US Army Corps
of Engineers
Wilmington District®

Wilmington Harbor 403 Letter Report

Wilmington, NC

APPENDIX J

Appendix J: Essential Fish Habitat

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Draft

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APPENDIX J - ESSENTIAL FISH HABITAT

SECTION J.1 INTRODUCTION

The U.S. Army Corps of Engineers, Wilmington District (USACE) is seeking to modify the existing federally authorized navigation channel from the lower end of the Anchorage Basin at the Port of Wilmington to the seaward limit of the ocean entrance channel and create an approximately nine-mile seaward expansion of the ocean entrance channel.

The Port of Wilmington has experienced significant growth in cargo volume and in the size of vessels calling at the port since the last major channel improvements were completed under the Wilmington Harbor 96 Act Project. The proposed improvements to the federal navigation channel would accommodate larger cargo vessels at Wilmington Harbor and enable the Port of Wilmington to improve transportation efficiencies.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires federal agencies to consult with the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) when their actions or the result of their actions may adversely affect essential fish habitat (EFH) or federally managed fisheries. MSA defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” EFH is designated through federal Fishery Management Plans developed by Fishery Management Councils (stewards of nearly all plans) or NMFS (steward of the plan for Highly Migratory Species). USACE, pursuant to section 305(b)(2) of the MSA has prepared this assessment to support consultation with NMFS regarding the proposed federal action that may adversely affect EFH.

Pursuant to the National Environmental Policy Act (NEPA), USACE is in the process of preparing a draft Environmental Impact Statement (EIS) for the proposed deepening and expansion of Wilmington Harbor. USACE is initiating consultation with NMFS under MSA through providing this assessment before the release of the draft EIS for public comment and is requesting comments at the close of the public comment period for the draft EIS.

The EFH assessment includes a brief description of the proposed federal action, an inventory of habitats and managed fishery resources that are present within the project action area, and assessment of potential effects of the proposed federal action on the resources.

SECTION J.2 PROJECT DESCRIPTION

The proposed federal action is to deepen the existing federally authorized navigation channel from the lower end of the Anchorage Basin at the Port of Wilmington to the seaward limit of the ocean entrance channel and create an approximately 9-mile seaward expansion of the ocean entrance channel (Figure 1). The action being considered would deepen most of the navigation channel from its current authorized depth of -42 feet mean lower low water (MLLW) to a new depth of -47 feet. The Entrance Channel reaches would be authorized an additional two feet of depth to account for ocean conditions. The proposed federal action would also expand the width of several of the reaches along the channel and add additional reach to the Outer Ocean Bar, Baldhead Shoal Reach 4.

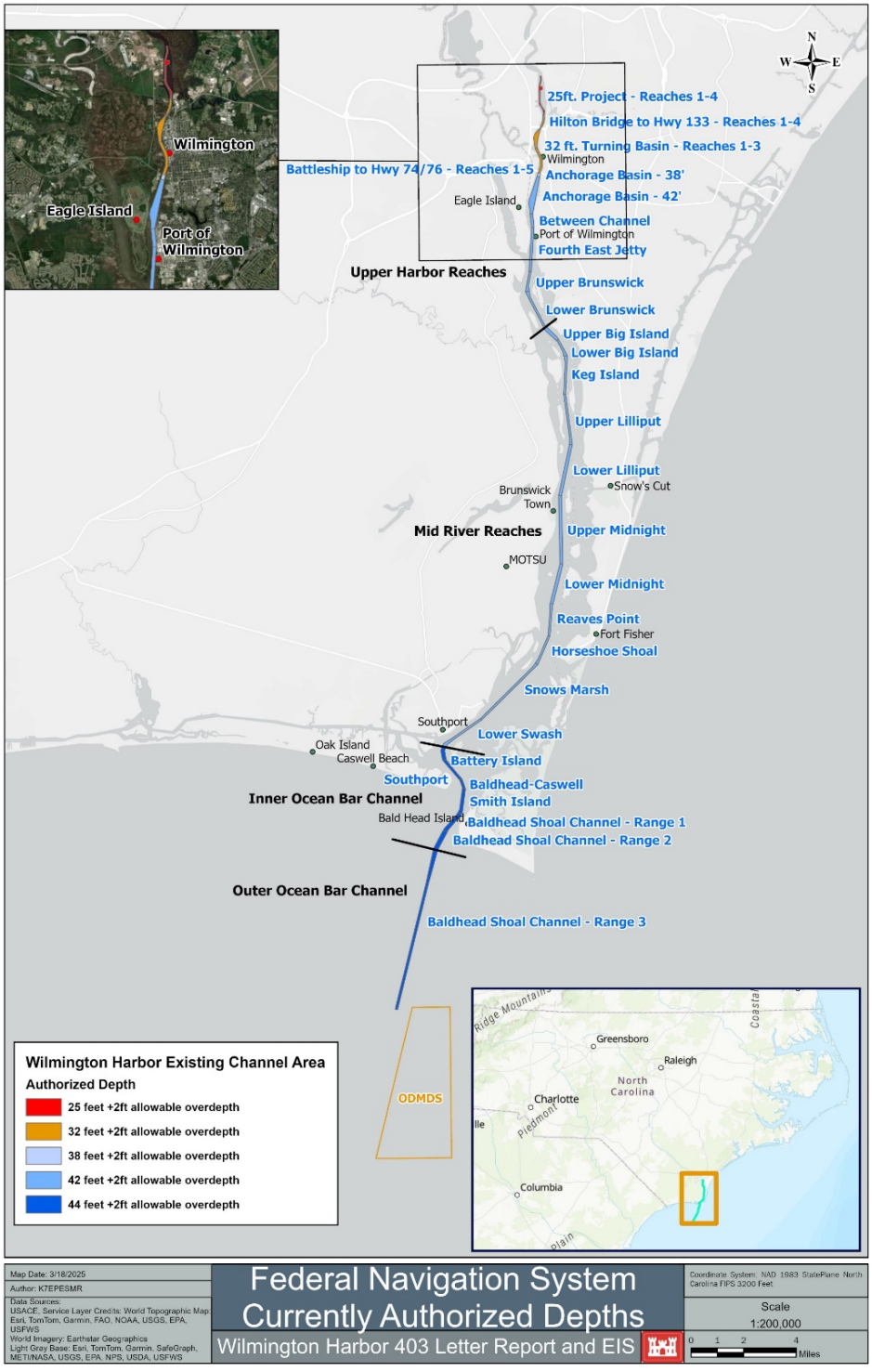

Figure 1 Map of the Wilmington Harbor Project Area

Furthermore, the proposed federal action includes the placement of dredged material in the Ocean Dredged Material Placement Site (ODMDS), the Wilmington Offshore Fisheries Enhancement Structure (WOFES), Baldhead Island Beach, Caswell Beach, Oak Island Beach, Ferry Slip Island, South Pelican Island, and additional areas for beneficial use, which is detailed further in Section 2.2.3 of this EFH and in the Beneficial Use Appendix D.

The purpose of the proposed federal action is to contribute to national economic development (NED) by addressing transportation inefficiencies for the forecasted vessel fleet, consistent with protecting the Nation's environment. Action is needed to address the constraints that contribute to inefficiencies in the existing navigation system's ability to safely and efficiently serve the forecasted vessel fleet and process the forecasted cargo types and volumes.

Additional details on the federal action are included below and are described in-depth in the EIS.

J.2.1 CHANNEL DESIGN

The 47-foot Action Alternative proposes to extend and deepen the entrance channel in combination with channel deepening and widening sections within the inner harbor channels. The proposed navigation improvements include:

Extend the existing entrance channel. The new channel would be dredged and extend approximately 48,000 feet (9.1 miles) seaward from Baldhead Shoal Channel - Reach 3 to waters that are consistently deeper than the currently maintained channel depth of -49 feet MLLW. The reach offshore of the existing pilot boarding station (Sta 490+00) would have a heading of approximately 30 degrees (inbound), which is an approximate 16-degree shift from the Baldhead Shoal Channel - Reach 3 (14-degree). This heading change would take advantage of the most direct navigation path, which is an existing deeper natural channel, minimizing dredging volumes and environmental impacts, while reducing construction and maintenance costs.

Deepen the existing entrance channel from the Battery Island reach to the pilot boarding station (Sta 490+00). The depth would increase from -44 feet to -49 feet MLLW to allow for adequate underkeel clearance for anticipated container vessels in areas affected by ocean waves.

- Construct side slopes of 5:1 (horizontal to vertical) from the Entrance channel to Battery Island.
- Deepen the existing inner harbor navigation channels, all reaches from Lower Swash to the Anchorage Basin from -42 feet to -47 feet MLLW.

Widen the existing inner harbor navigation channel as described in Section 2.5- of the Draft EIS. Construct side slopes of approximately 3:1 (horizontal to vertical) from Lower Swash to the Anchorage Basin. Over time, the slope will stabilize. The 3:1 design is to promote stability, and it is assumed that after construction, the slope will settle into a stable condition at 3:1.

Where rock is present within the proposed dredging footprint, an additional one foot of dredging below the project depth is required to remove the rock for safety purposes. In such areas, up to two additional feet of over-depth dredging is allowed, resulting in a potential total of three feet beyond the project depth. However, only the first foot is mandatory when rock is encountered. Over-depth dredging may occur during both initial construction and subsequent operation and maintenance dredging activities. Summary of project depth requirements can be found in Section 1.3 -of the Draft EIS.

The top of rock was determined using existing geotechnical and geophysical data from the 1996 Deepening Act and the 2012 Channel Improvements Project, along with new geotechnical vibracore data collected in 2023. Additional geotechnical and geophysical information will be collected in Pre-Construction & Engineering Design (PED) to further refine the top of rock surface throughout the channel. Blasting occurred during the last deepening effort in the early 2000s and consisted of removing rock from Lower Brunswick, Upper Big Island, Lower Big Island, and Keg Island reaches. Blasting may be needed again to deepen these reaches to their specified project depths. Ultimately, it will be up to the contractor to determine the correct means and methods to remove dredge material.

Place all dredged material in accordance with the dredged material placement plan, which includes the Ocean Dredged Material Disposal Site (ODMDS), bird islands, adjacent beaches and other beneficial uses, as described in Appendix D.

J.2.2 DREDGING AND DREDGED MATERIAL DISPOSAL

Construction of the proposed Wilmington Harbor navigation improvements would employ hydraulic pipeline (cutterhead), mechanical (bucket), and hopper dredges. Associated disposal operations would include hydraulic loading of barges for offshore transport to the ODMDS, mechanical scow loading for offshore transport to the ODMDS, direct transport to the ODMDS via self-propelled hopper dredges, and direct hydraulic pipeline disposal to several beneficial use sites. The use of hopper dredges would be limited to the outer Baldhead Shoal 2 and 3 entrance channel reaches and the proposed offshore extension reach. Construction of the remaining channel reaches would be accomplished predominantly by cutterhead dredges. Mechanical dredges would be used for the specific purpose of removing pre-treated rock from the ~4.4-mile Keg Island to Lower Brunswick channel reach.

J.2.2.1 DREDGED MATERIAL VOLUMES

The estimated total volume of material to be dredged in constructing the channel improvements is 35.1 million cubic yards; including 5.6 million cubic yards of O&M material, 24.8 million cubic yards of unconsolidated sand and silt and 4.6 million cubic yards of rock (limestone, siltstone, mudstone, and sandstone). Dredged material volume estimates are based on the proposed channel dimensions with an additional one-foot buffer added to reaches where rock is likely to be encountered and an additional two feet of allowable overdepth added to all reaches. All dredged material other than beneficial use material would be taken offshore for disposal in the Wilmington ODMDS. Estimated construction and maintenance volumes are well within the capacity of the ODMDS.

J.2.2.2 ROCK PRE-TREATMENT

Confined underwater blasting may be used as a pretreatment measure to break up rock for subsequent removal by cutterhead and mechanical (bucket) dredges. Areas potentially requiring confined blasting encompass ~158 acres of rock surface area within the Keg Island, Lower Big Island, Upper Big Island, and Lower Brunswick channel reaches. These reaches required blasting during the 2000s deepening effort, and it is expected that blasting or some other form of pretreatment of rock may be needed again to deepen these reaches to their specified project depth. Additional geotechnical and geophysical information will be collected in Planning, Engineering, and Design phase to further refine the rock surface. It will be up to the selected contractor to complete the work if pretreatment is required to remove rock from certain portions of the channel. If it is determined that blasting is needed, USACE would employ

avoidance and minimization measures. The Conceptual Plan (Appendix L) catalogs best management practices (BMPs) that are standardly applied during blasting activity to minimize underwater noise impacts on protected species. The Comprehensive Plan is developed later during the pre-construction phase and will be a more detailed document, which will provide the specific mitigation, monitoring, and reporting measures that USACE / the dredge contractor would ultimately implement during blasting activities within the Wilmington Harbor channel.

J.2.2.3 BENEFICIAL USES OF DREDGED MATERIAL

Under the proposed action, approximately 50% of all material taken out of the federal navigation channel with the initial deepening effort will be used for beneficial use activities. Beneficial uses of dredged material would include intertidal placement of fine-grained materials and sandy materials along riverbanks, back barrier areas, surrounding bird island areas, and along marshes in the Cape Fear River; beach placement in southeastern North Carolina; bird island placement, including existing and historic footprints (renourishment); and fish habitat rock placement at the existing WOFES (Figure 2; Table 1). These four categories of beneficial use will utilize all types of sediment obtained from the dredging activities, including but not limited to: non-beach quality sediment (fine-grained material including organics, ≤90% sand); beach quality sediment (sand and minimal organics, ≥90% sand); soft rock (rock not requiring blasting that can be removed by cutter-head dredge); and hard rock (will require blasting or fracturing before removal).

The methodologies for material placement, location, ecological effects, and the general plan for this material is further described in the Beneficial Use appendix (Appendix D).

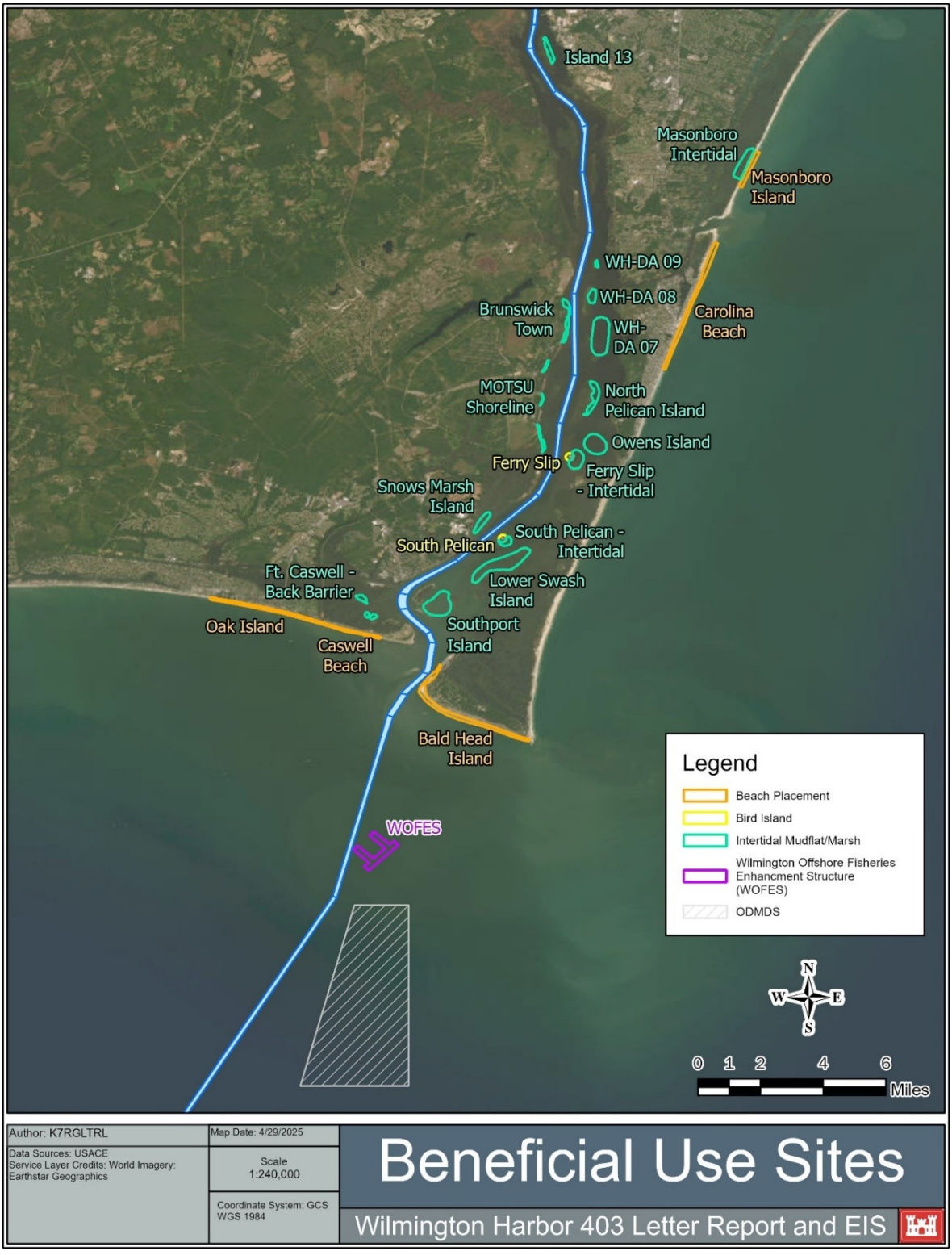

Figure 2 Map of the Proposed Beneficial Use Sites

Table 1 Proposed Beneficial Use Sites

Beneficial Use Site	Habitat	Material Composition	Lat/Long of Placement Area
Island 13	Intertidal Mudflat/Marsh	Silty/Clayey Sand	77.9518520°W 34.1604786°N
WH-DA 09	Bird Island	Sand	77.9298662°W 34.0620949°N
WH-DA 08	Bird Island	Sand	77.9319516°W 34.0472342°N
WH-DA 07	Intertidal Mudflat/Marsh	Silty/Clayey Sand	77.9282185°W 34.0288610°N
North Pelican Island	Intertidal Mudflat/Marsh	Clays/Silts	77.9313292°W 34.0009474°N
Brunswick Town	Intertidal Mudflat/Marsh	Silty/Clayey Sand	77.9437788°W 34.0364437°N
Brunswick Town – Wave Attenuators	Intertidal Mudflat/Marsh	Silty/Clayey Sand	77.9428231°W 34.0404212°N
MOTSU Shoreline	Intertidal Mudflat/Marsh	Silty/Clayey Sand	77.9548626°W 33.9909722°N
Owens Island	Intertidal Mudflat/Marsh	Silty/Clayey Sand	77.9305038°W 33.9790606°N
Masonboro Island	Beach Placement	Sand	77.8611864°W 34.1073995°N
Masonboro Island	Intertidal Mudflat/Marsh	Silty/Clayey Sand	77.8611864°W 34.1073995°N
Carolina Beach	Beach Placement	Sand	77.8771601°W 34.0656305°N
Ferry Slip-Intertidal	Intertidal Mudflat/Marsh	Silty/Clayey Sand & Sand	77.9391247°W 33.9719067°N
Ferry Slip	Bird Island	Sand	77.9423432°W 33.9733323°N
South Pelican	Bird Island	Sand	77.9732883°W 33.9356220°N
Snows Marsh Island	Intertidal Mudflat/Marsh	Clay/Silts	77.9828500°W 33.9431807°N
Lower Swash Island	Intertidal Mudflat/Marsh	Clays/Silts & Gravelly Silts/Clays	77.9736771°W 33.9239555°N
Southport Island	Intertidal Mudflat/Marsh	Clays/Silts & Gravelly Silts/Clays	78.0027589°W 33.9050561°N
Ft. Caswell - Back Barrier	Intertidal Mudflat/Marsh	Clays/Silts & Gravelly Silts/Clays	78.0363634°W 33.9042395°N
Bald Head Island	Beach Placement	Sand	77.9957081°W 33.8547791°N
Caswell Beach	Beach Placement	Sand	78.0336820°W 33.8909273°N

Beneficial Use Site	Habitat	Material Composition	Lat/Long of Placement Area
Oak Island	Beach Placement	Sand	78.0745135°W 33.9011803°N
WOFES	Rock Reef	Rock	78.0316430°W 33.7914153°N

J.2.2.4 CONSTRUCTION SCHEDULE

The proposed improvements to the Wilmington Harbor navigation channel would be constructed over a period of six years. The project construction schedule is included in Section 1.2 of the EIS.

SECTION J.3 ESSENTIAL FISH HABITAT IN PROJECT AREA

The final rule for implementing the EFH provisions of the MSA was released on 17 January 2002. Fishery Management Plans administered by the NMFS, South Atlantic Fishery Management Council (SAFMC), the Mid-Atlantic Fishery Management Council (MAFMC), and New England Fisheries Management Council (NEFMC) designate EFH in the project area. The EFH for a given species can include multiple habitats to support reproduction, juvenile and adult development, feeding, protection, and shelter during species' various life stages. This EFH assessment describes the habitat(s) and managed fishery resource(s) that may be present within the potential project footprint depending on time of year and life stage. The project footprint includes the Cape Fear River Estuary and the ODMDS. If any activities could potentially affect EFH adversely, the applicable federal agency must consult with the NMFS to develop measures to conserve EFH and support management of sustainable marine fisheries.

EFH in estuarine areas for fisheries that are managed by the NMFS, SAFMC, MAFMC, and NEFMC and occur within the placement or project area are listed in Table 2. EFH was identified within the project area using NOAA Fisheries Essential Fish Habitat Mapper (https://coast.noaa.gov/digitalcoast/tools/efhmapper.html) along with the User's Guide to Essential Fish Habitat Designations by the South Atlantic Fisheries Management Council (SAFMC 2024). Table 3 provides the common species that may be located in the project area, as listed on the NOAA EFH Mapper (accessed April 8 2025). Potential impacts were defined as: no adverse effect, adverse but not substantial, and adverse effects. No adverse effect was used when there was no effect on EFH or EFH is not designated at the project site. For adverse effect but not substantial, the adverse effects are no more than minimal, temporary, or can be alleviated with minor project modifications or conservation recommendations. The adverse effect is designated if the actions have substantial effects to EFH.

Table 2 EFH categories likely to be in project area (NOAA 2025b; NMFS Procedure 03-201-16)

Essential Fish Habitats	Potential Presence		Potential Impacts	
	Project Impact Area	In/Near Project Vicinity	Dredging Activities	Sediment Placement Activities
Estuarine and Marine Water Column	✓	✓	Adverse but not substantial	Adverse but not substantial
Estuarine Emergent Wetlands	✓	✓	Adverse but not substantial	No Adverse Effect
Palustrine Emergent Wetlands	✓	✓	Adverse but not substantial due to mitigation	No Adverse Effect
Submerged Aquatic Vegetation		✓	No Adverse Effect	No Adverse Effect
Subtidal and Intertidal Non-Vegetated Flats	✓	✓	Adverse but not substantial	Adverse but not substantial
Oyster Reefs and Shell Banks	✓	✓	Adverse but not substantial	Adverse but not substantial
Unconsolidated Bottom	✓	✓	Adverse but not substantial	Adverse but not substantial
Hardbottom and Artificial Reefs		✓	No Adverse Effect	No Adverse Effect
Coastal Inlets	✓	✓	Adverse but not substantial	Adverse but not substantial
State-Designated Nursery Areas	✓	✓	Adverse but not substantial	Adverse but not substantial
Sandy Shoals of Capes	✓	✓	Adverse but not substantial	No Adverse Effect

Table 3 NMFS, SAFMC, MAFMC, and NEFMC managed species potentially located in project area

Common Name	Scientific Name	Life Stage Use(s)	Fisheries Management Plan
Atlantic Sharpnose Shark	*Rhizoprionodon terraenovae*	Adult, Juvenile, Neonate	NMFS Highly Migratory Species
Blacknose Shark	*Carcharhinus acronotus*	Juvenile/Adult	NMFS Highly Migratory Species
Blacktip Shark	*Carcharhinus limbatus*	Juvenile/Adult	NMFS Highly Migratory Species
Bluefish	*Pomatomus saltatrix*	Adults, Eggs, Juvenile, Larvae	MAFMC Bluefish
Bonnethead Shark	*Sphyrna tiburo*	Juvenile/Adult	NMFS Highly Migratory Species
Clearnose Skate	*Raja eglanteria*	Juvenile	NMFS Highly Migratory Species

Common Name	Scientific Name	Life Stage Use(s)	Fisheries Management Plan
Coastal Migratory Pelagics	*Scomberomorus maculatus (Spanish Mackerel)*	ALL	SAFMC Coastal Migratory Pelagics
Penaeid Shrimp (Brown, Pink, and White Shrimp)	*Penaeus aztecus (Brown Shrimp)* *Penaeus duorarum (Pink Shrimp)* *Penaeus setiferus (White Shrimp)*	ALL	SAFMC Shrimp
Sand Tiger Shark	*Carcharias taurus*	Adult, Neonate/Juvenile	NMFS Highly Migratory Species
Sandbar Shark	*Carcharhinus plumbeus*	Adult, Juvenile	NMFS Highly Migratory Species
Scalloped Hammerhead Shark	*Sphyrna lewini*	Juvenile/Adult	NMFS Highly Migratory Species
Smoothhound Shark Complex	*Mustelus mustelus*	ALL	NMFS Highly Migratory Species
Snapper Grouper	*Centropristis striata* (Black sea bass)	ALL	SAFMC Snapper Grouper
Spinner Shark	*Carcharhinus brevipinna*	Juvenile/Adult, Neonate	NMFS Highly Migratory Species
Summer Flounder	*Paralichthys dentatus*	Adult, Juvenile, Larvae	MAFMC Summer Flounder, Scup, Black Sea Bass
Tiger Shark	*Galeocerdo cuvier*	Juvenile/Adult, Neonate	NMFS Highly Migratory Species
Windowpane Flounder	*Scophthalmus aquosus*	Juvenile	NEFMC Northeast Multispecies

J.3.1 ESTUARINE AND MARINE WATER COLUMN

The transient boundaries of the estuarine water column are variable due to wind- and tidal-driven inlet sea water mixing with upland freshwater sources and land surface runoff. With these mixing attributes, salinity levels vary within this estuarine EFH. Typically, the salinity groups include four ranges: oligohaline (< 5 practical salinity unit [psu]), mesohaline (5 to 18 psu), polyhaline (18 to 30 psu), and euryhaline (>30 psu). The saltwater tidal action and freshwater inflows are primary factors in estuarine circulation and nutrient/waste removal. Strong wind events and freshwater tributaries can increase turbidity, reducing light penetration, and adversely effecting submerged aquatic vegetation and phytoplankton photosynthesis. Freshwater rivers and stream inflows provide estuarine EFH habitats organic matter, nutrients, and finer grained sediments, whereas ocean-driven tides provide coarser sediments and act as a transport mechanism for estuarine-dependent species (i.e., at least one life stage occurs in the estuary). The ocean waters within this EFH act as a temperature stabilizer that offsets seasonal temperature extremes that would reduce productivity and diversity in the shallow upstream waters. Salinity, temperature, dissolved

organic matter, turbidity, total suspended solids, dissolved inorganic nitrogen, and dissolved oxygen are components normally used to characterize the estuarine water column. Other descriptors, such as adjacent structures (shoals, channels, and marshes), water depth, available fetch, and light availability are also used to further describe this EFH. The estuarine water column provides both migrating and residential species of varying life stages the opportunity to survive in a productive, active, unpredictable, and at times strenuous environment. As the transport medium for nutrients and organisms between the ocean and the upstream rivers and inland freshwater systems, the estuarine water column is as essential a habitat as any marsh, seagrass bed, or reef (SAFMC 2009).

The marine water column can exhibit various changes throughout time and space in the physical and biological characteristics, such as temperature, salinity, density, nutrients, light and depth (SAFMC 2009). Therefore, there are numerous potentially distinct water column habitats for a broad array of species and life stages within species. In the North Carolina region, physical processes are important and the shelf environment can be subdivided into three oceanographic zones (Atkinson et al. 1985; Menzel 1993). The outer shelf (40-75 m) is influenced primarily by the Gulf Stream and secondarily by winds and tides. On the mid-shelf (20-40 m), the Gulf Stream, winds, and tides almost equally affect the water column. Freshwater runoff, winds, tides and bottom friction influence inner shelf waters (0-20 m). In coastal waters, river discharge and estuarine tidal plumes contribute to the water column structure. Due to their important ecological function, areas of the offshore pelagic environments discussed above and the associated benthic habitats have been designated essential fish habitat-habitat and in some cases are considered habitat areas of particular concern (EFH-HAPC) (SAFMC 1998b). These areas are productive and highly dynamic oceanic areas.

J.3.2 ESTUARINE EMERGENT WETLANDS (SALT MARSH AND BRACKISH MARSH)

Salt marshes are transitional areas between land and water, occurring along the intertidal estuarine shorelines where salinity ranges from near ocean strength to near fresh in upriver marshes. The estuarine wetland is described as tidal wetlands in low-wave-energy environments, where the salinity is greater than 0.5 and is variable owing to evaporation and the mixing of seawater and freshwater (SAFMC 1998). Estuarine emergent marshes protect shorelines from erosion, produce detritus, filter overland runoff, and function as vital nursery area for various fish and many other species. Estuarine emergent wetlands are characterized by the presence of erect, rooted, herbaceous hydrophytes dominated by salt-tolerant perennial plants.

The structure and function of a salt marsh are influenced by tide, salinity, nutrients, and temperature. Estuarine intertidal marshes, as well as the network of tidal creeks that salt marshes drain into, provide refuge, forage, and nursery habitat for Council- and NMFS-managed species, other non-managed fishes, shellfish, invertebrates, as well as endangered and threatened species. Estuaries provide major sources of nutrients, nekton, prey fish, and detritus to other ecosystems, which is primarily facilitated by water movement. The cross-habitat transfer of energy and carbon from donor to recipient habitats plays a vital role in shaping food webs and productivity in recipient systems, particularly those supporting additional managed species, such as coastal migratory pelagics (e.g., mackerels), highly migratory pelagic species (e.g., Atlantic sharp nose sharks, blacktip sharks, and bull sharks), and species in the snapper grouper complex (Polis et al. 1997). Additionally, salt marsh estuaries provide commercial and economic value to

people; it is estimated that 95 percent of finfish and shellfish species harvested commercially in the U.S. are wetland-dependent, thus could be considered estuarine-dependent (SAFMC 1998).

J.3.3 PALUSTRINE EMERGENT WETLANDS (FRESHWATER WETLANDS)

Palustrine emergent wetlands are “All nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and all such tidal wetlands where ocean-derived salinities are below 0.5 ppt.” These wetlands would be considered tidal freshwater wetlands (Cowardin et al. 1985).

J.3.4 SUBMERGED AQUATIC VEGETATION (SAV)

Submerged Aquatic Vegetation (SAV) encompasses a number of species of rooted aquatic vascular plants that occur in North Carolina estuaries; including eelgrass, shoal grass, and widgeon grass. SAV beds occur on subtidal and occasionally intertidal sediments in sheltered estuarine waters. SAV beds provide important structural fish habitat and perform important ecological functions such as primary production, sediment and shoreline stabilization, and nutrient cycling (NCDEQ 2016). SAV habitats are important nursery areas for the juveniles of ocean-spawned estuarine-dependent species; including many important commercial and recreational species such as Atlantic croaker, black sea bass, bluefish, flounders, gag grouper, herrings, mullets, red drum, snappers, Spot, spotted seatrout, weakfish, southern kingfish, and penaeid shrimp. Bay scallops, hard clams, and blue crabs are also strongly associated with SAV; and large predatory species such as bluefish, flounders, red drum, and spotted seatrout are attracted to SAV beds for their concentrations of juvenile finfish and shellfish prey (Thayer et al. 1984).

The Wilmington Harbor 203 report conducted by the North Carolina State Ports (NCSP) stated that the only confirmed SAV beds in the Cape Fear River estuary, consisting of slender naiad (Najas gracillima), are located in the Brunswick River near the United States Highway 74/76 Bridge (NCSP 2022). Research on the slender naiad identified this plant as very rare in the North Carolina Coastal Plain (North Carolina Parks 2025). The slender naiad habitat type is freshwater ponds, lakes, and slow-moving streams that do not experience tidal action (North Carolina Botanical Garden 2025; IUCN 2025). The slender naiad is highly unlikely to be in the Cape Fear River where dredging will occur due to the lack of preferred habitat type and salinity range.

In a letter dated July 19, 2024, NMFS stated that oligohaline SAV was reported in Town Creek and the adjacent Brunswick River. They also mentioned that in 1995 the endangered and endemic Ramshorn snail (*Helisoma eucosmium*) was found on the vegetation in Town Creek. Due to the location of the proposed action, the proposed project is not likely to directly or indirectly affect the Town Creek SAV.

J.3.5 SUBTIDAL AND INTERTIDAL NON-VEGETATED FLATS

Subtidal and intertidal flat habitat types are characterized based on water depth compared to mean sea level and sediment types. Subtidal habitats may be composed of sand, mud, or some combination of the two. Intertidal flats are typically composed of sand. The intertidal flats are often influenced by wave action and tidal cycles. Subtidal and intertidal sand and mud flats serve as habitat to a diverse assemblage of infaunal and epifaunal organisms and provide shoreline protection against erosion and storms, sustenance through food web connections to foraging birds and finfishes, and carbon sequestration and organic degradation (Savarese n.d.).

Tidal flats are a critical component of coastal systems that serve as feeding grounds and refuge for a variety of animals. The system provides nursery grounds for early stages of development for many benthic estuarine species such as summer founder, red drum, gray snapper, blue crab, penaeid shrimp, and others use these EFH as nurseries.

These flats also serve as refuge areas for species avoiding predators and foraging area for fish, which use the tide cycles for access to estuarine feeding grounds (SAFMC 1998).

J.3.6 OYSTER REEFS AND SHELL BANKS

Oyster reefs and shell banks are defined by SAFMC as being the “natural structures found between and beneath tide lines, which are composed of oyster shell, live oysters, and other organisms.” This habitat is usually found adjacent to emergent marsh vegetation and provides the other three-dimensional structural relief in soft-bottom, benthic habitat (Wenner et al., 1996). The eastern oyster (*Crassostrea virginica*) is the dominant and principal reef-building species of estuarine shell bottom habitats in North Carolina. Optimal salinity for the eastern oyster ranges from 12 to 25 and can be found in the intertidal zone. Oyster reefs are extremely important to the aquatic ecosystem as they remove particulate matter, release inorganic and organic nutrients, stabilize sediments, provide habitat cover and serve as both indirect (i.e., house macroinvertebrates) and direct food sources for various fish species.

Oyster reef and shell bottom habitats in the Cape Fear River Estuary are generally confined to the lower estuary below Snows Cut. The distribution of oyster reefs in the estuary is limited by low salinity and a lack of hard substrate for larval settlement. Live oyster reefs that provide the functions listed above are confined to the lowermost approximately 10-mile reach of the estuary from Peters Point to the river mouth. North Carolina Department of Marine Fisheries (NCDMF) benthic habitat maps depicts areas of shell bottom habitat between Snows Cut and the Cape Fear Inlet.

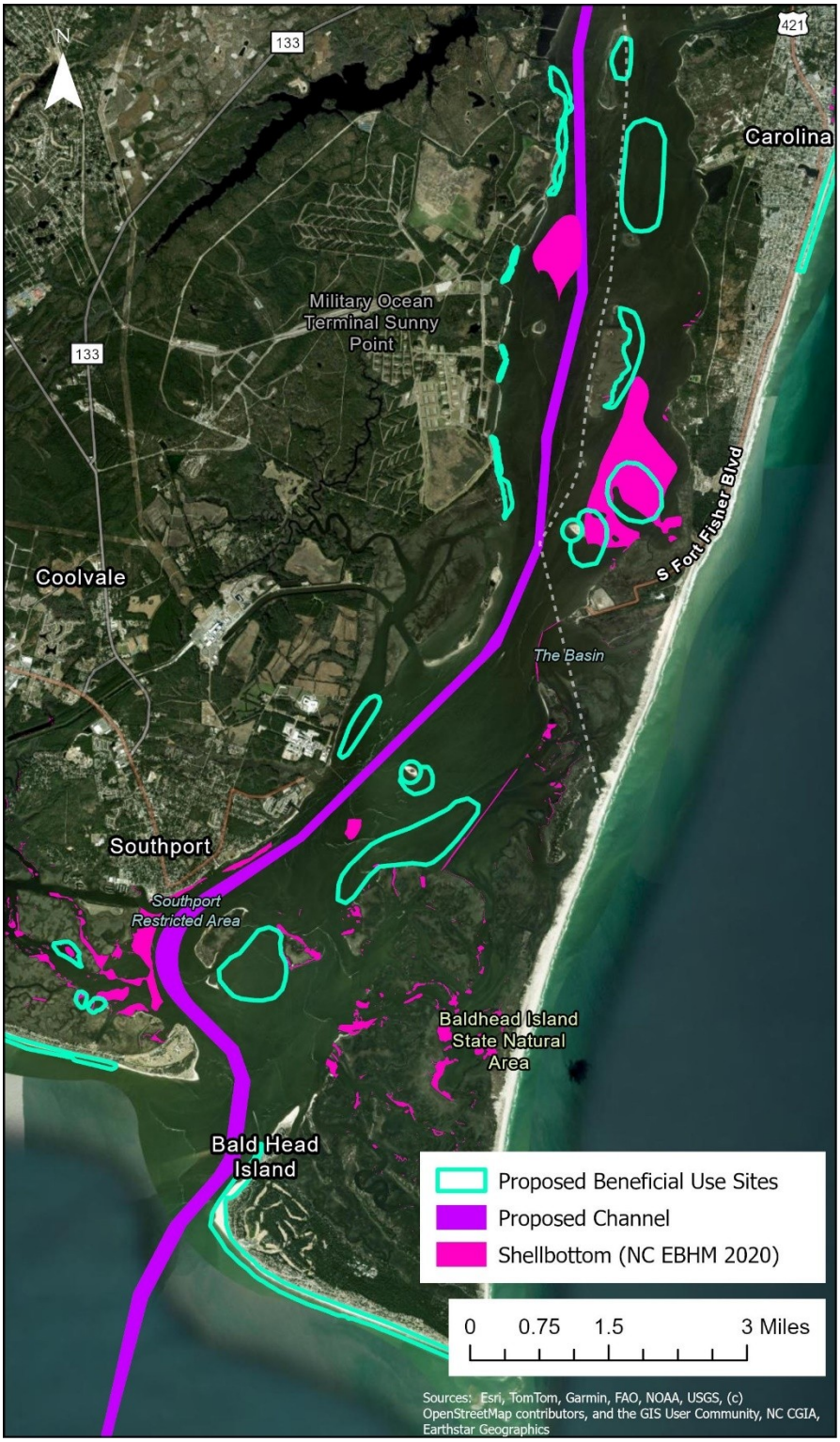

Figure 3 North Carolina Shell Bottom Habitat (NCDENR 2025)

J.3.7 UNCONSOLIDATED BOTTOMS

Unconsolidated bottom is defined as all wetland and deep-water habitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30% (Cowardin et al. 1985), where stone particle size ranges from 25.4 centimeter (cm) to 60.4 cm. Water regimens are restricted to subtidal, permanently flooded, intermittently exposed, and semi-permanently flooded. Diverse assemblages of fish and benthic macroinvertebrates, such as red drum, cobia, southern flounder, Atlantic croaker, spot, spotted seatrout, Atlantic menhaden, bay anchovy, striped mullet, weakfish, and blue crab, utilize these areas and serve as food sources for fish the SAFMC, MAFMC, or NMFS manage. Additionally, unconsolidated bottoms serve as EFH for the snapper grouper species.

J.3.8 HARDBOTTOM AND ARTIFICIAL REEFS

Hardbottom habitats exhibit varying degrees of colonization by marine algae and sessile invertebrates (e.g., sponges, soft corals, and hard corals). Marine macroalgae are the dominant colonizing organisms on North Carolina hardbottoms. Hardbottoms along the NC coast provide important foraging habitat and protective cover for tropical, subtropical, and warm-temperate reef fishes. Inner-shelf hardbottoms support a higher proportion of temperate species such as black sea bass, spottail pinfish, and estuarine-dependent migratory species (Huntsman and Manooch 1978, Grimes et al. 1982). Nearshore hardbottom sites support spawning of smaller and more temperate reef species such as black sea bass and sand perch and provide larval settlement sites and juvenile nursery habitats for reef-associated fishes, including taxa that are thought to spawn in deeper offshore waters (Powell and Robbins 1998). An analysis of the survey data did not identify any natural hardbottom habitats within the existing or proposed channel areas (NCSP 2022). Prior remote sensing surveys conducted by the USACE did not identify any hardbottom habitats within the new Wilmington ODMDS (USEPA and USACE 2001). The distribution of identified, natural hardbottoms is restricted to areas approximately two to three miles west of the existing ocean entrance channel and proposed offshore extension reach.

The WOFES was created in 1997 from limestone material that was dredged as part of the Wilmington channel deepening. The feature was designed with attributes and features to provide hardbottom habitats and attract fish. The WOFES is located adjacent (southeast side) to the designated Wilmington ODMDS.

J.3.9 COASTAL INLETS

Sand splits, jetties, islets, tidal flats, shoals, and sandbars are often associated with costal inlets which themselves are restricted areas of intense ebb and flow tidal changes. Inlets are often the bottlenecked area where the currents of the ocean, driven by tides, meet the freshwater flow from upland and upstream rivers, tidal creeks, and streams. Coastal inlets are areas of intense changes in energy caused by the daily tidal changes. Inlet habitats in the southeastern United States are frequently affected by waterway and beach nourishment projects. Coastal inlets are a critical corridor for migratory fish moving between the estuary system and the ocean for different life stages. For example, this EFH is a spawning area for blue crabs and red drum. The coastal inlet EFH is found within the proposed placement area in the Cape Fear River Estuary.

J.3.10 STATE-DESIGNATED NURSERY AREAS

State-designated nursery areas are locations where fish and crustaceans are found and are defined based on favorable physical, chemical, or biological factors. North Carolina has designated multiple types of nursery habitats; these habitats are listed in Table 4.

Table 4 List of North Carolina Designated Nursery Areas and the North Carolina Administration Codes (NCAC)(SAFMC 2024).

North Carolina Designation	Regulation	Comment
Primary Nursery Areas	15A NCAC 10C .0503 15A NCAC 03C .0103	N/A
Secondary Nursery Areas Special Secondary Nursery Areas	15A NCAC 03R .0104 15A NCAC 03R .0105	N/A
Strategic Habitat Areas and Critical Habitat Areas	15A NCAC 03H .0104 (4)(h)	None as of Nov 30 2010
Crab Spawning Sanctuaries	15A NCAC 03R .0110	N/A
Oyster Sanctuaries	15A NCAC 03R .0117	N/A
Outstanding Resource Waters	15A NCAC 02B .0225	N/A

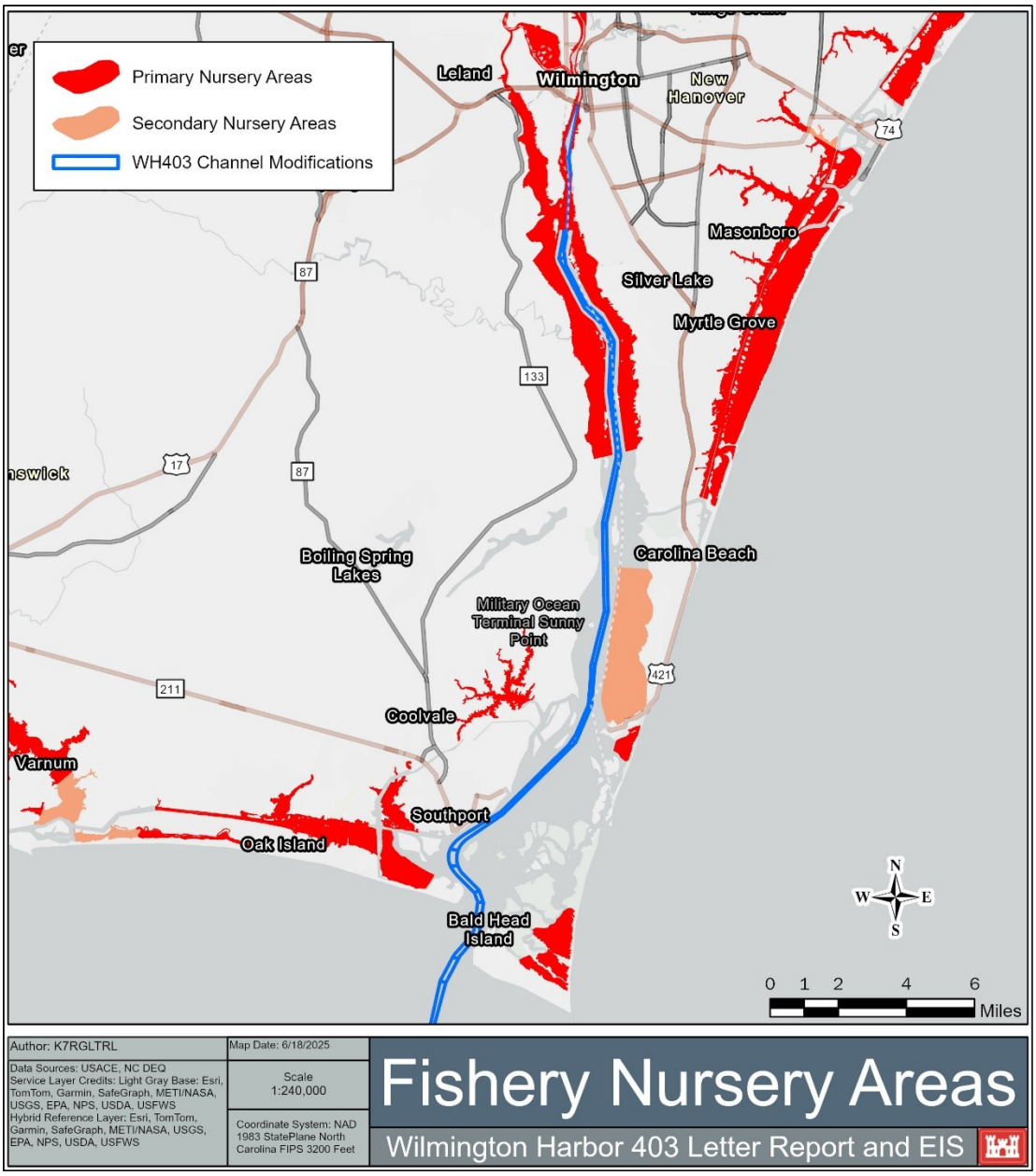

Figure 4 Primary and Secondary Nursery Areas in the Cape Fear River Estuary

J.3.10.1 NORTH CAROLINA PRIMARY NURSERY AREAS

The Cape Fear River estuary is an important nursery area for many estuarine-dependent fish and invertebrate species that spawn offshore and use estuarine habitats for juvenile development. Ocean-spawned larvae are transported shoreward by the prevailing currents and eventually pass through tidal inlets and settle in estuarine nursery habitats. Juveniles remain in the estuarine nursery areas for one or more years before moving offshore and joining the adult spawning stock (NCDEQ 2016). The majority of the waters in the Cape Fear River estuary above Lilliput Creek are state-designated Primary Nursery Areas (PNAs). Primary Nursery Areas are defined as “those areas in the estuarine system where initial post-larval development takes place” [15 North Carolina Administrative Code (NCAC) 3I

.0101(b)(20)(E)]. Primary Nursery Areas support uniform populations of very early juveniles and are typically located in the upper reaches of the estuarine system. In the case of many estuarine-dependent species, larval settlement occurs in the uppermost reaches of shallow tidal creek systems (Weinstein 1979, Ross and Epperly 1985). The majority of Primary Nursery Areas in North Carolina are comprised of shallow soft bottom habitats that are surrounded by salt/brackish marsh (NCDEQ 2016).

J.3.10.2 SECONDARY NURSERY AREAS AND SPECIAL SECONDARY NURSERY AREAS

Secondary nursery areas are those areas in the estuarine system where later juvenile development takes placeFigure . Populations are composed of developing subadults of similar size that have migrated from an upstream primary nursery area to the secondary nursery area located in the middle portion of the estuarine system. Secondary nursery areas have fishing restrictions that help the sustainability and production of the system. Special secondary nursery areas (SNNAs) are designated coastal water areas that refer to specific locations for shrimp nursery where there are seasonal closures for shrimp species. The Cape Fear River was designated as a SSNA in 1986 and has not been open to commercial shrimping since the SSNA designation. In 2021, the SSNA designation for the Cape Fear River was amended to a permanent secondary nursery area and the area is subject to additional gill net attendance.

J.3.10.3 STRATEGIC HABITAT AREAS AND CRITICAL HABITAT AREAS

Strategic habitat areas are defined as, “specific locations of individual fish habitats or systems of fish habitats that have been identified to provide exceptional habitat functions or that are particularly at risk due to imminent threats, vulnerability or rarity,” (NCDENR 2006). The strategic habitat areas use a combination of habitat characteristics and other criteria, such as ecological functions for fish, fish abundance, or vulnerability. There are proposed strategic habitat areas within the project footprintFigure .

Figure 5 Region 4 Strategic Habitat Area Nominations (NCDMF 2018)

J.3.10.4 CRAB SPAWNING SANCTUARIES

North Caroline created crab spawning sanctuaries were in all coastal inlets. The purpose of the sanctuaries is to protect mature females inhabiting these areas prior to and during the spawning season and sponge stage. It is unlawful to set or use trawls, pots, and mechanical methods for oysters, clams, or take crabs with the use of commercial fishing equipment from March 1 through October 31 in the Cape Fear River Inlet Sanctuary (NCDMF 2021).

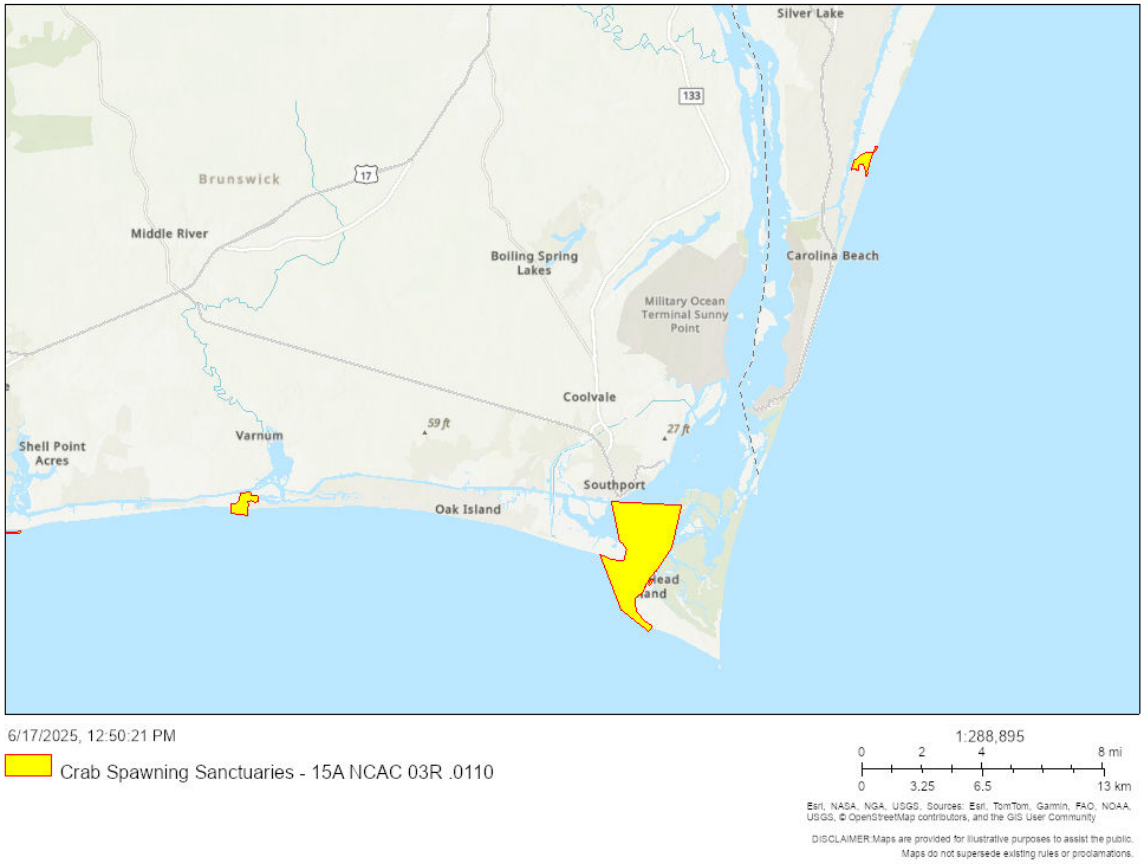

Figure 6. Crab spawning sanctuaries within the proposed project area (NCDEQ 2025d)

J.3.10.5 OYSTER SANCTUARIES

Oyster sanctuaries in North Carolina serve as restoration areas where harvesting is prohibited. The sanctuaries are created to protect the oyster reef, so the oysters can act as a brood stock for the rest of North Carolina's coastal waters. These reefs also act as habitat for clams, juvenile finfish, crabs, shrimp, and larger fish (NCDEQ 2025b). There are no oyster reef sanctuaries within the project area (NCDEQ 2025b).

J.3.10.6 OUTSTANDING RESOURCE WATERS

Outstanding resource waters are a subset of high-quality waters that are designated based on state surface water classifications. The high-quality waters are rated excellent based on biological, physical, and chemical characteristics through monitoring or special studies. The outstanding resource waters are intended to protect unique and special waters having excellent water quality and hold state or national ecological or recreational significance (NCDEQ 2025a). There are some outstanding resource waters within the proposed project areaFigure .

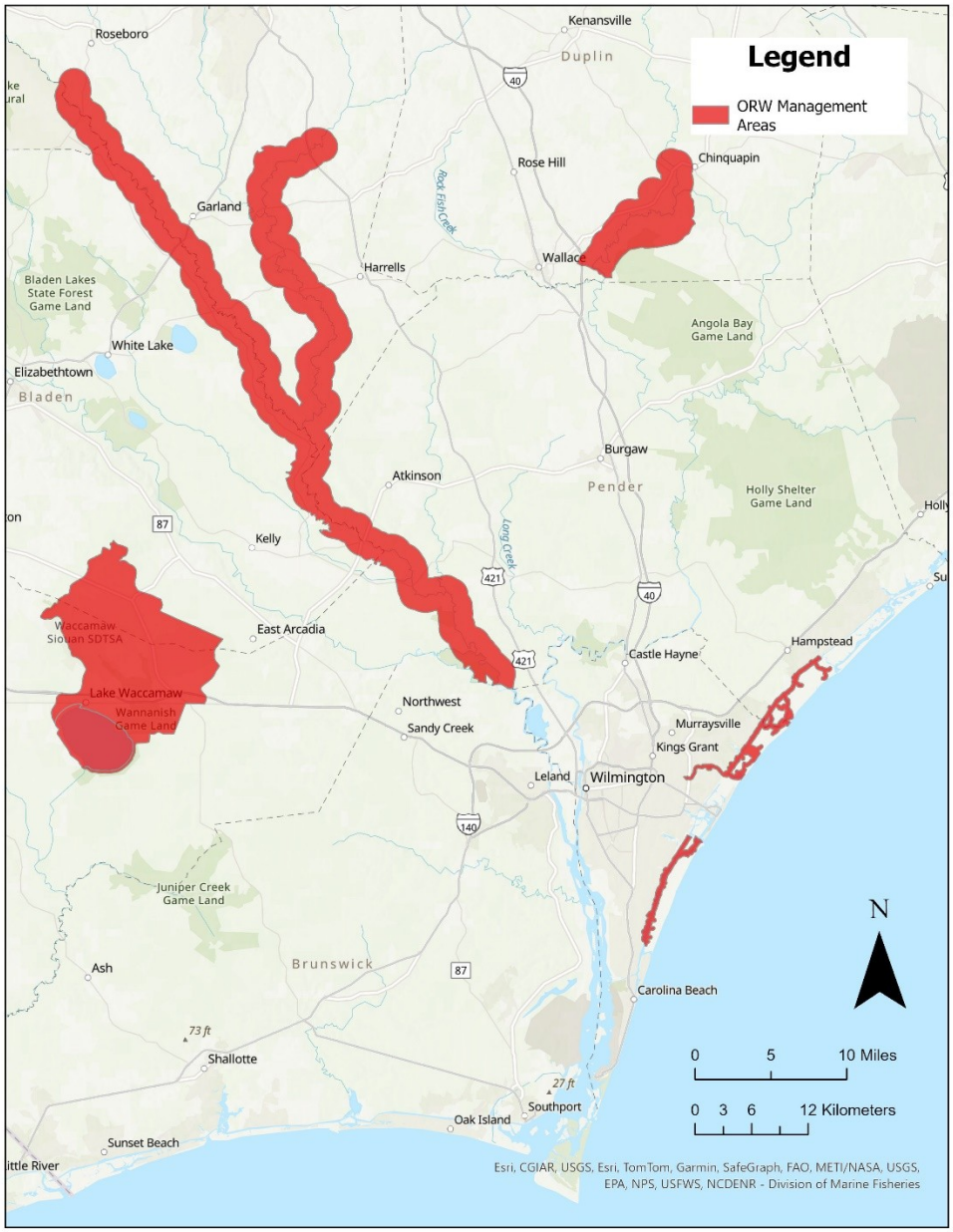

Figure 7. Outstanding Water Resources Map (NCDEQ 2025a)

J.3.10.7 SANDY SHOALS OF CAPES

Shoals are formed by the movement of water through the inlets of the harbor. Cape shoals are typically found in water depth from 2–18 ft (0.6–5.5 m), in contrast to adjacent waters that are 20–40 ft (6–12 m) deep. Many species such as coastal migratory pelagics feed on baitfish that congregate seasonally on shoals. Anadromous species such as shad, river herring, and stripped bass utilize cape shoals as a staging area for migration along the coast (SAFMC 1998).

These shoals in the Wilmington Harbor area include Jay Bird Shoals and Frying Pan Shoals. Jay Bird Shoals are located directly adjacent to the federal navigation channel, but Frying Pan Shoals is outside of the project area and will not be affected.

SECTION J.4 HABITAT AREAS OF PARTICULAR CONCERN (HAPC)

Habitat Areas of Particular Concern (HAPC) are a subset of EFHs that are rare, stressed by development, provide important ecological functions for federally managed species, or are especially vulnerable to anthropogenic (or human impact) degradation. HAPCs may include areas used for migration, foraging, reproduction, and development. HAPCs exist in intertidal and estuarine habitats within the project area. The MSA does not provide any additional regulatory protection to HAPCs. However, if HAPCs are potentially adversely affected, additional inquiries and conservation guidance may result during the NMFS EFH consultation (SAFMC 2024).

According to the SAFMC EFH User Guide, the project area is designated as HAPC for coastal migratory pelagic species, snapper grouper species, and penaeid shrimp due to the presence of coastal inlets, oyster/shell habitats, sandy shoals of capes, and state designated nursery habitats (SAFMC 2024). The EFH mapper identified summer flounder submerged aquatic vegetation as HAPC in the area.

Additionally, the SAFMC has determined that all state-designated habitat areas are considered HAPCs. For the Cape Fear River, which would include primary nursery areas, secondary nursery areas, crab spawning sanctuaries, and oyster sanctuaries.

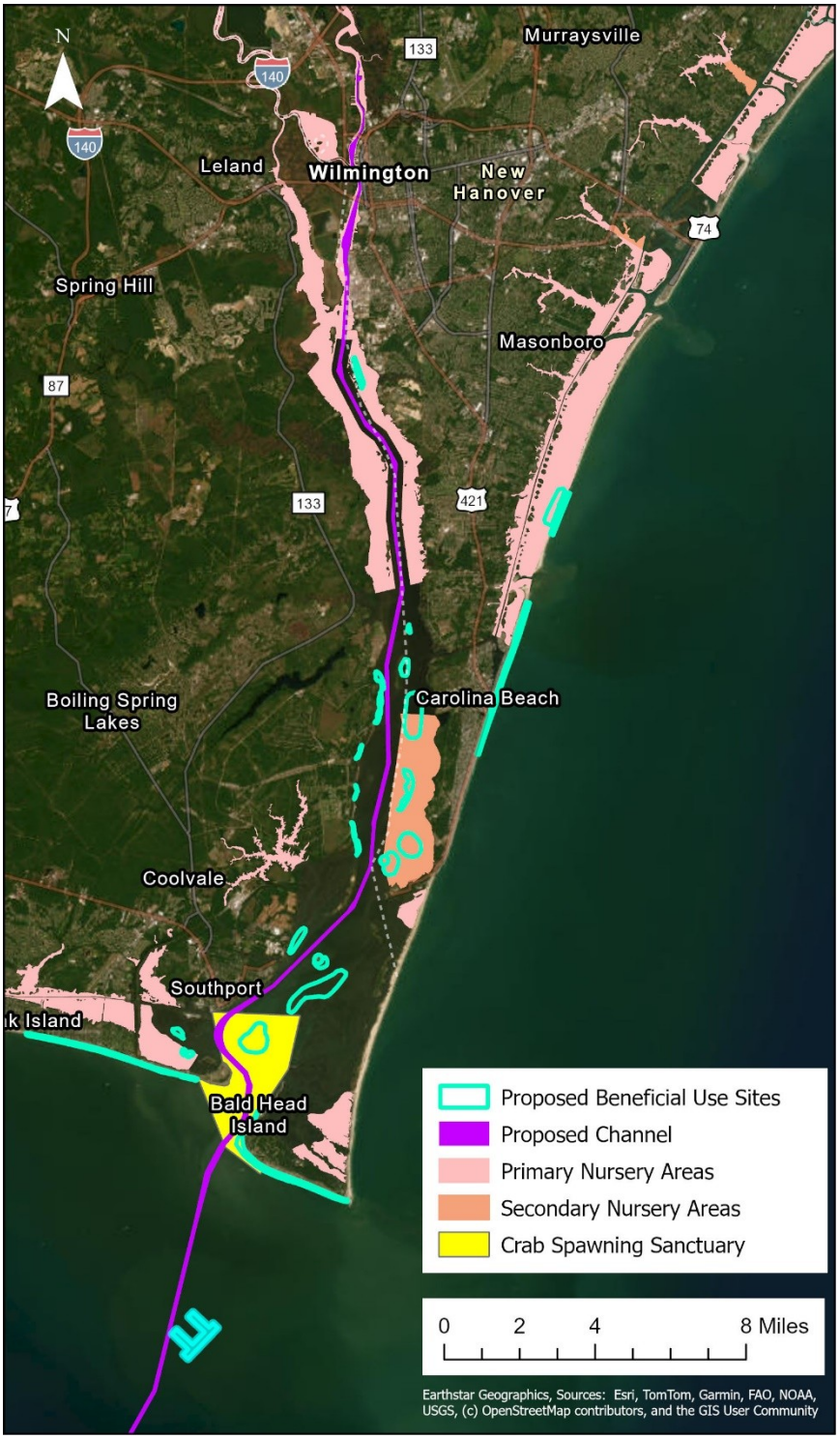

Figure 8. Map of HAPCs. Inlets are also HAPCs but were not included because accurate geospatial data was not procurable at the time of figure creation.

SECTION J.5 MANAGED SPECIES AND ESSENTIAL FISH HABITAT USE

J.5.1 PENAEID SHRIMP AND RELEVANT EFH

White, brown, and pink shrimp (penaeids) are managed by the SAFMC. These and other managed species that may be found in the project area are listed in Table 3.

Environmental conditions are believed to primarily control shrimp population sizes even though fishing reduces the populations over the season. Shrimping is not thought to affect successive year totals, unless the reproduction stock is affected by environmental circumstances. Each species, due to their migratory nature and reproductive capability, are able to recover from a low population from one year to the next. The loss or degradation of salt marsh nursery habitat for juvenile white and brown shrimp is one of the most serious threats (NCDENR 2006) to southeastern United States stocks. All coastal inlets and respective nursery habitats are of particular importance to shrimp.

The brown and white shrimp species' lifecycles are similar in that adults reproduce offshore, and eggs are hatched into free-swimming larvae. Both species undergo 11 larval stages to produce post-larvae. Within the estuary, post-larval shrimp grow rapidly; however, the rate is salinity- and temperature-dependent (SAFMC 2004). These shrimp species utilize related habitats with minor differences in substrate and salinity partiality. Once reaching a sub-adult size of three to five inches, the shrimp migrate seaward. Juvenile and adult shrimp are omnivores, feeding mostly at night on benthic organisms, algae, and detritus. Daytime feeding may occur in turbid waters rich in mysids, amphipods, polychaetes, and various types of organic debris (SAFMC 2004, NCDENR 2006). As with brown shrimp, pink shrimp eggs are also demersal (bottom dwellers). Records suggest a larval period of 15 to 25 days. The mechanism by which post-larvae are brought from spawning areas to inside the estuaries is not well-known. Post-larvae move into estuaries during late spring and early summer. In the South Atlantic, the nursery areas utilized within the estuaries are primarily dominated by the marsh grass Spartina alterniflora.

Shrimp have separate sexes (dioecious); females grow larger and are able to reproduce in less than 12 months and can expel between 500,000 and 1,000,000 eggs in a single event. Adult brown shrimp spawn in deep ocean waters over the continental shelf, while white shrimp remain nearshore. Larvae and post-larvae depend on ocean currents for transportation through inlets into estuarine nursery grounds. River mouths and inlet entrances are particularly important to estuarine shrimp recruitment. The majority of estuarine shrimp are found near shallow wetland systems. White shrimp may use freshwater submerged vegetation to some degree. However, brown shrimp primarily utilize estuarine submerged vegetation because of salinity inclinations. The use of oyster beds by white and brown shrimp occurs and is considered crucial in the absence of submerged vegetation (NCDENR 2006). In North Carolina sounds/estuaries, juveniles and adult phases of pink shrimp appear in June and July, whereas, in the southern portion of their range this occurs in April and May. Pink shrimp leave Florida estuaries within two to six months after having arrived as post larvae. Smaller pink shrimp may remain in the estuary during winter. Pink shrimp that survive the winter grow rapidly during late winter and early spring before migrating to the ocean.

White Shrimp

White shrimp are found along the Atlantic coast from New York to Florida. Spawning along the south Atlantic coast occurs from March to November, while May and June are reported as peak months. Spawning takes place in water ≥ 30 feet deep and within five miles of shore where they prefer salinities of ≥ 27 psu (Muncy 1984). The increase in bottom water temperature in the spring is thought to trigger spawning. After the demersal eggs hatch, the planktonic post-larvae live offshore for approximately 15 to 20 days. During the second post-larval stage, they move inshore on tidal currents and enter estuaries two to three weeks after hatching. Shallow muddy bottoms in low to moderate salinities are the optimum nursery areas for these benthic juvenile white shrimp. During this stage, the diet consists of zooplankton and phytoplankton. By June or July, the juveniles move to deeper creeks, rivers, and sounds. It has been documented that juvenile white shrimp tend to migrate further upstream than juvenile brown shrimp; as far as 130 miles in nearby northeast Florida (Pérez-Fartante 1969). Juveniles prefer to inhabit shallow estuarine areas with a muddy, loose peat, and sandy mud substrate with moderate salinities. Juvenile white shrimp are benthic omnivores (e.g., fecal pellets, detritus, chitin, bryozoans, sponges, corals, algae, and annelids) and feed primarily at night. White shrimp usually become sexually mature at age one during the calendar year after they hatch. The emigration of sexually mature adults to offshore waters is influenced primarily by body size, age, and environmental conditions. Studies have shown that a decrease in water temperature in estuaries triggers emigration in the south Atlantic (Muncy 1984). During fall and early winter, the south-migrating white shrimp provide a valuable fishery in southern North Carolina, South Carolina, and Georgia. White shrimp are omnivores preferring soft-muddy bottoms in areas of expansive brackish marshes (SAFMC 2004). The life span of white shrimp usually does not extend beyond one year.

Brown Shrimp

Brown shrimp occur from Massachusetts to the Florida Keys and west into the Gulf of America. They support an important commercial fishery along the south Atlantic coast, primarily in North and South Carolina. This species spawns in deep ocean waters during late winter or early spring. Larvae migrate from offshore to inshore areas as post-larvae (peak migration from February through April), frequently at night on incoming tides. Carried by currents and tides into estuaries, the larvae develop into post-larvae within 10 to 17 days. Once in the estuaries, post-larvae seek out the soft silty/muddy substrate common to vegetated and non-vegetated, shallow, estuarine environments. This environment yields an abundance of detritus, algae, and microorganisms that comprise their diet at this developmental stage. Post-larvae have been collected in salinities ranging from zero to 69 with maximum growth reported between 18 degrees centigrade (°C) and 25°C, peaking at 32°C. Maximum growth, survival, and efficiency of food utilization have been reported at 26°C (Lassuy 1983). Juveniles develop in four to six weeks, continuing into rapid sub-adult development depending on salinities and temperatures. The density of post-larvae and juveniles is highest among emergent marsh and submerged aquatic vegetation (Howe and Wallace 2000), followed by tidal creeks, inner marsh, shallow non-vegetated water, and oyster reefs. The diet of juveniles consists primarily of detritus, algae, polychaetes, amphipods, nematodes, ostracods, chironomid larvae, and mysids (Lassuy 1983). Emigration of sub-adults from the shallow estuarine areas to deeper, open water takes place between May through August, with June and July reported as peak months. The stimulus behind emigration appears to be a combination of increased tidal height and water velocities associated with new and full moons. As individuals increase in size, they move to deeper and saltier waters of the inlets until exiting to the ocean in late fall. After exiting the estuaries, adults seek out deeper (60-foot) offshore waters. Brown shrimp are omnivores and prefer muddy and peat bottoms, but can be

found on sand, silt, or clay mixed shell hash bottoms (SAFMC 2004, NCDENR 2006). Adults reach maturity in offshore waters within the first year of life at 5.5 to 5.7 inches long. They have a maximum life span of 18 months (NOAA 2025a).

Pink Shrimp

Pink shrimp occur on the Atlantic Coast from Chesapeake Bay south to the Florida Keys and are most abundant in water depths of 11-37 m. Pink shrimp reach sexual maturity at about 85 mm total length. Spawning occurs during the early part of the summer at depths of 3.7 to 15.8 m. During the larval stages, development is dependent on food availability, water temperature and quality of habitat. Depending on the environmental conditions, the larval period can last from 15-25 days. Post-larval movement from the spawning areas to estuaries are not well known, although some literature suggests that wind conditions and current movements assist in transport from the estuaries to offshore habitats. Migration offshore occurs during May/June off the Georgia coast (SAFMC 2009).

Penaeid Shrimp EFH in the Project Area

Of the shrimp EFH listed in the 2008 NMFS Essential Fish Habitat: A Marine Fish Habitat Conservation Mandate for Federal Agencies, those that exist within the placement area include: estuarine water column, estuarine emergent wetlands, unconsolidated bottom, marine water column, coastal inlets, and state-designated nursery areas. These EFHs provide transport, refuge, and feeding/developmental areas for post- larval, juvenile, and sub-adult penaeid shrimp. Tidal inlets and state-designated nursery areas are considered HAPCs for white, pink, and brown shrimp species.

J.5.2 SNAPPER/GROUPER SPECIES COMPLEX AND RELEVANT EFH

Many deepwater snapper grouper species utilize both pelagic and benthic habitats during several stages of their life histories; larval stages of these species live in the water column and feed on plankton. Most juveniles and adults are demersal and associate with hard structures like artificial reef structures, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings). Juvenile stages of some snapper grouper species also utilize inshore seagrass beds, mangrove estuaries, lagoons, oyster reefs, and embayment systems. In many species, various combinations of these habitats may be utilized during daytime feeding migrations or seasonal shifts in cross-shelf distributions (Gore et al. 2013).

Black Sea Bass

The project area is designated as EFH for the snapper grouper complex. Black sea bass are common within the project area and can be used as a proxy species for other species in the snapper grouper complex. The black sea bass is a temperate marine species that inhabits irregular hard-bottom areas, such as wrecks or reefs. They are found from Cape Cod to Cape Canaveral, and those found in the South Atlantic Bight usually occur more inshore with other tropical reef fish such as snappers, groupers, porgies and grunts. Black sea bass are protogynous hermaphrodites, that is, they change sex with size. Large individuals are males, and smaller individuals are female. The number of eggs produced in a spawning season ranges from 30 thousand to 500 thousand depending on the size of the fish. The spawning season is June through October in the Mid-Atlantic Bight, and February through May in the

South Atlantic Bight. Females reach sexual maturity when they are 7.5 inches long, and males when they are 9 inches long. Black sea bass may live up to 20 years, although fish older than 9 years are rare. The maximum size attained is 24 inches and 6 pounds. Black sea bass are opportunistic feeders eating whatever is available, preferring crabs, shrimp, worms, small fish and clams (SAFMC 2025).

Snapper/Grouper Complex EFH in Project Area

EFH for the snapper grouper complex species includes estuarine water column, estuary emergent wetlands, unconsolidated bottom, marine water column, coastal inlets, and state-designated nursery areas. These habitats provide migration, refuge, and feeding/developmental areas for post-larval, juvenile, and/or adults of these species. Furthermore, North Carolina tidal inlets, state-designated nursery areas, and oyster/shell bottoms are considered HAPCs for the grouper-snapper complex (NMFS 2008).

J.5.3 BLUEFISH AND RELEVANT EFH

Bluefish are migratory, pelagic species found in temperate and semi-tropical continental shelf waters around the world with the exception of the north and central Pacific. In North America, bluefish range from Nova Scotia to Florida in the Atlantic Ocean and from Florida to Texas in the Gulf of America (MAFMC 1990). Spawning in the South Atlantic Bight occurs near the shoreward edge of the Gulf Stream primarily during April and May (Kendall and Walford 1979). Larval development takes place in outer continental shelf waters within six meters of the surface. Transitional pelagic juveniles eventually move to estuarine and nearshore oceanic waters, which serve as the principal nursery habitats for juvenile development (Kendall and Walford 1979). Estuarine juveniles are most commonly associated with sandy soft bottom habitats; but also use mud and silt soft bottom habitats, SAV, marine macroalgae, oyster reefs, and tidal marsh grass (Shepherd and Packer 2006). Juvenile bluefish are common in high salinity estuaries along the southern North Carolina coast during summer and fall and are common in the nearshore ocean from spring through mid-winter. Adults use both inshore estuarine and offshore oceanic habitats. Adults are common in the nearshore ocean along the North Carolina coast from spring through mid-winter (MAFMC 1990). Adults undertake seasonal migrations, generally moving northward during spring and summer and southward during fall and winter.

Bluefish EFH in Project Area

Designated EFH habitats for juvenile and adult bluefish in the action area include the estuarine water column, estuary emergent wetlands, unconsolidated bottom, and marine water column.

J.5.4 COASTAL MIGRATORY PELAGICS AND RELEVANT EFH

The Gulf of America and the South Atlantic Fishery Management Councils jointly manage the coastal migratory pelagic (CMP) species. The area of management is from the Mexico/Texas border to New York. They are among the most important commercial and sport fishes. The habitat of adults in the coastal pelagic management unit is the coastal waters out to the edge of the continental shelf in the Atlantic Ocean. Within the area, the occurrence of coastal migratory pelagic species is governed by temperature and salinity. These species are seldom found in water temperatures less than 20°C. Salinity preference varies, but these species generally prefer high salinity, less than 36 (Gore et al. 2013).

Information captured in the NOAA's ELMR Program emphasized the importance and essential nature of estuarine habitat to all life stages of Spanish mackerel (SAFMC 1998).

Spanish Mackerel

The Spanish mackerel is important both commercially and recreationally. The Atlantic States Marine Fisheries Commission (ASFMC) and the SAFMC cooperatively manage Spanish mackerel, a member of the Scombridae family. Spanish mackerel management has resulted in a steady stock abundance increase since 1995; and based on 2002/2003 data, the population is not over-fished. Spanish mackerel are found within the coastal waters of the eastern United States and the Gulf of America. NOAA's Estuarine Living Marine Resource Program, a cooperative effort of the National Ocean Service and NMFS, compiles regional information on estuarine habitat by select marine fish and invertebrates. The accumulated data emphasize the essential nature and extreme importance that estuarine habitats have on Spanish mackerel life stages (ASMFC 2018).

Smaller than its congener the king mackerel (but have been reported to reach three feet in length), the Spanish mackerel's average adult weight is two to three pounds. Spanish mackerel are a fast- growing species, and both sexes are capable of reproduction by the second or third year (Mercer et.al. 1990). They have a life span of five to eight years (ASMFC 2009). Spanish mackerel form immense, fast-moving, and surface- feeding schools of comparable-sized individuals. The diet of scombrids consists primarily of fish and, to a lesser extent, penaeid shrimp and cephalopods. The fish that make up the bulk of their diet are small schooling clupeids [e.g., Atlantic menhaden, alewives (*Alosa pseudoharengus*), Atlantic thread herring (*Opisthonema oglinum*), anchovies], atherinids, and to a lesser extent jack mackerels (*Trachurus symmetricus*), snappers, grunts (*Haemulidae sp.*), and half beaks (*Hemiramphidae sp.*) (Collette and Nauen 1983). Shrimp and jellyfish have also been reported in stomach contents (Mercer et.al. 1990).

As ocean temperatures warm, Spanish mackerel seasonally migrate along the western Atlantic coast. With increasing water temperatures, Spanish mackerel move northward from Florida to Rhode Island between late February and July and return in the fall (Collette and Nauen 1983). Spanish mackerel spawn in groups over the inner continental shelf, and spawning takes place May through September with peaks in July and August. Batch spawning takes place, frequently inshore. Females grow faster and larger than males; and by age two, females may release up to 1.5 million eggs (Mercer et al. 1990). The eggs are pelagic and hatch into planktonic larvae. Larvae grow quickly and may be found inshore at shallow depths less than 30 feet. There are indications of vertical larval migration during night-time hours (Mercer et al. 1990). Spanish mackerel are dependent on estuaries during larval and juvenile life stages (SAFMC 1998). Juveniles use estuaries as nursery areas. The continental shelf, tidal estuaries, and coastal waters are all habitats for adult Spanish mackerel. However, adults spend most of their life in the open ocean; but can be found over deep reefs, grass beds, and estuarine shallows (ASMFC 2009). Their distribution is considered primarily dependent on water salinity and temperature (ASMFC 2009; Mercer et al.1990).

Coastal Pelagic Species EFH in the Project Area

Coastal migratory pelagic species depend on estuarine systems for various life stages. Spanish mackerel juveniles depend on estuarine habitats. Estuarine EFHs provide transport, refuge, and feeding grounds, as well as developmental areas. Many important prey species for coastal pelagics are associated with estuarine areas. As the transport medium for nutrients and organisms between the ocean and inland freshwater systems, the estuarine water column is a very important essential habitat, and emergent salt marshes provide important refuge and foraging grounds. There is estuarine habitat in the placement area

for coastal pelagic species. Furthermore, the sandy shoals of capes are considered HAPCs for the coastal migratory pelagic species in the study area (NMFS 2024).

J.5.5 HIGHLY MIGRATORY SPECIES AND RELEVANT EFH

Table 5 Highly Migratory Species that may be in the Project Area

Common Name	Scientific Name	Life Stage Use(s)	Fisheries Management Plan
Atlantic Sharpnose Shark	*Rhizoprionodon terraenovae*	Adult, Juvenile, Neonate	NMFS Highly Migratory Species
Blacknose Shark	*Carcharhinus acronotus*	Juvenile/Adult	NMFS Highly Migratory Species
Blacktip Shark	*Carcharhinus limbatus*	Juvenile/Adult	NMFS Highly Migratory Species
Bonnethead Shark	*Sphyrna tiburo*	Juvenile/Adult	NMFS Highly Migratory Species
Clearnose Skate	*Raja eglanteria*	Juvenile	NMFS Highly Migratory Species
Sand Tiger Shark	*Carcharias taurus*	Adult, Neonate/Juvenile	NMFS Highly Migratory Species
Sandbar Shark	*Carcharhinus plumbeus*	Adult, Juvenile	NMFS Highly Migratory Species
Scalloped Hammerhead Shark	*Sphyrna lewini*	Juvenile/Adult	NMFS Highly Migratory Species
Smoothhound Shark Complex	*Mustelus mustelus*	ALL	NMFS Highly Migratory Species
Spinner Shark	*Carcharhinus brevipinna*	Juvenile/Adult, Neonate	NMFS Highly Migratory Species
Tiger Shark	*Galeocerdo cuvier*	Juvenile/Adult, Neonate	NMFS Highly Migratory Species

The highly migratory species (HMS) complex encompasses pelagic species that travel long distances and cross domestic and international boundaries. The HMS fisheries include species such as tuna, sharks, swordfish, and billfish; the HMS has identified 39 species of sharks that they divide into three groups: large coastal sharks, small coastal sharks, and pelagic sharks. Of these species, small coastal sharks are the most likely to use EFHs in the project area. The EFH mapper identified 10 managed shark species that have EFH consisting of nearshore continental shelf waters within the project area (NOAA 2025b). Sharks are found in a wide variety of coastal and ocean habitats; including estuaries, nearshore and continental shelf waters, and the open ocean. Although managed sharks move primarily through the open ocean, several species move to shallow coastal waters and estuaries to pup. These nearshore/estuarine habitats also function as nursery areas for the developing young, with neonates typically remaining in these areas throughout their early life stages. Subtidal bottom in nearshore waters along the southern North Carolina coast serve as pupping grounds for the Atlantic sharpnose shark (*Rhizoprionodon terraenovae*), bonnethead shark (*Sphyrna tiburo*), blacknose shark (*Carcharhinus acronotus*), spinner shark (*C. brevipinna*), blacktip shark (*C. limbatus*), sandbar shark (*C. plumbeus*), and scalloped hammerhead shark (S. lewini). Neonates from southern North Carolina waters are found primarily in June and July (Beresoff and Thorpe 1997, Thorpe et al. 2004).

Highly Migratory Species EFH in the Project Area

Potential EFH locations for the species discussed above include estuarine water column, unconsolidated bottoms, and estuarine emergent wetlands. Sharks may utilize any of the EFHs in the project area, especially for foraging. Their use of tidal areas may be limited based on size of individuals and high tide water depths.

J.5.6 OTHER MANAGED SPECIES AND RELEVANT EFH

Other managed species for this report include Summer Flounder and Windowpane Flounder. These species are in the following fisheries management plans: SAFMC Summer Flounder, Scup, and Black Sea Bass and NEFMC Northeast Multispecies, respectively. Of these species, summer flounder are the most likely to use EFHs in the project area (Table 6).

Summer Flounder

Table 6 Spatial Distribution and Relative Abundance of Summer Flounder (Nelson et al. 1991)

Life Stage	Southeast Estuaries- Cape Fear River		
	Tidal Fresh	Tidal Fresh	Tidal Fresh
Adult	Not present	Common	Common
Spawning Adult	Not present	Not present	Not present
Juveniles	Abundant	Abundant	Common

The summer flounder's range includes shallow estuarine and outer continental shelf waters from Nova Scotia to Florida and the northern Gulf of America (NEFSC 1999). Summer flounder display intense seasonal inshore/offshore migration patterns. From late spring through early fall, summer flounder are concentrated in estuaries and sounds until migrating to the offshore outer continental shelf wintering grounds (NEFSC 1999, ASMFC 2009). During fall and early winter, offshore spawning occurs and the larvae are carried by wind currents into coastal areas. Most larvae and juvenile development occurs principally within the estuaries and sounds. Most individuals are sexually mature at age two. Growth rates and maximum ages vary substantially between sexes; adult females routinely grow larger and older than males (NEFSC 2009).

Summer flounder will begin spawning at age two or three. Summer flounder eggs are pelagic, buoyant, and most plentiful between Cape Cod and Cape Hatteras. The eggs are spherical with a transparent rigid shell, and the yolk occupies approximately 95 percent of the egg volume (ASMFC 2009). Larval free feeding is initiated once the yolk- sac material is consumed, which is a function of the incubation temperature (NEFSC 1999).

The left-eyed flatfish begin with eyes on both sides of its body; the right eye migrating to the left side in 20 to 32 days post-emergence. Larvae migrate to inshore coastal areas from October to May where they burrow into the sediment and develop into juveniles. Late larval and juvenile summer flounder are active predators, preying on crustaceans, copepods, and polychaetes. Research indicates that appendages of benthic fauna are an important food source for post-larval summer flounders (NEFSC 1999). Burrowing behavior is influenced by predator and prey abundance, salinity, water temperature, tides, and time of day. Juveniles inhabit marsh creeks, mud flats, and seagrass beds; but prefer primarily sandy shell

substrates. Juveniles often remain inshore for 18 to 20 months. Males reach maturity at approximately ten inches; while females reach maturity at approximately 11 inches (NEFSC 1999; ASMFC 2009).

Adults primarily inhabit sandy substrates, but have been documented in seagrass beds, marsh creeks, and sand flats. Summer flounders are quick, opportunistic predators that ambush their prey, making use of a well-developed dentition. Their camouflage and bottom positioning allow for efficient predation on small fish and squid; crustaceans make up a large percentage of their diet (ASMFC 2009; NEFSC 1999). Adults are active during daylight hours and normally inhabit shallow, warm, coastal estuarine waters before wintering offshore on the outer continental shelf. Some research suggests that some older individuals may remain offshore year- round (NEFSC 1999).

Other Managed Species EFH in the Project Area

Potential EFH locations for the species discussed above include estuarine water column, unconsolidated bottoms, tidal creeks, and coastal inlets. Summer Flounder utilize the EFH in the project area during the juvenile and larval life stages as important nursery habitats. As adults, summer flounder utilize the EFH as important foraging grounds and habitat during warmer months.

All native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within the adult and juvenile summer founder EFH is HAPC. The proposed project area does not contain the HAPC for summer flounder.

SECTION J.6 ASSESSMENT OF EFFECTS

In this section, potential impacts to EFH as well as managed species within the action area are evaluated. Impacts to managed species is focused on the diagnostic species. Diagnostic species are used because of similarities in environmental conditions and preferences among different species. The chosen diagnostic species can be used to predict impacts to similar species in the area.

Additionally, if confined blasting is conducted to remove the rock material, we anticipate the impacts to EFH habitats to be similar to that of dredging activities.

J.6.1 POTENTIAL EFFECTS TO EFH

Direct and Indirect impacts to EFH due to dredging and sediment placement

Table 7 demonstrates the existing channel and side slope footprints and what the proposed increase in area is for each of the reaches within the channel for the proposed action of dredging to -47 feet. Table 8 describes the nursery areas and the potential impacts from the proposed actions. Table 9 lists each of the proposed beneficial use sites and includes information about the habitat created, material composition, and the existing and proposed area for subtidal, intertidal, and subaerial habitats.

Table 7 Direct Dredging Impacts from the -47ft Action. Side slope impacts represent the total area of water bottoms that would be deepened by side slope construction, determined by comparing design depths and existing bathymetry..

Channel Reach	Dredging Frequency	Channel Footprint (Acres)	Side Slope Impact			
			Existing Channel	Proposed Channel	Increase	
Anchorage Basin	Every Year		152	154	2	15.9
Between Channel	Every Year		35	40	5	4.3
Fourth East Jetty	When Needed		101	112	11	15.9
Upper Brunswick	Every 2 to 4 Years		43	52	9	15.6
Lower Brunswick	Every 2 to 6 Years		81	99	18	33.4
Upper Big Island	Every 2 to 6 Years		53	54	1	17.4
Lower Big Island	Every 2 to 6 Years		38	46	8	12.6
Keg Island	Every 2 to 6 Years		75	93	18	25
Upper Lilliput	Every 3 to 6 Years		97	120	23	25.6
Lower Lilliput	Every 3 to 6 Years		145	145	0	31.1
Upper Midnight	Every 2 to 6 Years		189	189	0	33.2
Lower Midnight	Every 2 to 6 Years		114	114	0	16.2
Reaves Point	Every 3 to 6 Years		64	77	13	12.3
Horseshoe Shoal	Every 3 to 6 Years		58	72	14	10.1

Channel Reach	Dredging Frequency	Channel Footprint (Acres)	Side Slope Impact			
			Existing Channel	Proposed Channel	Increase	
Snows Marsh	Every 3 to 6 Years		147	183	36	30.3
Lower Swash	When Needed		97	160	63	17.7
Battery Island	Every 3 to 4 Years		45	73	28	13.4
Southport	Every 3 to 4 Years		63	103	40	8.8
Baldhead - Caswell	When Needed		22	32	10	5
Smith Island Channel	Every 3 to 4 Years		77	108	31	24.3
Total Inner Harbor	-		1696	2026	330	368.1
Baldhead Shoal - Reach 1	Every 5 to 6 Years		48	54	6	18.7
Baldhead Shoal - Reach 2	Every 5 to 6 Years		44	49	5	20.4
Baldhead Shoal - Reach 3	Every Year		350	374	24	94.6
Baldhead Shoal - Reach 4	N/A		0	562	562	17.2
Total Entrance Channel	-		580	1285	705	150.9

Color designations below
Adjacent or Containing Primary Nursery Area (PNA)

Channel Reach	Dredging Frequency	Channel Footprint (Acres)	Side Slope Impact			
			Existing Channel	Proposed Channel	Increase	
Adjacent or Containing Secondary Nursery Area (SNA) *Contains Crab Spawning Sanctuary (CSS)*						

Table 8 Summary of Channel Modification Impacts to Nursery Areas and Crab Spawning Sanctuaries. Adjacent is defined as having the habitat area within 1000ft of a reach of interest.

	Increased Channel Footprint	Side Slope Impacts
Within PNA	15.3	49.9
Adjacent to PNA	79.7	115.8
Within SNA	0	0
Adjacent to SNA	27	71.8
Within CSS	174	87.9

Table 99 Impacts based on the Beneficial Use Placements

		Acres of Habitat Conversion				HAPC Impacts		
BU Site	**Habitat**	***Site Area (acres)***	***Subtidal Bottom***	***Intertidal Bottom***	***Subaerial***	***PNA***	***SNA***	***Shellbottom***
Estuary								
Island 13	Intertidal Mudflat/Marsh	50.95	-40.1	40.0	0.0	50.7		
WH-DA 09	Intertidal Mudflat/Marsh	7.74	-5.9	4.8	1.1			
WH-DA 08	Intertidal Mudflat/Marsh	52.3	-41.1	37.8	3.3			
WH-DA 07	Intertidal Mudflat/Marsh	301.99	-227.3	227.3	0.0		158.7	
North Pelican Island	Intertidal Mudflat/Marsh	92.86	-0.4	0.4	0.0		92.5	
Brunswick Town	Intertidal Mudflat/Marsh	64.86	-24.3	30.8	-6.5			
Brunswick Town – Wave Attenuators	Intertidal Mudflat/Marsh	16.49	-3.8	3.8	0.0			
MOTSU Shoreline	Intertidal Mudflat/Marsh	43.11	-20.3	20.5	-0.2			
Owens Island	Intertidal Mudflat/Marsh	183.11	-163.7	163.7	0.0		183.1	183.1
Masonboro Island	Intertidal Mudflat/Marsh	131.13	-6.6	6.4	0.0	130.8		
Ferry Slip-Intertidal	Intertidal Mudflat/Marsh	108.13	-82.1	82.0	0.0		102.8	106.9
Ferry Slip	Bird Island	25.07	9.3	-13.0	3.8		16.2	
South Pelican	Bird Island	25.07	2.2	-6.6	4.4			

		Acres of Habitat Conversion				HAPC Impacts		
BU Site	**Habitat**	***Site Area (acres)***	***Subtidal Bottom***	***Intertidal Bottom***	***Subaerial***	***PNA***	***SNA***	***Shellbottom***
Snows Marsh Island	Intertidal Mudflat/Marsh	63.93	-50.4	50.4	0.0			
Lower Swash Island	Intertidal Mudflat/Marsh	379.98	-263.9	263.9	0.0			353.9
Southport Island	Intertidal Mudflat/Marsh	255.97	-238.4	238.4	0.0			254.1
Ft. Caswell Back-Barrier	Intertidal Mudflat/Marsh	48.82	-25.1	25.2	0.0	22.7		48.6
SUM		1852	-1182.0	1175.7	5.8	204.2	553.3	946.6
Beach								
Masonboro Island	Beach Placement	73.81	-11.18	1.44	9.74	6.4		
Bald Head Island	Beach Placement	269.52	-104.19	7.16	97.05			
Caswell Beach	Beach Placement	17.77	-8.72	0.34	8.37			
Oak Island	Beach Placement	181.26	-46.64	-24.56	71.19			
Carolina Beach	Beach Placement	233.75	-106.1	22.1	83.9			
SUM		776	-276.78	6.52	270.26	6.4		
Offshore								
WOFES	Rock Reef	252.32	252.32	0	0			
Color designations below Within Primary Nursery Area Within Secondary Nursery Area								

Estuarine and Marine Water Column

The proposed dredging and sediment placement would cause short-term and minor impacts to turbidity within the estuarine and marine water column. Turbidity plumes associated with dredging and placement activities are limited to a few hundred feet and most of the turbidity will likely settle out quickly once the dredging and placement is completed (NMFS 2020). There would be short-term and non-substantial effects from turbidity because the dredged sediment will settle quickly and not result in long lasting turbidity plumes. A study conducted by Gailani et al. 2003 found that after construction ends increases in total suspended solids (TSS) are negligible within 12 to 24 hours. Total suspended solid (TSS) concentrations associated with cutterhead dredge sediment plumes typically range from 11.5 to 282.0 mg/L with the highest levels (550.0 mg/L) detected adjacent to the cutterhead dredge and concentrations decreasing with greater distance from the dredge. The TSS levels expected for cutterhead dredging (up to 550.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L) (NOAA 2025c). Additionally, the project area is naturally turbid because of the dynamic nature of the tidally influenced systems; species that inhabit these systems are acclimated to a highly turbid environment. No permanent or temporary impacts or changes in temperature, dissolved oxygen levels, salinity or pH would occur within the Cape Fear Estuary as a result of turbidity plumes from the placement activities.

The proposed channel improvements would result in limited impacts to water quality. Dissolved oxygen and temperatures will not be significantly impacted by the proposed action. Impacts to DO concentrations were predicted to be less than 0.2 mg/l, with improvements of up to 0.1 mg/l present in some areas. Impacts to temperature were predicted to be less than 0.1 °C. Salinity concentrations would increase slightly (<5 psu) in the areas adjacent to Eagle Island, but impacts are spatially limited and not expected to be significant to the euryhaline estuarine species present in the area. Water quality impacts are further evaluated in Section 3.4 of the EIS. The impacts of water quality changes to aquatic species habitat were evaluated using habitat suitability indices (HSI), and more details of model methodology and results are available in Appendix H.

Estuarine and Palustrine Emergent Wetlands

The deepening would not have any direct impacts on tidal wetlands but there would be indirect impacts. Comparisons between the No Action and Proposed Action show that the harbor deepening would cause relative upstream shifts in salinity that will result in conversion of wetland habitat types shown in Table 10.

Table 1010 Conversion of Wetlands by Type due to the Proposed Project

Wetland Type	Acres Lost	Acres Gained
Tidal Freshwater	1,071	-
Oligohaline	204	-
Mesohaline	-	1,114
Polyhaline	-	87
Euhaline	-	75

Minor changes in the marsh plant community composition would not be expected to degrade the refuge, primary production, or forage EFH functions that are associated with these habitats. Additional information on the wetlands conversion and impacts is discussed in Appendix I.

There are no expected adverse effects to wetlands due to the sediment placement activities for beneficial use. However, there will be marsh restoration efforts to enhance and preserve tidal freshwater and oligohaline wetlands. The details of the marsh restoration plan will be included in Appendix M.

Subtidal and Intertidal Non-Vegetated Flats

The proposed project will place fill in areas of the Cape Fear Estuary's subtidal and intertidal flats burying some organisms, while other organisms that are more motile will likely avoid and survive the dispersal event. Impacts to subtidal and intertidal areas due to sedimentation and burial are expected to be temporary and minor in nature. Although intertidal habitats will experience some negative effects, the intertidal habitat will increase in size due to the beneficial use of dredged material resulting in an overall long-term benefit. The additional fill will provide substrate for intertidal flat habitat, and it is expected that species will colonize the new fill and be comparable to other nearby intertidal habitats within two years of construction (Wilber and Clarke 2007).

There is a net loss of 1,459 acres of subtidal habitat, gain of 1,182 acres of intertidal habitat, and a gain of 276 acres of supratidal habitat.

Oyster Reefs and Shell Banks

There will be no direct impacts to shell bottom from the new dredging activities associated with the project, based on benthic habitat mapping provided by the NCDMF.

The distribution of oyster reefs in the estuary is limited by salinity to the lowermost ~10-mile reach of the CFR (Rodriguez 2009). Therefore, oyster reefs would not be affected by confined blasting at locations 18 miles or more above the estuary mouth.

Adjacent oyster reefs may also experience some temporary, indirect effects such as turbidity increases and sedimentation during dredging and placement. The reefs may also experience sedimentation from currents carrying the dredged material during tidal cycles. Heavy sedimentation on oyster reefs can cause direct oyster mortality, loss of foraging habitat, loss of shelter functions for other reef fishes and crustaceans when sediments fill the interstitial spaces between oyster shells (Wilber and Clarke, 2001). However, the results of sediment plume monitoring during hydraulic barge overflow loading at Wilmington Harbor indicate that suspended sediment plumes are narrow and confined to the navigation channel in the immediate vicinity of the barge (Reine et al. 2002). Monitoring detected no evidence of plume migration or elevated TSS concentrations over the adjacent flats during either the ebb or flood tide surveys. Furthermore, according to Colden and Lipcius (2015), eastern oysters that were subjected to experimental sediment deposition did not exhibit significant mortality or sublethal effects until at least 70% of the shell height was buried. Therefore, it is expected that any sediment suspension and redeposition effects on shell bottom habitats would be temporary and minor.

Habitat Suitability Index modeling indicates that the project would increase suitable habitat for eastern oysters in the study area by up to 3 percent. Increased quantities of oyster reefs would result in improved habitat conditions for all species and life stages that utilize this habitat type.

The proposed project also includes beneficial use of dredged material. The proposed beneficial use locations include placement on approximately 946.6 acres of shell bottom habitat. However, the beneficial

use sites will be surveyed prior to any placement activities to ensure placement will avoid live oyster reef or vegetation resources.

Unconsolidated Bottom

The proposed dredging activities within Cape Fear River Estuary would require removal of material from the open water habitat/unconsolidated EFH. Given the abundance of nearby habitats for organisms to recruit from, the newly dredged areas will likely recover quickly (NMFS 2020). Any loss of habitat would be short-term, and through primary and secondary succession, would not cause substantial adverse effects to the reestablishment of the existing benthic communities or alter the capacity of the EFH to support healthy populations of managed species over the long-term. Early successional benthic organisms will likely rapidly colonize the dredged footprint from abundant adjacent habitat (McCall, 2012; Van Dolah et al., 1984). Studies of benthic recovery in South Carolina showed recovery from dredge sites in less than 9 months and studies in Georgia indicated recovery in dredged channels within 3 months. These recovery rates are due to recolonization from adults vertically migrating from shallow sediment deposits and horizontally migrating from relatively undisturbed habitats (Wilber and Clarke 2007). Newell et al, 1998, characterized typical recovery times at 6-8 months for mud habitats and 2-3 years for sand and gravel substrates.

The amount of unconsolidated bottom that will be impacted by dredging activities and beneficial use placement will account for much smaller percentage of the total area supporting this EFH type within the study area. Within the Inner Harbor, 1,696 acres of the estuary currently experiences maintenance dredging. Due to the proposed project, this acreage will increase by 330 acres to a total of 2,026 acres. The 2,026 total acres represents less than 10% of the greater than 22,000 acres of unconsolidated bottom adjacent to the channel from bank to bank. The impacts to the small percentage of the total area will not impact the foraging of demersal fish because there is abundant adjacent habitat; the mobile species can temporarily relocate to areas where construction is not occurring.

The amount of unconsolidated bottom that would be impacted by the proposed placement activities would be temporary and because no hardening measures will be in place the sediment will be allowed to move within the estuary system during normal tidal cycles.

Additionally, the abundance of habitat adjacent to the proposed placement area will be available for species to use, therefore, the predicted temporary impacts from placement will have minor long-term (approximately two years) impacts to this EFH or dependent species. Recovery is normal for healthy salt marsh habitats if the disturbance event is under the critical threshold and if there are adjacent unaffected habitats that can serve as a source for colonists (McCall, 2012). This direct impact would be minor and long-term (approximately two years); however, these effects are balanced with the benefits that beneficial use provides to species and the overall system.

USACE anticipates there will be renourishment activities for the beneficial use sites; however, it will be dependent on maintenance dredging timing, sediment compatibility, and capacity at the beneficial use locations.

Hardbottom and Artificial Reefs

It is anticipated that there will be no direct or indirect adverse impacts to the hardbottom resources from the dredging activities due to the identified hardbottom areas being two to three miles west of the existing ocean entrance channel and proposed offshore extension reach (NCSP 2022).

There would be no adverse impacts to the existing hardbottom resources from the beneficial use placement actions. However, one of the beneficial use placement options includes the enhancement of the WOFES. Enhancement of the WOFES would improve EFH for managed species that rely on this habitat type.

Coastal Inlets

Tidal inlets are a critical conduit for the larvae of ocean-spawning/estuarine-dependent fishes and invertebrates that spawn offshore on the continental shelf and use estuarine habitats for juvenile development. Successful larval recruitment to estuarine nursery areas is dependent on transport through a relatively small number of narrow tidal inlets. Larvae are concentrated in inlets during ingress periods, and thus are potentially more vulnerable to entrainment by dredges. However, model-projected larval entrainment studies at Beaufort Inlet indicate that entrainment rates are very low regardless of larval concentrations and the distribution of larvae within the water column (Settle 2003). Even under worst case conditions when the dredge is operating 24 hours/day and all larvae are assumed to be concentrated in the bottom of the navigation channel, the model-projected entrainment rate barely exceeds 0.1% of the daily (24-hour) larval flux through the inlet. Channel construction would temporarily increase the intensity of dredging operations in the Cape Fear River estuary, but the loss of larvae due to entrainment would have negligible effects on marine and estuarine-dependent fish and invertebrate populations.

There will be no direct impacts to the coastal inlets within the project vicinity. The inlets may experience some temporary, indirect effects such as turbidity increases during dredging activities and changing sediment compositions after renourishment. Shifts in tidal current velocities may also impact coastal inlets after construction.

State-Designated Nursery Areas

The proposed new dredging of unconsolidated bottom will encompass primary nursery area habitat in the Anchorage basin, between channel, and Fourth East Jetty reaches. There are 35.31 acres of primary nursery areas currently within the federal navigation channel and with the proposed channel increase there will be 50.6 acres of primary nursery areas within the new channel. This results in an increase of 15.29 acres of primary nursery areas that would be disturbed by the proposed project actions. Additionally, the proposed project will impact crab spawning sanctuaries within the project area. Of the 3,682 acres of crab spawning sanctuary habitat in the Wilmington Harbor, 308.1 acres of the habitat is in the current federal navigation channel or 8.4 percent of the available habitat. The proposed action would increase the impacted crab spawning sanctuary habitat to 423.7 acres or 11.5 percent of the available habitat. The proposed project will result in an addition 115.6 acres (+3.1 percent) of crab spawning sanctuary impacted. The effects of deepening the unconsolidated bottom habitat within the nursery areas would result in a reduction of benthic infaunal prey productivity as described above in the unconsolidated bottom section.

The proposed beneficial use projects will also impact primary and secondary nursery areas. There is anticipated to be 204.2 acres of impacts to estuaries in primary nursery areas, 6.4 acres of impacts to beach within primary nursery areas, and 553.3 acres of estuaries in secondary nursery areas. The beneficial use locations are outside of the crab spawning sanctuary habitat.

Additionally, the state-designated nursery areas may experience some temporary, indirect effects such as turbidity increases during dredging and placement activities. These impacts would be reoccurring during operations and maintenance dredging events and subsequent beneficial use placement activities.

Sandy Shoals of Capes

Jay Bird Shoals is outside of the channel widening footprint; however, the channel deepening may extend the channel side slopes into the shallow areas of the shoal. The impacts to shoals are substantial similar to that of unconsolidated bottom.

J.6.2 POTENTIAL EFFECTS TO MANAGED SPECIES

Additional effects to fisheries and other species are included in the HSI analysis in Appendix H.

Direct and Indirect impacts to Managed Species due to dredging and sediment placement

Shrimp

EFH-HAPCs for brown, pink and white shrimp include coastal inlets (SAFMC, 2009). Over-wintering areas and nursery habitats inside inlets are also important. The project area includes productive estuarine habitats that may be used by brown and white shrimp, such as emergent marsh, unvegetated bottom, and oyster beds. Hopper and cutterhead dredges have the potential to entrain invertebrates during all cycle phases; however, the loss of individuals due to entrainment would have negligible effects on the invertebrate populations.

Localized temporary turbidity would occur during dredging and placement activities. This could potentially have adverse effects on shrimp physiology and behavior. However, the locations being proposed for dredging and placement activities are in already naturally turbid environments and due to the content of the material being proposed for placement activities, turbidity levels will return quickly back to background levels after construction efforts are completed (12 to 24 hours).

The food-base of shrimp within the potential project footprint would likely be affected by changes in water quality. However, the food base would recover rapidly as water quality rebounds quickly following construction. Individuals would likely forage in adjacent areas that have not been physically affected.

If it is determined that confined blasting is needed, injurious effects to shrimp may include physical trauma (barotrauma from rapid pressure changes and exoskeleton damage), hearing and sensory damage (overwhelmed mechanoreceptors), and behavioral changes (avoidance behavior or stress response). Blasting would have adverse effects to shrimp within the blast radius. However, the confined blasting will occur in a limited, targeted area. Additionally, the three shrimp have high fecundity and migratory behavior, so they are capable of rebounding from very low population sizes in one year to large populations the next, provided environmental conditions are favorable (NCDMF 2022).

Overall impacts associated with the dredging and proposed placement activities to the shrimp would primarily occur during construction activities and would be temporary and minor in nature. Impacts associated with confined underwater blasting would be adverse but would not substantially affect the population of the fishery.

Snapper-Grouper Complex - Black Sea Bass

The project area includes estuarine resources that may be used by snapper species and their prey. A potential effect of the project would be that adult, juvenile, and post-larval snapper and their pray populations may be directly taken through dredging activities. Minor effects on the black sea bass population may occur if individuals or their pray species are taken as a result of entrainment or other dredging activities. These effects would not have a significant impact on the black sea bass populations.

Productive estuarine marshes and benthic habitat, particularly useful for snapper grouper foraging and refuge for young, would be indirectly impacted. The project would potentially cause localized turbidity from suspended materials, which would be minor and temporary as described above. More developed and mobile life stages would migrate to other suitable area habitats avoiding localized construction, but adjacent habitats to the placement location may still be temporarily affected by changes in turbidity. However, because these fish have the ability to migrate away from the construction activities and there is abundant adjacent habitat to the project areas, the effects of any turbidity plumes, which are transient and temporary, would be minimal.

Minor effects on black sea bass may result if prey habitat is removed or prey populations decline due to changes in salinity or dissolved oxygen. However, these migratory species are likely to move to another area where suitable prey would be found, or the species would adapt their diet. There is also abundant similar adjacent habitat throughout the Cape Fear River Estuary. Black sea bass are often found in mixed salinity estuaries and are unlikely to be affected by the small shifts in salinity that may result from this project.

These factors and any changes in prey fish populations would potentially cause temporary effects to the health and condition of juvenile and adult snapper in the area, but it is unlikely that the proposed action would cause significant impacts to the species.

Due to the location of the confined blasting and the limited area, black sea bass are unlikely to be within the confined blasting footprint. Therefore, there are no effects to black sea bass from blasting actions.

Overall impacts associated with the dredging and proposed placement activities to the grouper-snapper complex would primarily occur during construction activities and would be temporary and minor in nature.

Bluefish

Juvenile and adult individuals of bluefish utilize estuarine habitats in the project area during critical life stages for activities such as feeding and juvenile development. The routes of effect for the Bluefish would be similar to the snapper grouper.

Due to the location of the confined blasting and the limited area, bluefish are unlikely to be within the confined blasting footprint. Therefore, there are no effects to bluefish from blasting actions.

Overall impacts associated with the dredging and proposed placement activities to the bluefish would primarily occur during construction activities and would be temporary and minor in nature.

Coastal Migratory Pelagics - Spanish Mackerel

Juvenile and adult individuals of the coastal migratory pelagic species complex, like Spanish mackerel, utilize estuarine habitats in the project area. Estuarine marshes and other inlet habitats are particularly important for feeding and refuge/development. Entrainment is a route of effect for this species; entrainment is unlikely to be a significant issue because of the species ability to migrate away from dredging equipment.

Direct impacts to Spanish mackerel may include turbidity plumes associated with the dredging activities. However, because these fish are highly mobile and fast-moving, they have the ability to migrate away from the construction activities and potentially avoid direct exposure to increased suspended solids. The effects of any turbidity plumes, which are transient and temporary, would be minimal as described above. Additionally, the Spanish mackerel species prefers high salinity waters and are unlikely to be affected by the small shifts in salinity that may result from this project.

Developmental areas and prey species would be indirectly affected by the project. More developed and mobile life stages would migrate to other suitable area habitats avoiding localized construction, but adjacent habitats to the placement location may still be temporarily affected by changes in turbidity and circulation patterns. These factors and any changes in prey fish populations would potentially cause temporary affects to the health and condition of mackerel in the area. However, because these fish have the ability to migrate away from the placement activities, the effects of any turbidity plumes, which are transient and temporary, would be minimal.

Due to the location of the confined blasting and the limited area, coastal migratory pelagics are unlikely to be within the confined blasting footprint. Therefore, there are no effects to coastal migratory pelagics from blasting actions.

Overall, impacts associated with the proposed action to the coastal migratory pelagic complex would occur during construction activities and would be temporary and minor in nature.

Highly Migratory Species

Highly migratory species use the shallow coastal waters and estuaries in the project area for foraging and nursery during the younger life stages of the species. The nearshore ocean in Brunswick County and New Hanover County is documented as a pupping area for multiple species of sharks in the highly migratory species category. Entrainment is a potential route of effect for these species; however, entrainment is unlikely to be a significant issue because of the species ability to migrate away from dredging equipment. They are fast moving and can avoid the dredging equipment. The effect is lessened by the species' ability to avoid water column and bottom disturbances.

The neonates may have to migrate to nursery areas including coastal creeks and closer into the muddy bottoms of estuaries. There is abundant adjacent habitat in the area, so it would not affect the fitness of individuals to move to alternative habitats. While the deepening of the channel and placement of dredged material may result in the loss of foraging area and prey species, it would not affect the survival of species.

The temporary degradation of water quality due to dredging activities is the highest concern to highly migratory species. Direct impacts to highly migratory species may include turbidity plumes associated with the dredging activities. However, because these fish are highly mobile and fast-moving, they have the ability to migrate away from the construction activities and potentially avoid direct exposure to increased suspended solids. The effects of any turbidity plumes, which are transient and temporary, would be minimal. Additionally, the migratory species prefer high salinity waters and are unlikely to be affected by the small shifts in salinity that may result in the upper estuary from this project.

Developmental areas and prey species may be indirectly affected by the project. More developed and mobile life stages would migrate to other suitable area habitats avoiding localized construction, but adjacent habitats to the placement location may still be temporarily affected by changes in turbidity and circulation patterns. However, because these fish have the ability to migrate away from the placement activities, the effects of the construction activities would be minimal.

If it is determined that confined blasting is needed, injurious effects to sharks that are within the blasting footprint may include physical injury and mortality, behavioral disruption, and indirect ecological impacts. The effects of confined blasting on fishes in the Cape Fear River estuary were investigated through a series of test blasts conducted during the fall and winter of 1998/1999 (Rickman 2000; Moser 1999a; Moser 1999b). Most of the anticipated injuries for sharks would be internal hemorrhaging and organ displacement and damage. Some impacts on fisheries in the form of mortality and injury would be unavoidable, but the blast mitigation test results indicate that impacts would be limited to a small area. Therefore, with the implementation of an effective mitigation plan, blasting would not be expected to have a significant adverse effect on the fishery (NCSP 2022).

Overall, impacts associated with the proposed action to the highly migratory species would occur during construction activities and would be temporary and minor in nature. Impacts associated with confined underwater blasting would be adverse but would not substantially affect the population of the fishery.

Other Managed Species - Summer Flounder

Other managed species potentially using the project area include summer flounder during almost all their life stages. For these species, foraging and other behaviors may be altered as a result of placement activities. There could be reduced feeding efficiency due to impaired visibility due to turbidity plumes or the benthic prey could be smothered. However, summer flounder are opportunistic feeders and can adapt their diet based on the availability of prey (MAFMC 2002). In addition, summer flounder have the ability to migrate away from the placement activities, so the effects of any turbidity plumes, which are transient and temporary, would be minimal.

Indirect effects on summer flounder may result if prey habitat is removed or prey populations decline in the project area. However, these migratory species are likely to move to another area where suitable prey would be found or the species would adapt their diet. There is abundant similar adjacent habitat around the Cape Fear River Estuary.

If it is determined that confined blasting is needed, injurious effects to summer flounder that are within the blasting footprint may include physical injury and mortality, behavioral disruption, and indirect ecological impacts. The effects of confined blasting on fishes in the Cape Fear River estuary were investigated through a series of test blasts conducted during the fall and winter of 1998/1999 (Rickman 2000; Moser 1999a; Moser 1999b). Most of the anticipated injuries for flounder would be swim bladder damage,

including ruptures and hemorrhaging. Some impacts on fisheries in the form of mortality and injury would be unavoidable, but the blast mitigation test results indicate that impacts would be limited to a small area. Therefore, with the implementation of an effective mitigation plan, blasting would not be expected to have a significant adverse effect on the fishery (NCSP 2022).

Additionally, the creation of additional marsh habitats would be beneficial to summer flounder species. The marsh habitats are important for juvenile summer flounder and the creation and preservation of marsh habitats would help sustain healthy populations of the fish and their prey species.

Overall, impacts associated with the proposed action to the summer flounder would occur during construction activities and would be temporary and minor in nature. Impacts associated with confined underwater blasting would be adverse but would not substantially affect the population of the fishery.

J.6.3 SUMMARY OF EFFECTS AND DETERMINATION

The proposed project would have potential direct and indirect effects on EFH, managed species, and habitats associated with managed species. During dredging and placement activities, there will be some direct and indirect effects to estuarine and marine water columns, estuarine and palustrine emergent wetlands, subtidal and intertidal flats, oyster reefs and shell bottoms, unconsolidated bottoms, hardbottoms and artificial reefs, coastal inlets, and state-designated nursery areas.

Species and habitats associated with EFH are typically affected temporarily when placement and dredging activities occur. Overall impacts associated with the proposed placement activities to shrimp species, the grouper-snapper complex, bluefish, costal migratory pelagics, highly migratory species, and other managed species, would occur primarily during construction and placement activities and would be temporary and minor in nature. These species have the ability to migrate to other adjacent habitat to avoid direct impacts like construction and turbidity. Indirect placement impacts such as reduced water quality due to temporary increases in turbidity levels for activities such as feeding or spawning may also occur. However, these impacts would be short-term (within 12-24 hours) and minor in nature as the Cape Fear River estuary is a naturally turbid area due to tidal influences. Once dredging and placement activities are completed, any turbidity will quickly dissipate given the tidal currents. Short-term increases in turbidity will not have a measurable effect on the water temperature or dissolved oxygen concentrations.

Placement of dredged material as part of the beneficial use activities may adversely affect infaunal and bottom-dwelling organisms at the site by smothering immobile organisms, (e.g., invertebrate prey species) or forcing mobile animals (e.g., benthic oriented fish species) to migrate from the area. However, natural disturbances are common in coastal environments so faunal communities are resilient to many kinds of periodic disturbances. Recovery is normal for healthy salt marsh habitats if the disturbance event is under the critical threshold and if there are adjacent unaffected habitats that can serve as a source for colonists (McCall, 2012). This direct impact would be minor and long-term (approximately 2 years); however, these effects are balanced with the benefits that beneficial use provides to species and the overall system.

USACE has used the best scientific and commercial data available to complete this analysis and looks forward to further discussion on this project and its potential impacts.

J.6.4 INCIDENTAL PROJECT BENEFITS

Table 11 Summary Table of Incidental Impacts

Measure	EFH Benefit
Wetland Restoration – As mitigation for indirect conversion of freshwater wetlands, wetland restoration will occur at oligohaline/mesohaline wetlands adjacent to PNA to remove invasive species and enhance tidal creeks and ponds.	Improved habitat quality and increased intertidal habitat should provide additional foraging and refuge habitat to managed species and their prey including baitfish and macroinvertebrates such as shrimp and crabs. Additional ecosystem benefits, which have been measured across multiple salt marsh restoration projects, may be achieved over various temporal scales including improved habitat provisioning for increased floral and faunal diversity, enhanced hydrodynamic attenuation and sediment accretion, increased nutrient cycling and carbon sequestration (Billah et al., 2022)
Fish Passage – Fish passage structures will be constructed at Lock and Dam 1 and 2 as mitigation for impacts to anadromous fish spawning habitat.	Improved connectivity to spawning habitat is likely to improve anadromous fish spawning success within the project area. Improved spawning could result in increased prey availability, such as shad or herring, for EFH managed species.
Beneficial Use of Dredged Sediment – Beneficial use of dredged sediments will increase intertidal habitat by almost 1200 acres and provide long-term resilience to sea level change which is likely to result in loss of intertidal habitats over time.	Intertidal mudflats are less common than subtidal unconsolidated bottom, and provide important, high-quality foraging habitats for many managed species, including flounder.
WOFES – Rock dredged from the channel would be used to expand the existing artificial reef area.	WOFES provides high quality artificial reef habitat to managed species and is one of the only hardbottom habitats in near proximity. Expansion of WOFES would create additional foraging and refuge habitat to reef fish and their prey.

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