Trend, NOAA Gauge 8659084

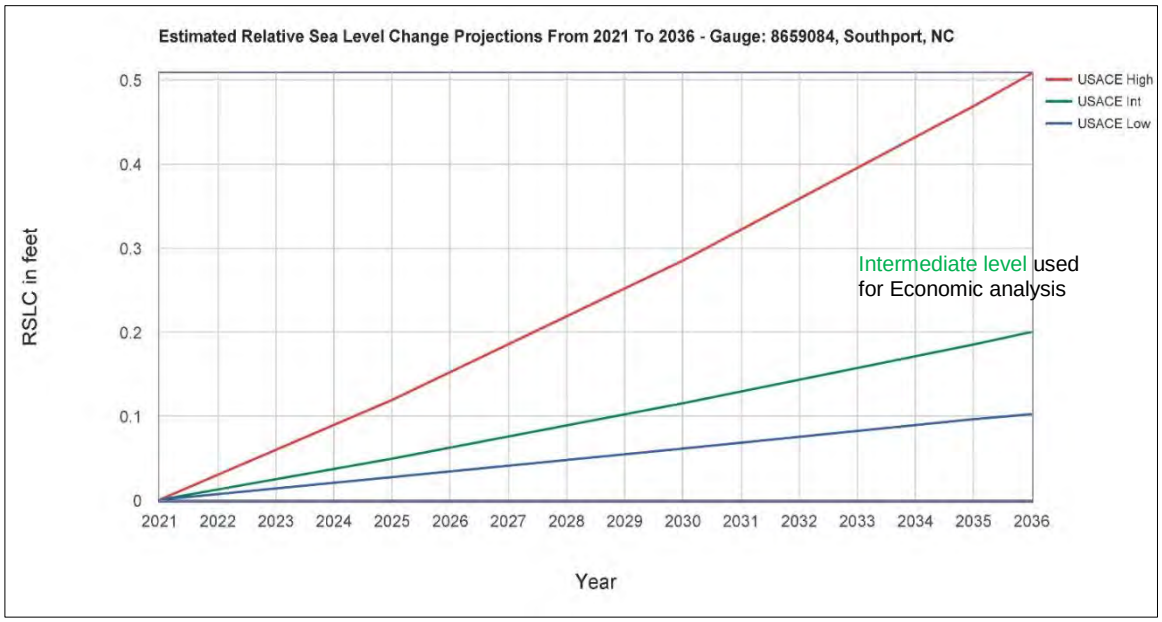


Figure 7-2. Project Sea Level Change, Start Year (FY 2021) to End of Project Life (FY 2036)

Potential impacts of rising sea level on total water levels experienced at the site include overtopping of waterside structures, increased shoreline erosion, and flooding of low lying areas. In general, relative sea level change (Baseline, Intermediate, and High) will not affect the overall function of the project. Relative vulnerability to flooding during extreme events is consistent between both the With and Without Project conditions. However, adaptation in the form of additional sand volume will be required to maintain project performance.

Alternative 1 (No Action): The No Action analysis assumes that sea level rise will be 0.21 feet over the remaining life of the project. Accelerated sea level rise rates would lead to higher storm surges and increase erosion rates, resulting in increased damages. The No Action alternative would not affect sea level rise.

Alternative 2 (Recommended Plan): Potential impacts of rising sea level on total water levels experienced at the site include overtopping of waterside structures, increased shoreline erosion, and flooding of low lying areas. In general, relative sea level change (Baseline, Intermediate, and High) will not affect the overall function of the project. Relative vulnerability to flooding during extreme events is consistent between both with and without project conditions. However, adaptation in the form of additional sand volume will be required to maintain project performance.

Alternative 3 (Offshore Borrow Source): Impacts of Alternative 3 would be similar to the Recommended Plan.

7.3 Water Quality

Water quality standards are State regulations or rules that protect lakes, rivers, streams and other surface water bodies from pollution. These standards are used to determine if the designated uses of a water body are being protected. Those uses are defined by the classifications assigned to the water body. Surface Water Classifications are designations applied to surface water bodies, such as streams, rivers and lakes, which define the best uses to be protected within these waters (for example swimming, fishing, drinking water supply) and carry with them an associated set of water quality standards to protect those uses.

All surface waters in North Carolina are assigned a primary classification by the North Carolina Division of Water Resources (15A NC Administrative Code 02B .0301 to .0317). Waters in the vicinity of the study area fall into two classifications. Waters of Masonboro Inlet and Banks Channel are classified as SC and High Quality Waters (HQW). SC waters are suitable for secondary recreation such as fishing, boating, and other activities involving minimal skin contact, aquatic life propagation and survival, and wildlife. HQW are waters which are rated excellent based on biological and physical/chemical characteristics through NCDWR monitoring or special studies, primary nursery areas designated by the Marine Fisheries Commission, and other functional nursery areas designated by the Marine Fisheries Commission. Waters of the Atlantic Ocean are classified as SB and are tidal salt waters protected for all Class SC uses in addition to primary recreation. Primary recreational activities include swimming, skin diving, water skiing, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis.

Inlets are highly dynamic resulting from ocean longshore currents, waves and tidal influences. Storms and maintenance dredging of the navigation channel all add to the levels of turbidity and suspended solids in the inlet.

The proposed action complies with Section 404(b)(1) (P.L. 95-2017) of the Clean Water Act. The Section 404(b)(1) evaluation is included in Appendix G. Dredged material consisting of ≥90 percent sand would be placed in the authorized placement areas under either the recommended plan or Alternative 3; therefore, renourishment events would be covered under the North Carolina Division of Water Resources' March 19, 2017, Water Quality Certification No. 4099: General Certification for Projects Eligible for U.S. Army Corps of Engineers Regional General Permit 198000048 (Emergency Activities on Ocean Beaches). It should be noted that although WQC #4099 is titled “Emergency Activities on Ocean Beaches,” based on coordination with NCDWR, WQC #4099 is applicable to the Wrightsville Beach CSRM project. All conditions of WQC #4099 will be met. The proposed action complies with Sections 404 and 401 of the Clean Water Act.

Alternative 1 (No Action): This alternative would have no effect on water quality.

Alternative 2 (Recommended Plan): Dredging in the borrow area would involve mechanical disturbance of the bottom substrate and subsequent redeposition of suspended sediment and turbidity generated during the estimated 45 days of dredging of Masonboro Inlet (54 concurrent days for two hopper dredges offshore) for each renourishment event. Factors that are known to influence sediment spread and turbidities are grain size, water currents and depths.

During renourishment, there would be elevated levels of turbidity and suspended solids in the inlet borrow area and the immediate area of sand deposition when compared to the existing non-storm conditions of the surf zone. Significant increases in turbidity are not expected to occur outside the immediate dredging and renourishment area (turbidity increases of 25 nephelometric turbidity units [NTUs]) or less are not considered significant). Turbid waters (increased turbidity relative to background levels but not necessarily above 25 NTUs) would stay close to shore and be transported with waves either up-drift or down-drift depending on wind conditions. Because of the low percentage of silt and clay in the borrow areas (≤ 10 percent), turbidity impacts would not be expected to be greater than the natural increase in turbidity and suspended material that occurs during storm events. Any increases in turbidity in the borrow area during renourishment would be expected to be temporary and limited to the area surrounding the dredging. Turbidity levels would be expected to return to background levels in the borrow area and surf zone when dredging ends.

Offshore borrow areas typically are less disturbed and have less turbidity than inlets. Dredging within an offshore borrow area would result in increased turbidity and would be expected to be limited to the area surrounding the dredging. Monitoring studies done on the impacts of offshore dredging indicate that sediments suspended during offshore work are generally localized and rapidly dissipate when dredging ceases (Naqvi and Pullen 1982, Bowen and Marsh 1988, Van Dolah et al. 1992). Considering the dynamic nature of sediment movement around the offshore borrow area, post-dredging infilling associated with the natural physical processes of the system is anticipated. Additionally, infilling is expected from side sloughing of native bottom sediments (beach quality sand) following dredging activities.

Dredging of the offshore borrow source likely would be accomplished using two hopper dredges, each concurrently taking 54 days, or a total of 108 dredging days of impacts for each renourishment event. Turbidity levels would be expected to return to background levels in the benthic zone and water column when dredging ends.

Pursuant to Section 404 of the Clean Water Act, the effects associated with the discharge of beach fill material into waters of the United States are discussed in the Section 404(b)(1) (P.L. 95-217) evaluation in Appendix G. Incidental fallback associated with hopper dredging operations in the offshore borrow areas is anticipated. Resultant water column impacts associated with sedimentation and turbidity are discussed in

Section 7.4.4; however, no measureable increase in bottom elevation is expected from the fallback of sediment during the dredging operations and the activity won't destroy or degrade waters of the United States (33 CFR Section 323.2(d)(4)(i)). Therefore, incidental fallback from hopper dredging in the borrow area is not being considered a discharge addressed under the Section 404 (b)(1) Guidelines Analysis.

Overall water quality impacts of the Recommended Plan would be expected to be short-term and minor. Living marine resources dependent on good water quality should not experience significant adverse effects from water quality changes.

Alternative 3 (Offshore Borrow Source): Impacts would be similar to the water quality impacts discussed above for offshore dredging for each renourishment event. Turbidity levels would be expected to return to background levels in the benthic zone and water column when dredging ends. Overall water quality impacts of this alternative would be expected to be short-term and minor. Living marine resources dependent on good water quality should not experience significant adverse effects from water quality changes.

7.4 Marine Resources

7.4.1 Benthic Resources

Aquatic organisms that live in close association with the bottom, or substrate, of a body of water, are collectively called the benthos. Benthic communities provide a link between planktonic and benthic production and commercially important fish species (Posey, 1991). Benthic communities of the project area exhibit a wide range of organism composition and density, and community structure may vary considerably depending on substrate type, salinity regime, proximity to structural habitat, and the like. Benthic substrate type and structural habitat within the project area range between fine- to coarse-grained sand; gravel and shell hash; and low-, moderate-, and high-relief hard bottom.

Offshore sand bottom communities along the North Carolina coast are relatively diverse habitats containing over a hundred polychaete taxa. Tube dwellers and permanent burrow dwellers are important benthic prey for fish and epibenthic invertebrates. These species are also most susceptible to sediment deposition, turbidity, erosion, or changes in sediment structure associated with sand mining activities, compared to other more mobile polychaetes. On ebb tide deltas, polychaetes, crustaceans (primarily amphipods), and mollusks (primarily bivalves) were the most abundant infauna, while decapod crustaceans and echinoderms (sand dollars) dominated the epifauna. Because periodic storms can affect benthic communities along the Atlantic coast to a depth of about 115 feet (35 m), the soft bottom community tends to be dominated by opportunistic taxa that are adapted to recover relatively quickly from disturbance. Many faunal species documented on the ebb tide delta are important food sources for demersal predatory fishes and mobile crustaceans, including spot, croaker, weakfish,

red drum, and penaeid shrimp. These fish species congregate in and around inlets during various times of the year, presumably to enhance successful prey acquisition and reproduction (Deaton et al. 2010).

The surf zone of the beach shoreface is extremely dynamic and is characterized as the area from mean low tide landward to the high tide mark. The area serves as habitat for invertebrate communities adapted to the high-energy, sandy-beach environment. Important invertebrates of the surf zone and beach/dune community include the mole crab (*Emerita talpoida*), coquina clams (*Donax variabilis*), polychaete worms, amphipods, and ghost crabs (*Ocypode quadrata*). Mole crabs and coquinas represent the largest component of the total macrofaunal biomass of North Carolina intertidal beaches, and they are consumed in large numbers by important fish species such as flounders, pompanos, silversides, mullets, and kingfish (Reilly and Bellis 1978). Beach intertidal macrofauna are also a seasonally important food source for numerous shorebird species.

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

The Masonboro Inlet/Banks Channel borrow area has a total maximum of 154 acres. When the inlet was dredged in 2002, 2006 and 2010; 120, 69, and 154 acres of the same benthic habitat were directly impacted by each renourishment event, respectively. The acreage of impact is highly dependent on the volume of sand required to renourish the beach (determined by the amount of beach erosion) and the amount of infilling (recharging) of the borrow area between renourishment events. A renourishment event using an offshore borrow area would directly impact approximately 123 acres of new benthic habitat each time.

Alternative 1 (No Action): This alternative would result in the long-term reduction in benthic macro-invertebrate abundance in the beach environment due to erosion and scour of beach habitat. There would be no effect to offshore benthic resources.

Alternative 2 (Recommended Plan): Beach placement may have negative effects on intertidal macrofauna through direct burial or increased turbidity in the surf zone; such effects would be expected to be localized, short-term, and reversible. Any reduction in the numbers or biomass (or both) of intertidal macrofauna present immediately after beach placement may have localized limiting effects on surf-feeding fishes and shorebirds because of a reduced food supply. In such instances, those animals may be

temporarily displaced to other locations, but would be expected to return following placement.

Benthic organisms within the inlet and offshore borrow source dredged for periodic renourishment would be lost. However, recolonization by opportunistic species would be short-term and expected to begin soon after the dredging activity stops. Because of the opportunistic nature of the species that inhabit the soft-bottom benthic habitats, recovery would be expected to occur within 1–2 years. Effects on estuarine-dependent organisms are not expected to be significant because renourishment-related activities in the offshore borrow source and on Wrightsville Beach would be localized. Demersal fish may incur a slight risk due to entrainment by dredging activities.

Alternative 3 (Offshore Borrow Source): Effects to intertidal macrofauna as a result of discharging of material on the beach would be similar to the Recommended Plan. This alternative would result in all four renourishment events permanently impacting about 123 new acres of benthic habitat in the offshore borrow source, resulting in a total of 492 acres. Benthic organisms within the offshore borrow source dredged for periodic renourishment would be lost. Only a small portion of an offshore borrow area would be dredged during each renourishment event thereby allowing for quicker recovery by opportunistic species. Because of the opportunistic nature of the species that inhabit the soft-bottom benthic habitats, recovery would be expected to occur within 1–2 years.

7.4.2 Inlet and Surf Zone Fishes and Nekton

The surf zone along the area beaches provides important fishery habitat on which some species are dependent. Surf zone fisheries are typically diverse, and 47 species have been identified from North Carolina; however, the actual species richness of fishes using the North Carolina surf area for at least part of their life history is much higher (Ross, 1996; Ross and Lancaster, 1996). According to Ross (1996), the most common species in the South Atlantic Bight surf zone are Atlantic menhaden (*Brevoortia tyrannus*), striped anchovy (*Anchoa hepsetus*), bay anchovy (*A. mitchilli*), rough silverside (*Membras martinica*), Atlantic silverside (*Menidia menidia*), Florida pompano (*Trachinotus carolinus*), spot (*Leiostomus xanthurus*), Gulf kingfish (*Menticirrhus littoralis*), and striped mullet (*Mugil cephalus*). Two species in particular, the Florida pompano and gulf kingfish (*M. littoralis*) seem to use the surf zone exclusively as a juvenile nursery area and are rarely found elsewhere. The South Atlantic Bight marine region extends southward from Virginia's James River to the Florida Keys. It encompasses the southern Virginia Shoreline and the entire Atlantic shoreline of North Carolina, South Carolina, Georgia and Florida. Seaward it reaches to 5,000 meters below sea level. The major recruitment time for juvenile fishes to surf zone nurseries is late spring through early summer (Hackney et al., 1996). Major surf zone species consume a variety of benthic and planktonic invertebrates, with most of the prey coming from the water column.

The dominant benthic prey are coquina clams; however, that is not the dominant food item throughout the South Atlantic Bight. Furthermore, many surf zone fishes exhibit prey switching in relation to prey availability, which could minimize potential adverse effects of beach renourishment.

Masonboro Inlet is an important passageway for the larvae of many species of commercially or ecologically important fish. Spawning grounds for many marine fishes are believed to occur on the continental shelf with immigration to estuaries during the juvenile stage. The shelter provided by the marsh and creek systems within the sound serves as nursery habitat where young fish undergo rapid growth before returning to the offshore environment. Transport from offshore shelves to estuarine nursery habitats occurs in three stages: offshore spawning grounds to nearshore, nearshore to the locality of an inlet or estuary mouth, and from the mouth into the estuary (Boehlert and Mundy, 1988).

In North Carolina, the majority of invertebrate species recruit between May and September and surf zone fish species recruit from March through September. The anticipated renourishment time frame for the project is from November 16 to March 31 (Dec 1 to April 15 if using a hopper dredge) and would avoid a majority of the peak recruitment and abundance periods of surf zone fishes and their benthic invertebrate prey source.

Oceanic nekton are active swimmers, not at the mercy of the currents, and are distributed in the relatively shallow oceanic zone. They are composed of three phyla-chordates, mollusks, and arthropods, with chordates (i.e., fish species) forming the largest portion. Any entrainment of adult fish, and other motile animals in the vicinity of the borrow source during dredging would be expected to be minor because of their ability to actively avoid the disturbed areas. Fish species are expected to leave the area temporarily during the dredging operations and return when dredging ceases.

Although entrainment of benthic oriented organisms would be expected from the proposed dredging activities, a hydraulic dredge operating in the open ocean would pump such a small amount of water in proportion to the surrounding water volume that any entrainment effects associated with dredging of borrow material for the project are not expected to adversely affect species at the population level. Though entrainment rates for both cutterhead suction and hopper dredges are both expected to be low, the mobile and surficial dredging nature of hopper dredges would likely propose a higher risk of entrainment than cutterhead suction dredges since cutterhead dredges are not mobile and operate most effectively while buried within a small surface area.

Alternative 1 (No Action): This alternative would have no effect on surf zone fishes, inlet and oceanic nekton.

Alternative 2 (Recommended Plan): Beach placement and subsequent turbidity increases may have short-term effects on surf zone fishes and prey availability. The 45 days of dredging in Masonboro Inlet/Banks Channel borrow area will result in increased turbidity during that time. However, the opportunistic behavior of the organisms within the dynamic surf zone environment enables them to adapt to short-term disturbances. Because of the adaptive ability of representative organisms in the area and the avoidance of peak recruitment and abundance time frames with a November 16 to March 31 renourishment time frame, such effects would be expected to be temporary and minor. Due to nekton's ability to avoid the disturbed areas, entrainment impacts are expected to be minor.

Dredging an offshore borrow area (for possibly one renourishment) with two hopper dredges will take about 54 days concurrent days. Any entrainment of adult fish, and other motile animals in the vicinity of the offshore borrow area during dredging would be expected to be minor because of their ability to actively avoid the disturbed areas. Fish species are expected to leave the area temporarily during the dredging operations and return when dredging ceases. Because of the adaptive ability of representative organisms in the offshore area and the avoidance of peak recruitment and abundance timeframes with a December 1 to April 15 renourishment time frame, such effects would be expected to be temporary and minor.

Alternative 3 (Offshore Borrow Source):

Beach placement impacts resulting from use of an offshore borrow area would be similar to the Recommended Plan. The main difference is that use of an offshore borrow source would result in a longer construction timeframe, resulting in a longer duration of increased turbidity.

Although entrainment of benthic oriented organisms would be expected from the proposed dredging activities, entrainment rates for hopper dredges are expected to be low. The mobile and surficial dredging nature of hopper dredges would likely pose a higher risk of entrainment than cutterhead suction dredges, since cutterhead dredges are not mobile and operate most effectively while buried within a small surface area.

Dredging an offshore borrow area with two hopper dredges will take 54 concurrent days. The longer dredging duration would result in increased impacts to fishes and nekton as compared to the Recommended Plan. Any entrainment of adult fish, and other motile animals in the vicinity of the offshore borrow area during dredging would be expected to be minor because of their ability to actively avoid the disturbed areas. Fish species are expected to leave the area temporarily during the dredging operations and return when dredging ceases.

7.4.3 Hard Bottoms

Hard bottoms are defined as localized areas not covered by unconsolidated sediments, where the ocean floor consists of hard substrate. In the South Atlantic Bight, such hard bottoms vary in relief from high (higher than 2.0 m (6.6 ft) to low (lower than 0.5 m (1.6 ft) profile and range nearshore (within the 3-nautical-mile territorial sea limit) to beyond the continental shelf edge (more than 200 m [656 ft] [Moser et al. 1995]). Hard bottoms are also called live bottoms because they support a rich diversity of invertebrates such as corals, anemones, and sponges, which are refuges and food sources for fish and other marine life. They provide valuable habitat for reef fish such as black sea bass, red porgy, and groupers. Hard bottoms are also attractive to pelagic species such as king mackerel, amberjack, and cobia. While hard bottoms are most abundant in southern portions of North Carolina, they are along the entire coast. Storms play a major role in distributing hard bottom, benthic communities as they remove sediments accumulated from bioerosion and redistribute the ephemeral bottom sediments, exposing or burying hard bottom surfaces (Riggs et al., 1998). The surficial sand sheet on the upper, flat, hard bottom is generally very thin, has an irregular distribution, and is highly mobile (Riggs et al., 1996).

Based on USGS multibeam backscatter surveys (Thieler 2001), limestone outcroppings may occur in the project area. During PED, additional surveys will be conducted to identify hard bottoms in the borrow area.

Alternative 1 (No Action): This alternative would have no effect on hard bottoms.

Alternative 2 (Recommended Plan): All hard bottoms in the project area will be identified and avoided (with ample buffer), therefore the Recommended Plan will have no effect on hard bottoms.

Alternative 3 (Offshore Borrow Source): Impacts of Alternative 3 would be similar to the Recommended Plan.

7.4.4 Essential Fish Habitat

The 1996 Congressional amendments to the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265) set forth new requirements for the NMFS, regional fishery management councils FMC, and other Federal agencies to identify and protect important marine and anadromous fish habitat. These amendments established procedures for the identification of Essential Fish Habitat (EFH) and a requirement for interagency coordination to further the conservation of federally managed fisheries. Table 7-1 shows the categories of EFH and Habitat Areas of Particular Concern (HAPC) for managed species that were identified in the Fishery Management Plan Amendments affecting the South Atlantic area. Table 7-2 lists the federally managed fish species of North Carolina for which Fishery Management Plans have been developed by the South Atlantic Fishery Management Council (SAFMC), Mid-Atlantic Fishery Management Council (MAFMC), and NMFS.

Table 7-1. Categories of Essential Fish Habitat and Habitat Areas of Particular Concern

ESSENTIAL FISH HABITAT	**GEOGRAPHICALLY DEFINED HABITAT AREAS OF PARTICULAR CONCERN**
Estuarine Areas	**Area - Wide**
Estuarine Emergent Wetlands	Council-designated Artificial Reef Special Management Zones
Estuarine Scrub / Shrub Mangroves	Hermatypic (reef-forming) Coral Habitat & Reefs
Submerged Aquatic Vegetation (SAV)	Hard Bottoms
Oyster Reefs & Shell Banks Intertidal Flats	Hoyt Hills
Palustrine Emergent & Forested Wetlands	Sargassum Habitat
Aquatic Beds	State-designated Areas of Importance of Managed Species
Estuarine Water Column Seagrass	Submerged Aquatic Vegetation
Creeks	
Mud Bottom	**North Carolina**
	Big Rock
Marine Areas	Bogue Sound
Live / Hard Bottoms	Pamlico Sound at Hatteras / Ocracoke Islands
Coral & Coral Reefs	Capes Fear, Lookout, & Hatteras (sandy shoals)
Artificial / Manmade Reefs	New River
Sargassum	The Ten Fathom Ledge
Water Column	The Point

Table 7-2. Essential Fish Habitat Species for Coastal NC (1 of 3)

E-EGGS L-LARVAL J-JUVENILE A-ADULT N/A-NOT FOUND	Mason Inlet	Banks Channel	Masonboro Inlet	Atlantic Ocean South of Cape Hatteras
COASTAL DEMERSALS				
Red Drum	E L J A	E L J A	E L J A	J A
Bluefish	J A	J A	J A	E L J A
Summer Flounder	L J A	L J A	L J A	E L J A
INVERTEBRATES				
Brown Shrimp	E L J A	L J A	E L J A	E L J A
Pink Shrimp	E L J A	L J A	E L J A	E L J A
White Shrimp	E L J A	L J A	E L J A	E L J A
Calico Shrimp	N/A	N/A	N/A	E L J A
COASTAL PELAGICS				
Dolphinfish	J A	N/A	J A	E L J A
Cobia	L J A	J A	L J A	E L J A
King Mackerel	J A	J A	J A	E L J A
Spanish Mackerel	L J A	L J A	L J A	E L J A
HIGHLY MIGRATORY				
Bigeye Tuna	N/A	N/A	N/A	E L J A
Bluefin Tuna	N/A	N/A	N/A	J A
Skip Jack Tuna	N/A	N/A	N/A	J A
Yellowfin Tuna	N/A	N/A	N/A	E L J A
Swordfish	N/A	N/A	N/A	E L J A
Blue Marlin	N/A	N/A	N/A	E L J A
White Marlin	N/A	N/A	N/A	E L J A
Sailfish	N/A	N/A	N/A	E L J A
Little Tunny	N/A	N/A	N/A	E L J A
SHARKS				
Spiny Dogfish	J A	N/A	J A	J A
Smooth Dogfish	J A	J	J A	J A
Small Coastal Sharks	J A	J A	J A	J A
Large Coastal Sharks	J A	N/A	J A	J A
Pelagic Sharks	N/A	N/A	N/A	J A
Prohibited/Research Sharks	J A	N/A	J A	J A

Table 7-2. Essential Fish Habitat Species for Coastal NC (2 of 3)

E-EGGS L-LARVAL J-JUVENILE A-ADULT N/A-NOT FOUND	Mason Inlet	Banks Channel	Masonboro Inlet	Atlantic Ocean South of Cape Hatteras
SNAPPER/GROUPER				
Black Sea Bass	L J A	L J A	L J A	E L J A
Bank Sea Bass	N/A	N/A	N/A	E L J A
Rock Sea Bass	J	J	J	E L J A
Gag	J A	J	J A	E L J A
Graysby	N/A	N/A	N/A	E L J A
Speckled Hind	N/A	N/A	N/A	E L J A
Yellowedge Grouper	N/A	N/A	N/A	E L J A
Coney	N/A	N/A	N/A	E L J A
Red Hind	N/A	N/A	N/A	E L J A
Goliath Grouper	N/A	N/A	N/A	E L J A
Red Grouper	N/A	N/A	N/A	E L J A
Misty Grouper	N/A	N/A	N/A	E L J A
Warsaw Grouper	N/A	N/A	N/A	E L J A
Snowy Grouper	N/A	N/A	N/A	E L J A
Yellowmouth Grouper	N/A	N/A	N/A	E L J A
Black Grouper	J	J	J	E L J A
Scamp	N/A	N/A	N/A	E L J A
Blackfin Snapper	N/A	N/A	N/A	E L J A
Red Snapper	N/A	N/A	N/A	E L J A
Cubera Snapper	N/A	N/A	N/A	E L J A
Lane Snapper	N/A	N/A	N/A	E L J A
Silk Snapper	N/A	N/A	N/A	E L J A
Vermillion Snapper	N/A	N/A	N/A	E L J A
Mutton Snapper	N/A	N/A	N/A	E L J A
Gray Snapper	J	J	J	E L J A
Gray Triggerfish	N/A	N/A	N/A	E L J A
Yellow Jack	J	J	J	E L J A
Blue Runner	J	J	J	E L J A
Crevalle Jack	J	J	J	E L J A
Bar Jack	J	J	J	E L J A
Greater Amberjack	N/A	N/A	N/A	E L J A
Almaco Jack	N/A	N/A	N/A	E L J A
Banded Rudderfish	N/A	N/A	N/A	E L J A
Atlantic Spadefish	N/A	N/A	N/A	E L J A
White Grunt	N/A	N/A	N/A	E L J A

Table 7-2. Essential Fish Habitat Species for Coastal NC (3 of 3)

E-EGGS L-LARVAL J-JUVENILE A-ADULT N/A-NOT FOUND	**Mason Inlet**	**Banks Channel**	**Masonboro Inlet**	**Atlantic Ocean South of Cape Hatteras**
Tomtate	N/A	N/A	N/A	E L J A
Hogfish	N/A	N/A	N/A	E L J A
Puddingwife	N/A	N/A	N/A	E L J A
Sheepshead	J A	J A	J A	E L J A
Red Porgy	N/A	N/A	N/A	E L J A
Longspine Porgy	N/A	N/A	N/A	E L J A
Sculp	N/A	N/A	N/A	E L J A
Blueline Tilefish	N/A	N/A	N/A	E L J A
Sand Tilefish	N/A	N/A	N/A	E L J A
SMALL COASTAL SHARKS	**LARGE COASTAL SHARKS**	**PELAGIC SHARKS**	**PROHIBITED SHARKS**	
Atlantic Sharpnose Shark	Silky Shark	Shortfin Mako	Sand Tiger	Reef Shark
Finetooth Shark	Tiger Shark	Porbeagle	Bigeye Sand Tiger	Narrowtooth Shark
Blacknose Shark	Blacktip Shark	Thresher Shark	Whale Shark	Smalltail Shark
	Spinner Shark	Ocean Whitetip Shark	Basking Shark	Atlantic Angel Shark
RESEARCH SHARKS	Bull Shark	Blue Shark	White Shark	Longfin Mako
Sandbar Shark	Lemon Shark		Dusky Shark	Bigeye Thresher
	Nurse Shark		Bignose Shark	Sharpnose Sevengill Shark
	Scalloped Hammerhead		Galapagos Shark	Bluntnose Sixgill Shark
	Great Hammerhead		Night Shark	Bigeye Sixgill Shark
	Smooth Hammerhead			

Alternative 1 (No Action): This alternative would result in no effects on EFH or HAPC.

Alternative 2 (Recommended Plan): Implementation of the Recommended Plan would directly affect the estuarine water column in Masonboro Inlet/Banks Channel and may result in short-term minor effects on estuarine life cycle requirements of managed species in the South Atlantic Region. Minor and short-term suspended sediment plumes

and related turbidity may affect the marine water column during dredging in the offshore borrow source. Due to the distance from the inlet, dredging operations would not be expected to directly affect any estuarine water column, and therefore, would not be expected to directly affect estuarine life cycle requirements of managed species in the South Atlantic Region.

Short-term, elevated turbidity levels could also occur during the renourishment operation and could be transported outside the immediate placement area via longshore and tidal currents. Turbidity associated with beach fill placement operations could extend into Masonboro Inlet/Banks Channel and the estuarine water column from longshore currents and tidal influx, however these effects are expected to be minimal. This alternative would not be expected to cause any significant adverse impacts to EFH or HAPC for managed species identified in the Fisheries Management Plan Amendments affecting South Atlantic Area. Physical and biological impacts to EFH would be short-term and localized on an individual and cumulative effects basis.

Alternative 3 (Offshore Borrow Source): Minor and short-term suspended sediment plumes and related turbidity may affect the marine water column during dredging in the offshore borrow source. Due to the distance from the inlet, dredging operations would not be expected to directly affect any estuarine water column, and therefore, would not be expected to directly affect estuarine life cycle requirements of managed species in the South Atlantic Region. Turbidity associated with beach fill placement operations could extend into Masonboro Inlet/Banks Channel and the estuarine water column from longshore currents and tidal influx, however these effects are expected to be minor. This alternative would have a greater impact as compared to the Recommended Plan due to the longer dredging times, but not be expected to cause any significant adverse impacts to EFH or HAPC for managed species identified in the Fisheries Management Plan Amendments affecting South Atlantic Area. Physical and biological impacts to EFH are short-term and localized on an individual and cumulative effects basis.

7.5 Wetlands and Floodplains

7.5.1 Wetlands

Executive Order 11990 directs all Federal agencies to issue or amend existing procedures to ensure consideration of wetlands protection in decision making and to ensure the evaluation of the potential effects of any new construction proposed in a wetland.

Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions (33 C.F.R. § 328.3). Wetlands possess three essential characteristics: hydrophytic vegetation, hydric soils, and wetland hydrology.

Although abundant salt marsh and tidal creek wetlands are in the study area, no wetlands are found along the ocean shoreline of the project area. Along Wrightsville Beach and within the proposed borrow sources, there are no Section 404 jurisdictional wetlands (having the three essential characteristics) that would be impacted by the proposed project. This project is in full compliance with EO 11990.

7.5.2 Flood Plains

The 100-year flood plain is established by the Federal Emergency Management Agency (FEMA) and is identified on Federal Insurance Rate Maps. Base flood elevations for flood zones and velocity zones are also identified by FEMA, as are designated floodways. All portions of the project area are within the 100-year floodplain.

Executive Order 11988 requires Federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "[e]ach agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities…"

Any placement of material on the beach would occur within the 100-year floodplain and would therefore constitute an alteration of the floodplain, displacing the floodplain seaward. Placement of dredged material on Wrightsville Beach cannot be accomplished outside the floodplain.

Alternative 1 (No Action): The No Action Plan will result in no changes to wetlands or hydrology, but the continued erosion would cause permanent loss of land area in the floodplain.

Alternative 2 (Recommended Plan): The alternative would not result in filling of wetlands and would not produce changes in hydrology that could affect wetlands.

The Recommended Plan will result in insignificant changes throughout the study area and therefore will not alter existing hydrology in the floodplain. The eight steps discussed in E.O. 11988 are addressed as follows:

1. Floodplain and/or wetland determination.

The project is within the 100-year floodplain. The proposed action will not adversely impact any floodplains or wetlands, upstream, within, or downstream of the project.

2. Public notification.

Public involvement began with scoping and will continue throughout the study process. This report will be provided to the public for comment. All comments received will be considered during development of the final report.

3. Identify and evaluate practicable alternatives to locating in the base flood plain.

The draft report discusses all practicable alternatives, and illustrates the deliberative process by which the proposed action was selected. Since the project involves beach renourishment, there is no alternative outside the Floodplain.

4. Identify the impacts of the proposed action.

Impacts of the Recommended Plan are fully discussed in the draft report, and are compared side-by-side in the System of Accounts analysis (Table 5-4).

5. Evaluate measures to reduce potential adverse impacts of the proposed action.

A has the lowest potential to produce adverse impacts of any alternative. Section 7 of the final report contains a thorough analysis of all positive and negative impacts, and presents them in a System of Accounts format (Table 5-4).

6. Re-evaluate the alternatives.

All alternatives were thoroughly evaluated and re- evaluated during the deliberative Corps planning process, and are presented in an evaluative, comparative, and screened process, in the report.

7. Make the final determination and present the decision.

The final determination and presentation of the Recommended Plan are contained in the draft report.

8. Implement the action.

Implementation of the Recommended Plan will result in no significant impacts to floodplains or wetlands. The existing hydrology of the floodplain will not be changed. The proposed project complies with Executive Order 11988.

Alternative 3 (Offshore Borrow Source): Impacts of Alternative 3 would be similar to the Recommended Plan.

7.6 Terrestrial Resources

Within the study area, the most significant terrestrial resources occur on Masonboro Island, the undeveloped portion of Shell Island and on the manmade and natural estuarine islands that occur in Wrightsville Sound. Masonboro Island is the largest undisturbed barrier island along the southern part of the North Carolina coast. Eighty-

seven percent of the 8.4-mile long island is covered with marsh and tidal flats. The remaining portions are composed of beach uplands and dredged material islands. Designated in 1991, Masonboro Island is the largest site, at 5,653 acres, within the North Carolina National Estuarine Research Reserve system. This site is also a Dedicated Nature Preserve, authorized by G.S. 143B-135.250 (deq.nc.gov). An extensive, stable dune system comprises the undeveloped portion of Shell Island. Vegetated principally with grasses, its value to some species of wildlife is limited.

Most of the manmade and natural estuarine islands of the area are heavily vegetated with shrubs and small trees. These islands are heavily used by marsh foraging mammals and birds. Terrestrial beach and dune communities that may be impacted by proposed project actions occur along most of the Wrightsville Beach shoreline. Terrestrial habitat types within the areas include sandy or sparsely vegetated beaches and dune communities. The first line of stable vegetation is outside or landward of the proposed project limits. Utility corridors may have herbaceous or shrub cover. Mammals occurring in this environment are opossums, cottontails, red foxes, gray foxes, raccoons, feral house cats, shrews, moles, voles, and house mice.

7.6.1 Vegetation

When compared to most of North Carolina's upland communities, the beach and dune community in the project area could be considered lacking in species variety in both plants and animals. The environment on the beach is severe because of constant exposure to salt spray, shifting sands, wind, and sterile soils with low water retention capacity. Beach vegetation known from the area includes beach spurge (*Euphorbia polygonifolia*), sea rocket (*Cakile edentula*) and pennywort (*Hydrocotyle bonariensis*). The threatened plant, seabeach amaranth (*Amaranthus pumilis*) occurs sporadically along the dune faces of Bogue Banks. The dunes along Bogue Banks are more heavily vegetated with American beach grass (*Ammophila breviligulata*), panic grass (*Panicum amarum*) sea oats (*Uniola paniculata*), broom straw (*Andropogon virginicus*) and salt meadow hay (*Spartina patens*) being commonly observed.

Alternative 1 (No Action): Long-term erosion is expected to destroy habitat for beach vegetation over time.

Alternative 2 (Recommended Plan): If the dune is under design template height or if the dredging contractor damages the dune during a periodic renourishment event, stabilization will be accomplished by planting vegetation during the optimum planting season following dune construction. Dune stabilization would be accomplished by planting vegetation on the dune during the optimum planting seasons. Representative native planting stocks may include sea oats (*Uniola paniculata*), American beachgrass (*Ammophila breviligulata*), and panic grass (*Panicum amarum*). The vegetative cover would extend from the landward toe of the dune to the seaward intersection with the storm berm for the length of the dune. Sea oats would be the predominant plant with

American beach grass and panic grass as a supplemental plant. Planting would be accomplished during the season best suited for the particular plant. Overall, minimal impacts to dune vegetation would be expected to occur due to replanting and placing material away from the vegetation along the berm.

Alternative 3 (Offshore Borrow Source): Impacts of Alternative 3 would be similar to the Recommended Plan.

7.6.2 Wildlife

Mammals occurring in this environment are opossums, cottontails, red foxes, gray foxes, raccoons, feral house cats, shrews, moles, voles, and house mice. Reptile and amphibian species observed include southern leopard frog, green tree frog, black rat snake, eastern cottonmouth, yellow-bellied turtle, and snapping turtle.

Birds common to the nearshore ocean in the project area are loons, grebes, gannets, cormorants, scoters, red-breasted mergansers, gulls, and terns (Sauer et al., 2008). The habitat and food source of such seabirds is the marine environment, whether coastal, offshore or pelagic. They can be divided into four groups by their feeding strategies, which are reflected in their anatomy, physiology, and habitat niche: surface feeders, surface swimmers/pursuit divers, plunge-divers, and scavengers and pirates (i.e., steal from other birds).

The beaches and inlets of the project vicinity are heavily used by migrating shorebirds. However, dense development and high public use of project area ocean front beaches may reduce their value to shorebirds. Along the ocean beach, black-bellied plovers, ruddy turnstones, whimbrels, willets, red knots, semi-palmated sandpipers, and sanderlings may be found (Sauer et al., 2008). Table 7-3 provides a more complete list of waterbirds found in the project area, and Table 7-4 shows the State-listed Species of Concern Nesting on Wrightsville Beach. The dunes of the project area support fewer numbers of birds but can be very important habitats for resident species and for other species of songbirds during periods of migration. Other birds occurring in the area are mourning doves, swallows, fish crows, starlings, meadowlarks, redwinged blackbirds, boat tailed grackles, and savannah sparrows (Sauer et al., 2008).

The black skimmer, least tern, gull-billed tern, common tern and American oystercatcher are state-listed species of concern for New Hanover County, North Carolina, and are found on Wrightsville Beach year round during both the breeding season and during migration, with peak abundance occurring in the summer months. Terns feed by diving from the air on insects and small fish, the black skimmer feeds on shrimp or small fish by flying just above the water with the tip of the long lower mandible shearing the surface and the American Oystercatcher forages by walking in the shallow water searching for shellfish and marine worms by sight. All these bird

species may use Wrightsville Beach for roosting, foraging, breeding, and nesting (Potter et al., 1980).

Although it is possible that shorebird nesting could occur in the project area during the spring and summer months (April 1–August 31), most of the bird species have been displaced by development pressures and heavy recreational use along the beach, thus, traditional nesting areas on the project beach have been lost. Many of the bird species have retreated to the relatively undisturbed dredged material disposal islands that border the navigation channels in the area. Nonetheless, it is possible that shorebird species would still attempt to nest in the project area. To protect bird nesting, the NCWRC discourages beach work between April 1 and August 31. Since 2009, least terns, black skimmers, American oystercatchers, common terns and willets have gathered at the south end of Wrightsville Beach, outside but adjacent to the project area, to find mates and raise their young. Because it hosts large numbers of birds, the site serves as a significant nesting site for beach-nesting species in North Carolina. As many as 20 percent of the state's least terns and black skimmers have nested there, and their success helps maintain healthy populations in the state and in the region (NC Audubon.org).

Table 7-3. Waterbirds Surveyed in the Project Area by National Audubon Society 2009-2018.

Black-bellied Plover	American Kestrel	Fish Crow	Osprey
Piping Plover	Barn Swallow	Forster's Tern	Pied-billed Grebe
Semipalmated Plover	Belted Kingfisher	Great Black-backed Gull	Purple Martin
Wilson's Plover	Black Scoter	Great Blue Heron	Purple Sandpiper
Killdeer	Black Skimmer	Great Egret	Razorbill
American Oystercatcher	Black Tern	Green Heron	Red-breasted Merganser
Greater Yellowlegs	Black-legged Kittiwake	Gull-billed Tern	Red-tailed Hawk
Willet	Boat-tailed Grackle	Herring Gull	Red-throated Loon
Spotted Sandpiper	Bonaparte's Gull	Hooded Merganser	Red-winged Blackbird
Whimbrel	Brown Pelican	Horned Grebe	Ring-billed Gull
Marbled Godwit	Bufflehead	House Finch	Rock Dove
Ruddy Turnstone	Canada Goose	House Sparrow	Royal Tern
Red Knot	Caspian Tern	Laughing Gull	Sandwich Tern
Sanderling	Common Loon	Least Tern	Snowy Egret
Dunlin	Common Nighthawk	Lesser Black-backed Gull	Tree Swallow
Western Sandpiper	Common Tern	Mourning Dove	Turkey Vulture
Least Sandpiper	Cooper's Hawk	Northern Gannet	White Ibis
Short-billed Dowitcher	Surf Scoter	Northern Harrier	
American Crow	Double-crested Cormorant	Northern Mockingbird	

Table 7-4. State-listed Species of Concern Nesting on Wrightsville Beach (National Audubon Society)

Year	Black Skimmer	Common Tern	Least Tern	Gull-billed Tern	American Oystercatcher
2009	60	0	100	0	0
2010	80	2	68	0	1
2011	118	4	305	0	1
2012	92	7	597	0	3
2013	137	14	235	2	4
2014	101	12	6	0	4
2015	175	12	232	0	4
2016	123	14	349	0	4
2017	165	16	167	0	5
2018	157	9	0	0	4

Alternative 1 (No Action): Beach erosion would result in the loss of roosting, foraging, breeding, and nesting habitat for mammals, reptiles, amphibians and birds.

Alternative 2 (Recommended Plan): Periodic renourishment would not be expected to have an adverse effect on wildlife found along the beach. However, short-term

transient effects could occur to mammalian species using the dune and fore-dune habitat, but those species are mobile and would be expected to move to other, undisturbed areas of habitat during the 45 (cutterhead) or 54 day (hopper) periodic renourishment events.

Although the project area is heavily developed and sustains heavy recreational use, migratory shorebirds could still use the project area for foraging and roosting habitat. A hydraulic cutterhead dredge would be used for dredging the area within Masonboro Inlet/Banks Channel, and a hopper dredge likely would be used for the offshore borrow area, pumping the dredged material directly to the designated beach fill area. Bulldozers would be used to construct seaward shore parallel dikes to contain the material on the beach, and to shape the beach to the appropriate renourishment cross-section template. Beach renourishment activities could temporarily affect the roosting and intertidal macro-fauna foraging habitat, however, recovery often occurs within one year due to the fact that material is compatible with existing beach sediments. Birds that use the inlet as feeding grounds would be temporarily impacted during dredging activities, but would be expected to return following dredging.

To the greatest extent practicable, periodic renourishment with a cutterhead dredge would occur from November 16 to March 31, taking approximately 45 days. If two hopper dredges are used, dredging would not start before December 1, but would last about 54 days, ending no later than April 15. Before each renourishment event, pipeline placement will be coordinated with the appropriate resource agencies to minimize impacts to the significant nesting site at the southern end of Wrightsville Beach. Birds that use the offshore borrow area as feeding grounds may be temporarily impacted during dredging activities, but would quickly return when the dredge leaves. When the offshore borrow area is used, there would be no pipeline on the the south end of Wrightsville Beach, so there would be no impacts to bird habitat in that area. This alternative would not be expected to significantly affect breeding and nesting shorebirds or colonial waterbirds in the project area.

Alternative 3 (Offshore Borrow Source): Renourishment activities with two hopper dredges are expected to concurrently last 54 days each (108 working days), a relatively significant increase in renourishment duration and associated disturbance over cutterhead renourishments with the Recommended Plan. Birds that use offshore borrow areas as feeding grounds may be temporarily impacted during dredging activities, but would quickly return when the dredge leaves. Since no pipeline would be required on the the south end of Wrightsville Beach, there would be no impacts to bird habitat in that area.

7.7 Endangered and Threatened Species

The Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531–1543), provides a program for the conservation of threatened and endangered (T&E) plants and animals and the habitats in which they are found. The lead Federal agencies for implementing the ESA are the US Fish and Wildlife Service (USFWS) (http://www.fws.gov/) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service (http://www.nmfs.noaa.gov/). In accordance with Section 7 (a)(2) of the ESA, USACE and BOEM have coordinating with the USFWS and NMFS since beginning this study.

A list of threatened and endangered (T&E) species for the project area was obtained from and the USFWS IPAC website (https://ecos.fws.gov/ipac/). Table 7-5 includes T&E species that could be present in the area based upon their historical occurrence or potential geographic range. However, the actual occurrence of a species in the area depends upon the availability of suitable habitat, the season of the year relative to a species' temperature tolerance, migratory habits, and other factors.

Table 7-5. Federally Threatened and Endangered Species Potentially Present In Project Area.

Species	Status	Effect Determination
Mammals		
West Indian Manatee */Trichechus manatus*	Threatened	MANLAA*
Blue, Finback, Sei and Sperm Whales	Endangered	No effect
Humpback Whale */Megaptera novaeangliae*	Endangered	MANLAA
North Atlantic Right Whale */Eubaleana glacialis*	Endangered	MANLAA
Fish		
Atlantic Sturgeon */cipenser oxyrhynchus oxyrhynchus*	Endangered	MANLAA
Shortnose Sturgeon */Acipenser brevirostrum*	Endangered	No effect
Birds		
Piping Plover */Charadrius melodus*	Threatened	MANLAA
Red Knot */Calidris canutus rufa*	Threatened	MANLAA
Reptiles		
Green Sea Turtle */Chelonia mydas*	Threatened	MANLAA
Hawksbill Sea Turtle */Eretmochelys imbricata*	Endangered	MANLAA
Kemp's Ridley Sea Turtle */Lepidochelys kempii*	Endangered	MANLAA
Leatherback Sea Turtle */Dermochelys coriacea*	Endangered	MANLAA
Loggerhead Sea Turtle */Caretta caretta*	Threatened	MANLAA
Flowering Plants		
Seabeach Amaranth */Amaranthus pumilus*	Threatened	MANLAA
Critical Habitats		
North Atlantic Right Whale		No effect
Atlantic Sturgeon		No effect
Loggerhead Sea Turtle		No effect
Piping Plover		No effect

*May Affect Not Likely to Adversely Affect

7.7.1 Large Whales—Blue Whale, Finback Whale, Humpback Whale, North Atlantic Right Whale (NARW), Sei Whale, and Sperm Whale

Source: https://www.fisheries.noaa.gov/species/north-atlantic-right-whale

Blue whale, finback whale, humpback, North Atlantic right, sei whale, and sperm whales all occur infrequently in the ocean off the coast of North Carolina. Of these, only the NARW and the humpback whale routinely come close enough inshore to encounter the project area. Humpback whales were listed as "endangered" throughout their range on June 2, 1970 under the Endangered Species Act and are considered "depleted" under the Marine Mammal Protection Act. Humpbacks are often found in protected waters over shallow banks and shelf waters for breeding and feeding. They migrate toward the poles in summer and toward the tropics in winter and are in the vicinity of the North Carolina coast during seasonal migrations, especially between December and April. Since 1991, humpback whales have been seen in nearshore waters of North Carolina with peak abundance in January through March. In the Western North Atlantic, humpback feeding grounds encompass the eastern coast of the United States, the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland. Major prey species include small schooling fishes (herring, sand lance, capelin, mackerel, small Pollock, and haddock) and large zooplankton, mainly krill (up to 1.5 tons per day) (http://www.nmfs.noaa.gov).

The NARW continues to be one of the most critically endangered populations of large whales in the world. NMFS estimates ~400 are known to be alive during (NMFS, 2018). There are 6 major habitats or congregation areas for the western NARW; these are the coastal waters of the southeastern United States, the Great South Channel, Georges Bank/Gulf of Maine, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Scotian Shelf. However, the frequency with which NARWs occur in offshore waters in the southeastern U.S. remains unclear. While it usually winters in the waters between Georgia and Florida, the NARW can, on occasion, be found in the waters off North Carolina. The occurrence of NARWs in the State's waters is usually associated with spring or fall migrations.

When defining critical habitat for right whales, the NMFS considered the physical and/or biological features of foraging and calving habitats. The physical and biological features

of right whale calving habitat that are essential to the conservation of the North Atlantic right whale are: (1) Calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface temperatures from a minimum of 7 °C, and never more than 17 °C; and (3) water depths of 6 to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 nm^2 of ocean waters during the months of November through April. When these features are available, they are selected by right whale cows and calves in dynamic combinations that are suitable for calving, nursing, and rearing, and which vary, within the ranges specified, depending on factors such as weather and age of the calves.

The NMFS's Unit 2 contains the essential features for calving right whales in the southeastern U.S (Figure 7-4). This area comprises waters of Brunswick County, North Carolina; Horry, Georgetown, Charleston, Colleton, Beaufort, and Jasper Counties, South Carolina; Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden Counties, Georgia; and Nassau, Duval, St. John's, Flagler, Volusia, and Brevard Counties, Florida.

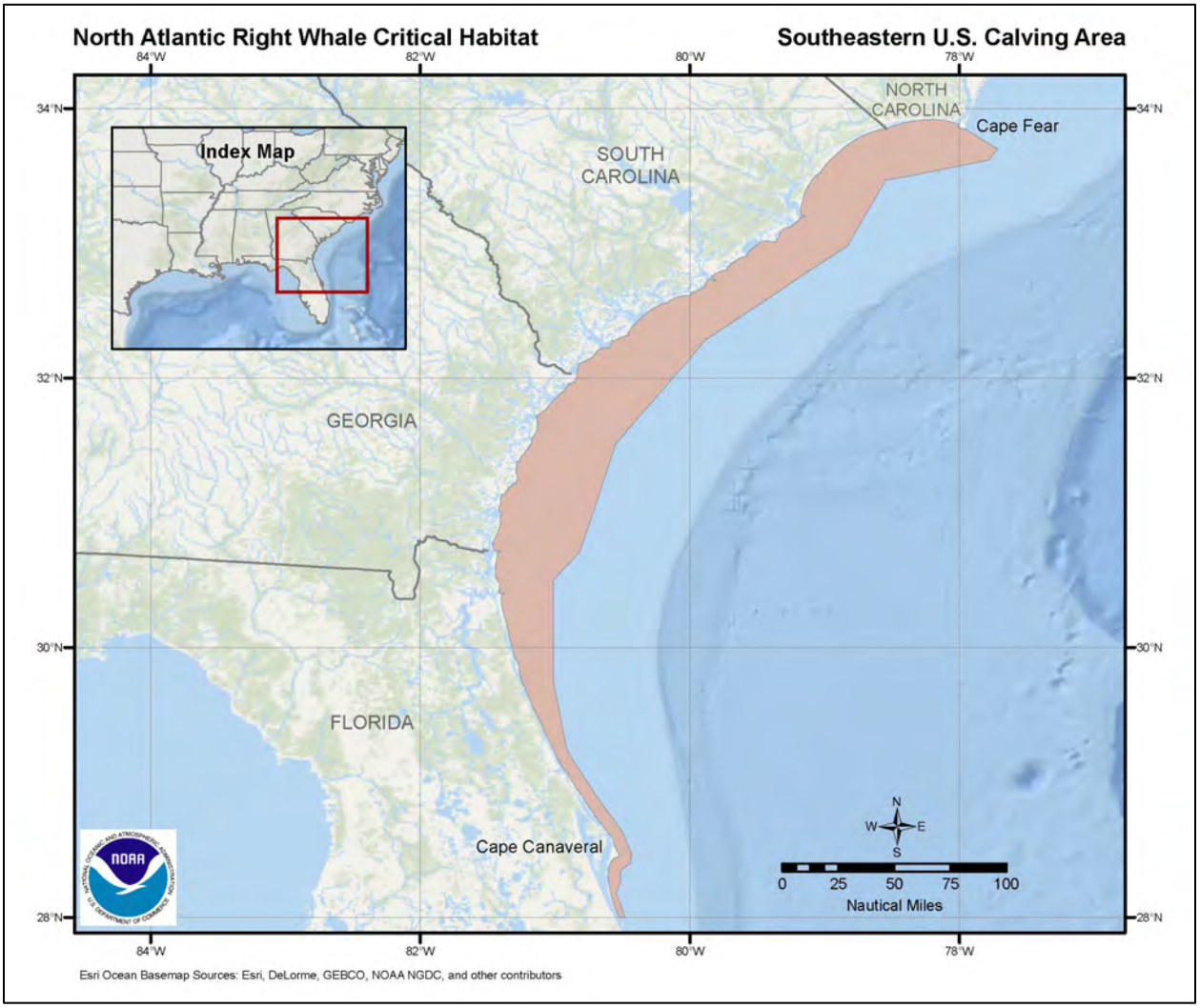


Figure 7-3. North Atlantic Right Whale Critical Habitat

Alternative 1 (No Action): This alternative would have no effect on the six species of whales potentially in the project area.

Alternative 2 (Recommended Plan): Of the six species of whales being considered, only the NARW and humpback whale would normally be expected to occur within the project area during the periodic renourishment event. Therefore, this alternative is not likely to adversely affect the blue whale, finback whale, sei whale, and sperm whale. Humpback whales are most abundant in the project area January through March coinciding closely with dredging window of November 16 to March 31, while NARW abundance times are much less known. Dredging offshore is expected to take two hopper dredges 54 concurrent days. The risk of potential vessel strikes could be more than double than using the Masonboro Inlet/Banks Channel borrow area. Conditions outlined in previous consultations in order to reduce the potential for accidental collision (i.e. contractor pre-project briefings, large whale observers, slow down and course alteration procedures, etc.) will be implemented as a component of this project. Based on the implementation of these conditions, the proposed project may affect, but is not likely to adversely affect the NARW and humpback whale species.

There is no NARW critical habitat in the project area, therefore the project will have no effect on NARW critical habitat.

Alternative 3 (Offshore Borrow Source): The distance from the offshore borrow area to the beach placement area is unknown at this time, but likely would be 2-5 miles offshore. Vessel strikes to humpback and NARW are more likely to occur farther from the coastline versus the inlet. Also, Alternative 3 would be accomplished by two hopper dredges working for 54 concurrent days, each. Potential vessel strikes could be more than double than dredging Masonboro Inlet/Banks Channel. Therefore, except for the increased chance of accidental collision due to the offshore borrow area distance and the associated increase in renourishment time, impacts of this alternative would be similar to the Recommended Plan.

7.7.2 West Indian Manatee

Source: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=4469

Manatees are a sub-tropical species with little tolerance for cold. Though they are generally restricted to warm inland and coastal waters of Florida, in warmer months they may be found throughout the United States. North Carolina is one location along the Southeast coast where the manatee is an occasional summer resident. The species can be found in shallow (5 feet to usually <20 feet), slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas. The West Indian manatee is herbivorous and eats aquatic plants such as hydrilla, eelgrass, and water lettuce. Manatees are thermally stressed at water temperatures below 18ºC (64.4ºF); therefore, during winter months, when ambient water temperatures approach 20ºC (68ºF), the U.S. manatee population confines itself to the coastal waters of the southern half of peninsular Florida and to springs and warm water outfalls as far north as southeast Georgia. During the summer months, sightings drop off rapidly north of Georgia and are rare north of Cape Hatteras. However, they are sighted infrequently in southeastern North Carolina with most records occurring in July, August, and September, as they migrate up and down the coast. The Species is considered a seasonal inhabitant of North Carolina with most occurrences reported from June through October.

Alternative 1 (No Action): This alternative would have no effect on manatees.

Alternative 2 (Recommended Plan): All dredging will occur in the winter months when overall occurrence of manatees in the project vicinity is infrequent. Dredging offshore increases the number of dredges, time and distance traveled as compared to dredging from the inlet, resulting in a greater chance of vessel strikes. Guidelines for Avoiding Impacts to the West Indian Manatee (USFWS, 2017) precautionary measures will be implemented for transiting vessels associated with the project. The habitat and food supply of the manatee will not be significantly impacted. This alternative may affect, but is not likely to adversely affect the manatee.

Alternative 3 (Offshore Borrow Source): This alternative takes two hopper dredges 54 concurrent days and a longer traveling distance as compared to dredging from the inlet, resulting in a greater chance of vessel strikes than Alternative 2. Guidelines for Avoiding Impacts to the West Indian Manatee (USFWS, 2017) precautionary measures will be implemented for transiting vessels associated with the project to minimize impacts. All dredging will occur in the winter months when overall occurrence of manatees in the project vicinity is infrequent. The habitat and food supply of the manatee will not be significantly impacted. This alternative may affect, but is not likely to adversely affect the manatee.

7.7.3 Sea Turtles

Source: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=6199

All five species of sea turtles identified above are known to occur in both the estuarine and oceanic waters of North Carolina. Loggerhead, green, and Kemp's ridley sea turtles are known to frequently use coastal waters offshore of North Carolina as migratory travel corridors and commonly occur at the edge of the continental shelf when they forage around coral reefs, artificial reefs, and boat wrecks.

Results from satellite tracking survey of male loggerhead sea turtles aggregated for mating in the Port Canaveral, FL, shipping entrance channel suggest that residents and transients co-occurred in near shore waters during April and mid-May, after which time residents moved offshore to deeper waters (>26m) and transients dispersed to multiple locations along the U.S. East Coast, including Cape Hatteras, NC. These results are consistent with other studies tracking male loggerhead sea turtles suggesting that that Cape Hatteras, NC may represent a seasonally important landmark for adult male loggerheads. Male turtles appear to migrate to Cape Hatteras in the fall before over-wintering near the edge of the continental shelf to the east/southeast of Cape Fear, NC.

Of the five species of sea turtles considered for this project, only the loggerhead sea turtle (*Caretta caretta*), the green sea turtle (*Chelonia mydas*), and the leatherback sea turtle (*Dermochelys coriacea*) nest regularly on North Carolina beaches and have the potential to nest within the project area.

With a few exceptions, the entire Kemp's ridley population nests on the approximately 15 miles of beach in Mexico between the months of April and June. The hawksbill sea turtle nests primarily in tropical waters in south Florida and the Caribbean. Considering the infrequency of Kemp's ridley nesting occurrence throughout North Carolina and the lack of historical nesting of hawksbill sea turtles, these species are not anticipated to nest within the project area. The loggerhead is considered to be a regular nester in the state, while green sea turtle nesting is infrequent and primarily limited to Florida's east coast (300 to 1,000 nests reported annually).

Wrightsville Beach consists of approximately 4.5 linear miles of available nesting habitat. Table 7-6, shows the total number of recorded nesting activity on these beaches from 2009 to 2018. A total of 49 nests were laid within the project areas since 2009.

Table 7-6. North Carolina Wildlife Resources Commission's Historic Data of Turtle Nests on Wrightsville Beach.

Year	Number of Nests
2009	1
2010	1
2011	3
2012	3
2013	9
2014	1
2015	4
2016	15
2017	10
2018	2

In order to avoid periods of peak sea turtle abundance during warm water months and minimize impacts to sea turtles in the offshore environment, the proposed dredging window for this project using a cutterhead is 16 November through March 31 and December 1 to April 15 for a hopper dredge. Also, during all hopper dredging activities, the use of turtle deflecting dragheads, inflow and/or overflow screening, and NMFS certified turtle observers will also be implemented. By adhering to this dredging window to the maximum extent practicable, all subsequent beach placement of sediment will occur outside of the North Carolina sea turtle nesting season of May 1 through November 15. The limits of the nesting season window are based on the known nesting sea turtle species within the state and the earliest and latest documented nesting events for those species.

Critical Habitat: The NMFS identified physical biological features (PBF)s of habitat essential for the conservation of the loggerhead sea turtle, the Primary Constituent Elements (PCE)s that support the PBFs, and the specific areas identified using these PBFs and PCEs. A description of the means used to identify PBFs, PCEs and specific areas can be found in the proposed rule 78 FR 18000, March 25, 2013.

Of the five categories of habitat identified in Loggerhead critical habitat, only Nearshore Reproductive Habitat occurs in the project area (Figure 7-5). Nearshore Reproductive Habitat is described as the PBFs of nearshore reproductive habitat as a portion of the nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to

the open-water environment as well as by nesting females to transit between beach and open water during the nesting season.

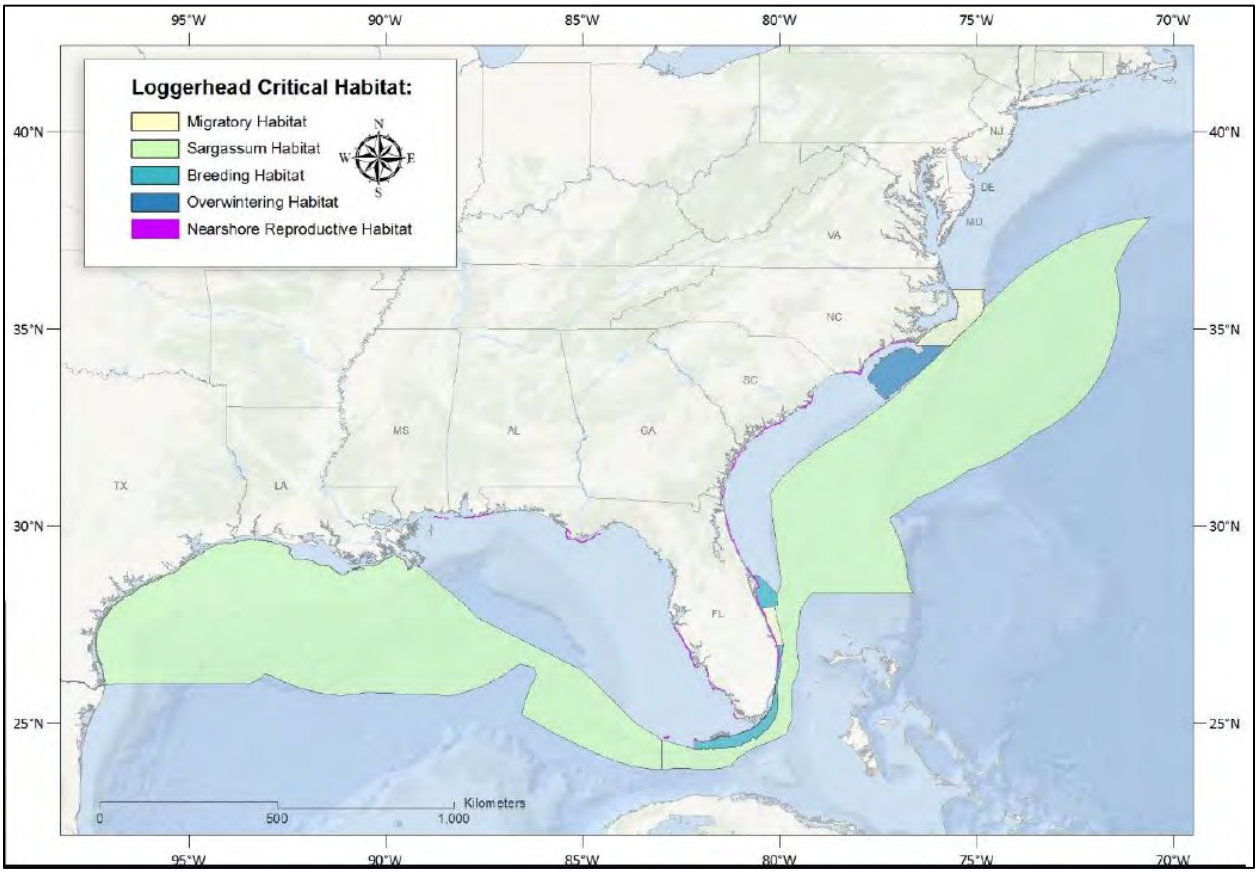


Figure 7-4. Loggerhead Critical Habitat

Alternative 1 (No Action): This alternative would have no effect to sea turtles from dredging. This alternative would result in the long-term reduction of available nesting habitat due to erosion.

Alternative 2 (Recommended Plan): There are inherent changes in beach characteristics as a result of mechanically placing sediment on a beach from alternate sources. The change in beach characteristics often results in short-term decreases in nest success and/or alterations in nesting processes. However, when done properly, beach renourishment projects may mitigate the loss of nesting beach when the alternative is severely degraded or non-existent habitat. Though significant alterations in beach substrate properties may occur with the input of sediment types from other sources, re-establishment of a berm and dune system with a gradual slope can enhance nesting success of sea turtles by expanding the available nesting habitat beyond erosion and inundation prone areas.

Considering that the proposed environmental window will avoid the sea turtle nesting season to the maximum extent practicable, the use of turtle deflecting dragheads,

inflow and/or overflow screening, and NMFS certified turtle and whale observers the proposed project may affect but is not likely to adversely affect nesting loggerhead, green, and leatherback sea turtles by altering nesting habitat.

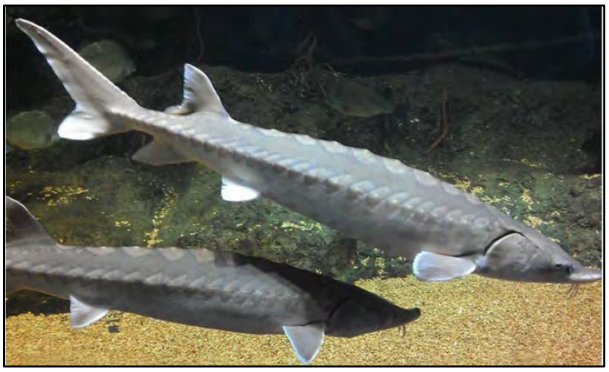
The proposed dredging activities for each four year renourishment interval may occur in areas used by migrating turtles. Although cutterhead dredges do not pose risks to benthic-oriented sea turtles through physical injury or death by entrainment, the risk of lethal impacts still exists as some sea turtle species may be found year-round in the dredging area. Hopper dredges pose risks to benthic-oriented sea turtles through physical injury or death by entrainment. Though limiting hopper dredge activities to the maximum extent practicable, to the December 1 to April 15 environmental window will avoid periods of peak turtle abundance during the warm water months, the risk of lethal impacts still exists as some sea turtle species may be found year-round in the offshore borrow area. Therefore, the proposed project may affect, but is not likely to adversely affect loggerhead, leatherback, green, hawksbill, and Kemp's ridley sea turtles.

Loggerhead Critical Habitat - The proposed project will not result in an adverse modification of critical habitat for the threatened loggerhead sea turtle.

Alternative 3 (Offshore Borrow Source): This alternative takes two hopper dredges 54 concurrent days as compared to one cutterhead 45 days dredging from the inlet, as a result, increasing potential impacts to sea turtles. Therefore, the proposed project may affect, but is not likely to adversely affect loggerhead, green, hawksbill, and Kemp's ridley sea turtles. Based on historic hopper dredging take data, the proposed project may affect, but is not likely to adversely affect leatherback sea turtles.

Impacts associated with beach placement and associated impacts to loggerhead critical habitat would be similar to the Recommended Plan.

7.7.4 Sturgeon



Source: https://www.fisheries.noaa.gov/species/atlantic-sturgeon

Shortnose Sturgeon- Populations of shortnose sturgeon range along the Atlantic seaboard from the Saint John River in New Brunswick, Canada to the Saint Johns River, Florida. It is apparent from historical accounts that this species may have once been

fairly abundant throughout North Carolina's waters; however, many of these early records are unreliable due to confusion between this species and the Atlantic sturgeon (*Acipenser oxyrhynchus*). The shortnose sturgeon is principally a riverine species and is known to use three distinct portions of river systems: (1) non-tidal freshwater areas for spawning and occasional over wintering; (2) tidal areas in the vicinity of the fresh/saltwater mixing zone, year-round as juveniles and during the summer months as adults; and (3) high salinity estuarine areas (15 parts per thousand (ppt.) salinity or greater) as adults during the winter.

Atlantic Sturgeon - The general life history pattern of Atlantic sturgeon is that of a long lived, late maturing, estuarine dependent, anadromous species. The species' historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida. Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems. Comprehensive information on current or historic abundance of Atlantic sturgeon is lacking for most river systems; however, use of the Cape Fear River, NC for spawning and nursery habitat is well documented. Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers, where optimal flows are 46-76 cm/s and deep depths of 11-27 meters. Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces. Juveniles spend several years in the freshwater or tidal portions of rivers prior to migrating to sea. Upon reaching a size of approximately 76-92 cm, the subadults may move to coastal waters, where populations may undertake long range migrations.

Effective September 18, 2017, the NMFS designated critical habitat for the distinct population segment of Atlantic sturgeon (Figure 7-6). Specific occupied areas designated as critical habitat for the Carolina distinct population segment of Atlantic sturgeon contain approximately 1,939 km (1,205 miles) of aquatic habitat in the following rivers of North Carolina and South Carolina: Roanoke, Tar-Pamlico, Neuse, Cape Fear, Northeast Cape Fear, Waccamaw, Pee Dee, Black, Santee, North Santee, South Santee, and Cooper, and the following other water body: Bull Creek. Unit C4 (Cape Fear River, NC/Northeast Cape Fear River, NC) is the closest critical habitat river to the proposed project.

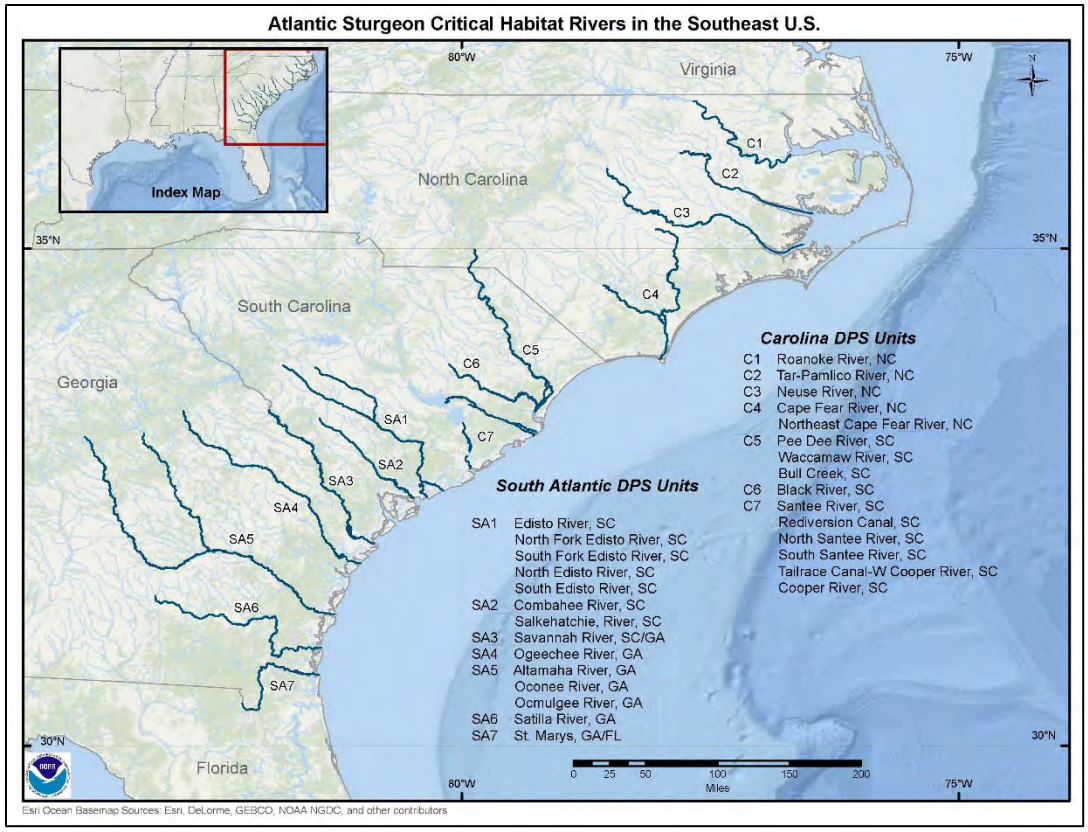


Figure 7-5. Atlantic Sturgeon Critical Habitat

Alternative 1 (No Action): This alternative would have no effect on sturgeon species and no effect on Atlantic sturgeon critical habitat.

Alternative 2 (Recommended Plan): As it is not likely that shortnose sturgeon would be present in the inlet or beach area, the proposed project will have no effect on the shortnose sturgeon.

Though no site specific data pertaining to Atlantic sturgeon distribution within the borrow sources available, based on their documented migratory pathways using existing tagging data, it is likely that sturgeon may be migrating through or spending time in or near the inlet.

Although cutterhead dredges do not pose risk to benthic oriented sea turtles through physical injury or death by entrainment, the risk of lethal impacts still exist. Hydraulic dredging techniques may also indirectly impact Atlantic sturgeon through (1) short-term impacts to benthic foraging and refuge habitat, (2) short-term impacts to water and sediment quality from re-suspension of sediments and subsequent increase in turbidity/siltation, and (3) disruption of spawning migratory pathways.

The offshore borrow source maybe used for possibly one renourishment event and may use a hopper dredge to complete the work. Hopper dredges pose risks to Atlantic

sturgeon through physical injury or death by entrainment. Atlantic sturgeon are covered by the Section 7(a)(2) and 7(d) Endangered Species Act Jeopardy Analysis, April 2014. Endangered species observers on board hopper dredges will be responsible for monitoring for incidental take of Atlantic sturgeon. For hopper dredging operations, dragheads as well as all inflow and overflow screening will be inspected for sturgeon species following the same ESO protocol for sea turtles. Hopper dredge activities, to the maximum extent practicable, will be accomplished during the December 1 to March 31 dredging window. Therefore, the proposed dredging activities, may affect, but are not likely to adversely affect the Atlantic sturgeon species. Beach placement activities would have no effect on Atlantic sturgeon.

There is no designated critical habitat in the project area, therefore this alternative will not result in an adverse modification of Atlantic sturgeon critical habitat.

Alternative 3 (Offshore Borrow Source): As it is not likely that shortnose sturgeon would be present in the beach area and as dredging will occur in the offshore environment, it has been determined that the actions of the proposed project will have no effect on the shortnose sturgeon.

Though no site specific data pertaining to Atlantic sturgeon distribution within the offshore borrow area is available, based on documented migratory pathways using existing tagging data, it is likely that sturgeon may be migrating through or spending time in or near the borrow area.

This alternative would likely be accomplished by two hopper dredges working 54 concurrent days as compared to one cutterhead 45 days dredging from the inlet, as a result, increasing potential impacts to Atlantic sturgeon.

Due to the hopper dredge protection measures and the likelihood of migrating sturgeon, this alternative may affect, but is not likely to adversely affect Atlantic sturgeon. Beach placement activities would have no effect on Atlantic sturgeon.

There is no designated critical habitat in the project area, therefore this alternative will not result in an adverse modification of Atlantic sturgeon critical habitat.

7.7.5 Seabeach Amaranth

Source: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=8549

Seabeach amaranth is an annual or sometimes perennial plant that usually grows between the seaward toe of the dune and the limit of the wave uprush zone occupying elevations ranging from 0.2 to 1.5 m above mean high tide. Greatest concentrations of seabeach amaranth occur near inlet areas of barrier islands, but in favorable years many plants may occur away from inlet areas. Seabeach amaranth is considered a pioneer species of accreting shorelines, stable foredune areas, and overwash fans. Seed dispersal of seabeach amaranth is achieved in a number of ways, including water and wind dispersal.

Historically, seabeach amaranth was found from Massachusetts to South Carolina, but according to recent surveys, its distribution is now restricted to North and South Carolina with several populations on Long Island, New York. The decline of this species is caused mainly by development of its habitat, such as inlet areas and barrier islands, and increased off-road vehicle and human traffic, which tramples individual plants.

Seabeach amaranth surveys have been performed along all of Wrightsville Beach, NC since 1992. Based on the available data, a total of 4,390 plants have been recorded along Wrightsville Beach (Table 7-7). Shoreline erosion and accretion processes associated with natural storm events and beach dynamics likely play an important role in explaining the random spatial and temporal abundance patterns since 1992.

Since seabeach amaranth seeds are fairly resilient and germination is dependent on critical physical conditions, populations of seabeach amaranth are very dynamic, with numbers of plants fluctuating dramatically from year to year. Germination begins in April as temperatures reach about 25ºC (77ºF) and continues at least through July with greatest germination occurring at 35ºC (95ºF). Seed production begins in July or August, peaks in September, and continues until the plant dies. Seabeach amaranth is physically controlled (salt water inundation, temperature, emergence at depth, etc.) rather than biologically controlled (web worm). Furthermore, seedlings are unable to emerge from depths greater than 1cm; however, seabeach amaranth seeds are resilient, and century–old seeds of some species of amaranth are capable of successful germination and growth.

Table 7-7. Total Amaranthus Count by Year on Wrightsville Beach

Year	Total	Year	Total
1992	416	2005	244
1993	157	2006	4
1994	38	2007	9
1995	1,323	2008	3
1996	289	2009	0
1997	22	2010	0
1998	191	2011	2
1999	1	2012	0
2000	5	2013	0
2001	64	2014	0
2002	104	2015	0
2003	735	2016	1
2004	782	2017	0
		Total	**4,390**

Alternative 1 (No Action): This alternative would have a long-term negative effects to seabeach amaranth due to loss of habitat from erosion.

Alternative 2 (Recommended Plan): Beach renourishment will restore much of the existing habitat lost to erosion and is expected to provide long-term benefits to seabeach amaranth; however, renourishment every four years and the resulting deep burial of seeds on a portion of the beaches may slow germination and population recovery over the short-term. Therefore, the project may affect, but is not likely to adversely affect seabeach amaranth.

Alternative 3 (Offshore Borrow Source): Impacts of Alternative 3 would be similar to the Recommended Plan.

7.7.6 Piping Plover

Source: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=6039

The Atlantic Coast piping plover population breeds on coastal beaches from Newfoundland to North Carolina (and occasionally in South Carolina) and winters along the Atlantic Coast (from North Carolina south), the Gulf Coast, and in the Caribbean where they spend a majority of their time foraging. Since being listed as threatened in 1986, only 800 pairs were known to exist in the three major populations combined and by 1995 the number of detected breeding pairs increased to 1,350. This population increase can most likely be attributed to increased survey efforts and implementation of recovery plans.

The species typically nests in sand depressions on unvegetated portions of the beach above the high tide line on sand flats at the ends of sand spits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Piping plovers head to their breeding grounds in late March or early April and nesting usually begins in late April; however, nests have been found as late as July. The largest reported nesting concentration of the species in the State appears to be on Portsmouth Island where 19 nests were discovered in 1983. The southernmost nesting record for the state was one nest located in Sunset Beach by in 1983. Feeding areas include intertidal portions of ocean beaches, washover areas, mud flats, sand flats, wrack lines, and shorelines of coastal ponds, lagoons, or salt marshes. Prey consist of worms, fly larvae, beetles, crustaceans, mollusks, and other invertebrates.

The piping plover is a fairly common winter resident along the beaches of North Carolina. On July 10, 2001, the USFWS designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as critical habitat for the wintering population of the piping plover where they spend up to 10 months of each year on the wintering grounds. Constituent elements for the piping plover wintering habitat are those habitat components that are essential for the primary biological needs of foraging, sheltering, and roosting, and only those areas containing these primary constituent elements within the designated boundaries are considered critical habitat. The USFWS has defined textual unit descriptions to designate areas

within the critical habitat boundary. These units describe the geography of the area using reference points, include the areas from the landward boundaries to the MLLW, and may describe other areas within the unit that are utilized by the piping plover and contain the primary constituent elements.

NC-12 and NC-13 are USFWS designated piping plover critical habitat units within the vicinity of the project. NC-12 is located at the northern most tip of Wrightsville Beach and NC-13 includes the northern most tip of Masonboro Island and portions of Masonboro Inlet (Figure 7-7). It includes the contiguous shoreline from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur along the Atlantic Ocean and either inlet. Though the limits of critical habitat are constantly evolving based on the presence or absence of constituent elements, this approximation facilitated a more detailed and site specific impact analysis relative to the proposed action.

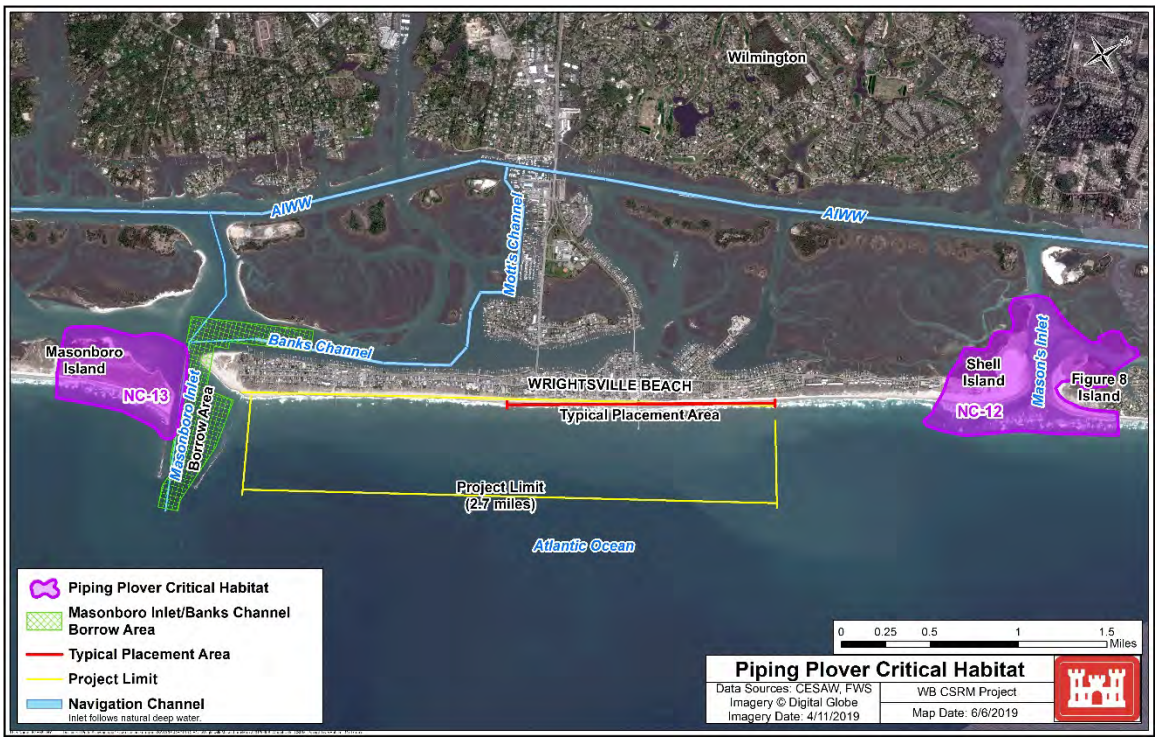


Figure 7-6. Piping Plover Critical Habitat

Alternative 1 (No Action): Beach erosion would result in the loss of roosting, foraging, breeding, and nesting habitat for piping plover.

Alternative 2 (Recommended Plan): The long-term effects of the project may restore lost roosting and nesting habitat through the addition of beach fill; however, short-term impacts to foraging, sheltering and roosting habitat may occur during renourishment. Inlet dredging will require a pipeline running from the inlet to the northern extent of the project, which has the potential to impact piping plover. When the offshore borrow

area is used, there would be no impacts to the birds at the south end of Wrightsville Beach adjacent to the inlet due to dredging or pipeline routes. Therefore, it has been determined that the project may affect, but is not likely to adversely affect the piping plover. Considering that the project renourishment limits and associated activities will avoid the designated piping plover critical wintering habitat and associated constituent elements at NC-12 and NC-13, the proposed project no effect to critical habitat.

Alternative 3 (Offshore Borrow Source): Although renourishment activities will take place from December 1 to April 15, to the greatest extent practicable, this alternative would likely be accomplished by two hopper dredges working 54 concurrent days as compared to one cutterhead working 45 days (dredging from the inlet), resulting in a minor increase in short-term impacts to foraging, feeding, sheltering, and roosting habitat as compared to Alternative 2. No impacts to the birds at the south end of Wrightsville Beach, adjacent to the inlet, due to dredging or pipeline routes would occur. Other impacts of this alternative would be similar to the Recommended Plan.

7.7.7 Red Knot

Source: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=1864

The Red Knot (*Calidris canutus rufa)* is a medium-sized shorebird that undertakes an annual 30,000 km hemispheric migration, one of the longest among shorebirds. Their migration route extends from overwintering sites in the southernmost tip of South America at Tierra del Fuego, up the Eastern coast of the Americas through the Delaware Bay, and ultimately to breeding sites in the central Canadian Arctic. Red Knots break their migration into strategically timed and selected non-stop segments, of approximately 1,500 miles, throughout the entire Atlantic coast, including North Carolina. These staging areas consist of highly productive foraging locations which are repeatedly used year to year. As the Red Knot moves towards the northern extent of its migration route, the timing of departures becomes increasingly synchronized. One critical foraging stop for Red Knots occurs in the Delaware Bay where they feed almost exclusively on horseshoe crab eggs, due to their high fat content and ease of digestion, in order to reach threshold departure masses (180-200 grams) prior to heading for the Arctic breeding grounds. The arrival of the Red Knot in the Delaware Bay coincides with the spawning of the horseshoe crabs, which peaks in May and June. Birds arrive

emaciated and can nearly double their mass (~4.6 grams/day) prior to departure if foraging conditions are favorable, eating an estimated 18,000 fat-rich horseshoe crab eggs per day. This critical foraging stopover enables Red Knots to achieve the nutrient store levels necessary for migration, survival, and maximizing the reproductive potential of the population. In order to increase their body mass at such a rapid rate during their refueling stopover in the Delaware Bay, Red Knots morph their guts during their migration route from South America to Delaware.

Red Knots feed extensively in the intertidal zone and on small coquina clams and horseshoe crab eggs. So they are either seen feeding voraciously or resting. Once they build up adequate fat reserves, they fly to their next stopover site. Some Red Knots have geo-locators on their leg bands and such data demonstrate that they can fly 100s of miles without stopping if they have adequate fat stores.

The best places for them to feed and rest are large intertidal areas for foraging, with foredunes in which to rest. No disturbance at these sites from pedestrians, dogs, or vehicles would be tolerated by the birds; thus, busy sites are not used.

Alternative 1 (No Action): Beach erosion would result in the loss of migrating and wintering habitat for red knots.

Alternative 2 (Recommended Plan): Inlet dredging will require a pipeline running from the inlet to the northern extent of the project, which has the potential to impact red knots. When the offshore borrow area is used, no impacts to the birds at the south end of Wrightsville Beach, adjacent to the inlet due to dredging or pipeline routes, would occur. Short-term impacts of the proposed action on the Red Knot would result from the placement of sediment on Wrightsville Beach every four years. This activity would restore beach and intertidal area for this species. The long-term effects of the project may restore migrating and wintering habitat through the addition of beach renourishment activities within Wrightsville Beach; however, short-term impacts to foraging, feeding, sheltering, and roosting habitat may occur during renourishment events. The placement of beach quality sand on Wrightsville Beach may affect, but is not likely adversely affect the Red Knot because it will (1) avoid large scale disturbance within the entire range limits of Red Knot foraging distribution and allow for areas of un-impacted or recovered foraging habitat within a given year, (2) avoid roosting timeframes or provide appropriate buffers around existing roosting habitat identified during shorebird surveys and renourishment operations, and (3) result in beach placement on Wrightsville Beach in only the winter months and no later than March 31, or April 15 if by hopper dredge, once every 4 years.

Alternative 3 (Offshore Borrow Source): No impacts to the birds at the south end of Wrightsville Beach adjacent to the inlet, due to dredging or pipeline routes, would occur. Although renourishment activities will take place from December 1 to April 15, to

the greatest extent practicable, this alternative would likely be accomplished by two hopper dredges, working 54 concurrent days offshore as compared to one cutterhead, working 45 days in the inlet, resulting in a minor increase in short-term impacts to foraging, feeding, sheltering, and roosting habitat as compared to Alternative 2. Other impacts of this alternative would be similar to the Recommended Plan.

7.8 Socioeconomic Resources

Demographics

According to the US Census Bureau, the 2010 population of Wrightsville Beach was 2,477, and 202,607 for New Hanover County, making it the 9th most populous county in North Carolina. In the past several years, the county has seen strong population growth. In fact, between 2000 and 2010, the county grew by over 26 percent. According to reports by the North Carolina State office of Budget and Management, New Hanover County is expected to increase in size to over 270,000 persons by 2029. The ethnic makeup of New Hanover County is 79.9 percent white, 16.9 percent African American, less than 1 percent Native American, less than 1 percent Asian, less than 1 percent Pacific Islander, and less than 1 percent from other races. 2.1 percent of the population were Hispanic or Latino of any race. Wrightsville Beach's racial makeup was 98.1 percent white, with less than 1 percent of each additional race represented. The Hispanic population in Wrightsville Beach represents less than 1 percent of the total population.

Economics

New Hanover County has a service-based economy that has benefited from an influx of permanent residents, and a thriving tourism industry. The service sector includes banking/finance, real estate, insurance, healthcare, and related commercial businesses. The percentage of the workforce employed in social services (defined as educational services, healthcare, or social assistance) is 13 percent, with the highest percentage of individuals working in the Finance-Insurance-Real Estate industry (24 percent), followed by Construction (15 percent).

With numerous notable attractions located in its borders and nearby, tourism is a critical component of the New Hanover County and Wrightsville Beach economy. In addition to miles of beaches, the county possesses numerous access points to the Intercoastal Waterway, which is popular for recreational fishing and boating related activities.

Income

On average, the socioeconomic composition of New Hanover County and Wrightsville Beach is higher than the remainder of North Carolina. The median household incomes are $51,232 and $77,232 respectively for the county and town, which is higher than the

State average of $48,256. The per capita incomes in New Hanover County and Wrightsville Beach are $31,708 and $69,591 respectively, both higher than the State average of $25,774.

Alternative 1 (No Action): In the absence of a project, the probability of damages to existing structures increases, increasing potential adverse impacts to the existing tax base and impacts to commercial and public entities.

Alternative 2 (Recommended Plan): This alternative would continue economic growth. Also, this alternative will minimize damages to residential, public and commercial structures, as well as reduce damages to critical infrastructure.

Alternative 3 (Offshore Borrow): This alternative would be similar to the Recommended Plan.

7.8.1 Aesthetic and Recreational Resources

All project area beaches are available for a multitude of beach recreation activities—swimming, surfing, wading, walking, sightseeing, picnicking, sunbathing, surf fishing, jogging, and so on. The total environment of barrier islands, beaches, ocean, estuaries, and inlets attracts many residents and visitors to the area to enjoy the total aesthetic experience created by the sights, sounds, winds and ocean sprays. Two ocean piers (Johnny Mercer's and Oceanic) are located in the project area and are considered important recreational facilities. During fall months, recreational surf fishing is a popular activity. These ocean piers, private recreational vessels, and charter boats that use the nearshore waters also contribute to the local economy. Wrightsville Beach is available for a multitude of beach recreation activities—swimming, surfing, wading, walking, sightseeing, picnicking, sunbathing, surf fishing, jogging, and so on.

A scenic setting is provided by the ocean and sound, coastal beaches, and the numerous vessels common to these waters, including commercial and recreational boats. The marine environment provides opportunities for boating and fishing.

Alternative 1 (No Action): This alternative would have an adverse and long-term detrimental effect on aesthetic and recreational resources due to beach erosion.

Alternative 2 (Recommended Plan): Renourishments are planned to be completed between either November 16 to March 31 (cutterhead) or December 1 to April 15 (hopper), thereby avoiding the peak summer tourist season. When work activities in any area are completed, aesthetic values and recreational opportunities would be restored or enhanced as renourishment equipment is moved away.

The ocean and navigable waters in the vicinity of the study area would be affected to a minor extent in that dredges, barges, and other watercraft associated with the work would be on-site for 45 days when dredging the inlet and 54 days when during renourishment events. However, that is judged to be an insignificant effect.

Placement of beach fill would result in temporary use of dredge pipeline, bulldozers, and other equipment on the beach. These objects would detract from the normal appearance of the beach as well as create elevated levels of noise, vibration, lighting, etc. within the renourishment area. Also, recreational activities on beaches may experience some interruption or interference during work periods, but the degenerated, eroded conditions of the beaches already presents recreational constraints. After work is completed on the beach and the heavy equipment is removed, the resulting wider beach would be expected to represent an aesthetic enhancement and an improvement for recreation.

Implementation of the Recommended Plan would result in an overall, short-term minor adverse and long-term beneficial effects on aesthetic and recreational resources. Implementing the proposed action could cause a temporary reduction of aesthetic appeal and some interference with recreational activities in the areas of project renourishment.

Alternative 3 (Offshore Borrow Source): This alternative would result in overall, short-term minor adverse and long-term beneficial effects on aesthetic and recreational resources. Except for the increase of renourishment time of 45 days to dredge the inlet as compared to 54 days to dredge offshore, impacts of Alternative 3 would be similar to the Recommended Plan.

7.8.2 Commercial and Recreational Fishing

Commercial and recreational fishermen extensively utilize the nearshore marine and estuarine waters of North Carolina's northeast coast on a year-round basis. The USACE maintains navigation channels in Pamlico Sound and Hatteras Inlet that are actively fished, or provide passage to other waters, including the Atlantic Ocean. In addition, recreational surf fishermen frequently utilize area beaches.

Recreational fishing includes fishing from head boats, charter boats, private boats, piers, and the surf. Fishing from head boats is best in the winter months for snapper and grouper. Fishing from charter boats is excellent for king mackerel and bottomfish during the winter. Offshore, gulfstream species, like yellowfin tuna and wahoo are available. Inside fishing has been successful for inshore species such as red drum, speckled trout, and flounder.

Private boat anglers can find bluefin tuna in the nearshore area, king mackerel, and other bottomfish species in the offshore, and other species such as speckled trout, red drum, and flounder can be found in the inside areas of the creeks and AIWW.

Alternative 1 (No Action): As the inlet naturally shoals in, navigation may be restricted to shallower draft fishing boats. Boats not able to safely navigate may have to access the ocean through Carolina Beach Inlet. Impacts from shoaling may be reduced through maintenance of the Masonboro Inlet Federal navigation project, as Federal funding allows. This alternative may result in long-term moderate negative effects to commercial and recreational fishing.

Alternative 2 (Recommended Plan): During inlet dredging, fishing boat traffic would be temporarily delayed but during past dredging work in the inlet, boat traffic has been allowed to periodically navigate through the work area. Once dredging is completed, area mariners would benefit from the restored safe navigation conditions in the channel. Because each renourishment is expected to have a short duration (45 days), impacts to fishing should be minimal. During a possible one-time dredging from the offshore borrow source, this alternative will have no effect on commercial and recreational fishing because there would be no inlet work that impedes traffic.

Alternative 3 (Offshore Borrow Source): This Alternative would have no effect on commercial and recreational fishing because this there would be no inlet work that impedes traffic.

7.9 Cultural Resources

From the mid-seventeenth century to the mid-eighteenth century the Cape Fear region of North Carolina remained relatively unsettled. Numerous factors contributed to the lack of settlers into the area including the geography of the region, the hostile Cape Fear Indians, pirates who used the area as a base of operations, and the subsequent closing of the Carolina land offices by the proprietors (Hartzer 1983).

However, by the mid-eighteenth century a number of factors helped to clear the way for settlement of the Cape Fear Region. Piracy had been prevalent in the area but after 1718 both Edward Teach (Blackbeard) and Stede Bonnet were captured and killed off North Carolina; thus, piracy in the region was reduced to a great degree. The fear of hostile Indians in the region was also reduced when colonists defeated the Cape Fear and Tuscarora Indians after a series of bloody battles which ended around 1720 (Hartzer 1983).

In 1725 Colonel Maurice Moore founded the town of Brunswick, 12 miles above the mouth of the Cape Fear River. Moore had fought in the area during the Indian wars and was determined to return and settle the area. In response to Moore's attempt to settle the region, proprietary governor George Burrington reopened the land office in 1725. By 1733 a new town was established 16 miles upriver from Brunswick called New Carthage (1733), New Liverpool, New Town (or Newton), then Wilmington (1740). Both quickly became commercial and political rivals, each vying to control southeastern North Carolina (Hartzer 1983). In 1740 the town of Wilmington had replaced Brunswick as the county seat of New Hanover.

Both Brunswick and Wilmington became central outposts for the distribution of Naval stores such as turpentine, rosin, tar, and pitch. These Naval stores were the leading export of North Carolina and remained so through 1870. While Brunswick catered to larger ships because of its location, Wilmington became an important port for smaller vessels involved with the coastal and West Indian markets. Wilmington became the premier port as Brunswick was abandoned by the British in 1776 (Watts et al. 1978).

Although Masonboro Inlet was in close proximity to Wilmington, it played only a minor role in the commercial activity of the area. Documentation of commerce within the Cape Fear region during the eighteenth and nineteenth centuries shows that Masonboro Inlet was used mainly by local fisherman with shallow draft vessels (Watts et al. 1978).

During the United States' Civil War, Wilmington became the Confederacy's most essential port for the importation of war materials. The Union blockade used Masonboro Inlet as a base for attacks against Confederate salt works in the area and to destroy an unfinished Confederate fortification on the south side of the inlet (Watts et al. 1978:8). From 1865 to 1920, Wilmington remained an important port for the exportation of products such as turpentine, cotton, and guano. Concurrently, Wrightsville Beach (north of Masonboro Inlet) grew as a popular tourist resort. Although growth in the area increased, Masonboro Inlet continued to be used primarily by smaller fishing vessels. Larger vessels were discouraged by the inlet's continually shifting channel and shallow waters (Watts et al. 1978).

Table 7-10 represents a list of vessels documented to have wrecked in the Wrightsville Beach vicinity.

Table 7-8. Vessels Documented to have Wrecked in the Wrightsville Beach Vicinity (1 of 2)

Date	Vessel Name	Vessel Type	Comments
June 1, 1842	Ashley	brig	total loss, 1 mile north of Deep Inlet
January 12, 1856	Sam Berry	steamer	wrecked on reef 3 miles south of inlet
July 6, 1862	Unknown	schooner	discovered burning on shore at Masonboro inlet
August 1, 1862	Lizzie of Nassau	sloop	captured and destroyed 12 to 15 miles above Fort Fisher, 4 miles out to sea
November 4, 1862	Sophie	bark	forced aground and destroyed south of Masonboro Inlet
November 5, 1862	Unknown	schooner	destroyed south of inlet
November 17, 1862	J.W. Pindar	schooner	forced aground and destroyed south of Masonboro Inlet
January 14, 1863	Columbia	Federal gunboat	grounded and lost ashore south of Masonboro Inlet
February 10, 1864	Emily of London	steamer	sighted aground north of Masonboro Inlet and destroyed by Union forces
February 10, 1864	Fanny and Jenny	steamer	forced aground and destroyed north of Masonboro Inlet
November 15, 1864	Unknown	schooner	wrecked south of Masonboro Inlet
1860's	Unknown	wooden	May be vessel burned during the Civil War
May 6, 1873	Toy	schooner	ran ashore just inside Masonboro Inlet
October 1887	Naomi	schooner	Middle of Wrightsville Beach
March 24, 1888	Frances	schooner	ran ashore on Wrightsville beach, total loss
February 1893	Oklahoma	steam launch	struck the bar while attempting to enter Moore's Inlet, during heavy seas
Fall, 1894	Najaiden	Norwegian barque	wrecked on Wrightsville Beach
1896	Unknown		Near Masonboro Inlet

Sources: Watts et al. 1978 and Watts 1995

Table 7-8. Vessels Documented to have Wrecked in the Wrightsville Beach Vicinity (1 of 2)

Date	Vessel Name	Vessel Type	Comments
February 1906	Katie	schooner	Unknown
October 29, 1929	Unknown	yacht	grounded on Masonboro beach while attempting to go through the inlet
August 1932	Summer Girl	cabin cruiser	struck the wreck of a sunken blockade runner just north of the mouth of Masonboro Inlet
1943	Unknown	50-foot vessel	unconfirmed loss of a U.S. Coast Guard vessel
Late 1940's, early 1950's	Unknown	two wooden-hulled boats	Captain Linwood Roberts, charter boat captain, stated that two vessels sunk in Masonboro Inlet
1951	Unknown	30-32 ft. shrimp boat	vessel struck the wreck of a Civil War blockade runner just north of the mouth of Masonboro Inlet
1970's	Unknown	small pleasure craft	inboard pleasure vessel ran aground south of Masonboro Inlet

Sources: Watts et al. 1978 and Watts 1995

In 1977 the USACE Wilmington District completed a magnetometer survey of Masonboro Inlet/Banks Channel. This survey was undertaken to locate any submerged cultural resources that might have been impacted by modifications to the existing inlet. These modifications, that were to be implemented during the summer of 1978, included the construction of a 3,450 foot jetty along the south side of the existing inlet and the dredging of a channel 400 feet wide and 14 feet deep (in Masonboro Inlet). A total of five magnetic anomalies in the survey area were noted (Saltus, 1978).

Additional investigations of the Masonboro Inlet and Island anomalies were conducted by the Underwater Archaeology Unit of the North Carolina Division of Archives and History in 1977 (Watts et al., 1978). The survey relocated the potentially significant magnetic targets originally located in the 1977 magnetometer survey. Anomaly 1 was the remains of a sidewheel steamer located north of the existing jetty at Masonboro Inlet. Anomaly 2 was located near the seaward end of the existing north jetty. Anomaly 3 was located south of the navigation channel within Masonboro Inlet, and anomaly 4 was located near the northern tip of the inlet (Watts et al. 1978).

The Underwater Archaeology Unit of the North Carolina Division of Archives and History conducted a magnetometer survey of known magnetic anomalies between the north

jetty of Masonboro Inlet and Johnny Mercer's Pier in 1984. A total of six targets were investigated during the survey. One target, near the end of the north jetty, was identified as a series of iron I-beams extending out of the sand. It is speculated that these I-beams either served as cribbing supports or as a structural component from the vessel Columbia (Watts 1995).

In 2010 and 2018, sabots thought to be associated with the Columbia were unearthed during dredging and beach renourishment operations. In both cases, these discoveries were closely coordinated with the North Carolina Office of State Archaeology and have resulted in implementation of buffer areas around the Columbia to help ensure the site's integrity.

Alternative 1 (No Action): No known archeological resources are above MHW in the project area that could be exposed due to beach erosion.

Alternative 2 (Recommended Plan): Renourishment activities have the potential to encounter buried shipwrecks, but all known sites near the inlet borrow source have been documented and will be avoided. Prior to final designation of potential borrow source and renourishment, and in order to achieve full compliance with Section 106 of the National Historic Preservation Act of 1966 and the Abandoned Shipwreck Act of 1987, magnetometer surveys will be conducted in areas under consideration and will be coordinated with the North Carolina Office of State Archaeology, where appropriate, to ensure that all identified shipwrecks and archaeological sites eligible or potentially eligible for listing on the National Register of Historic Places will not be affected by the proposed project. All locations identified as acceptable alternatives for beach access for pipeline, pipe staging areas, location of pipeline routes, and offshore anchoring will be coordinated with the North Carolina Office of State Archeology. Contractors shall be made aware that in the event unknown resources are encountered, work in that area shall cease until assessment and consultation by the USACE and NC Underwater Archaeology Branch has been completed. No effect to historic properties is anticipated for beach renourishment activities.

Alternative 3 (Offshore Borrow Source): Impacts of Alternative 3 would be similar to the Recommended Plan. Prior to final designation of potential borrow source and renourishment, and in order to achieve full compliance with Section 106 of the National Historic Preservation Act of 1966 and the Abandoned Shipwreck Act of 1987, magnetometer surveys will be conducted in areas under consideration and will be coordinated with the North Carolina Office of State Archaeology, where appropriate, to ensure that all identified shipwrecks and archaeological sites eligible or potentially eligible for listing on the National Register of Historic Places will not be affected by the proposed project.

7.10 Noise

Noise is a prominent feature in the study area because of the sound of the breakers and at times, tourists and traffic on the beach. The sounds of breakers are tranquil and add to the pleasure experienced by visitors.

No large manufacturing, industrial, or mining-type operations are located nearby. No airports or other area establishments or entities produce unbearable noise levels on the community.

Any harbor or open-water coastal environment has a number of underwater ambient noise sources such as commercial and recreational vessel traffic, dredges, wharf/dock construction (e.g., pile driving), natural sounds (e.g., storms, biological), and so on. To better assess potential species effects (i.e., disturbance of communication among marine mammals) associated with dredge specific noise from navigation maintenance, deepening, or borrow source dredging operations, Clarke et al. (2002) performed underwater field investigations to characterize sounds emitted by bucket, hydraulic cutterhead, and hopper dredge operations. A summary of results from the study are presented below and are a first step toward developing a dredge sounds database that will encompass a range of dredge plant sizes and operational features:

Cutterhead Dredge

Noise generated by a cutterhead dredge is continuous and muted and results from the cutterhead rotating within the bottom sediment and from the pumps used to transport the effluent to the placement area. The majority of the sound generated was from 70 to 1,000 hertz (Hz) and peaked at 100 to 110 decibel (dB) range. Although attenuation calculations were not completed, reported field observations indicate that the cutterhead dredge became almost inaudible at about 500 meters (Clarke et al., 2002).

Hopper Dredge

The noise generated from a hopper dredge is similar to a cutterhead suction dredge except there is no rotating cutterhead. The majority of the noise is generated from the dragarm sliding along the bottom, the pumps filling the hopper, and operation of the ship engine/propeller. Similar to the cutterhead suction dredge, most of the produced sound energy fell within the 70- to 1,000-Hz range; however peak pressure levels were at 120 to 140 dB (Clarke et al., 2002).

Dredging produces broadband and continuous, low-frequency sound (below 1 kHz) and estimated source sound pressure levels range between 168 and 186 dB re 1 µPa at 1 m, which can trigger avoidance reaction in marine mammals and marine fish. In some instances, physical auditory damage can occur. Auditory damage is the physical reduction in hearing sensitivity due to exposure to high-intensity sound and can be either temporary (temporary threshold shift) or permanent (permanent threshold Shift)

depending on the exposure level and duration. Other than physical damage, the key auditory effect is the increase in background noise levels, such that the ability of an animal to detect a relevant sound signal is diminished, which is known as *auditory masking*. Masking marine mammal vocalizations used for finding prey, navigation and social cohesion could compromise the ecological fitness of populations (Compton et al.,2008).

Alternative 1 (No Action): This alternative would have no effect on noise.

Alternative 2 (Recommended Plan): This alternative would renourish Wrightsville Beach approximately every four years for 45 days (cutterhead) or 54 days (two hoppers). Noise in the outside environment associated with beach renourishment activities would be expected to minimally exceed normal ambient noise in the project area, however, renourishment noise would be attenuated by background sounds from wind and surf. Though noise generated from dredging equipment is within the hearing range of sea turtles, marine mammals, and fishes, no injurious effects would be expected because they can move from the area, and the significance of the noise generated by the dredging equipment dissipates with an increasing distance from the noise source.

On the basis of the ability of marine mammals to move away from the immediate noise source, noise generated by cutterhead and hopper dredging activities would not be expected to affect the migration, nursing/breeding, feeding/sheltering or communication of large whales. Although behavioral effects are possible (i.e., a whale changing course to move away from a vessel), the number and frequency of vessels present in a given project area would be small, and any behavioral impacts would be expected to be minor.

Alternative 3 (Offshore Borrow Source): This alternative would renourish Wrightsville Beach approximately every four years for 45 days (cutterhead) or 54 days (two hoppers). Although the noise impacts for renourishment events would take more time and two hopper dredges as compared to one cutterhead, the distance to the offshore borrow area from Wrightsville Beach would dissipate noise generated by the dredging equipment to a greater extent and no injurious effects would be expected.

7.11 Hazardous, Toxic and Radioactive Wastes (HTRW)

A review of the EPA Superfund National Priorities List identified three sites in New Hanover County. All three were over five miles inland.

USACE standard tiered approach for analyzing the potential for encountering contaminated sediments in the potential borrow sources was used to assess the potential borrow sources for HTRW. According to that analysis, before any chemical or physical testing of sediments would be conducted, a reason to believe that the

sediments could be contaminated must be established. The sources of the sediments in the selected borrow sources are derived from sediment transport and deposition by ocean currents. The probability of the areas being contaminated by pollutants is low.

The bottom sediments that would be dredged from the borrow sources and placed on the beach would consist of predominately fine- to medium-grain size sand with some shell. Therefore, no further analyses or physical and chemical testing of the sediments is recommended. It would not be expected that any hazardous and toxic waste sites would be encountered during periodic renourishment. However, if any hazardous and toxic waste sites are identified, response plans and remedial actions would be the responsibility of the local sponsor.

Alternative 1 (No Action): This alternative would have no effect to HTRW.

Alternative 2 (Recommended Plan): Since no HTRW exists in the project area, this alternative would have no effect to HTRW and no HTRW would be produced with implementation of the Recommended Plan.

Alternative 3 (Offshore Borrow Source): Impacts of Alternative 3 would be similar to the Recommended Plan.

7.12 Summary of Notable Environmental Differences

The table below is a summary of the environmental resources with the greatest impact differences of the Recommended Plan and Alternative 3.

Table 7-9. Summary of Notable Environmental Differences

	Alternative 1 (No Action)	Alternative 2 Recommended Plan (Inlet Borrow Source)	Alternative 3 (Offshore Borrow Source)
Dredging Days	0 dredging days	1 Cutterhead: 45 dredging days	2 Hoppers: 108 dredging days (54 each)
Benthic Impacts	No impacts	Same 154 acres each renourishment	New 123 acres each renourishment
Threatened and Endangered Species	Erosion causing impacts to sea turtle nesting critical habitat, piping plover and red knot foraging, sheltering, roosting and nesting habitat and seabeach amaranth habitat.	Minor impact from pipeline/route. Beach nourishment reduces erosion and protects habitat for sea turtle nesting, piping plover nesting and red knot foraging and seabeach amaranth.	Use of hopper dredge results in increased chance of collision with NARW and other marine mammals and increased chance of sea turtle and sturgeon entrainment. Beach nourishment reduces erosion and protects habitat for sea turtle nesting, piping plover nesting and red knot foraging and seabeach amaranth.
Dredging Noise	No impacts	45 days of dredging noise per renourishment	108 days of dredging noise per renourishment

7.13 Cumulative Impacts

The Council on Environmental Quality (CEQ) defines cumulative impact as:

*The impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (*40 CFR 1508.7).

For the purposes of this analysis, we are considering proposed projects as well as potential navigation dredged material placements in order to make full disclosure of potential impacts. Many of these projects may never occur for lack of permitting, funding, environmental clearances, or other factors. The assessment of cumulative effects focused on effects of the following on important coastal shoreline resources.

1) existing Beach Renourishment projects

2) proposed future Beach Renourishment continued maintenance
3) Federal (USACE) Navigation Beach Placement (placing navigation maintenance sediment on beaches)
4) existing and potential offshore borrow sources

Alternative 1 (No Action): The No Action Alternative is where no Federal participation in renourishment occurs. This alternative would cause erosion of the beach and dunes, and increase the risk of coastal storm damage to homes, businesses and infrastructure of Wrightsville Beach. Significant impacts to NED, RED, EQ and OSE would be expected.

Actions Affecting Beach Resources: Sources of beach impacts include local beach maintenance activities (i.e. beach renourishment, beach scraping, sand bags, etc.), placement of dredged material from maintenance of navigation channels, and beach renourishment (berm and dune construction with long-term periodic maintenance).

Local Maintenance Activity: Under the existing condition, the project area may be subjected to repeated and frequent maintenance disturbance by individual homeowners and local communities following storm events. These efforts are primarily made to protect adjacent shoreline property. Such repairs consist of dune rebuilding using sand from beach scraping and/or upland fill. Limited fill and sandbags are generally used to the extent allowable by Coastal Area Management Act permits. These maintenance efforts could keep the natural resources of the barrier island ecosystems from re-establishing a natural equilibrium with the dynamic coastal forces in some limited areas.

7.13.1 Non-Federal Beach Renourishment

Several local beach renourishment efforts have been conducted or are in the permitting process throughout North Carolina (Table 7-10). The number of locally funded beach renourishment activities has increased substantially in the last 20 years as local communities continue to seek avenues for restoring severely eroding shorelines. Though non-Federal beach renourishment efforts continue to increase, many of these projects are being pursued as one-time interim efforts until the Federal beach renourishment projects can be implemented. Therefore, this increase in permitted non-Federal projects does not necessarily reflect a subsequent increase in resource acreage impacts. Many of the non-Federal projects occur within the limits of Federal projects which are already authorized but un-funded (i.e. Dare County Beaches) or projects which are under study (i.e. Wrightsville Beach). Beaches that have been nourished pursuant to State and Federal permits, or have submitted a permit application to be nourished, are provided in Table 7-10. Individually, these projects total approximately 97 miles of beach or 32 percent of North Carolina beaches.

7.13.2 Federal (USACE) Beach Renourishment

Federal beach renourishment activities typically include the construction and long-term (50-year) maintenance of a berm and dune. The degree of cumulative impact would increase proportionally with the total length of beach renourishment project constructed. The first Federal North Carolina beach renourishment projects were constructed at Carolina and Wrightsville Beaches in 1965, and totaled approximately 6.4 miles. An additional 3.8 miles of Federal beach renourishment project was constructed in 1998 at Kure Beach. In 2000, a coastal storm risk management project along 14 miles of Dare County Beaches was authorized, but has not yet been constructed. Topsail Beach, Surf City and North Topsail Beaches, as well as Bogue Banks, have authorized Federal CSRM projects, but have not been funded for construction. Funding has been provided for planning, engineering and design (PED) of the Bogue Banks project. Only Carolina Beach and Wrightsville Beach are currently under study by the Wilmington District (Table 7-11). Considering all existing and proposed Federal and non-Federal renourishment projects, and recognizing that some of the projects are overlapping or represent the same project area, approximately 112 miles or 37 percent of the North Carolina coast could eventually have private or Federal beach renourishment projects.

Table 7-10. Summary of non-Federal beach renourishment projects in North Carolina that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. This list does not include small scale beach fill activities (1 of 4).

Federal/ Non-Federal	Project	Source of Sand for Renourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Straight-line Distance From the Project Area (miles)
Non-Federal	*Town of Kill Devil Hills –Beach Renourishment Project	Offshore Borrow Areas	Kill Devil Hills	4	179.6
	*Town of Nags Head – Beach Renourishment Project	Offshore Borrow Areas	Nags Head	10	177.4
	Emergency Highway 12 Mirlo Beach in Rodanthe NC	Offshore Borrow Area	Southern Pea Island to Mirlo Beach	2	162.4**
	*Bogue Banks FEMA Project	USACE ODMDS-Morehead City Port Shipping Channel	Emerald Isle (2 segments), Indian Beach, Salter Path, Pine Knoll Shores	13	64.7**
	*Bogue Banks Restoration Project - Phase I- Pine knoll Shores and Indian Beach Joint Restoration	Offshore Borrow Areas	Pine Knoll Shores and Indian Beach	7	69.1**
	*Bogue Banks Restoration Project- Phase II – Eastern Emerald Isle	Offshore Borrow Areas	Indian Beach and Emerald Isle	6	62.7**
	*Emerald Isle FEMA Project	USACE ODMDS-Morehead City Port Shipping Channel	Emerald Isle	4	61

*Projects which may utilize the same borrow sources and/or overlap beach placement locations.

**Distance measured from midpoint between the projects.

Table 7-10. Summary of non-Federal beach renourishment projects in North Carolina that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. This list does not include small scale beach fill activities (2 of 4).

Federal/ Non-Federal	Project	Source of Sand for Renourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Straight-line Distance From the Project Area (miles)
Non-Federal	*Emerald Isle "Hotspots" FEMA Project	USACE ODMDS-Morehead City Port Shipping Channel	Emerald Isle	7	61
	*Bogue Banks Restoration Project - Phase III- Bogue Inlet Channel Realignment Project	Bogue Inlet Channel	Western Emerald Isle	5	55.9
	*North Topsail Dune Restoration (Town Of North Topsail Beach)	Upland borrow source near Town of Wallace, NC	North Topsail Beach	NA	29.5
	*North Topsail Beach Shoreline Protection Project	New River Inlet Realignment and Offshore Borrow Area	North Topsail Beach	11	29.5
	*Topsail Beach – Beach Renourishment Project	Disposal Island	Topsail Beach	6	18.2
	*Topsail Beach – Beach Renourishment Project	New Topsail Inlet	Topsail Beach	6	18.2

*Projects which may utilize the same borrow sources and/or overlap beach placement locations.

**Distance measured from midpoint between the projects.

Table 7-10. Summary of non-Federal beach renourishment projects in North Carolina that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. This list does not include small scale beach fill activities (3 of 4).

Federal/ Non-Federal	Project	Source of Sand for Renourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Straight-line Distance From the Project Area (miles)
Non-Federal	Rich Inlet Management Project	Relocation of Rich Inlet	Figure Eight Island	NA	14.2
	Figure Eight Island	Banks Channel and Nixon Channel	North & South Sections of Figure Eight Island	3	11.7
	Masons Inlet Relocation Project	Masons Inlet (new channel) and Masons Creek	North end of Wrightsville Beach and south end of Figure Eight Island	2	9.4
	*New Hanover County Beaches-Beach Renourishment	TBD	Wrightsville Beach, Carolina Beach, Kure Beach	TBD	1.3**
	Bald Head Island Creek Project	Bald Head Creek	South Beach	0.4	20
	Bald Head Island – Beach Renourishment	Offshore Borrow Area (Jay Bird Shoals)	West and South Beach of Bald Head Island	4	20
	Bald Head Island-Terminal Groin and Beach Renourishment	Offshore Borrow Area (Jay Bird Shoals)	Terminal Groin Fillet	NA	20
	*Holden Beach-Terminal Groin and Beach Renourishment	Unconstructed	Holden Beach w/in vicinity of Lockwoods Folly Inlet	TBD	26.9

*Projects which may utilize the same borrow sources and/or overlap beach placement locations.

**Distance measured from midpoint between the projects.

Table 7-10. Summary of non-Federal beach renourishment projects in North Carolina that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. This list does not include small scale beach fill activities (4 of 4).

Federal/ Non-Federal	Project	Source of Sand for Renourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Straight-line Distance From the Project Area (miles)
Non-Federal	*Holden Beach Interim Beach Renourishment	Offshore Borrow Area	Holden Beach	4	29.3
	*Holden Beach East & West	Upland Borrow Source (Truck Haul)	Extension of 933 Project	3	29.3
	*Ocean Isle-Terminal Groin and Beach Renourishment	Unconstructed	Ocean Isle Beach w/in vicinity of Shallotte Inlet	TBD	34.9

*Projects which may utilize the same borrow sources and/or overlap beach placement locations.

**Distance measured from midpoint between the projects.

Table 7-11. Summary of Federal beach renourishment projects in North Carolina that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. This list does not include small scale beach fill activities (1 of 4).

Federal/Non-Federal	Project	Constructed?	Source of Sand for Renourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Straight Line Distance From the Project Area (miles)
Federal	*Dare County Beaches, NC Bodie Island (Coastal Storm Damage Reduction)	No	Offshore Borrow Areas	Kitty Hawk and Nags Head Beaches	14	179**
	*Dare County Beaches, NC Hatteras to Ocracoke Portion	No	NA	Hatteras and Ocracoke Island (Hot Spots)	10	131.4
	*Cape Lookout National Seashore- East Side of Cape Lookout Lighthouse	Yes	Channel	East Side of Cape Lookout Lighthouse	1	83.9
	Beaufort Inlet Dredging- Section 933 Project (Outer Harbor)	Yes	Beaufort Inlet Outer Harbor	Indian Beach, Salter Path, and Portions of Pine Knoll Shores	7	78.6**
	*Morehead City Harbor, NC Deep Draft Navigation Project	Yes	Cutoff Channel	Atlantic Beach	1.1	77.5

*Projects which may utilize the same borrow sources and/or overlap beach placement locations.

**Distance measured from midpoint between the projects.

Table 7-11. Summary of Federal beach renourishment projects in North Carolina that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. This list does not include small scale beach fill activities (2 of 4).

Federal/Non-Federal	Project	Constructed?	Source of Sand for Renourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Straight Line Distance From the Project Area (miles)
Federal	Beaufort Inlet and Brandt Island Pumpout-Section 933 (Dredge Disposal to Eastern Bogue Banks)	Yes	Beaufort Inlet Inner Harbor and Brandt Island Pumpout	Fort Macon and Atlantic Beach	4	76.2**
	*Bogue Banks, NC (Coastal Storm Damage Reduction)	No	Offshore Borrow Areas	Communities of Bogue Banks	24	73
	*Surf City and North Topsail Beach-(Coastal Storm Damage Reduction)	No	Offshore Borrow Areas	Surf City and North Topsail Beach	10	38.8
	*West Onslow Beach New River Inlet (Topsail Beach) (Coastal Storm Damage Reduction)	No	Offshore Borrow Areas	Topsail Beach	6	29.2
	*Wrightsville Beach (Coastal Storm Damage Reduction)	Yes	Masonboro Inlet and Banks Channel	Wrightsville Beach	3	6.5

*Projects which may utilize the same borrow sources and/or overlap beach placement locations.

**Distance measured from midpoint between the projects.

Table 7-11. Summary of Federal beach renourishment projects in North Carolina that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. This list does not include small scale beach fill activities (3 of 4).

Federal/ Non-Federal	Project	Constructed?	Source of Sand for Renourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Straight Line Distance From the Project Area (miles)
Federal	*Carolina Beach and Vicinity, NC Carolina Beach Portion (Coastal Storm Damage Reduction)	Yes	Carolina Beach Inlet	Carolina Beach	2	6.5
	*Carolina Beach and Vicinity, NC Area South Portion (Coastal Storm Damage Reduction)	Yes	Wilmington Harbor Confined Disposal Area 4 and an Offshore Borrow Area	Kure Beach	2	9.2
	*Wilmington Harbor, NC	Yes	Inner Ocean Bar – Smith Island and Bald Head-1 and 2	Bald Head Island – West and South Beach	2.8	20
	*Wilmington Harbor, NC	Yes	Inner Ocean Bar – Smith Island and Bald Head-2	Caswell Beach and Oak Island	4.4	21.6**
	Wilmington Harbor Deepening (Section 933 Project) – Sand Management Plan	Yes	Wilmington Harbor Ocean Entrance Channels	Bald Head Island, Caswell Beach, Oak Island	4	20.6**

*Projects which may utilize the same borrow sources and/or overlap beach placement locations.

**Distance measured from midpoint between the projects.

Table 7-11. Summary of Federal beach renourishment projects in North Carolina that have recently occurred, are currently underway, or will occur in the reasonably foreseeable future. This list does not include small scale beach fill activities (4 of 4).

Federal/Non-Federal	Project	Constructed?	Source of Sand for Renourishment	Beachfront Nourished	Approximate Length of Shoreline (miles)	Approximate Straight Line Distance From the Project Area (miles)
Federal	Oak Island Section 1135-Sea Turtle Habitat Restoration	Yes	Upland Borrow Area-Yellow Banks	Oak Island	2	23
	*Brunswick County Beaches, NC - Oak Island Caswell, and Holden Beaches (Coastal Storm Damage Reduction)	No	Offshore Borrow Areas – Frying Pan Shoals	Caswell Beach, Oak Island, Holden Beach	30	24.7**
	Holden Beach (Section 933 Project)	Yes	Wilmington Harbor Ocean Entrance Channels	Holden Beach	2	29.3
	*Ocean Isle Beach, NC (Coastal Storm Damage Reduction)	Yes	Shallotte Inlet	Ocean Isle Beach	2	35.8

*Projects which may utilize the same borrow sources and/or overlap beach placement locations.

**Distance measured from midpoint between the projects.

7.13.3 Federal (USACE) Navigation Channels - Beach Placement

Maintenance material from dredging the AIWW, inlets, and connecting channels in the vicinity of the study area has historically been placed within approved placement limits along the beach (Table 7-12). Throughout North Carolina, a total of approximately 41 miles of beach (~14 percent of North Carolina beaches) are approved for placement of beach quality dredged material from maintenance dredging of navigation channels. However, not all of these projects are routinely dredged and a majority of the authorized placement limits are not fully utilized. Additionally, many of the approved placement limits overlap with existing Federal or non-Federal renourishment projects. Therefore, without double counting for overlapping beach projects, navigation dredged material is placed along approximately 19 miles, or 6 percent of North Carolina beaches (Table 7-13). The Wilmington District currently uses about 50 percent of the length of beach in North Carolina that is approved for this purpose and does not anticipate significant increases in beach placement in the foreseeable future.

Beach quality sand is a valuable resource that is highly sought by beach communities. When beach quality sand is dredged from navigation projects, it has become common practice of USACE to make this resource available to beach communities when applicable laws, regulations, funding and other considerations allow. Placement of this sand on beaches represents return of sediment to the littoral system.

Table 7-12. Summary of dredged material placement activities on the oceanfront beach associated with dredging of Federal Navigation Channels. Projects listed and associated placement locations and quantities may not be all encompassing and represent an estimate of navigation placement activities for the purposes of this cumulative impacts assessment (Part 1 of 3).

PROJECT		PLACEMENT LOCATION	APPROVED PLACEMENT LIMITS	ESTIMATED ACTUAL PLACEMENT LIMITS	ESTIMATED QUANTITY (CY)
Outer Banks	Avon	Begins at a point 1.15 miles south of Avon Harbor and extends north 3.1 miles	3.1 miles (16,368 lf)	0.4 miles or 2,000 linear feet	<50,000 every 6 years
	Rodanthe	Extends from road to Rodanthe Harbor south 700' to south end of beach placement area (straight out from existing dirt road). North end at Wildlife Refuge Boundary (PINWR)	.91 miles (4,800 lf)	0.4 miles or 2,000 linear feet	<100,000 every 6 years
	Ocracoke Island	Begins at a point 5,000 linear feet south of Hatteras Inlet and extends southward about 3,000 linear feet	0.6 miles (3,000 lf)	0.4 miles or 2,000 linear feet	<100,000 every 2 to 3 years
	Rollinson (Hatteras)	Begins at a point 0.85 miles south of Hatteras Harbor and extends north 5.85 miles to a point north of Frisco, NC	5.85 miles (30,888 lf)	0.4 miles or 2,000 linear feet	<60,000 every 2 years
	Silver Lake (Teaches Holes/Ocracoke)	From a point 2,000' NE of inlet and extending approximately 2,000 linear feet (0.4 miles-Ocracoke Island)	0.4 miles (2,000 lf)	0.4 miles or 2,000 linear feet	<50,000 every 2 years
	Oregon Inlet	Pea Island National Wildlife Refuge (PINWR)	3 miles (15,840 lf)	1.5 miles or 7.920 linear feet	300,000 as needed
	Drum Inlet	Core Banks. From a point 2,000 feet on either side of inlet extending for 1 mile in either direction	2 miles (10,560 lf)	1 miles or 5,280 linear feet	298,000 initial, 100,000 for maintenance (Assume 8 year cycle)
Beaufort	*Morehead City (Brandt Island)	2,000 feet west of inlet, Fort Macon and Atlantic Beach to Coral Bay Club, Pine Knoll Shores	7.3 miles (38,300 lf)	5.2 miles or 27,800 linear feet	3.5 million every 8 years
	*AIWW Section I, Tangent B	Pine Knoll Shores, vicinity of Coral Bay	2 miles (10,560 lf)	0.4 miles or 2,000 linear feet	<50,000 every 5 years

* Navigation beneficial use of dredged material placement sites which may overlap with existing Federal or non-Federal beach renourishment projects.

Table 7-12. Summary of dredged material placement activities on the oceanfront beach associated with dredging of Federal Navigation Channels. Projects listed and associated placement locations and quantities may not be all encompassing and represent an estimate of navigation placement activities for the purposes of this cumulative impacts assessment (Part 2 of 3).

PROJECT		PLACEMENT LOCATION	APPROVED PLACEMENT LIMITS	ESTIMATED ACTUAL PLACEMENT LIMITS	ESTIMATED QUANTITY (CY)
Swansboro	*AIWW Bogue Inlet Crossing Section I, Tangent H through F	Approx. 2,000 feet from inlet going east to Emerald Point Villas, Emerald Isle (Bogue Banks)	1 mile (5,280 lf)	0.4 miles or 2,000 linear feet	<100,000 every 2 years
Browns Inlet	AIWW Section II, Tangents F, G, H	Camp Lejeune, 3,000 feet west of Browns Inlet extending westward	1.58 miles (8,300 lf)	1 miles or 5,280 linear feet	<200,000 every 2 years
New River Inlet	*AIWW New River Inlet Crossing Section II, Tangents I & J, Channel to Jacksonville. Section III, tangents 1 & 2	N. Topsail Beach, 3,000 feet west of inlet extending westward to Maritime Way (Galleon Bay area)	1.5 miles (8,000 lf)	0.8 miles or 4,000 linear feet	<200,000 every 2 years
New Topsail Inlet (Hampstead)	*AIWW, Sect. III	Topsail Island, Queens Grant	0.5 miles (2,500 lf)	0.5iles or 2,500 linear feet	<50,000 every 6 years
	*AIWW, Topsail Inlet Crossing & Topsail Creek	Topsail Beach, from a point 2,000 feet north of Topsail Inlet	1 mile (5,280 lf)	0.4 mi or 2,000 linear feet	<75,000 every 2 years
Wrightsville Beach	AIWW Sect. III, Tang 11 & 12 Mason Inlet Crossing	Shell Island (north end of Wrightsville Beach) from a point 2,000 feet from Mason Inlet	0.4 miles (2,000 lf)	0.4 mi or 2,000 linear feet	<100,000
	*Masonboro Inlet Sand Bypassing	At a point 9,000 feet from jetty extending southward midway of island	1.2 miles (6,000 lf)	1 mile or 5,280 linear feet	500,000 every 4 years

* Navigation beneficial use of dredged material placement sites which may overlap with existing Federal or non-Federal beach renourishment projects.

Table 7-12 continued. Summary of dredged material placement activities on the oceanfront beach associated with dredging of Federal Navigation Channels. Projects listed and associated placement locations and quantities may not be all encompassing and represent an estimate of navigation placement activities for the purposes of this cumulative impacts assessment. (Part 3 of 3).

PROJECT		PLACEMENT LOCATION	APPROVED PLACEMENT LIMITS	ESTIMATED ACTUAL PLACEMENT LIMITS	ESTIMATED QUANTITY (CY)
Carolina Beach	AIWW, Section IV, Tangent 1	Southern end of Masonboro Island at a point 2,000 linear feet from Carolina Beach Inlet extending northward to Johns Bay area	1.3 miles (7,000 lf)	0.4 miles or2,000 linear feet	<50,000 as needed
	AIWW, Section IV, Tangent 1	North end of Carolina Beach at Freeman Park	0.6 miles (3,000 lf)	0.6 miles or 3,000 linear feet	<50,000 every 2 years
Caswell Beach	*Caswell Beach	Beachfront on eastern end of island	4.7 miles (25,000 lf)	4.7 miles or 25,000 linear feet	1.1 million every 6 years
Bald Head Island	*Bald Head Island	Beachfront on eastern and western shoreline	3.0 miles (16,000 lf)	3.0 miles or 16,000 linear feet	1.1 million every 2 years (except every 6th when it goes to Caswell)
Oak Island	AIWW	Beachfront on eastern end of the shoreline	0.5 miles (2,500 lf)	0.5 miles or 2,500 linear feet	<50,000 every 2 years
Holden Beach	AIWW	Beachfront on eastern end of the shoreline	0.4 miles (2,000 lf)	0.4 miles or 2,000 linear feet	<50,000 every 2 years
Ocean Isle	AIWW	Beachfront on eastern end of the island within the vicinity of Shallotte Blvd	0.3 miles (1,600 lf)	0.3 miles or 1,600 linear feet	<50,000 every 2 years

* Navigation beneficial use of dredged material placement sites which may overlap with existing Federal or non-Federal beach renourishment projects.

Table 7-13. Summary of cumulative mileage of North Carolina Ocean beach that could be impacted by beach renourishment and/or navigation disposal activities.

Project Type	Total Miles Impacted (*w/o double counting for overlapping projects)	Percent NC Beach
Federal and Non-Federal Beach Renourishment	112	37
Federal Authorized Maintenance Beach Placement	19	6
TOTAL	**131**	**43**

7.13.4 Offshore Borrow Source

The Wrightsville Beach Recommended Plan includes the Masonboro Inlet/Banks Channel and an offshore borrow source. There are many possible sequences and methods for dredging and placing available material on the beach for the project and a site specific borrow source use plan has yet to be defined. Each renourishment interval will utilize varying components of the borrow source with a sequence of temporary impacts to benthic resources over the life of the project. Subsequent intervals of dredging within the borrow source may occur in portions not previously been dredged. This cyclic use of borrow sources would result in cumulative effects from space crowded perturbations on a local scale.

7.13.5 Statewide Impacts

Beach quality sediment identified for all Federal and non-Federal renourishment projects throughout North Carolina is most often identified from: upland sites, maintenance or deepening of navigation channels, and/or offshore borrow sources (Tables 7-10, 7-11). For the purposes of this impact assessment, only inlet and offshore borrow sources are evaluated for cumulative marine resource impacts considering that upland sources are outside of the marine environment and navigation channels are repeatedly dredged already in order to maintain navigability. This assessment also addresses both the impacts to the borrow source and to the beaches where the material is placed. Of all the projects listed with offshore borrow sources in Tables 7-10 and 7-11, there is currently only one Federal (Carolina Beach and Vicinity, NC – Area South portion - includes southern Carolian Beach and all of Kure Beach) and four non-Federal (Bogue Banks FEMA, Bogue Banks Restoration Project – Phases 1&2, Bald Head Island Beach Renourishment, and Nags Head Beach Renourishment) offshore borrow sites that have received permits and/or authorizations and funding. Other offshore borrow sources identified for projects are either under study and have not been permitted and/or authorized or have received permits and/or authorizations but have not been funded or constructed. Considering only the projects that are currently in use, significant cumulative impacts associated with time

and space crowded perturbations are not expected considering that these borrow sources are spread throughout the state and the acreage of impact for these borrow sources relative to the available un-impacted sites throughout the state is relatively minimal.

The degree of cumulative impact would increase proportionally with the total length of beach impacted. The most likely projects to increase the length of North Carolina beach placement are beach renourishment projects.

Recognizing that many of the existing or proposed Federal and non-Federal beach renourishment project limits overlap and that some portions of the Federal approved beach placement limits are within these project areas as well, Table 7-13 provides an estimate of total mileage of North Carolina ocean beach that could cumulatively be impacted by beach renourishment or navigation placement activities without double counting the overlapping projects. Considering all proposed and existing placement and renourishment impacts throughout the ocean beaches of North Carolina, a significant portion of the shoreline may have beach placement activities in the foreseeable future, likely resulting in time and space crowded perturbations. However, recognizing the funding constraints to complete all authorized and/or permitted activities, the availability of dredging equipment, etc; it is very unlikely that all of these proposed projects would ever be constructed all at once. Therefore, though time and space crowded perturbations are expected in the reasonably foreseeable future, assuming each project adheres to project related impact avoidance measures, it is likely that adjacent un-impacted and/or recovered portions of beach will be available to support dependent species (i.e. surf zone fish, shore birds, etc.) and facilitate recovery of individual project sites to pre-project conditions. Neither potential impacts to borrow sites nor to beaches on which the material is placed are likely to result in unacceptable Statewide impacts.

7.13.6 Conclusion

Historically, the extent of beach renourishment activities on North Carolina beaches was limited to a few authorized Federal projects including: Wrightsville Beach, Carolina and Kure Beaches, and Ocean Isle Beach. However, in the past 20 years, a significant number of Federal and non-Federal beach renourishment efforts were pursued to provide coastal storm risk management along the increasingly developed North Carolina shoreline. Additionally, the number of non-Federal beach renourishment projects has increased in recent years in efforts to initiate coastal storm risk management measures while awaiting funding for Federal projects (i.e. Bogue Banks, Dare County, North Topsail Beach, Surf City and Topsail Beach). Considering the extent of coastal development and subsequent vulnerability to long and short-term erosion throughout the North Carolina shoreline, it is possible that many of the proposed Federal and non-Federal beach renourishment projects may be constructed in the future. Furthermore, the frequency of beach placement activities for protection of infrastructure will continue throughout the state, resulting in cumulative time and space crowded perturbations.

Assuming projects continue to adhere to environmental commitments for the reduction of environmental impacts, and un-developed beaches throughout the state continue to remain

undisturbed, it is likely that adjacent un-impacted and/or recovered portions of beach will be available to support dependent species (i.e. surf zone fish, shore birds, etc.) and facilitate recovery of individual project sites to pre-project conditions. Assuming recovery of impacted beaches and the sustainability of un-developed protected beaches (i.e. National/Federal and State Parks and Estuarine Reserves), the potential impact area from the proposed and existing actions is small relative to the area of available similar habitat on a vicinity and statewide basis. Additionally, due to the widespread distribution and small acreage relative to the available un-impacted sites, the cumulative impacts to the borrow sources would be minimal.

8 PLAN IMPLEMENTATION

8.1 Project Schedule

Table 8.1 shows the current project schedule following an assumed December 2020 project authorization (WRDA) of the project. The schedule assumes expeditious review and approval of the project through all steps, including authorization and funding, and as such, is subject to change.

Table 8-1. Project Schedule

Activity	Date
Sign Amended Project Partnership Agreement	FEB 2021
Complete Real Estate Acquisition	N/A
Complete Final Plans and Specs	JUN 2021
Award Construction Contract	AUG 2021
Begin First Renourishment	NOV 2021
Complete First Renourishment	APR 2022

8.2 Division of Plan Responsibilities

8.2.1 General

Federal policy requires that costs for water resources projects be assigned to the various purposes served by the project (See Table 8-2). These costs are then apportioned between the Federal government and the non-Federal sponsor according to percentages specified in section 103 of the Water Resources Development Act of 1986 (P.L. 99-662). For projects that provide coastal storm risk management to publicly owned shores, the purposes are usually (1) coastal storm risk management and (2) separable recreation. For the Wrightsville Beach, NC Coastal Storm Risk Management Project, there is no separable recreation component.

8.2.2 Cost Sharing

The Recommended Plan continues Federal participation in periodic renourishment using two borrow sources including Masonboro Inlet/Banks Channel and an offshore area. Continued use of the Masonboro Inlet/Banks Channel borrow source would require Congressional reauthorization to use Federal funds to work within this borrow area notwithstanding the financial restrictions of CBRA.

All project costs for the Recommended Plan are allocated to the purpose of coastal storm risk management. Since this project was initially constructed in 1965, there are no initial

construction cost-sharing requirements nor any lands, easements, rights-of-way, relocations and disposal (LERRDs) necessary for the project.

Cost-sharing for periodic renourishment (continuing construction) would be consistent with Section 215 of WRDA 99, which requires that such costs be shared 50 percent Federal and 50 percent non-Federal. Annual beach fill monitoring is also considered part of continuing construction and would be cost-shared 50/50 as well.

Annual OMRR&R costs, such as inspection costs and dune vegetation maintenance costs, are a 100 percent non-Federal responsibility. The Federal government is responsible for preparing and providing an OMRR&R manual to the sponsor.

As noted previously, current Federal policy requires that, unless there are other, overriding considerations, the NED plan would be the plan recommended for implementation. However, the non-Federal sponsor can request recommendation of a Locally Preferred Plan (LPP) that differs from the NED Plan if they are willing to pay 100 percent of the cost differential between the two plans. In this case, the non-Federal sponsor has not elected to pursue an LPP. Cost-sharing for the Recommended Plan is shown in Table 8-2 at October 2019 price levels.

As discussed in section 4.1.6 the non-Federal sponsor has already provided the required additional public accesses and parking requirements needed to support the determination of Federal interest in a CSRM project. The existing public accesses and parking areas have been validated and meet Corps' requirements.

All of these requirements may affect the cost-sharing percentages of Federal and non-Federal partners. This issue is also revisited prior to each renourishment event, and cost sharing may be adjusted accordingly. Continued maintenance (of access for the public by both access corridors and public parking) is an especially important factor in ensuring funding of the project. The non-Federal sponsor for the Wrightsville Beach project is fully aware of all the factors potentially affecting cost-sharing, and is wholly committed to meeting and maintaining these requirements in the future.

Table 8-2. Cost allocation and apportionment, First Costs, October 2018 (FY 2019) price levels using the Recommended Plan

Initial Project Construction Costs					
Project Purpose	**Project First Cost**	**Apportionment (Percent)**		**Apportionment $**	
		Non-Federal	**Federal**	**Non-Federal**	**Federal**
Coastal storm risk management	N/A	N/A	N/A	N/A	N/A
LERRD credit	N/A	N/A	N/A	N/A	
Cash portion	N/A	N/A	N/A	N/A	N/A
Total Financial Initial Project Construction Costs					
Project Purpose	**Project First Cost**	**Apportionment (Percent)**		**Apportionment $**	
		Non-Federal	**Federal**	**Non-Federal**	**Federal**
Coastal storm risk management	N/A	N/A	N/A	N/A	N/A
Total financial cost	N/A	N/A	N/A	N/A	N/A
Total Renourishment Costs					
Project Purpose	**Total Cost (4 Renourish-ments)**	**Apportionment (Percent)**		**Apportionment $**	
		Non-Federal	**Federal**	**Non-Federal**	**Federal**
Coastal storm risk management	$52,800,000	50	50	$26,400,000	$26,400,000
	Cost Per Year	**Apportionment (Percent)**		**Apportionment $**	
		Non-Federal	**Federal**	**Non-Federal**	**Federal**
Beach fill surveys	$6,000	50	50	$3,000	$3,000
Annual OMRR&R Costs					
	Cost per year	**Apportionment (Percent)**		**Apportionment $**	
		Non-Federal	**Federal**	**Non-Federal**	**Federal**
General repair, maintenance, inspection	$75,000	100	0	$75,000	$0

8.2.3 Financial Analysis

Since this project was originally constructed in FY 1965, the non-Federal sponsor has demonstrated their ability to provide for any and all cost sharing requirements. Cost sharing requirements are provided by the state of North Carolina and a hotel occupancy tax that is managed by New Hanover County. A non-Federal statement of financial capability will be provided to the USACE and included in the Integrated Final Report and Environmental Assessment.

8.2.4 Project Partnership Agreement

An amendment to the Project Partnership Agreement (PPA) will establish the responsibilities for project execution between the Federal government and the non-Federal sponsor. The terms of local cooperation to be required in the amendment to the PPA are described in Section 12, Recommendations. A Letter of Intent acknowledging this process and stating the non-Federal sponsor's intent to support project implementation will be obtained from Wrightsville Beach and included in the Integrated Final Report and Environmental Assessment.

Federal commitments regarding a renourishment schedule or specific provisions of the PPA cannot be made to the non-Federal sponsor on any aspect of the Recommended Plan or separable element until the following are true:

- The Recommended Plan is authorized in a Water Resources Development Act or similar legislation.
- Renourishment funds are appropriated, apportioned by the OMB, and their allocation is approved by the Assistant Secretary of the Army for Civil Works (ASA [CW])
- A draft amendment to the existing PPA has been reviewed and approved by the Assistant Secretary of the Army – Civil Works (ASA-CW)

In no case would the amendment to the PPA be executed nor would a periodic renourishment event be initiated on the project until the final report/EA has been fully coordinated, a Finding of No Significant Impact (FONSI) has been signed and the three aforementioned items completed.

8.3 Views of the Non-Federal Sponsor

The non-Federal sponsor, Wrightsville Beach, fully supports the Recommended Plan. A letter of support is included in this draft Integrated Final Validation Report and Environmental Assessment under Attachment 1 of this report.

9 STATUS OF ENVIRONMENTAL COMPLIANCE

9.1 National Environmental Policy Act (NEPA)

Prior to circulation of this EA, a scoping letter was sent out to local governments, State and Federal resource agencies and stakeholders requesting comments to identify significant resources and issues of concern. Comments received were considered in the development of this report. A formal scoping meeting was conducted at the Wrightsville Beach Town Hall on Thursday, April 27, 2018.

The Wilmington District will circulate the draft integrated report for a 30-day Public Review. All comments received will be addressed and will be considered in the development of the final report.

In accordance with Section 7 (a)(2) of the ESA, this EA will be coordinated with the U.S. Fish and Wildlife Service (USFWS) and NMFS to ensure that effects of the proposed project would not jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat of such species. The USACE is planning to accomplish all future work in accordance with the USFWS Wrightsville Beach Coastal Storm Risk Management Project Batched Biological Opinion dated August 4, 2016 and the 1997 National Marine Fisheries Service South Atlantic Regional Biological Opinion (SARBO) for the continued hopper dredging of channels and borrow areas in the Southeastern United States or any superseding SARBO that is prepared by NMFS.

On April 6, 2018, the USFWS provided the USACE with a letter that the Service concurs with the USACE determination that a Coordination Act Report under the Fish and Wildlife Coordination Act of 1958, as amended, is not required for continuation of the Wrightsville Beach CSRM project.

9.2 North Carolina Coastal Zone Management Program

The action addressed in this report will take place in the designated coastal zone of the State of North Carolina. Pursuant to the Federal Coastal Zone Management Act (CZMA) of 1972, as amended (P.L. 92-583), Federal activities are required to be consistent to the maximum extent practicable with the federally approved coastal management program of the state in which their activities would be occurring.

Along with a copy of the draft integrated report/EA for Wrightsville Beach, the USACE will submit a separate consistency determination to the N.C. Division of Coastal Management (CAMA) in accordance with Section 307 (c) (l) of the Federal Coastal Zone Management Act of 1972, as amended.

Section 1102 (a) states that “clean, beach quality material from navigation channels within the active nearshore, beach, or inlet shoal systems must not be removed permanently from the active nearshore, beach or inlet shoal system unless no practicable alternative exists.

Preferably, this dredged material will be disposed of on the ocean beach or shallow active nearshore area where environmentally acceptable and compatible with other uses of the beach." When considering a project's compliance with Section 1102, the NC Division of Coastal Management (NCDCM) has stated that the section should be read in concert with NCAC 7H.0208 (2)(G), which provides some flexibility for publicly funded projects, allowing them to be considered by review agencies on a case by case basis with respect to dredged material placement. Placement of dredged material associated with the proposed action will be done in accordance with this regulation with the majority of the clean, beach quality material (i.e., ≥90 percent sand) being placed on approved beach areas.

The Coastal Resources Commission designates areas as Areas of Environmental Concern (AEC) to protect them from uncontrolled development, which may cause irreversible damage to property, public health or the environment, thereby diminishing their value to the entire state. The following determinations have been made regarding the consistency of the proposed action with the State's management objective for each of the areas affected:

- **Public Trust Areas –** These areas include waters of the Atlantic Ocean and the lands thereunder from the mean high water mark to the 3-mile limit of state jurisdiction.

  Masonboro Inlet/Banks Channel is located within these Public Trust Areas. Acceptable uses include those that are consistent with protection of the public rights for navigation and recreation, as well as conservation and management to safeguard and perpetuate the biological, economic, and aesthetic value of these areas. The activities that comprise the proposed action are not intended to adversely impact the public's rights for navigation and recreation, and are consistent with conservation of the biological, physical, and aesthetic values of public trust areas.

- **Estuarine Waters –** Estuarine Waters are the state's oceans, sounds, tidal rivers and their tributaries, which stretch across coastal North Carolina and link to the other parts of the estuarine system: public trust areas, coastal wetlands and coastal shorelines.

  For regulatory purposes, the inland, or upstream, boundary of estuarine waters is the same line used to separate the jurisdictions of the Division of Marine Fisheries and the NC Wildlife Resources Commission. However, many of the fish and shellfish that spend part of their lives in estuaries move between the "official" estuarine and inland waters.

  Since the proposed project would dredge in the Masonboro Inlet/Banks Channel, short-term adverse impacts to the estuarine and ocean system will take place.

- **Ocean Erodible –** The Ocean Erodible AEC covers North Carolina's beaches and any other oceanfront lands that are subject to long-term erosion and significant shoreline changes. The seaward boundary of this AEC is the mean low water line. The landward limit of the AEC is measured from the first line of stable natural vegetation and is determined by adding a distance equal to 60 times the long-term average annual

erosion rate for that stretch of shoreline to the distance of erosion expected during a major storm. The width of the AEC varies from about 145 feet to more than 700 feet.

The proposed action would not adversely affect oceanfront lands at Wrightsville Beach. In fact, the disposal of beach quality sand from the Masonboro Inlet/Banks Channel onto Wrightsville Beach will reduce the erosion and storm damage potential.

- **Inlet Hazard –** This AEC covers lands next to ocean inlets. Inlet shorelines are especially vulnerable to erosion and flooding and can shift suddenly and dramatically. For each inlet along the coast, the Division of Coastal Management prepares a hazard area map that is reviewed and approved by the Coastal Resources Commission. Each area is mapped based on a statistical analysis of inlet migration, previous inlet locations, narrow or low lands near the inlet, and the influence of man-made features, such as jetties and channelization projects.

  The lands adjacent are not part of the project area and are not inhabited, but the proposed project would help maintain and stabilize an open inlet.

9.3 Coastal Barrier Resources Act (CBRA)

Masonboro Inlet, including Banks Channel, is an authorized feature of the AIWW. The waterway through Masonboro Inlet and Banks Channel serves as both a shallow draft navigation channel and the historic borrow source for the Wrightsville Beach CSRM project from 1970 through the present day. In addition to maintenance dredging and relocation of the navigation channels since 1957, Masonboro Inlet has been further modified by construction of north and south jetties in 1965 and 1980, respectively.

The Coastal Barrier Resources Act (CBRA) was enacted in October 1982, and established resource units on undeveloped coastal barriers within which Federal spending is restricted. Coastal Barrier Resource System (CBRS) Unit L09, established subsequent to the passage of the Act, includes the entirety of Masonboro Inlet and the southern part of Banks Channel.

The Act includes a set of exceptions that, if applicable, allow for Federal expenditures within CBRS units. Utilization of the exceptions found at 16 U.S.C. § 3505(a)(6) requires consultation with the applicable resource agency, in this case the US Fish and Wildlife Service of the Department of the Interior (DOI). When environmental review and long-term cost sharing agreements were established for this project in 1993, the Wilmington District determined that the exception found at 16 U.S.C. § 3505(a)(6)(G) (nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore a natural stabilization system) applied to the project. A subsequent clarification of the use of this exception by the DOI has made it clear that the DOI does not interpret this exception to be applicable in cases where sand is being removed from a CBRS unit to perform shoreline stabilization functions outside the unit. As a result, the Wilmington District has formulated an alternative, though not the

Recommended Plan, that avoids use of the traditional inlet borrow area for all subsequent renourishments.

Our initial environmental review, utilizing existing information about the inlet borrow source and new information gathered about the alternate borrow source, indicates that use of the inlet borrow source is environmentally preferable to the alternate (offshore) source, and would conserve Federal and non-Federal funds. Therefore, the Wilmington District proposes to continue to consider the inlet source as a potential borrow source for the project, with the explicit understanding that CBRA would prohibit the use of the inlet as a borrow source unless the Congressional re-authorization of the project allowing use of Federal funds to work within this borrow area notwithstanding the financial restrictions of CBRA. Without Congressional language of this sort, the offshore borrow alternative would be used for all future project renourishments for the period of analysis from FY 2022-FY 2036. Beyond this timeframe another source of sand would need to be identified.

While USACE does not typically consider alternatives that are outside the scope of current Congressional authority, the National Environmental Policy Act specifically allows for this type of consideration. In their Forty Most Asked Questions Concerning National Environmental Policy Act Regulations, the Council on Environmental Quality (CEQ) explains that:

> An alternative that is outside the legal jurisdiction of the lead agency must still be analyzed in the [applicable NEPA document] if it is reasonable. A potential conflict with local or federal law does not necessarily render an alternative unreasonable, although such conflicts must be considered. Section 1506.2(d). Alternatives that are outside the scope of what Congress has approved or funded must still be evaluated in the [NEPA document] if they are reasonable, because the [NEPA document] may serve as the basis for modifying the Congressional approval or funding in light of NEPA's goals and policies. Section 1500.1(a).

The Wilmington District proposes that, given the environmental benefits associated with continued use of the inlet borrow source, consideration be given to its continued use in accordance with the Recommended Plan, notwithstanding the restrictions of CBRA.

Designated map showing the Coastal Barrier Resources System in North Carolina indicates Unit L09 is located in the project area (Figure 9-1).

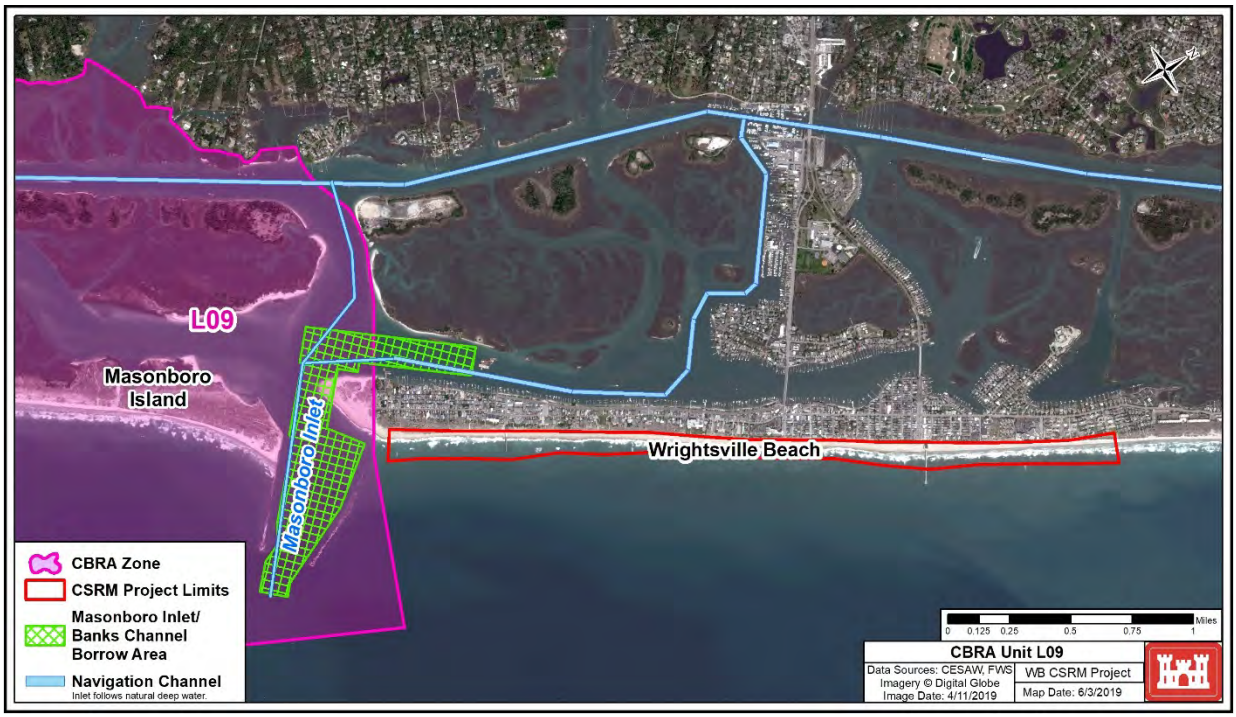


Figure 9-1. Project Area with CBRA Zone

9.4 Environmental Justice

Executive Order 12898 states that the Federal government would review the effects of its proposed actions on low income communities. Federal agencies are "to the greatest extent practicable and permitted by law" identify and address "as appropriate, disproportionately high and adverse human health and environmental effects of its programs, policies and activities on minority populations and low-income populations in the United States."

Minority and Low Income Populations. The ethnic makeup of New Hanover County is 79.9 percent white, 16.9 percent African American, less than 1 percent Native American, less than 1 percent Asian, less than 1 percent Pacific Islander, and less than 1 percent from other races. 2.1 percent of the population were Hispanic or Latino of any race. Wrightsville Beach's racial makeup was 98.1 percent white, with less than 1 percent of each additional race represented. The Hispanic population in Wrightsville Beach represents less than 1 percent of the total population.

Any individual with total income less than an amount deemed to be sufficient to purchase basic needs of food, shelter, clothing, and other essential goods and services is classified as poor. The amount of income necessary to purchase these basic needs is the poverty line or threshold and is set by the Office of Management and Budget (www.census.gov). The 2018 poverty line for an individual under 65 years of age was $13,064. The poverty line for a three-person family with one child and two adults was $20,212. For a family with two adults and three children, the poverty line was $29,967 (www.census.gov).

On average, the socioeconomic composition of New Hanover County and Wrightsville Beach is higher than the remainder of North Carolina. The median household incomes are $51,232 and $77,232 respectively for the county and town, which is higher than the State average of $48,256. The per capita incomes in New Hanover County and Wrightsville Beach are $31,708 and $69,591 respectively, both higher than the State average of $25,774. In 2017, the poverty rate in New Hanover County was around 16.1 percent, and for children ages 0-17 the poverty rate increased to 23.5%.

The proposed action would impact the following areas: Masonboro Inlet and Banks Channel, Wrightsville Beach, nearshore areas off Wrightsville Beach and an offshore borrow source.

The USACE evaluated potential project impacts of the proposed project and found that the information shows that the Recommended Plan would not cause disproportionately high and adverse impacts on minority populations or low income populations. No impacts to either minority/low-income populations or low income communities are anticipated as a result of the Proposed Action therefore the action would comply with EO 12898.

The 2010 US Census data showed the minority/low-income populations and low-income communities are not found on Wrightsville Beach. The proposed action would impact Wrightsville Beach and nearshore areas off Wrightsville Beach. Accordingly, the proposed action would not cause disproportionately high and adverse impacts on minority populations or low income populations. No impacts to either minority/low income populations or low income communities are anticipated as a result of the Proposed Action therefore the action would comply with EO 12898.

10 CONCLUSION

The Recommended Plan is feasible on the basis of engineering and economic criteria and is acceptable by environmental, cultural and social laws and standards.

Based on findings described in this draft report, it is in the Federal interest to implement the proposed action. Continued use of the Masonboro Inlet/Banks Channel borrow source would require an exemption from the provisions of CBRA for this project in the project's final Congressional authorization.

The Recommended Plan is supported by the non-Federal sponsor, the Town of Wrightsville Beach. The sponsor has the capability to provide the necessary non-Federal requirements identified and described in this report.

11 RECOMMENDATIONS

This study has addressed the needs for continued coastal storm risk management for the Town of Wrightsville Beach. The following recommendations include items for implementation by Federal, State of North Carolina, and local governments and agencies, including the validation project.

Hurricane Risk Education

Numerous people die each year as a result of hurricanes, primarily due to the failure to evacuate to an area of safety. Any loss of life is tragic, and any number of those deaths may have been prevented. Even one death prevented is sufficient reason to improve our methods of educating the public on hurricane and storm threats, and to ensure that all is done to warn all those residents or visitors to the coastline of North Carolina as to the dual hazards of wind and surge/waves. It is particularly vital to inform the public as to the potential for hurricane occurrence, particularly within the dangerous hurricane season, so they pay continued attention to media reports on weather. Education needs to include articulation of effects related to the potential magnitude of the threat, the urgency to heed potential calls to evacuate, and providing the means by which to make wise choices on evacuation methods and route (see recommendations given below under "Hurricane Evacuation Planning"). The following are suggested guidelines for implementation by State and local government, in the interests of good education on hurricane storm threats:

- Provide good science and information to the residents and visitors to coastal North Carolina, so they can understand the nature of the threat, and its possibility of happening at any time within the hurricane season. This information should be provided in both written form, and as an initial "page" on televisions provided in visitor's housing, and also in a variety of venues, including:
    - Posting and televised education in supermarkets, libraries, and public buildings;
    - Teacher-provided, posted and televised education in schools and at public meetings and gatherings, at intervals not to exceed 1 year;
    - Publically-posted and visitor-housing-posted information on evacuation routes, and procedures, on publicly-accessible websites, updated regularly (minimum 1 yr.).

There is nothing humanly possible to maintain the lives and safety of coastal North Carolina residents and visitors, if they do not have sufficient warning, and if they then do not use that knowledge to evacuate in a timely manner.

Education of hurricane risks is an on-going effort of multiple agencies and educational institutions, and not a funded program under existing USACE authorities. Updating of websites containing evacuation routes and procedures should be done under existing programs implemented by the state and local governments.

Hurricane and Storm Warning

Residents and visitors to the coast of North Carolina need to recognize that they live in, or visit, a high-hazard area. Although certain times of the year pose less risk than others, each year's hurricane season provides a strong possibility of hurricane impact somewhere along the coast of North Carolina. All residents and visitors need to be made aware of the current hurricane threat, but first meteorological conditions must be evaluated, and any threat must be assessed and characterized by experts with the National Oceanic and Atmospheric Administration's National Weather Service, and that interpretation passed to national and local media for dissemination. Continued support of NOAA's program, and the following supportive activities is critical to an adequate warning process:

- On-going efforts to upgrade the existing system of NOAA buoys, transmission capabilities, and advanced warning measures that provide data on the location and nature of weather conditions.
- Efforts directed at the interpretation of that data and its dissemination to the media and public, through the National Weather Service.
- Public appreciation for the need to be aware at all times of, and the need to listen to weather reports and advice given on various media. Television weather reports, radio, and the internet all provide excellent up-to-date information on weather conditions, and the development of threatening situations. Simply living in or visiting the barrier islands of North Carolina should be sufficient to create a consistent and on-going process of being exceptionally aware of the weather, and its potential consequences.
- The vital importance of heeding the advice of experts. One should know what needs to be done in the event of an approaching storm. Family members should conduct evacuation drills, keep needed phone numbers and travel supplies on hand, and be prepared to leave on short notice. One should be aware of evacuation routes, keeping a full tank of gas during the hurricane season, and having a plan for where one should go, how to maintain contact with other family members, and where one will re-locate temporarily, particularly if this turns out to be longer than expected.

Hurricane Evacuation Planning Upgrading

The critical need for adequate evacuation planning was borne out by Hurricanes Bertha, Fran, and Floyd, of the late 1990's, and brought even more to the forefront by the monumental impacts of Hurricane Katrina in 2005. An evacuation plan is an essential component of a comprehensive plan for ensuring the safety of residents of, and visitors, to the coast of North

Carolina. The preservation of life is the single most important goal and objective of the recommendations. Joint Federal Emergency Management Agency (FEMA)/ NOAA/Corps/State of North Carolina studies of evacuation routes and populations along the coastline has provided a tremendous amount of value to-date in aiding local government, individual and family readiness, in the face of approaching events. Support for this program is a critical element of the recommendations for the Town of Wrightsville Beach, in support of its residents and visitors. The following are important recommendations in support of efforts to support Hurricane Evacuation Planning:

- There is still much that can be done to update this on-going effort, and to provide new, and more widely-disseminated data and tools for evacuation planning by the State and the Town of Wrightsville Beach, and also for use by individuals and families in their preparation for an impending event.
- Evacuation route signage is an important part of a successful evacuation campaign. Maintenance of hurricane evacuation route signage is viewed as a vital link in ensuring the safety of residents and visitors alike.
- The provision of additional signage illustrating surge height achieved during past events would be an added and continual link to on-going education efforts. This could take the form of signs placed in locations in which there is significant traffic, such as major thoroughfares, where pedestrians walk, and particularly in those highest hazard zones based on elevation/depth data.

Evacuation Planning is an on-going effort of multiple agencies, including the USACE, but its implementation is not a funded program under existing USACE authorities. Updating of websites containing evacuation routes and procedures should be periodically updated under existing programs implemented by the State of North Carolina.

Floodplain Management

Management of the floodplain is a non-Federal responsibility, yet is considered a key component of all plans for coastal storm risk management. The Town of Wrightsville Beach participates in the National Flood Insurance Program, which requires the Town to engage in active and responsible floodplain management. Since so much of the Town of Wrightsville Beach is within a recognized floodplain, the Town continues to engage in activities that reduce threats to existing and potential future development, including structure setbacks, building code and construction monitoring, and flood zone management. The Town is encouraged to continue to update building codes, and encourage strong pursuit of activities such as first-floor elevation and building code upgrading, in the effort to reduce the potential for future structural and content damage.

Building Codes

The Town of Wrightsville Beach has adopted the International Building Code (IBC) to guide the design and construction of residential and commercial structures in the study area. In order to assure that the latest design and construction techniques are being used that apply to hurricane-resistant construction, all future construction is encouraged to follow the latest version of the IBC (2007) and ensure enforcement of the codes through diligent building permit processing and on-site inspections of construction. Annual training classes on the use and enforcement of the new IBC should be encouraged. In addition, the Town of Wrightsville Beach should consider adopting the document "FEMA 550 Guidelines for Elevating Residential Structures on the Gulf Coast" as a part of their updated building codes for construction, due to the possibility of surge inundation associated with hurricane events.

Long-term Critical Infrastructure and Services Upgrading

The upgrading of critical infrastructure and services, such as Fire and Police services, is considered a vital recommendation in the reduction of threats to lives and property. The need to bring these services up to immediate restoration in the wake of a hurricane is of vital importance to the community. The methodical upgrading of the Towns' Fire and Police services facilities as part of their Capital Improvement Programs will provide long-term savings in capital outlay, and potentially save lives and residential and commercial property damage. This program may be instituted under a modified Capital Improvement Program, where structures reaching the end of their economic life are successively replaced by upgraded structures, locating vital communications and power supplies above the elevation of a Maximum Probable Surge event, and capable of surviving the ravages of wind and/or surge, as funds become available.

Upgrading or replacement of services is primarily a local charge, implemented through Capital Improvement Plans, with funding from a variety of Federal, State, and local resources, and will take many years to accomplish, due to the varying age and condition of each facility.

Structural Risk Management Features

Based on the conclusions of this study, I recommend the implementation of the Recommended Plan that consists of a dune having a crown width of 25 feet at 12.5 feet NAVD88, together with a beach berm, having a crown width of 50 feet at 9.5 feet NAVD88, and a construction berm, having a crown width of 205 feet at 5.0 feet NAVD88. The dune and berms extend north 13,670 feet from Masonboro Inlet North Jetty. In addition to the main fill, the project includes a 2,000-foot-long transition on the north end. The total project length (including transitions) is 15,650 feet, with such modifications thereof as in the discretion of the Commander, USACE, may be advisable. Material for the beach fill would be from Masonboro Inlet/Banks Channel or an offshore borrow source, if required, to the Wrightsville Beach shoreline. Continued use of Masonboro Inlet/Banks Channel would require an exemption from CBRA in the project's final Congressional authorization. The renourishment interval for the project is four years.

As a result of this Validation Study and EA, I recommend that the project be authorized and implemented in accordance with the findings of this report.

I further recommend that renourishment of the proposed project be contingent on the project sponsor giving written assurances satisfactory to the Secretary of the Army that it will:

a. Provide 50 percent of periodic renourishment costs assigned to coastal storm risk management plus 100 percent of periodic renourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits and as further specified below:

(1). Provide all lands, easements, and rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the periodic renourishment, operation, and maintenance of the project;

(2). Provide, during renourishment, any additional amounts as are necessary to make its total contribution equal to 50 percent of periodic renourishment costs assigned to coastal storm risk management plus 100 percent of periodic renourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;

b. Operate, maintain, repair, replace and rehabilitate the completed project, or functional portion of the project between periodic renourishment events, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the periodic renourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total costs of renourishment of the Project,

and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the periodic renourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

g. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the periodic renourishment, operation, or maintenance of the project;

h. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by (42 U.S.C. 4601 – 4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the periodic renourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material placement, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable Federal labor standards and requirements, including but not limited to, 40 U./S.C. 3141 – 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying, and enacting without substantial change the provisions of the Davis- Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act

(formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S. C. 276c et seq.);

k. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires the non-Federal interest to participate in and comply with applicable Federal floodplain management and flood insurance programs, prepare a floodplain management plan within one year after the date of signing a Project Cooperation Agreement, and implement the plan not later than one year after completion of renourishment of the project;

l. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

m. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

n. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

o. Prevent obstructions of or encroachment on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the level of protection it affords, hinder operation and maintenance or future periodic renourishment, or interfere with its proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;

p. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

q. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

r. For so long as the project remains authorized, the non-Federal sponsor shall ensure continued conditions of public ownership, access, and use of the shore upon which the amount of Federal participation is based;

s. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of renourishment material from the project design section and provide the results of such surveillance to the Federal Government; and

u. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 22130, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the Non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

The non-Federal sponsor has indicated that they have available the necessary funds to provide the non-Federal share of the project first costs and periodic renourishment costs. I am confident that the non-Federal sponsor will provide their share.

This recommendation is subject to the cost-sharing policies as outlined in this report and is endorsed, provided that, prior to renourishment, the non-Federal sponsor enters into a written PPA, as required by Section 221 of Public Law 91-611, as amended.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works renourishment program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

The Administration's projections of future inflation are 2.785 percent annually. Based on these data, the total inflation adjusted (fully funded) project costs are estimated to be $91,710,000, including sunk costs through FY 2018, to continue Federal participation in periodic renourishment for the Recommended Plan through FY 2036. The Federal share of the fully funded project costs is currently estimated at $45,850,000. The non-Federal share of the fully funded costs is currently estimated at $45,850,000. Given the Administration's declared budgetary concerns, potential long-term costs associated with the proposed project may be vital to decision making. As previously indicated, the total project benefit-cost ratio is 5.2, which means that for every dollar spent for the project there are 5 dollars and 20 cents realized in National Economic Development (NED) benefits from the project.

These recommendations comply with Section 215 of the Water Resources Development Act of 1999, which sets cost sharing for periodic renourishment at 50 percent Federal and 50 percent non-Federal. In recent years the Federal share of periodic renourishment costs of new coastal storm risk management projects has been limited by the availability of funds. However, I recommend that this Validation Report, prepared under Section 1037 of the Water Resources Reform and Development Act of 2014, as amended, be approved.

In conclusion, I recommend an increase in the total maximum Section 902 of WRDA 1986 project cost limit to continue Federal participation in periodic renourishment of the Wrightsville Beach, NC Coastal Storm Risk Management in accordance with the Recommended Plan described within this report, notwithstanding the provisions of the Coastal Barrier Resources Act of 1982.

Robert J. Clark
Colonel, U.S. Army
District Commander

12 POINT OF CONTACT

Questions or comments regarding this draft Integrated Wrightsville Beach Validation Study and Environmental Assessment and the proposed action should be directed to:

US Army Corps of Engineers, Wilmington District
Environmental Resources Section
Attn: Mr. Eric Gasch
69 Darlington Avenue
Wilmington, NC 28403

Telephone: (910) 251-4553

Email: Eric.K.Gasch@usace.army.mil

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Attachment 1 - Sponsor Letter of Support

TOWN OF WRIGHTSVILLE BEACH
Post Office Box 626
321 Causeway Drive
Wrightsville Beach, North Carolina 28480
(910)239-1700
FAX (910)256-7910

June 16, 2019

Colonel Robert J. Clark
District Commander
U.S. Army Corps of Engineers
Wilmington District
69 Darlington Avenue
Wilmington, NC 28403

RE: Wrightsville Beach Validation Study

Dear Colonel Clark:

As the project sponsor, the Town of Wrightsville Beach expresses their support for the ongoing validation study to increase the Section 902 maximum project cost limit on the Wrightsville Beach coastal storm risk reduction project. Completion and authorization of this study would allow continuation of Federal participation in periodic renourishment through fiscal year (FY) 2036. We look forward to a completed study ready for authorization in the next Water Resources Development Act, hopefully in FY 2020.

The Town, New Hanover County and the Corps have been partners on this crucial project for almost 56 years, recently demonstrated in the completion of a periodic renourishment in 2018. This project has realized significant coastal storm risk reduction benefits to residents, businesses and critical infrastructure as well as providing exceptional recreational opportunities to the public.

We look forward to working with your staff and helping any way we can achieve completion and authorization of this study as quickly as possible. Please do not hesitate to call me at (910)239-1770.

Sincerely,

Timothy W. Owens
Town Manager

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