Appendix A
Essential Fish Habitat Assessment

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Maurice River Channel Maintenance Dredging
and
Beneficial Use of Dredged Material
Cumberland County, New Jersey

November 2022

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers, Philadelphia District, (USACE) has prepared an Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended, for the Maurice River Maintenance Dredging and Beneficial Use of Dredged Material Project in Cumberland County, New Jersey. The EA with an integrated Essential Fish Habitat (EFH) Assessment was previously provided to your office. Due to confusion regarding the presence of the EFH assessment components within the EA, a separate EFH analysis has been prepared pursuant to Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation & Management Act (MSA). The MSA requires the USACE to evaluate the proposed actions that occur within coastal waters of the United States. EFH textual descriptions are contained in fishery management plans developed by the regional fishery management councils. EFH for federally-managed species can include habitats such as wetlands, reefs, seagrass, rivers, and coastal estuaries that fish can spawn, breed, feed, and grow to maturity. This stand-alone EFH Assessment will be included in Appendix E of the final EA.

Authorized Federal Channel. The Maurice River Federal Navigation Channel, adopted as HD 59-644 in 1910 and modified as HD 73-275 in 1935, provides for a channel 7 feet deep and 150 feet wide in Delaware Bay across Maurice Cove to the mouth; thence a channel 7 feet deep, 100 feet wide to the fixed bridge at Millville, 21.5 miles above the mouth, and then 60 feet wide to the mill dam, a further distance of one-half mile, including a turning basin 7 feet deep at Millville. The total length of the Federal navigation project is about 24 miles. The Maurice River supports local fishing, the oyster industry and ship repair industries. The Federal channel requires periodic maintenance dredging to authorized depth. A portion of the channel was last dredged in 1996.

2.0 PROJECT LOCATION

The project area is located in Maurice River Township, Cumberland County, New Jersey (39.2279, -75.0211). The project area includes the lower portion of Maurice River navigation channel at the confluence with the Delaware Bay south of Bivalve, New Jersey and the northwest reach of the Heislerville Wildlife Management Area (Figure 1).

Figure 1: Channel dredging reach and Heislerville Wildlife Management Area

3.0 EXISTING ENVIRONMENT

The tides affecting the project area are semi-diurnal with two nearly equal high tides and two nearly equal low tides per day (or approximately 12 hours and 25 minutes per tidal period. Table 1 summarizes the 1983 – 2001 tidal epoch datums relative to Mean Lower Low Water (MLLW) and NAVD88 from NOAA's Tide and Currents (2022).

Datum	Description	Elevation (ft. MLLW)	Elevation (ft. NAVD88)
MHHW	Mean Higher-High Water	6.27	2.86
MHW	Mean High Water	5.84	2.43
MTL	Mean Tide Level	3.02	-0.39
MLW	Mean Low Water	0.19	-3.22
MLLW	Mean Lower-Low Water	0.00	-3.41

Table 1: Tidal datum values for Maurice River tide gauge at Bivalve, New Jersey

Water levels in the Maurice River cove area are predominately driven by astronomical tides; however, other factors such as sustained wind (*i.e.,* fetch), freshwater inflow from the river, rainwater runoff, and strong tides driven by storms can also affect water levels in the project area. Waters in this region of the Maurice River are turbid due to high concentrations of suspended sediments produced by strong tidal and wind-generated currents. The predominant wind direction varies by season, swinging to the south during summer. As wave energy in the bay approaches the Maurice River cove shoreline, it is limited by the shallow water depths. Normal wave heights are therefore generally low (less than 2 feet). The proposed project area is located in the lower reach of the authorized channel (11,500 linear feet) from station 1+500 to station 13+000 and adjacent flooded marsh system and has a predominately fine-grained sediment substrate. Grain size analyses of the channel sediments conducted in 2017 and 2022 are provided in Table 2. Sediment samples taken within the channel are predominantly fines (43.65 % to 95.1%) with fine, medium sand and coarse sands (9.8% to 38.8%).

2017

SOIL CLASSIFICATION	MR-1 %	MR-2 %	MR-3 %	MR-4 %
Coarse Sand	0	0.2	0.6	6.5
Fine Sand	3.9	7.2	7.6	5.7
Fines	95.1	87.1	86	43.6
Gravel	0	0	0.4	37
Medium Sand	1	5.5	5.4	7.2
Sand	4.9	12.9	13.6	19.4

2022

SOIL CLASSIFICATION	MR 5 %	MR 6 %	MR 7 %	MR 8 %	MR 9 %	MR 10 %	MR 11 %	MR 12 %
Coarse Sand	2.4	0.1	0.6	0.1	0.2	1	1	1.5
Fine Sand	29	5.7	8.2	2.6	35.5	3.4	3.1	4.3
Fines	61	91.6	83.7	96.1	36.2	93.3	92.8	91.3
Gravel	0	0	0	0	0	0	0	0
Medium Sand	7.6	2.6	7.5	1.2	28.1	2.3	3.1	2.9
Sand	39	8.4	16.3	3.9	63.8	6.7	7.2	8.7

Table 2: Soil classification of four Maurice River entrance channel samples (Tetra Tech, 2017, 2022).

Over the years, storms of note along the Delaware Estuary have caused many miles of shoreline along the Delaware Bay to retreat up to 75 feet. The combined effects of wind, waves, and elevated tidal water levels led to significant erosion along the Delaware bay shore. The study area continues to be subjected to progressive erosion of the shoreline and marshes due to long-term shore processes relating to storm events and SLR (Figure 2). Over the past several decades, the mouth of the Maurice River has been undergoing a rapid transition into a muddy delta. Siltation, channel erosion, and flooding have inundated the once pristine wetlands and meadows. Eroded material from wetlands has long been recognized as a source of shoal material within navigation channels within the area.

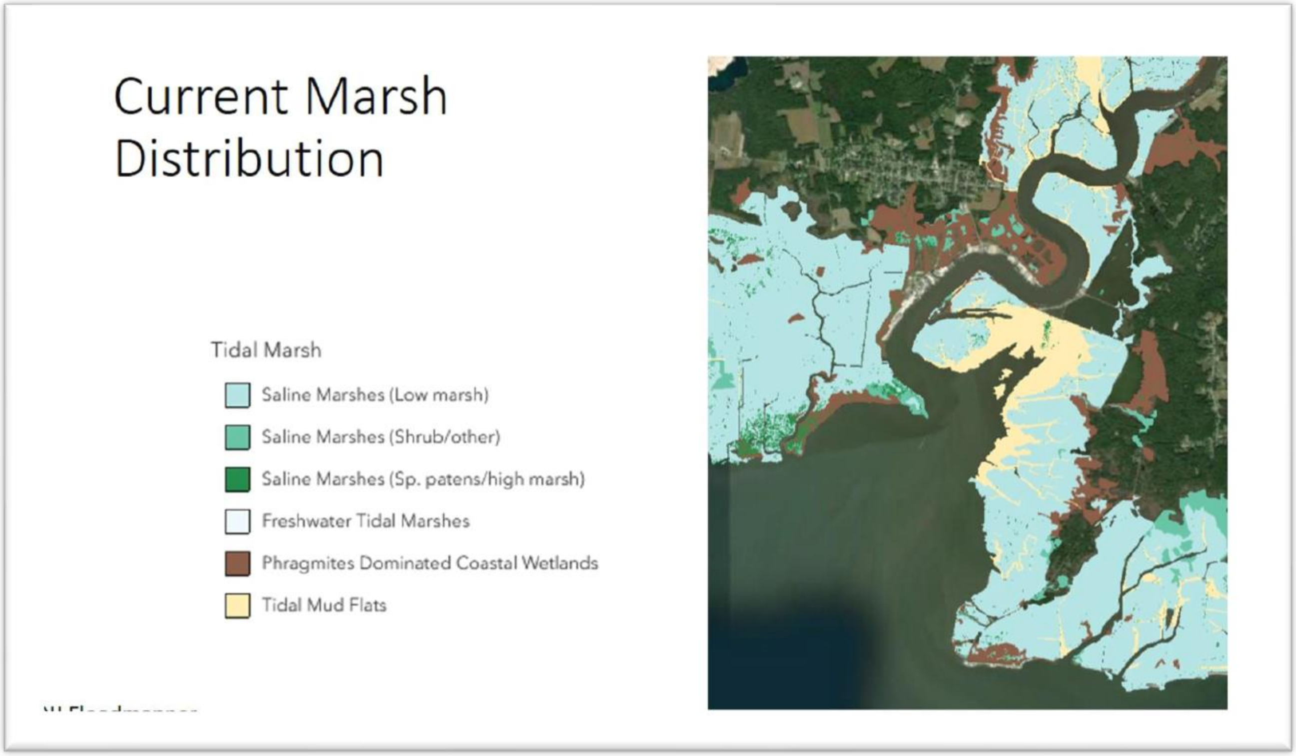

Figure 2: Current landcover data for the area (courtesy of L. Tedesco, The Wetlands Institute).

4.0 PROPOSED ACTION

For maintenance dredging operations, USACE utilizes Regional Sediment Management (RSM) and Engineering with Nature (EWN) principles and practices in a natural infrastructure approach. Maintenance dredging is necessary for navigation safety within authorized channels and will occur periodically, as needed. For the initial dredging operation scheduled to begin in winter 2023, the Philadelphia District proposes to dredge approximately 75,000-100,000 cubic yards (cy) of a portion of the lower Maurice River federally-authorized navigation channel between stations 1+500 to 11+500 and beneficially use the material by placing it in eroded marsh area in Heislerville Wildlife Management Area (WMA) (Figure 3). In a subsequent maintenance cycle, an additional 25,000-50,000 cy is anticipated to be dredged between stations 1+500 to 13+000, where needed, to the authorized depth of 7 ft MLLW with 2 ft allowable over-depth. Additional future maintenance dredging cycles will occur as needed, pending surveying. The proposed dredging operation will employ a hydraulic pipeline dredge and will require approximately 8 weeks of in-water work. Dredging will remove critical shoaling in priority areas within this lower reach in order to maintain a safe and reliable navigation channel for commercial and recreational vessels. The additional 25,000-50,000 cy proposed to be dredged from this reach will occur after a consolidation period of 1-2 years after the initial placement.

Figure 3: Proposed location of channel dredging and beneficial use placement areas.

Beneficial Use Placement Objective. The beneficial placement of the dredged material within the Heislerville Wildlife Management Area (WMA) will help to rebuild and bolster substrate elevations in an inter-tidal wetland/mudflat/shallow water marsh complex that has been subjected to excessive inundation and erosion for several decades. Several alternatives for dredging and placement locations within the general vicinity of the Maurice River Navigation Channel were evaluated. The alternative plans considered were 1) No Action (no channel maintenance dredging); 2) channel maintenance dredging and placement of dredged material in the upland Cape May CDF; 3) channel maintenance dredging and placement at East Point; and 4) channel maintenance and placement at the Heislerville WMA. The alternatives are described in detail in Section 3 of the EA and the reasons for why alternatives 1,2, and 3 were eliminated from further consideration. These reasons included: working with fine-grained sediments at these alternative locations was determined to be infeasible, other locations were not cost-effective, and other locations would not result in an environmental benefit and could pose increased potential adverse impacts to the environment. Two preferred placement areas were identified in collaboration with coastal engineers, scientists, landscape architects, and resource managers from the Philadelphia District USACE, the New Jersey Department of Environmental Protection (NJDEP), the U.S. Army's Research and Development Center (ERDC), the University of Pennsylvania (UP), and local officials (see Figure 3).

These proposed placement areas within the northwest Heislerville WMA for the beneficial use placement of channel maintenance material were selected in order to best achieve success in retaining the material within the localized estuarine system and provide a sediment benefit to a flooded marsh system to build and bolster the natural infrastructure that protects the Heislerville Dike, which in turn protects the critical impoundments and habitat located in the Heislerville WMA. These areas are managed by the NJDEP's Division of Fish & Wildlife. Both placement areas are each approximately 9 acres in size (Figure 4). The proposed placement objective is to enrich substrates incrementally within the existing but degrading subtidal, intertidal, and low marsh areas to increase their resiliency. This is a systems approach to enhancing existing habitats through sediment addition. The intent is to avoid conversion of low marsh habitat to other habitat types, such as high marsh or upland. This will be accomplished by avoiding the deposition of material in the low marsh portions of the placement site or placing lesser amounts to maintain elevations below mean high water. The project will include sediment nourishment to mudflats and adjacent subtidal areas to extend the footprint of the inter-tidal fringe.

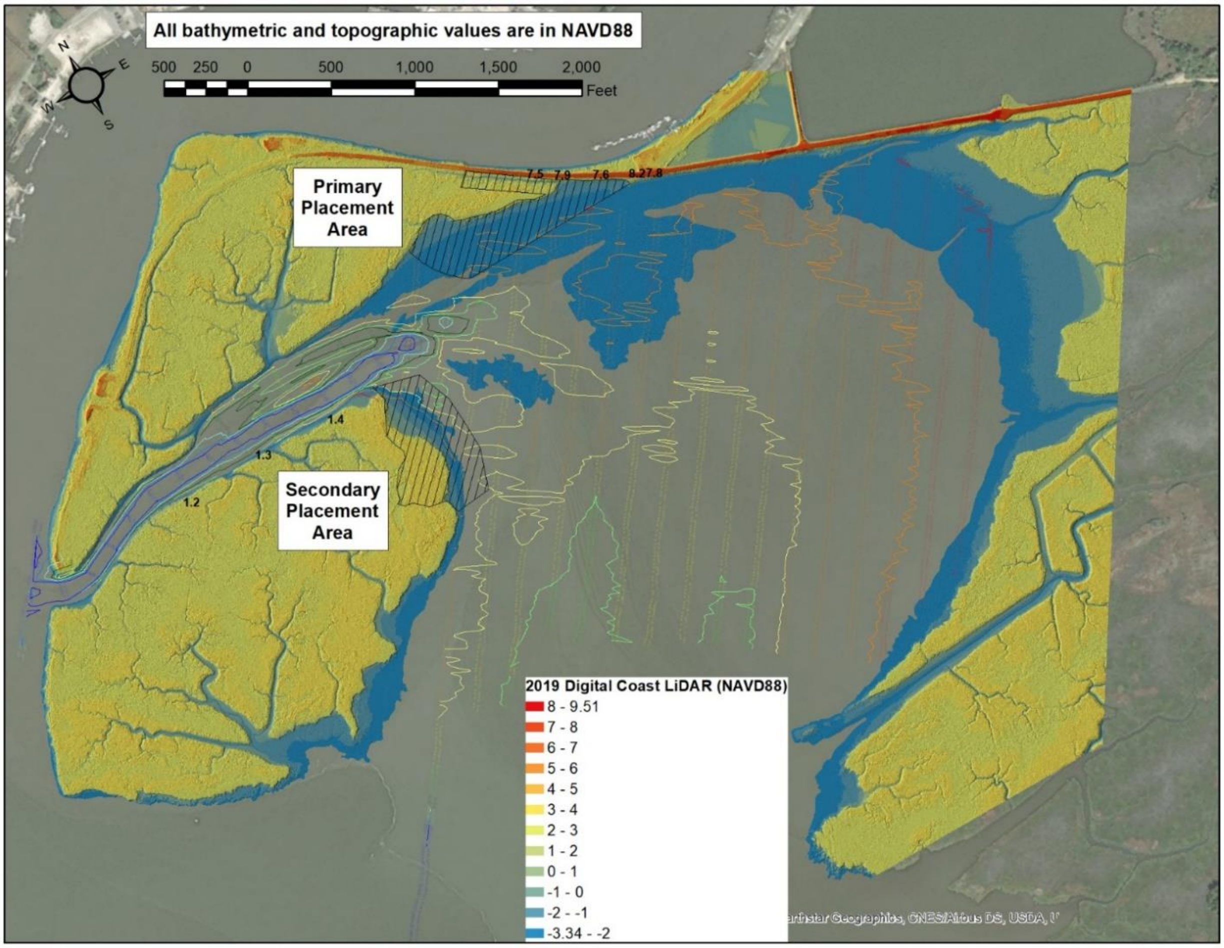

Figure 4: Proposed dredged material placement areas, primary and secondary locations.

The first-year placement will occur within the primary placement area, the majority of which is within an old railroad bed located bayward of the Heislerville dike. Containment will be incorporated into the design utilizing the stable foundation of the old railroad bed to build elevation adjacent to the dike. Containment efforts may include the use of turbidity curtains, coir logs, and/or hay bales, and earthen berms. The turbidity curtain planned will be similar to that used during the Mordecai Island restoration (USACE, 2022) since it adapted with phases of the tide and successfully stabilized the fine-grained sediment portion over time. There are no known areas of submerged aquatic vegetation (SAV) in the proposed dredging or placement areas. The primary placement area is comprised of approximately 60 percent mudflat and 30 percent subtidal and 10 percent low marsh and abuts with the Heislerville dike, which consists of broken concrete and stone and will serve to help contain the sediments. The secondary placement area is comprised of approximately 16 percent mudflat, 48 percent subtidal, and 36 percent low marsh. Elevations are shown in Figure 4. Deposition of dredged sediments will vary in the placement area but will not exceed 3.5 feet NAVD88. In the primary placement area, sediments that settle in subtidal habitat may convert a portion of habitat to intertidal mud flat habitat. Sediments that settle on existing intertidal mud flat may convert naturally to low marsh if sufficient elevations allow saltmarsh vegetation to establish. Any thin-layer placements within the low marsh will enrich the low marsh habitat resiliency. The sediment characteristics are not conducive to building above a low marsh elevation. In the secondary placement area, dredged sediments may serve to raise elevations to those that existed as low marsh prior to 1991 but are currently intertidal and subtidal.

The initial dredging and placement operation is currently scheduled to occur between January and March 2023. Monitoring of placement elevations and sediment consolidation via traditional and remote sensing techniques will be conducted and will occur prior to, during, and post-placement operations. Lessons learned from the first placement in Winter 2023 will inform the design and construction of the follow-on dredging and placement operation in subsequent years, based on resultant elevation and consolidation data from the first placement. The secondary placement area has been identified for sediment enrichment in the event that the initial primary placement area requires additional consolidation time between maintenance dredging cycles. Either placement area will receive sediment enrichment in future maintenance dredging cycles.

At the primary placement site, the marsh fronting the Heislerville dike structure protects the impoundments from the large fetch conditions that exist due to the flooded marsh having a direct connection to the Delaware Bay. The dike has been repaired multiple times by NJDEP as it protects the critical habitat located behind the dike in the Heislerville WMA. The WMA is managed by NJDEP's Division of Fish and Wildlife and is integral to the local community and also prevents the Maurice River and the Delaware Bay from being directly connected hydraulically. Compromise to this structure could result in significant changes to the geomorphology of the area which would have a negative impact on the surrounding saltmarshes, the commercial/private facilities north of it, and in turn, the entire local economy. The tidal marsh complex of habitats from a systems perspective provides numerous fish species vital resources for refuge, foraging, spawning, and nursery grounds.

Saltmarshes and their adjacent intertidal mudflats and shallow water are critical habitats for fish and wildlife. New Jersey's salt marshes are rapidly disappearing due to sea level rise (SLR), which is estimated to be between 5 and 6 mm/year. Parts of New Jersey's baycoast are sinking (subsidence) due to geological factors, which compounds wetland losses due to SLR. Saltmarshes must accrete sediments to keep pace with the rate of SLR. Excessive flooding of salt marshes prevents the vegetation from thriving, which in turn, renders them unable to trap sediments. Frequent inundation due to large storms and high erosion rates due to SLR over the past 50 years have resulted in extensive losses of tidal marshes. Wetlands in the Heislerville Wildlife Management Area have been severely impacted, resulting in exacerbated flooding, erosion, and subsidence. New Jersey has lost large coastal habitat areas, and it is estimated that another 28% of tidal marshes will be lost by 2050 (State of New Jersey, 2021). The loss of salt marshes in New Jersey is best exemplified at the Heislerville Wildlife Management Area (WMA). Since 1985, an estimated 40% of the salt marshes protecting Matts Landing Road Dike that preserves the WMA's migratory bird impoundments have been lost due to the constant stressors placed on this fragile ecosystem.

Channel maintenance dredging is necessary for navigational safety. By placing the dredged sediments in adjacent flooded degraded marshes as opposed to placement in an upland CDF, the dredged material can be used to sustain the marshes by raising the substrate elevation incrementally in the face of continued erosion and sea level rise. Multiple lifts will be needed over time for the fine-grained material to aid the marsh in keeping pace with SLR. The proposed beneficial use takes a systems approach to enhancing the wetland complex. Each successive placement operation will incrementally add sediment over time to the existing landscape to build elevation to bolster wetland habitats. The beneficial placement of sediments obtained from maintenance dredging of authorized navigation channels serves to retain the valuable sediments within the local estuarine system where they are needed. The strategic placement method will allow the sediments to flow and position naturally within the proposed placement areas to bolster the wetland habitats against excessive flooding. Dredge material placement within the primary site, abutting the toe of the Heislerville dike, will also provide natural and nature-based storm protection to the dike and infrastructure behind it. The placement areas will be monitored before, during, and after operations to document how fluidized sediments behave and augment subtidal, intertidal, and low marsh elevations. Lessons learned from the monitoring plan will inform adaptive management strategies for future placements.

The abundance of dredged materials from channel maintenance throughout the state of New Jersey provides a valuable and needed resource as well as opportunities to combine dredging needs with coastal marsh rehabilitation. Beneficial use of dredged material removed from navigation channels is preferrable to disposal of the sediments in upland contained disposal facilities (CDFs). The National Marine Fisheries Service (NMFS) has stated that it supports implementing positive and sustainable measures to meet the needs of the living resources and communities of the Maurice River because of the area's increased rates of erosion, sea level rise, loss of living resources (*e.g.* fish, shellfish, invertebrates, vegetation) and habitat. Placement of the dredged material on former but now excessively flooded marsh area (*i.e*. the proposed placement areas) is expected to raise the substrate elevations within the existing habitats such that they may better perform their valuable ecological services. Commercially and recreationally important living resources are dependent upon tidal marshes for foraging, spawning, and nursery areas. Wetlands represent a defining characteristic of a healthy estuarine ecosystem and help to maintain water quality through the interception of and filtering of upland runoff and tidal flushing.

<u>Monitoring and Adaptive Management Plan</u>. The following proposed monitoring plan was developed by the USACE, Philadelphia District (NAP) in coordination with USACE's ERDC, the NJDEP Division of Fish & Wildlife, the University of Pennsylvania's Weitzman School of Design (UP) and other project stakeholders to develop the comprehensive data collection and monitoring plan for the Heislerville Wildlife Management Area (WMA) beneficial use placement operation. Ongoing monitoring, research efforts and lessons learned being developed in the Seven Mile Island Innovation Laboratory (SMIIL) within the Cape May Wetlands Wildlife Management Area are also being leveraged for this work.

Proposed monitoring and data collection plans will occur for a minimum of 5 years post-placement and include:

Pre-Placement Monitoring

- Elevation data of the placement areas adjacent to the Heislerville Dike and in the Northwest Reach as well as the federal channel (including LiDAR (UAS), DEM from photogrammetry (UAS), INSAR from satellite (tentative), traditional boat and topo surveys)
- Multispectral imagery pre and post dredging using UAS
- Sediment sampling in channel and placement areas (2017 and 2022)
- Data collection and laboratory analysis of consolidation including additional cores within the channel and placement sites
- Drone photography at high and low tides (pre-placement and throughout construction)
- Leverage Seven Mile Island Innovation Lab monitoring, R&D efforts and lessons learned

During Placement

- Monitoring of dredged sediments and settling
- Installation of time-lapse cameras around the site to monitor surface change, flow velocity (dredging, within tidal creeks (with containment structures) pre-, during and post-dredging
- High resolution photography and video footage
- Documentation of innovative dredging technologies and techniques such as turbidity curtain concept, diffused discharge, use of natural landscape to move sediment to support intertidal or subtidal mudflats.
- Turbidity Monitoring including roving turbidity meter for project area and potential fixed meter as needed

Post-Placement

- Surface elevation post placement using LiDAR (UAS), DEM from photogrammetry (UAS), INSAR from satellite (tentative)
- Topographic and bathymetric data collection for minimum of 3 years
- Multispectral imagery pre- and post-dredging using UAS
- Aerial monitoring of elevation and topography and design of landscape features
- Subsurface imagery with time to monitor evolution of dredged fill (consolidation, sediment mixing, bioturbation) post-dredging
- Follow-up sampling on consolidation work including modeling
- Quantification of NNBF benefits for Heislerville Dike
- Leverage SMIIL monitoring, R&D efforts and lessons learned

5.0 ESSENTIAL FISH HABITAT

The lower Maurice River and confluence with the Delaware Bay have the potential to provide habitat for federally-managed fish species. The MSA and Fish and Wildlife Coordination Act (FWCA) require federal agencies to consult with NMFS on projects that may adversely affect EFH. NMFS will in turn, provide conservation recommendations for EFH and other NOAA trust resources. The Guide to Essential Fish Habitat Designations in the Northeastern United States Volume IV (NOAA 1999) and NOAA's EFH Mapper were used to identify federally-managed fish species and life stages within the vicinity of the proposed project area.

5.1 Federally-managed Species

Finfish represent a major resource group in the Maurice River cove project area and the Delaware Bay. Water depths range from 1-7 feet MLLW. Fish species of various life history stages occur in both the proposed dredging as well as the placement areas. NOAA Fisheries has designated EFH for 12 federally managed species in the project area based on life stages likely to be present (FishMapper accessed 7 March 2022). The species are listed in Table 3 for the open water (flooded marsh) area of Maurice River and Cove (Degrees, Minutes, Seconds: 39º13'48"N, Longitude= 76º58'59"W). Additionally, in a letter dated 25 October 2022, NMFS identified designated EFH for several Atlantic highly migratory species (*i.e.,* tuna, swordfish, billfish, and several species of sharks: the sandbar shark (*Carcharhinus plumbeus*), smoothhound shark complex (*Mustelus mustelus*) Atlantic stock, and sand tiger shark (*Carcharias taurus*) (Collette, B.B. and C.E. Nauen, 1983; Compagno, 1984). The managed species and life stages are listed below for the open water of the proposed channel dredging area and proposed saltmarsh and shallow water placement area (flooded marsh) and confluence with the Delaware Bay. EFH textual descriptions are contained in fishery management plans developed by the regional fishery management councils. EFH can include habitats such as wetlands, reefs, seagrass, rivers, and coastal estuaries that fish can spawn, breed, feed, and grow to maturity.

Table 3: Federally-managed fish species and life stages that may occur at the Maurice River project area.

Species	Lifestage(s) Found at Location
Little Skate *Leucoraja erinacea*	Juvenile Adult
Atlantic Herring *Clupea harengus*	Juvenile Adult
Red Hake *Urophycis chuss*	Adult
Windowpane Flounder *Pseudopleuronectes americanus*	Adult Juvenile

Winter Skate *Leucoraja ocellata*	Adult Juvenile
Clearnose Skate *Raja eglanteria*	Adult Juvenile
Longfin Inshore Squid *Doryteuthis pealeii*	Eggs
Bluefish *Pomatomus saltatrix*	Adult Juvenile
Atlantic Butterfish *Peprilus triacanthus*	Larvae Adult Juvenile
Scup *Stenotomus chrysops*	Juvenile Adult
Summer Flounder *Paralichthys dentatus*	Juvenile Adult
Black Sea Bass *Centropristis striata*	Juvenile Adult
Sandbar Shark *Carcharhinus plumbeus* (HAPC)	Neonate Adult
Sand Tiger Shark *Carcharias taurus*	Neonate Adult
Smoothhound Shark Complex *Mustelus* spp.	Adult

Habitat Area of Particular Concern (HAPC) has been designated in the project area for the sandbar shark. HAPCs either play important roles in the life history (*e.g.*, spawning or pupping areas) of federally managed fish species or are especially vulnerable to degradation from fishing or other human activities.

5.2 Species Life History Evaluations

Atlantic herring (*Clupea harengus*) are pelagic, schooling, plankton-feeding species that inhabits both sides of the North Atlantic Ocean. In the western North Atlantic this species ranges from Labrador to Cape Hatteras and supports major commercial fisheries. Adults migrate south into southern New England and mid-Atlantic shelf waters in the winter after spawning in the Gulf of Maine, on Georges Bank, and on Nantucket Shoals. Eggs occur predominantly in offshore, well-mixed waters of 32 – 33 ppt salinity, with tidal currents between 1.5 and 3.0 knots, water temperatures below 15° C, and in depths of 20 – 80 meters. Juvenile and adult herring are abundant in coastal and mid-shelf waters from southern New England to Cape Hatteras in the winter and spring. In the spring, adults return north, but juveniles do not undertake coastal migrations. Larval herring are limited almost exclusively to Georges Bank and the Gulf of Maine waters. Larvae typically metamorphose the following spring into young-of-year (YOY) juveniles. Atlantic sea herring prefer higher salinities (26 – 32 ppt) and juveniles and adults (including spawning adults) are typically found at depths of 15 – 130 meters (Stevenson and Scott 2005). Atlantic herring juvenile and adult forms may occur within the project area. These life stages will likely occur in low numbers and no significant adverse effects of the dredging and placement actions are anticipated.

Atlantic Butterfish (*Peprilus triacanthus*) are relatively small, fast-growing, short-lived, pelagic fish that form loose schools, often near the surface. Butterfish eggs and larvae are pelagic and occur from the outer continental shelf to the lower, high salinity parts of estuaries in the Mid-Atlantic Bight (MAB). Juveniles and adults are common in inshore areas, including the surf zone, as well as in sheltered bays and estuaries in the MAB during the summer and fall. Inshore EFH is the "mixing" and/or "seawater" portions of all estuaries on the Atlantic coast where butterfish eggs are common, abundant, which may include the waters of the project area. Butterfish eggs are buoyant, and the larvae are nektonic. Juveniles and adults are eurythermal and euryhaline, and are frequently found over sand, mud, and mixed substrates. Smaller juveniles often aggregate under floating objects and often live in the shelter of large jellyfish. Juvenile and adult butterfish in the MAB are typically found at depths ranging from 3 – 23 meters with water temperatures ranging from 8 – 26° C, salinities ranging from 19 – 32 ppt, and DO ranging from 3 – 10 mg/l. All life stages may occur in the project area, most likely in summer and fall (Cross *et al*., 1999). While some impacts to larvae may occur in the project area, since adult butterfish are pelagic and even juveniles are highly mobile, only minimal impacts to butterfish and EFH are expected to occur as a result of the proposed dredging and placement operations.

Black Sea Bass (*Centropristis striata*) are a warm temperate serranid that ranges from southern Nova Scotia and the Bay of Fundy to southern Florida and into the Gulf of Mexico. Black sea bass are typically found on the continental shelf in complex habitats such as reefs and shipwrecks, but young-of-year (YOY) fish also occur in large numbers in structurally complex estuarine habitats. Their distribution changes seasonally as fish migrate from coastal areas to the outer continental shelf while water temperatures decline in the fall and from the outer shelf to inshore areas as water temperatures rise in the spring. Adult sea bass are very structure oriented, especially during their summer coastal residency. Adults only enter larger estuaries and are most abundant along the outer Atlantic coast. Spawning occurs on the continental shelf, beginning in the spring off Cape Hatteras and progressing into the fall in the MAB and off southern New England. Eggs are pelagic with high average egg densities generally located on the continental shelf in the vicinity of large estuaries (Drohan *et al*., 2007).

Black sea bass migrate offshore to avoid cold inshore winter temperatures. After overwintering they return to inshore estuaries in late spring and early summer. They are uncommon in open unvegetated sandy intertidal flats or beaches. The diet of larval black sea bass is poorly known, but probably consists of zooplankton. Juvenile black sea bass are diurnal, visual predators and often prey on small benthic crustaceans (isopods, amphipods, small crabs, sand shrimp, copepods) and other epibenthic estuarine and coastal organisms. During the summer, adult black sea bass feed on a variety of infaunal and epibenthic invertebrates, especially crustaceans. Project operations are unlikely to impact black sea bass as the species gravitates towards structure which does not occur in the project area. Any juveniles or adults that may occur in the inshore area of the project will avoid the project site temporarily.

Bluefish (*Pomatomus saltatrix*) are a pelagic species that travel in schools of like-sized individuals and undertake seasonal migrations, moving into the MAB during spring and south or farther offshore during fall. Within the MAB they occur in large bays and estuaries as well as across the entire continental shelf. Bluefish spawn offshore in open ocean waters. Juvenile bluefish are found in estuaries, bays, and coastal ocean waters in the MAB and South Atlantic Bight in many habitats. Typically, they are found near shorelines, including the surf zone, during the day and in open waters at night. Like adults, they are active swimmers and feed on small forage fishes, which are commonly found in nearshore habitats. They remain inshore in water temperatures up to 30° C and return to the continental shelf in the fall when water temperatures reach approximately 15° C. Juvenile bluefish are associated mostly with sand but are also found over silt and clay bottom substrates. They usually occur at salinities of 23 – 33 ppt but can tolerate salinities as low as 3 ppt (Shepherd & Packer, 2005). Adults are generally pelagic. Juvenile and adult bluefish may occur in the project area between spring, summer, and fall. Juveniles and adults are motile and will likely temporarily avoid the project area during construction. The project is not expected to impact the available habitat utilized by bluefish in the area.

Red Hake (*Urophycis chuss*) occur in continental waters from the Gulf of St. Lawrence to the Mid-Atlantic states. During warmer months, they are most common in depths less than 100 m; during colder months, they are most common in depths greater than 100 m. In the MAB, red hake occur most frequently in coastal waters in the spring and fall; then move offshore to avoid the warm summer temperatures. Juveniles (< 24 cm) usually avoid shallow waters that are warmer than about 22° C, but they do inhabit deeper bays. Red hake spawn offshore in the MAB in the summer. Adults may be found in the project area although the species prefers deeper, cooler waters than those that occur in the project area (Steimle, 1999a). The proposed project is unlikely to impact red hake adults or EFH.

Scup (*Stenotomus chrysops*) are considered a demersal species. They spawn along the inner continental shelf from Delaware Bay to southern New England between May and August, mainly in bays and sounds. Young-of-Year (YOY) juveniles are commonly found from the intertidal zone to depths of about 30 m in portions of bays and estuaries where salinities are above 15 ppt. Juvenile scup appear to use a variety of coastal intertidal and subtidal sedimentary habitats during their seasonal inshore residency, including sand, mud, mussel beds, and seagrass beds. Adult scup are common residents in the MAB from spring to fall and are generally found in schools on a variety of habitats, from open sandy bottom to structured habitats such as mussel beds, reefs, or rough bottom. Larger adults are found in deeper waters while smaller sized adults are typically found in bays and estuaries. Adults move inshore during early May and June between Long Island and Delaware Bay. As inshore water temperatures decline to <8 to 9° C adult and juvenile scup leave inshore waters and move to warmer waters on the outer continental shelf south of the Hudson Canyon off New Jersey and along the coast from south of Long Island to North Carolina in depths ranging from 75 – 185 m. Juveniles and adults feed on variety of epifaunal and water column prey. Juvenile and adult Scup are likely to be found in the project area during warmer seasons. The species will migrate offshore into deeper waters once water temperatures fall (Steimle, 1999b). The project activities will likely cause juveniles and adults to avoid the construction area temporarily to subtidal waters and unlikely to be directly impacted by the operation.

Summer Flounder (*Paralichthys dentatus*) have a broad geographical range which encompasses shallow estuarine waters and outer continental shelf from Nova Scotia to Florida. Spawning occurs over the open ocean areas of the continental shelf during fall and winter. Summer flounder exhibit strong inshore–offshore movements with adults and juveniles normally inhabiting shallow coastal and estuarine waters during the warmer months of the year and moving offshore during the fall and winter for growth and spawning. Summer flounder eggs are offshore, planktonic and buoyant. Summer flounder eggs are present in the highest numbers from fall to early winter. Planktonic larvae and post-larvae derived from enter coastal and estuarine nursery areas to complete transformation. Juveniles are distributed inshore and occupy many estuaries during spring, summer, and fall.

Juvenile summer flounder utilize several different estuarine habitats such as marsh creeks, seagrass beds, mud flats, and open bay areas. As long as other conditions are favorable, substrate preferences and prey availability appear to be the most important factors affecting distribution. Summer flounder utilize sandy or mixed substrates as well as mud and vegetated habitats. Adults appear to prefer sandy habitats but can be found in a variety of habitats with both mud and sand substrates (Packer *et al*., 2003c). Given their association with sandy substrates, the summer flounder is not expected to occur in large numbers in the project area. Juveniles and adults may occupy the project area during the late spring, summer, or fall but are very wary of disturbance and will move out of the area to avoid the construction area temporarily. The proposed project is not anticipated to adversely affect summer flounder.

Windowpane Flounder (*Pseudopleuronectes americanus*) are a shallow water mid- and inner-shelf species found primarily between Georges Bank and Cape Hatteras on bottom habitats with a substrate of mud or fine-grained sand. Spawning occurs on inner shelf waters, including many coastal bays and sounds, and on Georges Bank. Windowpane flounder eggs and larvae are often observed in the MAB from February to November with peaks in May and October. Windowpane eggs are buoyant and are found in surface waters. Larvae are initially planktonic then settle to the bottom. Juveniles and adults are similarly distributed. They are found in most bays and estuaries south of Cape Cod throughout the year at depths less than 100 meters, bottom temperatures (3 – 12° C in the spring and 9 – 12° C in the fall), and salinities (5.5 – 36 ppt). Juveniles that settle in shallow inshore waters move to deeper offshore waters as they grow. Adults occur primarily on sand substrates in the MAB. YOY and older juveniles are common within 100 feet of shore of the coastal and offshore waters (out to the offshore boundary of the EEZ). These waters include seawater (salinity > 25.0 ppt) and brackish salinity zones (0.5 < salinity < 25.0 ppt). Adults and juvenile stages would be expected to occur in the project area during most of the year. These life stages would be expected to temporarily leave the action area during construction with minimal impact to shallow water habitat (Chang *et al*., 1999). The proposed placement of dredged material within eroded wetlands is expected to improve habitat quality for juvenile and adult summer flounder by enhancing habitat for prey species.

Little Skate (*Leucoraja erinacea*) is considered a shallow water species and occurs from the top of the subtidal zone to depths of 90 m. It has a relatively narrow distribution, found only in the northwest Atlantic from Grand Banks, Canada to Cape Hatteras, North Carolina. It is one of the dominant members of the demersal fish community of the northwest Atlantic. Its center of abundance is in the northern section of the MAB and on Georges Bank, where it is found all year over almost the entire range of temperatures. Little skate do not make extensive migrations, although where it occurs inshore the species moves onshore and offshore with seasonal temperature changes. Little skate are generally found on sandy or gravelly bottom, but can also occur on mud. Skates are known to remain buried in depressions during the day, but they may feed at any time during a 24-hour period. Little skate deposit eggs in water not deeper than 27 m on sandy bottoms (Packer *et al*., 2003a). Essential fish habitat source document: little skate, *Leucoraja erinacea*, life history and habitat characteristics. NOAA Technical Memorandum NMFSNE- 175. U.S. Department of Commerce, National Oceanic and Atmospheric administration Northeast Fisheries Science Center Woods Hole, MA. 76 pp. Juvenile and adult stages may occur in the project rea. Eggs are unlikely to be found in the project area. The species is highly mobile and will likely avoid the area of temporary disturbance. No direct impact to Little skate is anticipated to result from dredging and placement operations although indirectly EFH and food prey resources will be temporarily impacted by the proposed federal action.

Sand Tiger Shark (C*archarias taurus*) is commonly found in coastal embayments and nearshore waters, from the surf zone to the outer continental shelves from the surface to a minimum of 183 m. This species exhibits a preference for near-bottom habitats but often occurs in midwater or surface zones. Sand tiger sharks typically feed on bony fishes, small sharks, rays, squids, crabs, and lobsters. EFH for neonates (≤125 cm) is shallow coastal waters to 25 meters deep from Barnegat Inlet, NJ south to Cape Canaveral, FL. Neonate sand tiger sharks may be occur in the near-bottom habitats as well as other parts of the water column in the project although depths may be too shallow in the placement area (Pollard & Smith, 2009). Neonate sand tiger sharks and adults are mobile and likely to temporarily leave the area during construction. No impact to sand tiger shark or EFH is anticipated. No direct impact to sand tiger shark is anticipated to result from dredging and placement operations although indirectly EFH and food prey resources will be temporarily impacted by the proposed federal action.

Sandbar shark (*Carcharinus plumbeus*) is an abundant, coastal–pelagic shark of temperate and tropical waters that occurs inshore and offshore. It is found on continental and insular shelves and is common at bay mouths, in harbors, inside shallow muddy or sandy bays, and at river mouths, but tends to avoid sandy beaches and the surf zone. Sandbar sharks migrate north and south along the Atlantic coast, reaching as far north as Massachusetts in the summer. Sandbar sharks bear live young in shallow Atlantic coastal waters between Great Bay, New Jersey, and Cape Canaveral, Florida, including Delaware Bay. Neonates and juveniles inhabit shallow coastal nursery grounds during the summer and move offshore into deeper, warmer water in winter. Late juveniles and adults occupy coastal waters as far north as southern New England and Long Island. The area is included as HAPC for the species. Neonates and adult life stages are likely to occur in the proposed dredging area although the species is less likely to be found in the shallow water depths within the proposed placement areas. Sandbar sharks are a mobile species and expected to temporarily leave the area of construction. No direct impact to sandbar shark is anticipated to result from dredging and placement operations although indirectly EFH and food prey resources will be temporarily impacted by the proposed federal action.

Winter Skate (*Leucoraja ocellata*) occur from the south coast of Newfoundland and the southern Gulf of St. Lawrence to Cape Hatteras. Its center of abundance is on Georges Bank and in the northern section of the MAB. Habitat in the MAB includes estuarine and nearshore coastal shelf waters. The winter skate is a benthic species. Habitat ranges from shoreline to 317 m, but it is most abundant at depths <150 m. Eggs of winter skate are deposited throughout the year off southern New England and from summer to autumn off Nova Scotia. Winter skate migrate to deeper colder waters during summer months. The species appears to concentrate in deeper, warmer waters in the winter and move into shallower waters during spring and summer. Juveniles prefer sand and gravel bottoms. The winter skate remains buried in depressions during the day and is more active at night. It may feed at any time during a 24-hour period (Packer *et al.,* 2003b; Sulikowski *et al*., 2009.). Adults and juveniles may occur in the project area. The species is motile and likely to temporarily leave the action area during construction. Minimal direct impacts are expected to result from the project however, there may be indirect impacts to EFH and potential prey food resources in the dredging and placement areas.

Longfin Inshore Squid (*Doryteuthis pealeii*) is a schooling species of the molluscan family Loliginidae. It is distributed in continental shelf and slope waters from Newfoundland to the Gulf of Venezuela and occurs in commercial abundance from southern Georges Bank to Cape Hatteras. The squid is commonly encountered in late spring in nearshore waters but appears to be more dispersed in summer. In fall, small squid are abundant and tend to increase in numbers with depth, highest over mud bottom. Eggs generally inhabit shallow waters, <50 m deep and near shore. Larvae and juveniles are found in coastal and inshore waters, with eggs and larvae at the surface and juveniles in the upper 10 m of the water column. Adults may be found in shallow inshore waters up to 180 m deep from March to October. Adults are typically found over mud or sandy mud bottoms, and have been found at surface temperatures ranging from 9 – 21° C and bottom temperatures ranging from 8 – 16° C (Jacobson, 2005). The project area contains EFH for longfin squid eggs. Since the eggs float, minimum impact may result from dredging and placement activities.

5.3 Prey Species

Invertebrates. Marine benthic invertebrates are bottom-dwelling species that can be grouped into two categories: infaunal (benthic invertebrates living within the substrate) and epifaunal (benthic invertebrates living onthe surface of the substrate). Benthic invertebrates are found in and on the substrate of the intertidal and subtidal habitats. Polychaetes (segmented worms with bristles) are an important component of the benthic infaunal community; epifaunal biota include amphipods, crabs, Atlantic horseshoe crabs (*Limulus polyphemus*) eggs, and various univalve and bivalve mollusks such as soft-shell clam (*Mya arenaria*). Invertebrates provide an important food source for bottom feeding fish and include species that are commercially and recreationally important. The Atlantic horseshoe crab is a marine chelicerate arthropod found along the US Atlantic and Gulf of Mexico coasts. Although not considered a prey species for fish, it merits specific attention as a significant, at-risk component of the intertidal and subtidal zones in the project area. It provides food for endangered sea turtles and migrating shorebirds. Horseshoe crab eggs provide a key food resource for federally listed shorebird species, particularly the red knot. Horseshoe crab burrowing activities affect the habitat available for other species through bioturbation. Nearshore, shallow water, intertidal flats are considered important habitat for development of juvenile horseshoe crabs. The species is now in decline across most of its geographic range. Project construction would not likely temporarily disrupt intertidal habitat if the operation occurs during the cooler months when horseshoe crabs are not likely to be present in the project area.

Finfish. More than 60 species of marine and anadromous fish, sometimes known as shore fishes, use the shallow and intertidal waters of the project area for feeding and refugia. These fish include boreal, temperate, and semitropical seasonally migratory species. In the spring and summer the fish generally move inshore while in the fall and winter the movement is offshore, with some species undertaking long coastal migrations to semi-tropical waters. Some examples of commercially and recreationally important species in the nearshore zone are Atlantic menhaden (*Brevoortia tyrannus*), weakfish (*Cynoscion regalis*), striped bass (*Morone saxatilis*), summer flounder (*Paralichthys dentatus*), bluefish (*Pomatomus saltatrix), black sea bass (Centropristis striata*), Atlantic croaker (*Micropogonias undulatus*), northern kingfish (*Menticirrhus saxatilis*), spot (*Leiostomas xanthuru*s), and silverside (*Menidia menidia.* The most abundant fish species in the bay are silversides (*Menidia spp*.), killifish *(Fundulus spp*.), and Atlantic menhaden. Project construction may temporarily cause fish to leave the immediate dredging and placement areas to nearby undisturbed areas, returning after operations cease.

6.0 IMPACTS ASSESSMENT

6.1 Direct Impacts

The project will result in direct impacts to some intertidal and subtidal habitat EFH within the navigation channel and the placement areas. The temporary increase in total suspended solids (TSS) and turbidity in the water column at the dredging and placement sites has the potential to directly impact EFH as well as managed species and their prey. In the channel, dredging activities

may cause fish and/or prey species to move away from the disturbance. Benthic epifaunal and infaunal prey species would likely be most affected by the turbidity plume within the channel or placement areas. Egg or larval stages would most likely be affected by increased turbidity. To minimize adverse effects, dredging and placement will not occur during the spring reproductive season (March 1 to June 30). Outside of the immediate action areas, total suspended solids in the water column would not significantly impact EFH, managed species or their prey. Since the total area that would incur these direct impacts represents a small portion of these habitats in the immediate region, the impact on the affected species is expected to be minimal; the primary species-specific impact would occur to species with non-motile life stages (*i.e.* invertebrate prey species) that use habitats that will be removed or buried during construction. Operational controls and best management practices will aid in reducing impacts to EFH, associated managed species, and their prey. Project construction could temporarily impede foraging by fish in the immediate vicinity until sediment settles. The exact movement of the sediment is difficult to predict, however, the placement areas are somewhat sheltered inside the flooded marsh area where water depths are shallow. This should encourage sediment nourishment on the surrounding mudflats. The project would permanently impact habitat directly by raising the elevation of portions of the area where the sediments flow and settle. Overall, adverse impacts resulting from increased turbidity and TSS concentrations
would be minor and temporary in duration.

For non-motile individuals, particularly benthic invertebrate infauna, the primary type of impact would be permanent, resulting in a temporary reduction in abundance of benthic organisms (prey species) through removal (dredging) or burial (dredged material placement). Some invertebrate species, such as bivalves, are capable of moving upward through the new sediments and survive. Additionally, the reproductive mechanisms of most invertebrates allows for rapid recolonization through recruitment from adjacent, undisturbed areas.

Fish occupation of waters within the project impact area is highly variable spatially and temporally. Fish early life stages (*e.g.* eggs, larvae) are more susceptible to direct impacts to due dredging and placement operations due to their limited mobility. Older life stages are motile and would likely leave the project area during construction to avoid these impacts. All demersal species could be adversely impacted temporarily through water quality impacts (elevated turbidity and lower dissolved oxygen) during in-water placement. Highly pelagic Atlantic species, such as tuna, swordfish, billfish, including their early life stages, are unlikely to be in the shallow waters of the project area. These species occur over the continental shelf feeding and known spawning areas include the Gulf of Mexico and the Mediterranean (Pew Memorial Trust, 2018).

Fish species that are more oriented to bottom or demersal waters may be directly impacted by elevated water turbidity levels due to the dredging and placement action. Dredging-related direct impacts to fish species can be minimized by scheduling the operation during the cooler months of the year outside of the spawning season for most Federally-managed species in the project area. No dredging or placement operations will occur between March 1 and June 30 to minimize impacts to anadromous species. Seasonal abundances are highly variable, as many species are highly migratory. This variability introduces uncertainty to evaluating impacts to EFH, but also distributes the risk temporally and spatially. All impacts would be expected to be minimal and subside within minutes after each placement and upon project completion. Salinity and dissolved oxygen levels in the water column are not expected to be impacted by the dredging and placement operation. There are not contaminants in the sediments that would impact water quality.

Underwater soundscapes are important to many species of estuarine and coastal fishes. Underwater sounds generated from hydraulic cutterhead suction dredges are typically low in intensity and frequency. Hydraulic cutterhead suction dredging generally produces sound below 1,000 Hz in frequency at one meter below the surface. The majority of the sound produced by cutterhead suction dredges occur in the 70 to 1,000 Hz ranges (Clarke *et al*., 2002). Underwater noise generated by dredging may impact EFH soundscapes and managed fish species in the Action Area. Despite these concerns, only a few studies have examined the sound levels of dredging equipment and the potential impacts these sound levels have on aquatic organisms. Research suggests that dredging noise, especially in soft, non-gravelly sediments, is not likely to produce physiologically damaging results to fish, though it may mask natural sounds used by larvae to locate suitable habitats, and some fishes may demonstrate a change in swimming as a result of noise inputs into their habitat.

During the operation, stabilization measures will be implemented to minimize adverse effects such as turbidity curtains, earthen berms, and/or coir logs to reduce sediments from flowing outside of the defined placement areas. The turbidity curtain planned will be similar to that used during the Mordecai Island restoration (USACE, 2022) since it adapted with phases of the tide and successfully stabilized the fine-grained sediment portion over time. The proposed placement objective is to enrich substrates incrementally within the existing but degrading subtidal, intertidal, and low marsh areas to increase their resiliency. This is a systems approach to enhancing existing habitats through sediment addition. The fluidized sediments pumped onto the placement area will naturally flow to lower areas and settle, providing for a range of final elevations that mimic the natural topography of the area. This will also result in a range of placement thicknesses that benefit the marsh habitats. Lower intertidal mud flat will naturally receive the finer grained material and will build elevation slowly. The intent is to avoid conversion of low marsh habitat to other habitat types, such as high marsh or upland. Healthy saltmarshes provide important habitat for a variety of fish species. Sediment deposition on the expansive subtidal and intertidal mudflats bordering low marsh will reduce the stressors to marsh platform resilience. Beneficial use of dredged material provides the additional sediments to augment the existing natural topography and mosaic of subtidal/intertidal/low marsh habitats that mimics the current marsh configuration but at higher overall elevations. The intent is to provide additional substrate elevation to marsh fringe areas to provide added stabilization and protection to reduce marsh habitat loss. This object in turn, improves valuable habitat for fish.

6.2 Indirect Impacts

For all motile individuals, construction-related impacts during the operation would be temporary. Motile life stages will avoid direct impacts and likely move away from the area of temporary disturbance. Indirectly, there will be no long-lasting adverse impacts to water quality in or adjacent to the project area. In contrast, enriching the substrate within an excessively flooded marsh system will provide a positive impact for Federally-managed fish species through the eventual re-establishment of intertidal marsh habitat acreage that had been lost. The extent to which intertidal marsh edge develops will be ascertained through post-construction monitoring. Minimal and temporary impacts to the water quality in or adjacent to the project area are expected. Fall *et al.* (2022) documented a turbidity study following an unconfined strategic sediment placement operation on a marsh on Gull Island within the SMIIL system. Roving turbidity surveys found that the resulting turbidity plume was localized, only extending about 20 meters offshore and 100 meters along shore, and that when conditions were calm (wind speeds <5m/s), the plume direction and intensity were driven by tidal circulation. Monitoring showed that near-bed turbidities during active placement operations were greater than typical background conditions but were often less than those conditions observed during high wind or storm events. Post-placement turbidity monitoring was observed to be similar to levels documented in the region prior to any placement activities.

Elevated turbidity poses a temporary impact to marine organisms. Turbidity is not expected to have a negative impact to bivalve prey species because these species are adapted to the fine sediments native to the area and the periodic increases in suspended sediments and other stresses following coastal storms and other perturbations, such as eroding marsh edges. Several studies have demonstrated that shellfish are capable of withstanding elevated turbidity levels for short time periods (*i.e.,* days) with no significant metabolic consequences or mortality (Wilbur and Clarke, 2001; Norkko *et al*., 2006).

Infauna and smaller, less motile epifauna that are food resources for fish that are buried during placement operations will pose an indirect impact on Federally-managed species (both benthic and pelagic). Fish will expand their foraging areas to seek out prey until the disturbed habitat had sufficient time for infauna and epifauna species to recolonize the area. Greene (2002) cited literature on recolonization studies for a wide latitudinal range along the east coast and reported recovery between 2 and 7 months. Intertidal habitat recovery is particularly rapid (perhaps one to two growing seasons), as many invertebrate prey species have high reproductive and growth rates. Re-colonization of infaunal species will be stimulated by adult populations that inhabit similar environments adjacent to the project area. Construction duration at most sites is short (a few months at most) and recolonization can begin as soon as the project is completed. The immediate project area represents a very small percentage of the extensive foraging grounds in this region. Thus, the overall indirect impacts to EFH species and EFH is expected to be minimal. The temporary loss of benthic prey resources caused by removal or burial would not have significant adverse effects on EFH for any species that feeds primarily on more motile epifaunal organisms (*e.g.,* crabs, mysids, sand shrimp) or fish, since these motile organisms would likely move from the area temporarily as well to avoid the disturbance.

<u>Benefits of sediment placement.</u> Low estuarine marshes are an important habitat for many invertebrates that comprise the bottom of the heterotrophic food web. Coastal wetlands throughout the U.S. have been detrimentally altered by diking. These areas have low elevation

associated with long-term lack of tidal inundation that prevents sediment accretion. The surrounding area of the lower Maurice River was historically used for salt hay farming (*Spartina*). In the 1930s, wetlands were diked and the hydraulic connection to the river was blocked. Without the diurnal tidal flushing, the area no longer received sedimentation and could not keep pace with sea level rise and quickly converted to mudflats and open shallow water as farming plots were abandoned. The adverse impact of salt hay farming continues as these farmlands did not naturally restore and became mudflats and open water.

Some areas that have partially revegetated sit at lower elevations due to the long-term restricted tidal flow and are now excessively flooded. This left most previously farmed areas submerged for much longer periods, thereby reducing their capacity for intertidal vegetative growth. Given current rates of sea level rise, these marshes cannot recover elevation deficits naturally to keep pace with sea level. The loss of wetlands from decades of subsidence and inundation has reduced intertidal low marsh habitat for fish and invertebrates. Former salt hay farming practices have left Matt's Landing Road, the Heislerville WMA dike, and the surrounding infrastructure directly exposed to storms. The beneficial use of sediments dredged from the navigation channel and placed in these degraded saltmarshes to bolster their elevations will benefit the ecological food web and energy system.

Wetlands are among the most productive ecosystems in the world, often compared to rain forests and coral reefs. An immense diversity of species of microbes, plants, insects, amphibians, reptiles, birds, fish and mammals exist within a marsh ecosystem. Adding sediment to a flooded, degraded marsh system contributes to the resiliency of these habitats in providing food for species life-cycles. Currently, open water and mudflats comprise the majority of the habitat type in the project area. Without sufficient protection to adjacent vegetated wetlands, there is insufficient dead plant matter available to break down in the water to form detritus. This enriched organic material provides food for many small aquatic insects, shellfish and small fish that are food for larger predatory fish, reptiles, amphibians, birds and mammals. A healthy proportionate combination of habitats (*i.e.* shallow water, intertidal mudflats, and vegetated marsh) provides nutrients and primary productivity necessary for the development of organisms that form the base of the food web that ultimately feeds many of the managed fish species. The beneficial use placement of dredged material is expected to provide increase resiliency by elevating the existing substrates within the flooded marsh system of the Heislerville WMA.

6.3 Climate Change

Climatic changes such as sea level rise and increasing global temperatures are predicted to continue for the foreseeable future. Predicted climate change impacts such as increased ocean temperatures, ocean acidification, sea level rise, and changes in currents, upwelling and weather patterns, have the potential to cause changes in the nature and character of the estuarine ecosystem. Climate change is impacting marine fish and invertebrate species worldwide. Climate vulnerability is the extent to which abundance or productivity of a species is impacted by climate change. New Jersey is at the epicenter of climate change challenges, as sea level rise (SLR) combined with land subsidence has magnified the issue. Protection of the Heislerville WMA from the increasing threat of storm surge and coastal flooding due to climate change is vital. By enriching substrate elevations in the proposed placement areas, low marsh vegetation may eventually re-establish naturally in areas eroded and flooded.

The proposed project strives to counter the negative effects of SLR on coastal estuarine systems. SLR is reducing the amount of available intertidal saltmarsh habitat that is critical as nursery and foraging areas for many fish species. Hare *et al*. (2016) conducted a climate vulnerability assessment on 82 fish and invertebrate species in the Northeast U.S. shelf, including exploited, forage, and protected species. They found that climate vulnerability is high to very high for approximately half the species assessed. Diadromous and benthic invertebrate species exhibited the greatest vulnerability; having a high potential for distribution changes, illustrating how important support for beneficial use projects are within channel maintenance programs. Wetlands' microbes, plants and wildlife are part of global cycles for water, nitrogen and sulfur. Atmospheric maintenance is also a function of wetlands function**.** Wetlands store carbon within their plant communities and sediments instead of releasing it to the atmosphere as carbon dioxide. Thus, wetlands help to moderate global climate conditions.

Beneficial Use placements of channel maintenance material by the USACE as well as efforts by the NJDEP and the U.S. Fish & Wildlife Service, The Nature Conservancy, and The Wetlands Institute are working to improve wetland habitats within New Jersey coastal marshes in response to SLR. Under present and future sea level rise scenarios, rates are approaching or exceeding typical marsh accretion rates resulting in enhanced concerns about the resilience of coastal marshes. There is currently wide scale loss of high and low marsh areas as they become excessively flooded. With ongoing SLR, projections of marsh conversion to open water and the continued loss of vegetated marsh areas, sediment enrichment through BU placement becomes increasingly more important.

6.4 Cumulative Impacts

Cumulative impacts are those resulting from the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

As noted previously, the cumulative impacts over several decades that have come about as a result of prior land uses (*i.e.* salt hay farming) and sea level rise have caused a significant adverse effect on the marsh/intertidal flats/shallow water complex in the lower Maurice River region. The NJDEP’s Division of Fish and Wildlife manages the Heislerville Wildlife Management Area where the proposed placement areas are located. Their mission is to protect and manage the state’s fish and wildlife to maximize their long-term biological, recreational, and economic values. In order to protect and enhance the wetland complex of habitats in the lower Maurice River region, sediment enrichment is needed to bolster the flooded former marsh areas. Beneficial placement of channel maintenance dredged material in the Heislerville WMA is crucial.

Present actions in the project area are consistent with its residential, coastal setting and restoration objectives of valuable saltmarsh habitat. These projects have been undertaken to improve the health and sustainability of the region against further degradation due to subsidence, flooding, sea level rise and other ongoing threats. Future activities in this area are anticipated to remain similar to present actions. In 1996, NJDEP's Division of Engineering and Construction reconstructed approximately 4,000 feet of the Heislerville Dike within the Heislerville WMA. In 1998, NJDEP placed sunken barges to serve as breakwaters along the point of Basket Flats to reduce the wave energy entering the area of the flooded marsh behind it. In 2007, a bulkhead was erected at the Port Norris marine police station to combat the continued shoreline deterioration and structural damage. In 2012 the Heislerville dike that was breached during Hurricane Sandy was temporarily repaired but breached again in 2012 and during successive high tides. Additional repairs were completed in 2013 to halt the continuous breaching.

In 2013, NJDEP's Division of Fish & Wildlife partnered with Ducks Unlimited to refurbish the Heislerville WMA's impoundments. These impoundments, located immediately east of Maurice River along Matts Landing, were transformed from stagnant lakes into palustrine wetland, thereby improving habitat conditions and foraging areas for migratory and local birds. A cooperative effort between NJDEP's Office of Natural Resource Restoration and Office of Engineering and Construction, the Maurice River Township, USFWS, and NOAA worked to address degradation of Thompsons Beach. The area over time has incurred both development and erosion. Thompsons Beach lies to the immediate east of the mouth of the Maurice River at the southeast end of the Heislerville WMA, where it fronts the same greater marsh complex adjoining the mouth of the Maurice River. The effort restored the beach habitat there through removal of rubble, timber, and debris in order to improve the coastal habitat.

In 2018, NJDEP's Office of Coastal Engineering repaired and reinforced the Heislerville dike again following a series of winter storms, and in 2019 placed sediment at East Point (along the southeast mouth of the Maurice River) to stabilize the shoreline. Lastly, Rutgers University developed the Delaware Estuary Living Shoreline Initiative (DELSI) in 2008. The objective of this initiative is to stabilize eroding shorelines using a combination of plants, natural structures, and intertidal shellfish to trap sediment, absorb wave energy and provide water filtration. DELSI has developed ten different living shoreline projects within the Maurice River area and to date, has created approximately 1,630 feet of living shorelines that have led to an increase of 7,775 square feet of wetlands. DELSI's recent initiatives in the Maurice River area consists of 200 feet of oyster castles and oyster shell bags along an eroded wetland bank along the lower east Maurice River bank and 1,322 square feet of oyster shell bags and coir logs at Matts Landing. Section 1 of the EA provides a detailed discussion on relevant Federal and nonfederal prior actions that have taken place in the vicinity.

The adverse effects of these past and similar anticipated future actions have been temporary (*i.e.* water turbidity, benthic disturbance) and not adversely cumulative. The majority of impacts are short-term in nature and should not significantly contribute to a decline in the ecological services of the project area but in fact, strive to accomplish the opposite and provide a positive benefit. The direct effects of the current proposed project are not anticipated to magnify the impacts from other actions in the area. Therefore, no significant cumulative impacts to EFH are projected as a result of the proposed project. This EFH assessment has identified minimal potential adverse impacts to EFH and Federally-managed species. Compensatory mitigation is not proposed because the project is designed to benefit the environment.

The Philadelphia District USACE is embracing the goal of beneficially using 100% of clean New Jersey coastal channel sediments and developing cost effective ways to do so. USACE is a provider when it comes to sediment, a much-needed currency in the natural coastal system in the Maurice River region. In 2019, USACE, the state of New Jersey, and the Wetlands Institute launched the Seven Mile Island Innovation Lab (SMIIL). The SMIIL encompasses about 24 square miles of tidal marshes, coastal lagoons, tidal channels and bays between the Cape May County mainland and the barrier island communities of Stone Harbor and Avalon, NJ. The initiative is designed to advance and improve dredging and marsh restoration through innovative research, collaboration, knowledge-sharing, and practical application.

Under the SMIIL, USACE and partners have completed several dredging and habitat improvement projects (*e.g.* Great Flats and Ring Island near Stone Harbor and Sturgeon Island within the Cape May Wetlands WMA). The work proposed at Maurice River will provide another example of using dredged sediments to enhance and fortify inundated marsh elevation and reduce marsh edge erosion. Monitoring the site will document the efforts to bolster substrate elevations and potentially restore unvegetated marsh fringing mudflats to low marsh habitat and enhance tidal flats and shallows for fish habitat. With ongoing partnerships, coordination at all levels, improvements to design and project implementation, and strong science to support innovation, USACE proposes to conduct similar efforts within the lower Maurice River region and will continue to work to advance best practices through strategies and solutions that address the long-term issues and sustainability of the coastal region.

7.0 CONCLUSIONS

The preferred Beneficial Use placement alternative for material dredged from the Maurice River Federal Navigation Channel is expected to modify between 9 and 18 acres of flooded and degraded marsh through sediment placement. The activity will pump the fluidized sediments (*i.e.* wetland nourishment) into the adjacent flooded and degraded marsh to increase substrate elevations within a designated area within the primary and secondary placement areas. Coastal wetlands are particularly vulnerable to sea level rise (Mitchell *et al*., 2017). Coastal wetlands are a critical natural or nature-based feature (NNBF) that provide a suite of ecosystem benefits and can provide flood risk reduction capability (Narayan *et al*., 2016). The advantages of beneficially using dredged sediment to nourish wetlands have been documented in several studies (Ray 2007; Colten *et al*., 2022) and some saltmarsh plants have the capacity for rapid recovery after dredged sediments are placed in a flooded marsh habitat (Berkowitz *et al*. 2019) to encourage intertidal wetland vegetation to re-establish and reduce erosion effects. The area will require multiple placement operations in order to achieve elevations resilient to storm impacts and marsh enhancement. The consultation period for this effort is 10 years.

Consultation would be re-initiated in the event that any significant changes are initiated for future placement operations based on lessons learned and adaptive management.

The surface waters, water column, intertidal, and benthic habitats of the project area have the potential to experience localized, temporary impacts as a result of implementing the proposed project. The benthic habitats and biological community found directly in the project footprint will be subject to removal or burial by sediments from dredging and placement operations. The project will also cause short-term increases in turbidity in the vicinity of the dredging and placement areas. The material to be dredged is primarily silt with some sand and a study completed by Fall *et al*. (2022) shows that with current placement methodologies, the material does not flow far from the placement location and consolidates under the influence of gravity; thus, only a localized area in the vicinity of the dredge and placement sites is likely to be impacted by elevated concentrations of suspended sediments.

The project is not expected to significantly adversely affect spawning habitat, nursery habitat, foraging or living habitat for Federally-managed fish species or HAPC. This determination is based on the project's small footprint, the sediment characteristics of the dredged material, and the localized nature and temporary duration of the project. Project activities are expected to occur during off-season months to avoid the period of time that EFH-designated species are migrating and spawning. Impacts to transiting and migrating fish due to turbidity are expected to be minimal as the species that occur in this naturally turbid area are adapted to such conditions. Project activities will take place in Maurice River cove where there is an expansive area for fish to transit and avoid any project-related activity and localized increases in turbidity within the water column. Although studies have shown that turbidity impacts organism behavior, coastal and estuarine organisms are exposed to suspended sediments from tidal flows, currents, and storms; therefore, they have adaptive behavioral and physiological mechanisms for dealing with this feature of the habitat.

Best management practices will be implemented during dredging to minimize disturbances to the environment. No dredging or placement activities will occur between March 1 to June 30. To minimize air emissions associated with the dredging vessel, the dredge will not run idle and shut off to the extent practical when not in use. All onboard personnel are responsible for observing water-related activities for the presence of federally-listed species and will abide by procedures required for the protection of threatened and endangered marine species. During the operation, stabilization measures will be implemented to minimize adverse effects such as turbidity curtains, earthen berms, and/or coir logs to reduce sediments from flowing outside of the defined placement areas.

Shallow subtidal habitat in combination with low marsh habitat and intertidal mudflat habitat provides the same functional value with as much or more complexity, particularly for younger fish life stages. The dredge utilized will be a small, shallow draft hydraulic pipeline dredge with a controlled outfall to reduce flow. The cutterhead will be activated only once it is embedded into the bottom sediments and not when it is suspended in the water column. Direct placement of material will not occur on submerge aquatic vegetation. The abundance and/or distribution of benthic and phytoplankton prey species will be temporarily impacted during and immediately following project activities. However, the short-term and transient nature of water column disturbances will not cause substantial or long-term effects to planktonic prey species. Impacts to the benthic prey community of EFH-designated species will also be temporary. Full benthic recovery is expected within months to a year after dredging and placement activities. Further, these areas are subjected to high energy, unstable environments due to the current open fetch and storms, and as a result do not promote stable long-term benthic communities regardless of project activities. For all of the aforementioned reasons, the proposed project will not significantly adversely affect essential fish habitat. The majority of impacts are short-term in nature and should not significantly contribute to a decline in the ecological services of the project area but in fact, the project is expected provide a positive benefit to EFH, federally-managed species and their prey by improving their habitats.

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