ENVIRONMENTAL APPENDIX

Elizabeth River and Southern Navigation Improvements Draft Integrated General Reevaluation Report and Environmental Assessment

Appendix H – Essential Fish Habitat

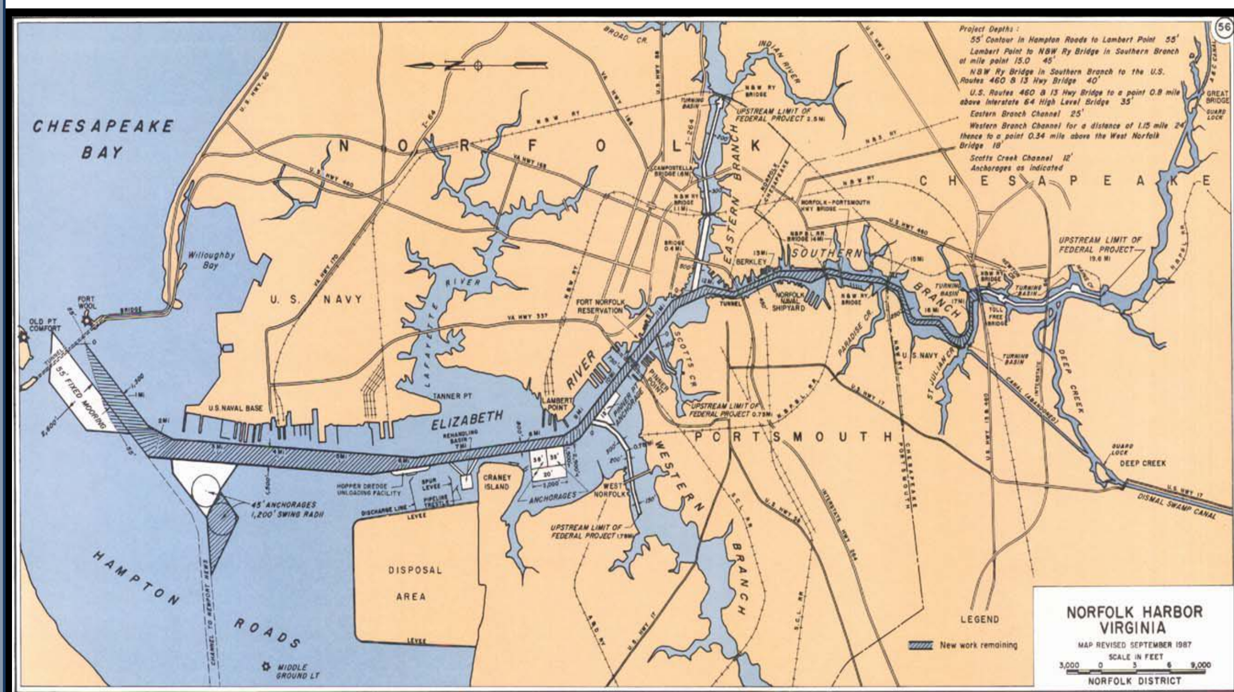
12 December 2017

U.S. Army Corps of Engineers
Norfolk District

THE PORT OF VIRGINIA®

Essential Fish Habitat Assessment

Elizabeth River and Southern Branch Navigation Improvements



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1.0 INTRODUCTION

The purpose of this document is to provide the Essential Fish Habitat (EFH) assessment conducted for the construction and maintenance of the Elizabeth River and Southern Branch Navigation Improvements Project, as required by the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA), as amended. The objectives of this EFH Assessment are to describe, in detail, how the actions of dredging may affect EFH, federally managed species, and their prey species, designated by the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) and the regional Fisheries Management Council (FMC), for the Region of Influence (ROI) of the project. The FMC's, with assistance from NOAA Fisheries are required to delineate EFH in fisheries management plans for all federally-managed fisheries in order to conserve and enhance those habitats. Essential Fish Habitat is defined in the MSA as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

This EFH Assessment includes four components of the proposed action; an analysis of the effects of the proposed action, including cumulative effects of the proposed action on EFH, the managed species, associated species such as prey species including affected life history stages, and proposed mitigation measures selected to minimize expected project effects, if applicable.

2.0 PURPOSE, NEED, AND SCOPE

The federal navigation channels from the Lamberts Bend to the Chesapeake Extension (green area in Figure 1) are authorized under the Norfolk Harbor and Channels, Virginia, Project, which is a single purpose deep draft navigation project located in Hampton Roads. The Hampton Roads Harbor is a 25-square-mile natural harbor serving the port facilities in the cities of Norfolk, Newport News, Portsmouth, Chesapeake, and Hampton in southeastern Virginia. Since its authorization in 1986, the Norfolk Harbor and Channels Project has been constructed in separable elements based on the needs of the port community and the financial capability of the non-federal sponsor, the Virginia Port Authority, agent of the Commonwealth of Virginia. The portion of the Norfolk Harbor and Channels being evaluated in this study are those from the Lamberts Bend to the Chesapeake Extension that are currently authorized to depths ranging from 45 to 35 feet and maintained to depths ranging from 40 to 35 feet.

The purpose of this investigation is to identify whether the authorized plan for the portion of the Norfolk Harbor and Channels from the Lamberts Bend to the Chesapeake Extension is still in the federal interest and to evaluate measures which would improve the operational efficiency of commercial vessels currently using the federal navigation channel and commercial vessels projected to use the federal navigation channel in the future. The need for this investigation arises from inefficiencies currently experienced by commercial vessels that are projected to continue in the future.

The project is located in in the Commonwealth of Virginia. The Elizabeth River is situated within Norfolk Harbor adjacent the Cities of Chesapeake, Norfolk, and Portsmouth. Norfolk Harbor is located in the southeastern part of the Commonwealth of Virginia at the southern end of Chesapeake Bay, midway on the Atlantic Seaboard, approximately 170 miles south of Baltimore, Maryland, and 220 miles north of Wilmington, North Carolina. The harbor is formed by the confluence of the James, Nansemond, and Elizabeth Rivers.

The project occurs on subaqueous land, which is owned by the Commonwealth of Virginia and the Craney Island Dredged Material Management Area (CIDMMA) which is owned and operated by the USACE. A future dredged material placement site, the Craney Island Eastern Expansion (CIEE) will be initially owned and operated by the USACE. The Virginia Marine Resources Commission manages state-owned subaqueous lands in Virginia. Dredged material may also be rehandled and disposed of at approved offsite facilities.

The project area for this project can be divided up into three channel segments: Segment 1, Segment 2, and Segment 3.

The remainder of the Norfolk Harbor and Channels and Anchorage F, which is shown in on Figure 1 in navy blue, is being evaluated for deepening and widening (widening is limited to meeting areas in the vicinity of the Thimble Shoal Channel), but is not part of this federal action or Biological Assessment. It will be a separate project and will be the subject of a separate Biological Assessment.

Figure 1. Location of Elizabeth River and Southern Branch Channels and location of the Norfolk Harbor and Channels (blue) shown for reference (green).

3.0 EXISTING CONDITIONS

Segment 1
The authorized project dimensions for this segment (Figure 2) include a channel 45 feet deep and 750 feet wide from Lamberts Bend to the junction of the Southern and Eastern branches; thence 45 feet deep and 450 feet wide in the Southern Branch to the Norfolk & Portsmouth Beltline Railroad Bridge; including an approach and turning area 45 feet deep opposite the Norfolk Naval Shipyard; thence 45 feet deep and 375 feet wide to the North and West Railroad Bridge. The U.S. Army Corps of Engineers (USACE) maintained this segment to a depth of 40 feet under a previous project authorization. However, the Navy has already dredged and will maintain a portion of Segment 1, from Lamberts Bend to the Norfolk Naval Shipyard (NNSY). Specifically, for a length of three miles, it has dredged a 600-foot-width of the 750-foot width of federal channel from Lambert's Bend to the confluence of the Eastern and Southern Branches (the Elizabeth River Reach). From thence, for a length 2.0 miles, it has dredged a width of 450 feet, in keeping with the existing channel width, terminating at the Norfolk Naval Shipyard (Southern Branch Lower Reach). The channel segment is maintained to a depth of 47 feet MLLW from Lamberts Point to the NNSY.

Material is dredged from this area via a hydraulic cutterhead pipeline dredge and/or a clamshell dredge. The dredged material removed from the Lamberts Bend to Paradise Creek is placed at CIDMMA. For the purpose of the project economic analysis this channel segment was divided into Segment 1a (north of the Perdue facility) and Segment 1b that portion of the federal channel south of Perdue (Figure 2).

Segment 2
This portion of the channel (Figure 3) is authorized to a depth of 40 feet, and maintained to 35 feet deep, and between 250 feet to 500 feet wide from the Norfolk Southern Railway Bridge to the U. S. Routes 460 and 13 Highway bridges. There is a turning basin at the mouth of St. Julians Creek, 40 feet deep, 400 to 600 feet long, and 800 feet wide; a turning basin not yet constructed at the mouth of Milldam Creek, 40 feet deep and 800 feet square.

Material is dredged via hydraulic cutterhead pipeline dredge and/or clamshell dredge. Dredged material removed from the Southern Branch Channel is placed at CIDMMA. The sediment composition of the Southern Branch Channel is roughly 25% sand, 45% silt, 30% clays.

Segment 3
This portion of the channel (Figure 4) is authorized to a depth of 35 feet and maintained to 35 feet deep from the Gilmerton Bridge to the Chesapeake Extension and includes the Mains Creek Turning Basin. Material is dredged via hydraulic cutterhead pipeline dredge and/or clamshell dredge. Dredged material removed from the Southern Branch Channel is placed at CIDMMA.

Craney Island Dredged Material Management Area

The CIDMMA is located in the eastern portion of the Atlantic Coastal Plain and adjacent to the confluence of the James River, Elizabeth River, and Nansemond River, and is in close proximity to the Chesapeake Bay and the Atlantic Ocean. The CIDMMA is a 2,500 acre confined disposal facility that was constructed by the USACE and completed in 1957 in the Hampton Roads area of Virginia. The CIDMMA was authorized by the River and Harbor Act of 1946 and constructed from 1956-1958. The Federally-owned facility is operated by USACE and is used by private interests, local municipalities, Federal and Commonwealth of Virginia government agencies for the disposal of dredged material from Norfolk Harbor and its adjacent waterways.

Dredged material is received in two different ways at the CIDMMA. It is either pumped directly into one of three upland containment cells or it is deposited in the rehandling basin and then pumped into the facility. The Craney Island Rehandling Basin is a large deeper area off the southeast shoreline of the island that can beused for overboard placement of dredged material. Since it began operation, the CIDMMA has received, on average, 3.5 million cubic yards of dredged material per year. However, there have been several years when it has received more than 10 million cubic yards.

Offsite Upland Disposal Facilities

Sediments within portions of the Elizabeth River have the potential to contain elevated levels of heavy metals, polyaromatic hydrocarbons (PAH's) and phthalates, the level of which could preclude disposal either offshore or at the CIDMMA. These sediments will be required to be disposed at an offsite upland disposal facility.

4.0. PROJECT AND MAINTENANCE SCHEDULE

Construction is anticipated to begin in approximately 2023 but is contingent on funding availability. Construction of the Elizabeth River and Southern Branch Navigation Improvements Project will take approximately two years to complete. Maintenance dredging is anticipated to occur every six to eight years but may occur on an elevated scheduled (if there is an eminent need, for example storm-related shoaling) or a delayed schedule due to funding availability. Maintenance dredging will take approximately three to six months to complete and will be contingent on the type and size of the dredge used. Construction may occur at any time of the year. Construction may occur at any time of the day or night, however, continuous operations are not anticipated as there will be time needed for equipment maintenance and personnel shifts.

5.0 PREFERRED ALTERNATIVE

The Elizabeth River and Southern Branch Navigation Improvements Feasibility Study is currently underway and the final array of alternatives that are being evaluated in detail are the following: a No Action/Future Without Project Alternative, Alternative 1 (the National Economic Development Plan), and Alternative 2 (the Locally Preferred Plan which is the Preferred Alternative). For the economic analysis, the project area was divided up into three segments: Segments 1, 2, and 3 (Figures 2-4). Based on the results of the economic analysis, no additional deepening beyond existing project maintenance will occur in Segment 3 for either of the action alternatives. Therefore, all of the alternatives will include just the existing maintenance of channel depths in Segment 3 (Figure 4). The only differences between the action alternatives are the deepening depths in Segment 1a. For the No Action/Future Without Project Alternative, there would be no deepening, and current channel depths would be maintained. Alternative 1 includes deepening of Segment 1a of the Elizabeth River to a required depth of 44 feet up to Perdue Farms and Segment 1b would be dredged to a required depth of 42 feet (Figure 2). Segment 2 (Figure 3) would be dredged to a required depth of 39 feet. For Alternative 2, the only difference from Alternative 1 is that Segment 1a up to Perdue

Farms would be dredged to a required depth of 45 feet instead of 44 feet.   For Alternative 2, Segment 1b would be dredged to a required depth of 42 feet, and Segment 2 would be dredged to a required depth of 39 feet.

For the environmental impact analysis we evaluated dredging, volume, and duration impacts during construction deeper than the required (or target) dredging depth. This is because dredging beyond the required depth sometimes may be allowed for advanced maintenance and allowable paid and nonpaid overdepth and also because dredging to an exact depth out in the field is not practical. Therefore, the dredging depths, volumes, and durations vary between the economic analysis and the environmental impact analysis in our study. For the environmental impact analysis, we assumed that for construction of Alternative 1 or Alternative 2, the maximum, potential dredging depths would include the required depth in addition to 1 foot of Advanced Maintenance in addition to two feet of Paid Allowable Overdepth in addition to 2 feet of Nonpaid Allowable Overdepth and an additional foot of dredging in areas where contaminated dredged material is anticipated (in Segment 1 and Segment 2).

The Preferred Alternative, Alternative 2, is the alternative with the deepest maximum, potential dredging depths and consists of the following:

- Deepening Segment 1a to a required depth of 45 feet, with an additional 6 feet of maximum, potential advanced maintenance, overdepth, and contamination removal which equates to a maximum, potential 51 foot channel depth.
- Deepening of Segment 1b to a required depth of 42 feet, with an additional 6 feet of maximum, potential advanced maintenance, overdepth, and contamination removal which equates to a maximum, potential 48 foot channel depth.
- Deepening Segment 2 to a required depth of 39 feet, with an additional 6 feet of maximum, potential advanced maintenance, overdepth, and contamination removal which equates to a maximum, potential 45 foot channel depth.
- Segment 3 will be maintained to its current required depth of 35 feet, with an additional 5 feet of maximum, potential advanced maintenance and overdepth which equates to a maximum, potential 40 foot channel depth.

For the purpose of this EFH, we refer to required depths throughout the text but in terms of the impact analysis (effect determination), the estimated maximum, potential construction dredging depth of Alternative 2, the Preferred Alternative, will be evaluated (Table 1). Please see the table on the following page for the conversion of how to interpret dredging required depths versus maximum, potential dredging depths that may occur.

Dredging will be conducted via hydraulic cutterhead pipeline dredge and/or mechanical dredge. When meeting sediment testing standards, dredged material will be disposed at the CIDMMA. For dredged material that does not meet sediment testing standards, material will be disposed of at an approved upland disposal site.

The number of vessel calls is anticipated to increase in the future as compared to existing conditions either with or without implementation of the proposed deepening project. However, in future conditions with implementation of the proposed deepening project, we would anticipate that the deepened channel system would allow for larger vessels to transport commodities more efficiently and would result in fewer vessel calls as compared to the future without project condition. We would not anticipate a change in container vessel speeds transiting the harbor in the existing as compared to future conditions with and without project.   The service speed for vessels with a carrying capacity of around 14,000 Twenty-Foot Equivalent Units (TEUs) is similar to the smaller vessel size of 8,000 TEUs. Vessel speeds for the container vessels would be approximately 18-24 knots in the unrestricted speed portions of the Action Area. There is an existing speed restriction of six knots in a portion of Segment 1 in the Action Area that extends from the junction of the Southern and Eastern Branches of the Elizabeth River and the Norfolk and Portsmouth Belt Line Railroad Bridge between Chesapeake and Portsmouth, Virginia. The remaining portions of the Action Area are not under a vessel speed restriction.

Table 1. Estimated maximum, potential construction dredging volumes and durations and estimated maintenance dredging volumes and duration of the Elizabeth River and Southern Branch Navigation Improvements Project for the No Action/Future Without Project Alternative and Alternative 2, the Preferred Alternative.

				Estimated Construction Maximum				Estimated Maintenance - 50 Years		Summary - Construction Maximum and Maintainance	
Alternative	**Required Depth - feet (ft)**	**Current Volume above Existing Maintained Depth (cubic yards)**	**Estimated Maximum Depth (ft) = Required Depth + 1 ft Advanced Maintenance + 2 ft Paid Allowable Depth + 2 ft Non-Pay Allowable Overdepth + 1 ft Contamination Removal (select segments only)**	Estimated Maximum Volume (cubic yards)	Estimated Maximum Dredging Duration (Months)	Estimated Maximum Total Bottom Disturbance (square feet)	Estimated Maximum Change/Delta (increase) in Bottom Disturbance - (square feet)	**Estimated 50 Year Maintenance Volume (cubic yards)**	**Estimated 50 Year Maintenance Dredging Duration (months)**	**Estimated Maximum Volume - Volume Above Existing + Allowable Pay + Non-Pay + Maintenance Volume (cubic yards)**	**Estimated Maximum Construction + 50 Year Maintenance Dredging Duration (months)**
No Action Alternative/Future Without Project (NAA/FWOP)- Segment 1 Elizabeth River Reach	40	55,804	46	480,234	0.70	14,345,062	-	1,579,750	3.44	2,115,788.73	4.15
NAA/FWOP - Segment 1 Lower Reach	40	3,818	46	64,783	0.09	5,209,099	-	71,300	0.21	139,901.58	0.31
NAA/FWOP - Segment 1 Middle Reach	40	10,050	46	197,351	2.18	2,064,875	-	38,250	0.29	245,650.50	2.47
NAA/FWOP - Segment 2	35	1,938	40	359,206	4.48	5,020,273	-	884,800	6.27	1,245,944.38	10.75
NAA/FWOP - Segment 3	35	495,977	40	1,222,383	15.25	4,269,028	-	83,350	0.59	1,801,710.10	15.84
Total										**5,548,995.29**	**33.52**
Alternative 2 - Segment 1A	45	63,969	up to 50, 51 in MR	2,499,984	3.65	20,737,337	976,689	1,826,389	3.98	4,390,341.61	7.63
Alternative 2- Segment 1B	42	5,704	up to 48	71,877	0.79	2,039,347	180,960	5,144	0.04	82,724.58	0.83
Alternative 2 - Segment 2	39	1,938	up to 45	1,590,006	19.84	5,729,763	709,490	982,128	6.96	2,574,072.50	26.80
Alternative 2 - Segment 3	35	495,977	40	1,222,383	15.25	4,269,028	-	83,350	0.59	1,801,710.10	15.84
Total										**8,848,848.79**	**51.11**

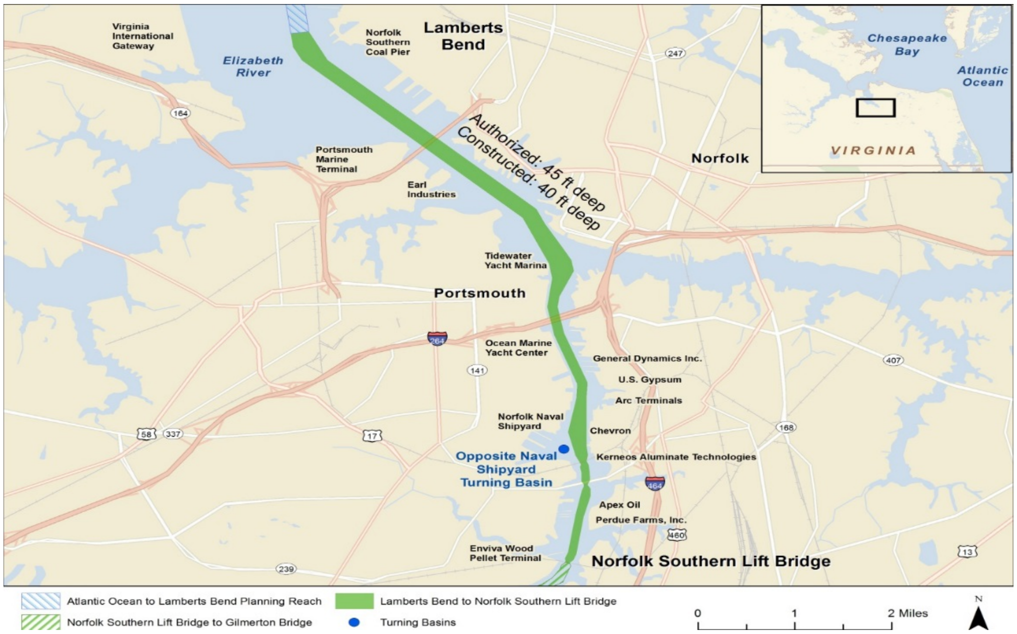

Figure 2. Segment 1, Elizabeth River and Southern Branch Navigation Improvements Project from Lambert's Bend to the Norfolk Southern Lift Bridge.

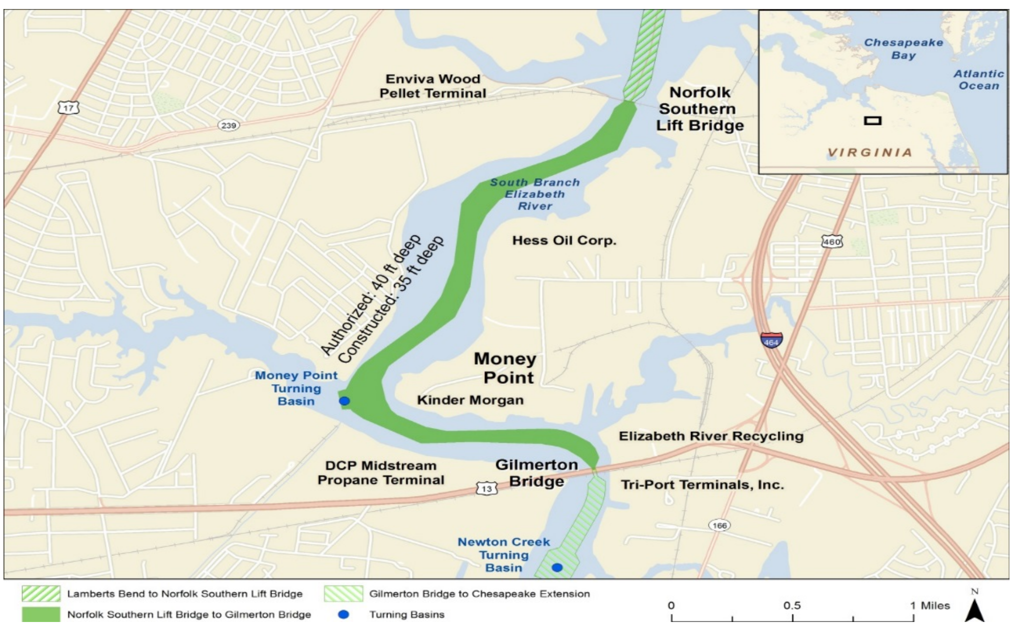

Figure 3. Segment 2, Elizabeth River and Southern Branch Navigation Improvements Project from the Norfolk Southern Lift Bridge to the Gilmerton Bridge.

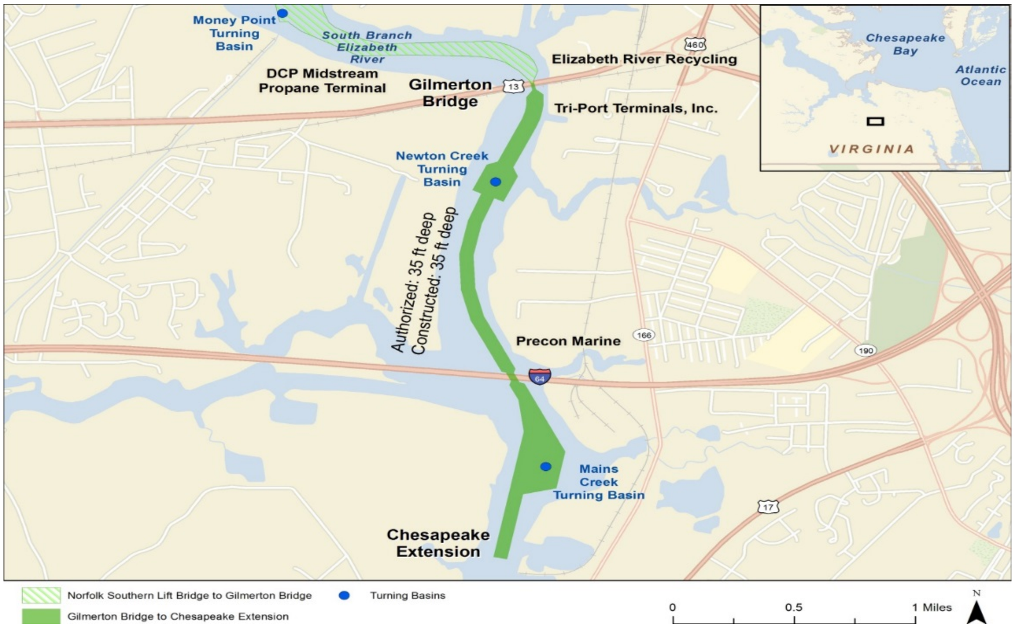

Figure 4. Segment 3, Elizabeth River and Southern Branch Navigation Improvements Project from the Gilmerton Bridge to the Chesapeake Extension.

6.0 SUBMERGED AQUATIC VEGETATION (SAV)

Submerged Aquatic Vegetation (SAV) is very important in Virginia waters for certain life stages of many fish species (Terceiro 2006; Love and May 2007; Phillips et al. 1989). SAV can be found throughout areas of the Chesapeake Bay and its tidal tributaries. SAV is a critical food and habitat source for a wide variety of waterfowl, shellfish, and fish species, and also provides a complex refuge that serves as nursery and juvenile habitat for many fish species (Fisher and Willis 2000).

Areas with SAV coverage consistently have both a larger abundance of and a greater diversity of fish species than non-vegetated areas (Orth and Heck 1980). The use of SAV areas by fish species is most prevalent during the summer months when water temperatures are higher and dissolved oxygen is lower (Love and May 2007; Orth and Heck 1980). The increased use of SAV habitats directly corresponds with the increased biomass produced by the plants during the spring and early summer months. The rise in SAV coverage and biomass also directly coincides with the proliferation of fish larvae within the Chesapeake Bay area. In the Chesapeake Bay region, fish larvae (of all species) are most numerous between March and August, with the highest density in May (Cowan and Birdsong 1985).

However, during the late 1960's through early 1970's, water quality declined significantly in the Chesapeake Bay and its tributaries. The decline in water quality was predominately from increased sediment and nutrient loading. These factors and others contributed to the deterioration of SAV coverage throughout the Norfolk Harbor and the Chesapeake Bay region.

The most recent (2016) SAV survey by the Virginia Institute of Marine Science (VIMS) indicates that SAV is not present in any of the projects segments, including the Elizabeth River. The absence of SAV within the project area can affect the life stage and presence/absence of a species in a given area. Within the project vicinity, SAV was only found in some of the southern tributaries in the Newport News/Hampton area. Areas with SAV coverage were generally smaller, shallow tributaries that feed into the Chesapeake Bay.

Species with EFH in the Region of Influence are described below.

7.0 ESSENTIAL FISH HABITAT

The 1996 amendments to the Magnuson-Stevens Act put forth a mandate for NOAA Fisheries Service, regional Fisheries Management Council's (FMC) and other federal agencies to identify and protect EFH of economically important marine and estuarine fisheries. To achieve this goal, suitable fish habitats need to be maintained.

Table 2. Species with Essential Fish Habitat in the Elizabeth River and Southern Branch project area (Guide to Essential Fish Habitat Designations in the Northeastern United States 2016).

Species	Egg	Larval/Neonate	Juveniles	Adults
Atlantic butterfish (*Peprilus triacanthus*)	X	X	X	X
Atlantic sturgeon (*Acipenser oxyrhynchus*)				X*
black sea bass (*Centropristis striata*)			X	X
bluefish (*Pomatomus saltatrix*)			X	X
cobia (*Rachycentron canadum*)	X	X	X	X
dusky shark (*Carcharhinus obscurus*)		X		
king mackerel (*Scomberomorus cavalla*)	X	X	X	X
red drum (*Sciaenops occelatus*)	X	X	X	X
sandbar shark (*Carcharhinus plumbeus*)		X	X	X
sandbar shark (*Carcharhinus plumbeus*)		HAPC	HAPC	HAPC
Shortnose sturgeon (*Acipenser brevirostrum*)	**	**	**	**
Spanish mackerel (*Scomberomorus maculatus*)	X	X	X	X
summer flounder (*Paralichthys dentatus*)		X	X	X
windowpane flounder (*Scopthalmus aquosus*)				X

X* = Adults and sub-adult life stages of Atlantic sturgeon may occur in the project area
HAPC = Habitat Area of Particular Concern.
** = No life stage of the shortnose sturgeon are expected in the project area

8.0 MANAGED FISH SPECIES

The seasonal and year-round locations of the designated EFH for the managed fisheries are described below. The EFH determination is based on species distribution and habitat range.

8.1 Atlantic Butterfish

The proposed dredging occurs within an area designated EFH for all four life stages (egg, larvae, juvenile, and adult) of the Atlantic butterfish. The essential habitat for this species occurs in pelagic waters over the Continental Shelf, and the depth for each stage varies.

Butterfish eggs are found from the shore to 600 feet, the larvae are found at depths between 33 and 6,000 feet, while juveniles and adults are found between 33 and 1,200 feet. Preferred water temperature for each life stage also varies. Eggs have been found at water temperatures between 11˚and 17˚C; larval butterfish are found in temperatures varying from about 9˚to 19℃. Juvenile and adult fish are generally found at temperatures between 3˚and 28˚C (NOAA/NMFS 2014). Juvenile and adult butterfish are pelagic and overwinter along the 100 fathom contour of the continental shelf from late autumn through early spring. Both juveniles and adults are common in the high salinity and mixing zones of estuaries from Massachusetts Bay to the mid-Atlantic during warmer months.

8.2 Atlantic Sturgeon

Atlantic sturgeon are an anadromous bony fish that are distinguishable from other fish by five rows of bony scutes along the length of their body, a protrusible mouth, and heterocercal tail. They are slow growing and late maturing, and have been recorded to reach up to 16 feet in length and 60 years of age. They are bottom feeders that suck food into a ventrally-located protruding mouth. The diet of adult and subadult includes mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish. (NMFS 2012).

Spawning for the Chesapeake Bay Distinct Population Segment (DPS) is only known to occur in the James River. Spawning migrations generally occur during April-May in Mid-Atlantic systems; water temperature plays a primary role in triggering the timing. Male sturgeon begin upstream spawning migrations when waters reach approximately 6°C (43°F), and remain on spawning grounds through the spawning season. Females begin spawning migrations when temperatures are closer to 12°C to 13°C (54-55°F), make rapid spawning migrations upstream, and quickly depart following spawning. Spawning is believed to occur in flowing water between the salt front of the estuaries and the fall line of large rivers, when and where optimal flows are 46-76 centimeters per second and depths are three to 27 meters. Sturgeon eggs are deposited on hard bottom substrate such as cobble, coarse sand, and bedrock. At temperatures of 20°C and 18°C, hatching occurs approximately 94 and 140 hours, respectively, after egg deposition. Larval Atlantic sturgeon are assumed to inhabit the same riverine or estuarine areas where they were spawned. Studies show that age zero through age two sturgeon occur in low salinity waters; as such, no eggs, larvae, or young of the year are likely to occur in the proposed project area. However, older fish are more salt tolerant and can occur in high salinity waters as well as low salinity waters. Atlantic sturgeon may remain in the natal estuary for months to years before migrating to open ocean as subadults (NMFS 2012).

Adults may pass through the northern limits of the project area as they move to the James River to spawn in the spring, and then again as they return to the ocean. Subadults could be present in or near the Action Area year-round, but are less likely to be present in the winter months when individuals would be at overwintering areas, which are not known to occur in the project area (NMFS 2012). The Navy (2009) had noted in their EIS for dredging that the Atlantic sturgeon, regularly occur within the Chesapeake Bay during late spring/summer months.

In 2017 NMFS designated Critical Habitat for the Gulf of Maine, New York Bight, and Chesapeake Bay DPSs of Atlantic sturgeon in the Federal Register. These locations are in Maine, New York, New Jersey, Pennsylvania, Maryland, and Virginia. The locations in Virginia include the Potomac, Rappahannock, York, and James Rivers, out to their confluence with the Chesapeake Bay. The James River is the nearest Critical Habitat designation to the ROI, though it does not fall within the ROI for the Elizabeth River and Southern Branch of the Elizabeth River Navigation Improvements Project. This area is depicted on the map entitled, "Chesapeake Bay, Unit 5, James River." (Federal Register 81 FR 20057).

8.3 Black Sea Bass

The proposed dredging site occurs within the EFH for the juvenile and adult life stages for the black sea bass. Juvenile black sea bass occur in a wide variety of temperatures and depths, and are associated with hard bottomed habitats, including shellfish and eelgrass beds, and man-made structures in sandy/shelled areas. Adult black sea bass are found in either natural or man-made structured habitats with sand and shell as the preferred substrate. (NOAA/NMFS 2014).

Juvenile young-of-year migrate to warmer waters offshore or more southerly waters in the winter. Juveniles migrate inshore and northerly as waters warm above six degrees Celsius, and over-wintering juveniles return to coastal estuarine areas. Adults are in estuaries from May through October and are generally found in deeper, offshore waters during the winter months (Steimle et al. 1999).

8.4 Bluefish

The proposed dredging site occurs within an area designated EFH for both juvenile and adult bluefish. This species is the sole representative of the family Pomatomidae and is closely related to jacks, pompanos, and roosterfish (USACE 2014). The bluefish inhabits the continental shelf waters of temperate zones and are commonly found in large bays and estuaries. Generally, juvenile bluefish occur in Mid-Atlantic estuaries from May through October; adults enter estuaries earlier in the season, beginning in April (NOAA/NMFS 2014). Both adults and juveniles are opportunistic feeders and will forage on available food. The adults and juveniles prefer warm water temperatures (above 14-16℃ and migrate south of Cape Hatteras in the winter months). Juveniles are generally found in salinities ranging from 23-33 parts per thousand, but can withstand salinities as low as three parts per thousand. Adults generally prefer high salinities, greater than 25 parts per thousand.

8.5 Cobia

The proposed project area is designated as EFH for all life stages of cobia. Cobia are a warm water, pelagic fish found throughout the Chesapeake Bay. Spawning and juvenile cobia inhabit high salinity bays, estuaries, and seagrass beds. Adults prefer structures that interrupt the open water such as pilings, buoys, and anchored boats. Adults are also found inshore inhabiting bays and inlets. Cobia are opportunistic feeders, eating crustaceans and small fish. Cobia have been known to spawn in estuaries and shallow bays with water ranging from six to nine meters in depth. This species prefer warm water temperatures, usually greater than 27℃ and salinities ranging from 12- 20 parts per thousand. Juvenile and adult fish tend to migrate to the southern portions of the Bay and offshore during the cold winter months.

8.6 Dusky Shark

The proposed dredging area lies within the EFH for the juvenile life stage of the dusky shark. The dusky shark can reach up to four meters in length. Similar to many elasmobranchs, female dusky sharks give birth to live young, typically a litter of six to 14 pups. They usually reproduce every three years. This species typically eats fish, including smaller elasmobranchs such as other sharks, skates, and rays, though other prey, such as squid and sea turtles, are taken on occasion. In the North Atlantic, they range from George's Bank through the Gulf of Mexico, preferring warm, temperate waters. The species prefers oceanic salinities and is not commonly found in estuaries. Due to this temperature preference, northern populations tend to migrate seasonally. The dusky shark inhabits waters from the coast to the outer continental shelf and adjacent pelagic waters. It is not a common shark, and its slow reproductive rate makes it vulnerable to over exploitation.

Essential fish habitat for early juveniles, fish up to 115 centimeters in length, includes very shallow coastal waters, inlets and estuaries to the 25 meter isobaths. Coastal and pelagic waters between 25 - 200 meter isobaths and shallow coastal waters, inlets, and estuaries to the 200 meter isobath is the EFH identified for late juvenile dusky sharks (NOAA/NMFS 2014).

8.7 King Mackerel

The proposed project area is designated as EFH for all life stages of king mackerel. King mackerel are solitary, open-ocean inhabitants found in the upper portion of the water column and are typically found in ocean environments along beaches and in the outer waters of estuaries. They are concentrated off the coast of the Carolinas in the spring, summer, and fall, and migrate south for the winter. Virginia is generally considered the northernmost extent for the Atlantic coastal group of king mackerel.

Neither the eggs nor larvae of this species are likely to be found in the project area – they prefer to spawn in coastal oceanic waters. However, juvenile and adult fish may be encountered in the project area (USACE 2014).

8.8 Red Drum

The proposed project area is designated EFH for all life stages of red drum. Juvenile red drum body color is silvery while mature adult fish are coppery brown or red. This species is identified by one large black spot near the base of its caudal fin. Red drum inhabit coastal estuaries and move into deeper waters either offshore or near the mouth of bays and inlets to spawn (Holt 2008). Juveniles tend to swim in shallow waters, while adults travel in schools in bays and coastal environments.

Red drum are known to occur in a variety of habitats to a depth of 50 meters offshore. These habitats include tidal freshwater, estuarine emergent vegetated wetlands (flooded saltmarshes, brackish marsh, tidal creeks), estuarine scrub/shrub (mangrove fringe), submerged rooted vascular plants (sea grasses), oyster reefs/ shell banks, unconsolidated bottom (soft sediments), high salinity oceanic surf zones, and artificial reefs (NOAA/NMFS 2014).

8.9 Sandbar Shark

Female sandbar sharks grow to be about three meters in length, while males can reach lengths up to two meters. They typically roam in small groups segregated by sex in coastal waters. This species migrates seasonally to avoid overwintering in cold, northern waters – although they can range from Cape Cod to the western Gulf of Mexico, individuals are not found north of the Carolinas in the winter months. The preferred diet of sandbar sharks includes menhaden, bluefish, mackerel, crabs, and skates.

Recent research predicts the highest abundance of juvenile sandbar sharks to be in water with a salinity greater than 20.5 parts per thousand and depth greater than about six meters (Grubbs 2001). Additionally, Grubbs (2001) found "…the primary nursery areas include the outer mouth of the York River but very little of the James River located closer to the mouth. This may be explained by the higher volume of freshwater discharge and increased industrial and agricultural runoff typical of the lower James." All shallow coastal waters to the 25 meter isobaths are designated EFH for early juveniles, which includes all sandbar sharks up to 90 centimeters. This area is also EFH for late juveniles, between 91 and 179 centimeters. Also, benthic areas at the shelf break between the 100 and 200 meter isobaths during the winter months are considered EFH for late juveniles. EFH for the adult life stage includes all shallow coastal waters to the 50 meter isobaths.

The proposed action lies within a designated Habitat Area of Concern (HAPC) for all life stages of the sandbar shark. This species is the principle species caught in the commercial shark fishery of the U.S. Atlantic coast and is also important recreationally; however, the stock is considerably depleted. Sandbar sharks, like many other elasmobranchs are viviparous, or bare live young. The primary reason that the local waters are considered HAPC is because the lower Chesapeake Bay is one of the most important nursery grounds for this species on the U.S. East Coast – large numbers of female sharks give birth in the area, and the lower Eastern Shore and Chesapeake Bay are important nursery grounds for the juveniles (Ellis and Musick 2007; Grubbs 1995; Heist et al.1995). Although much of the lower bay is considered HAPC for the sandbar shark, this species prefers nursery areas near the outer mouth of the York River due to better water quality conditions; so it is predicted that the HAPC would not be affected with implementation of the Elizabeth River Navigation Improvements Project

8.10 Shortnose Sturgeon

Adult shortnose sturgeon feed primarily on small crustaceans and mollusks in estuarine waters. Juvenile sturgeon forage on insect larvae. They reach lengths of up to 100 centimeters, are long-lived (15-20 years), mature late in life, and are highly fecund. They are anadromous and migrate to freshwater to spawn during late winter and early summer. Juveniles migrate to and from freshwater for several years, eventually remaining in estuarine waters and joining adult migration patterns. Shortnose sturgeon were once abundant in Chesapeake Bay; however, the population has declined significantly since the first published account of their presence in 1876 (NMFS 1998). In 1996, eight shortnose sturgeons were captured in the upper Bay between Kent Island and the Chesapeake and Delaware Canal, and one in the Potomac River. In 1997, nine shortnose sturgeon were captured in the upper Chesapeake Bay between Miller's Island and the mouth of the Susquehanna River. In 2006, two female, egg-bearing shortnose sturgeon were found in the Potomac River.

As described by NMFS (2012), the shortnose sturgeon is found in 19 rivers along the U.S. Atlantic coast. It occurred historically in the Chesapeake Bay. However, NMFS indicated that despite numerous sturgeon studies in Virginia waters, only one shortnose sturgeon has been documented in all of Virginia since 1996, and that was in the Chesapeake Bay. Prior to 1996, according to NMFS, there were only 15 published historic records of them in the Bay; and they were mostly based on personal observations in the 1970s and 1980s. Therefore, NMFS concluded in 2012 that this species is very unlikely to be found in the Bay or within the Action Area (NMFS 2012). It is highly unlikely that shortnose sturgeon are present in the ROI, therefore, there will be no further discussion of impacts for this species.

8.11 Spanish Mackerel

The proposed project area is designated as EFH for all life stages of Spanish mackerel. The Spanish mackerel inhabits coastal waters, but are known to come closer to shore, towards the outer reaches of estuaries. They primarily feed on estuary dependent species such as the bay anchovy and Atlantic menhaden. Spanish mackerel are migratory, generally moving north each spring, spending summer in the northern part of their range (mid-Atlantic) and migrate south in the fall to wintering grounds off the coast of South Florida. Spanish mackerel prefer water temperatures greater than 26℃ and salinities between 30-36 parts per thousand.

Like the king mackerel, neither the eggs nor larvae of this species are likely to be found in the project area – they prefer to spawn in coastal oceanic waters. However, juvenile and adult fish may be encountered in the project area (USACE 2014).

8.12 Summer Flounder

The proposed project area occurs within the EFH for the larval, juvenile, and adult stage of the summer flounder. Larval and juvenile summer flounder are commonly found in a wide variety of habitats with the juveniles preferring a sandy/mixed substrate over a mud/silt substrate. Adults are most commonly found in sandy substrates but are also present in a variety of substrates with both mud and sand, including marsh creeks, seagrass beds, and sand flats. The summer flounder's optimal salinity range is between 10-30 parts per thousand.

In general, summer flounder larvae are most abundant nearshore (12-50 miles from shore) at depths between 9 and 70 m. They are most frequently found in the southern part of the Mid-Atlantic Bight from November to May. Juveniles inhabit estuarine habitats, including salt marsh creeks, seagrass beds, mudflats, and open bay areas, which are used as nursery areas. Juveniles prefer water temperatures greater than three degrees Celsius. Adult flounder are found in shallow coastal and estuarine waters during warmer months and move offshore to the outer Continental Shelf to depths of about 152 meters during the colder months (NOAA/NMFS 2014). Fall migration of flounder out of the Chesapeake Bay begins in October.

Burying behavior of summer flounder is affected by substrate type, water temperature, tide, salinity concentrations, and the presence or absence of prey species; while they do not tend to seek cover in vegetated areas, there is an "edge effect" in which the species bury themselves close to vegetation and relief structure to ambush prey. This species is a bottom-dwelling predator, relying on its flattened body, agility, sharp teeth, and ability to change color and pattern on its dorsal surface. Small fishes, squid, worms, shrimp, and other crustaceans make up the bulk of this species' diet. Summer flounder can live up to 20 years of age, with females living longer and growing larger than males (up to 95 centimeters total length) (USACE 2014).

8.13 Windowpane Flounder

The proposed navigation improvement project area is designated as Essential Fish Habitat for adult windowpane flounder. Windowpane flounder are a fast growing, left-eyed flounder that inhabit near-shore waters, estuaries, and the continental shelf in the northwest Atlantic Ocean. This species is most plentiful from Georges Bank to the Chesapeake Bay, though they are known to occur from the Gulf of Saint Lawrence south to Florida. Windowpane flounder are most abundant in shallow waters (one to two meters) over sandy, sandy/silty, or muddy substrates. However, they can be found anywhere from shallow shoreline areas to a depth of about 60 meters (Hendrickson 2006). Adults tend to be found in waters with temperatures below 26.8℃ and a salinity ranging from three to six parts per thousand (NOAA/NMFS 2014).

The diet of adult windowpane flounder consists of small crustaceans and a multitude of fish larvae, including their own species (Chang et al. 1999). Predators of this species include black sea bass, thorny skate, goosefish, Atlantic cod, spiny dogfish, weakfish and summer flounder. Egg and larval windowpane flounder can be found in water depths of less than 70 m, with an average surface temperature of less than 20℃; windowpane eggs are found in surface waters, while larvae are abundant in pelagic waters (NMFS 1998). Larvae and egg abundance in the middle Atlantic are observed from February to November with peaks in May and October (NMFS 1998).

Windowpane flounder can reach a maximum length of 45 centimeters (Miller et al. 1991). Adults reach sexual maturity at three to four years of age and about 22 centimeters long, and they spawn along the near shore coastal shelf during the spring and summer months in the Chesapeake Bay region. Spawning occurs along the bottom in water temperatures between nine and 13.5˚C (Chang et al. 1999).

9.0 PREY SPECIES

Benthic Invertebrates

The typical Chesapeake Bay ecosystem includes benthic communities of epifauna (organisms that live attached to surfaces on the bay bottom) such as oysters, sponges, sea squirts, seas stars, and barnacles. Infauna are benthic communities that burrow into bottom sediments and are characterized by worms, clams and other tunneling organisms.

Benthic communities have varied roles in the Bay ecosystem. Filter feeders such as clams, oysters, and sponges clarify and clean the waters of the bay, through their biological processes, removing particulate matter and potentially toxic materials, providing for a healthy marine environment. As primary and secondary consumers, these organisms pass the energy of primary producers (phytoplankton) to higher levels of the food web. Many benthic species are food sources for managed species and their prey.

Atlantic menhaden (*Brevoortia tyrannus*)

Atlantic menhaden are found along the Atlantic seaboard from Nova Scotia to Jupiter Inlet, Florida. A pelagic, obligate filter-feeding species, Menhaden are a commercially important resource of the Chesapeake Bay (Wenner and Sedberry 1989). Menhaden feed primarily on phytoplankton and small crustaceans (Lewis and Peters 1994). Atlantic menhaden are seasonally abundant in the Chesapeake Bay region, particularly during the winter and spring. During the summer months, Atlantic menhaden are as not common in the estuary (Wenner and Sedberry 1989).

Atlantic menhaden spawn in the ocean from March to May, and again in September and October in the northern part of their range. Their eggs are demersal and usually hatch within 48 hours. Larvae migrate from the ocean to the upper portions of the estuary during the spring months. Juveniles typically migrate to sea in the fall, after spending their first year in the estuary. Menhaden are found in the Chesapeake Bay throughout the year, but are more abundant in the winter and the spring (Wenner and Sedberry 1989). Large concentrations may congregate along shoaled areas in coastal bays and estuaries the summer and move to deeper ocean waters as the temperatures cool.

Bay Anchovy (*Anchoa mitchilli*)

The bay anchovy is a year round resident species found in all parts of the Chesapeake Bay and its tributaries. The bay anchovy is typically found near the surface in open water habitats (Orth and Heck 1980). Within the Chesapeake Bay, the bay anchovy is one of the most abundant fish, providing an important food base for many piscivorous species (Jung and Houde 2003). Spawning occurs over a wide salinity range; with the peak spawning range is 13-15 parts per thousand. The spawning season is approximately from April to October, with the greatest number of eggs being produced in July and August. The eggs are demersal. This species moves to deeper waters off the Chesapeake Bay and its lower tributaries during the winter months (or when the water temperatures fall below 14℃).

Herring

The general term for the group of fish referred to as Herring, encompasses several fish species (herring, shad, and anchovies) from the order Clupeiformes. The family Clupeidae, for the Chesapeake Bay, is represented by the following species: *Alosa pseudiharengus* (Alewife, big-eye or branch herring), *Alosa aestivalis* (blueback herring or glut herring), *Alosa sapidissima* (American or white shad), *Alosa mediocris* (Hickory shad), *Brevoortia tyrannus* (Atlantic menhaden), *Dorosoma cepedianum* (Gizzard shad), and *D. petenense (*Threadfin shad). The family Engraulidae is represented by the *Anchoa mitchilli* (Bay Anchovy). All of the *Alosa sp.* are anadromous and found throughout all portions of the Chesapeake Bay.

Alewife runs occur from March through April and demersal eggs are spawned in fresh or tidal-waters that have slow moving currents. *A. aestivalis* spawn in water about 21℃. Larvae and juveniles utilize the upper tributaries of the Chesapeake Bay from fresh water to brackish water. *A. pseudoharengus* eggs hatch in about 6 days at 16℃. The young and adult of both species utilize mid-estuarine areas in the summer and return to the deeper oceanic waters in the winter. They are predominantly plankton feeders (diatoms, copepods), but can also feed on shrimp, insects, small fish, squid and fish eggs. *A. sapidissima* usually appear in the upper river as early as February and spawn through April, usually in tidal-fresh water. Most shad ascend the rivers when water temperatures are between 13 to 19℃. Spawning grounds are in tidal fresh waters over shallow flats with fine gravels or sandy bottoms. The eggs are large and demersal. The eggs hatch after 12-15 days of water temperatures at 11℃. After spawning, the adults leave the Chesapeake Bay in June and return to coastal waters. Young *A. sapisisima* remain in the Chesapeake Bay and its tributaries throughout the warmer months. Yearlings have been known to reside in the Chesapeake Bay's deeper waters or head to the oceanic waters in the winter. Immature shad remain at sea for 3 to 6 years, or until they reach maturity. Juveniles mainly feed on copepods, but include mysid shrimp as they mature. Adults are known to feed on copepods, ostracods, amphipods, mysids, isopods, insects, algae and small fish. This species is highly influenced by water temperature throughout several life stages.

9.1 Atlantic Croaker (*Micropogonias undulates*)

The widely abundant Atlantic croaker inhabits areas of the Atlantic and Gulf coasts, from Cape Cod, Massachusetts to Campeche, Mexico (Lassuy 1983; Barbieri et al.1994). Croakers are a demersal species, preferring areas with sandy or muddy substrates. Adults are typically found in deeper portions of rivers or bays, while juveniles are found in more shallow, nearshore areas. Juvenile croaker reside in the Chesapeake Bay region year round, occupying tidal streams with soft mud and plant material (Cowan and Birdsong 1985).

Croakers are highly opportunistic feeders that rely on readily available food sources. Although the diet of croakers changes as the fish age, all ages feed from the lower portion of the water column. The diet of adult and juvenile croaker consists of a variety of polychaetes, crustaceans, small fish, and other invertebrates (Hewitt et al. n.d.; Chao and Musick 1977; Lassuy 1983). Larval and post-larval croakers feed on zooplankton, detritus, and benthic macroinvertebrates (Lassuy 1983).

Adult croaker enter the bay in the early spring and will remain in foraging grounds throughout the summer (Hewitt et al. n.d.). Juvenile croaker will utilize portions of the estuary and its tributaries as nursery and feeding areas. Croakers reach maturity around two years of age, but some individuals can live up to four or five years (Lassuy 1983). However, there is some evidence suggesting that a large number of adults die after the fall spawning event in their second year (Pearson 1929; Gunter 1938; Parker 1971).

There is some variation in the literature about the duration of the spawning season and the location of spawning activities. In the Chesapeake Bay area, croakers typically spawn offshore between September and November (Cowan and Birdsong 1985). On the other hand, some studies have suggested that the offshore spawning season extends into January and February (Hildebrand and Schroeder 1928; Joseph et al. 1964). Furthermore, other reports have suggested that spawning may be occurring within the estuary as well as offshore (Barbieri et al. 1994). Spawning occurred between July and October for croaker in the estuary (Barbieri et al. 1994).

Larvae and post larvae were observed in the Chesapeake Bay region from November to January (Cowan and Birdsong 1985). By late summer, the earliest hatched young have entered the Chesapeake Bay and migrated into the tributaries. By the end of October, most adults have left the Chesapeake Bay and moved offshore.

9.2 Blue Crab (*Callinectes sapidus*)

The blue crab can tolerate a wide range of salinity gradients in the Chesapeake Bay, from its lower Bay waters (up to 32 parts per thousand) to the upper reaches of its tributaries. Mating occurs from June through October in the middle and upper Bay waters, peaking in July and August. Impregnated females then migrate towards the lower Bay to the high-salinity spawning grounds, while males remain in the fresh waters, both wintering in the muddy bottoms of deeper channels. Eggs hatch at salinities of 20 to 32 parts per thousand and within a few weeks assume a planktonic life as a zoeae. After about six weeks and several molts, the zoeae become a benthic megalops and eventually turn into a juvenile crab. The juveniles and megalops migrate up the Chesapeake Bay and into all its tributaries.

9.3 Killifish/Mummichog/Mud Minnow *(Fundulus spp.)*

Fundulus species frequent both salt and brackish waters. However, in the Chesapeake Bay area, the killifish species tend to prefer higher salinities, while mummichogs prefer lower salinities (Abraham 1985). *Fundulus spp*. are generally very tolerant of temperature and salinity fluctuations. *Fundulus heteroclitus*, the common killifish spawns from April to August. It is common in the shallow brackish coves of inlets of the Chesapeake Bay. The preferred habitat of mummichogs consists of muddy bottoms in areas with some *Spartina sp*. coverage, while some killifish species prefer more sandy sediments. *Fundulus spp*. will utilize a wide variety of food sources; including organisms found within the water column, or in the intertidal and subtidal benthos (Abraham 1985). The diet of *Fundulus spp*. includes: algae, crustaceans, polychaetes, snails, insects, small fishes, and shrimp. *Fundulus spp*. are a common prey species of a wide variety of birds and predatory fishes. Other *Fundulus spp. f*ound in the Bay include: *F. majalis, F. ocellaris, F. diaphanous, F. confluentus* and *F. luciae.*

9.4 Silversides (*Menidia menidia*)

The geographic range of the silverside extends from Nova Scotia and the Magdalen Islands to Volusia County, Florida. The Silverside is found throughout the Chesapeake Bay region, but rarely enters fresh water habitats. The Silverside prefers tidal creeks with submerged grasses, but will move to deeper channel waters in the winter. Larvae and juveniles are most abundant in areas with relatively low salinity (one to 14 parts per thousand). Even so, it is possible that all life stages, especially adults, may be present in the project area due to this species' abundance in the Chesapeake Bay.

The diet of adult and juvenile silversides consists of a variety of copepods, insects, worms, mollusk larvae, algae, diatoms, mysids, cladocerans, detritus, and amphipods (Orth and Heck

1980; Fay et al. 1983). Silversides are an important prey species for striped bass, Atlantic mackerel, and bluefish. Silversides reach maturity by age one, with most adults not surviving to two years of age (Fay et al. 1983).

The spawning season for silversides is between April and August, with an average of four or five spawning events during the season (Fay et al. 1983). They spawn in schools around shallow, pooled areas of water along the low tide area. The eggs are sticky with filaments so they have a tendency to cling to vegetation and one another. They are protected from many predators by their shallow water habitat.

9.5 Spot (*Leiostomus xanthurus*)

Spot are widely abundant throughout the Atlantic coast, from Massachusetts to Florida (Wenner and Sedberry 1989). Spot are an important food source to many species of piscivorous birds and fish such as spotted sea trout (*Cynoscion nebulosus*) and striped bass (*Morone saxatilis*) (Phillips et al. 1989). Spot are epibenthic feeders that consume a wide variety of polychaetes, copepods, decapods, nematodes, bivalves, siphons, and (Clarke and Wilbur 2000; Chao and Musick 1977; Phillips et al. 1989). Although spot are tolerant to a wide range of temperatures (8-31° C) and salinities (0-60 parts per thousand), the tolerance to salinity decreases with the age of the fish. Juvenile spot prefer tributaries with salinities greater than 16 parts per thousand, while adults are less tolerant of salinity fluctuations and are more abundant at lower salinities (Phillips et al. 1989).

Primary nursery areas for post-larval and juvenile spot occur in higher salinity bays, tidal creeks and SAV beds (Phillips et al. 1989; Love and May 2007). In these habitats, post-larval and juvenile spot represent 80-90 percent of the total number of fish present (Weinstein and Brooks 1983). After the first year, spot move from the higher reaches of the tributaries to the lower reaches of the tributaries. Spot spawn at sea from November through February in moderately deep water (Cowan and Birdsong 1985). Adults begin to return to the Chesapeake Bay in late spring to early summer, where they reside until fall migration to offshore spawning grounds. Once water temperatures drop again in the fall (typically November) most adults return to the sea. Larvae and juveniles migrate inshore earlier than adults, between mid-December and February (Phillips et al. 1989).

9.6 Weakfish (*Cynoscion regalis*)

Weakfish are found along the Atlantic seaboard, from Massachusetts to Florida (Mercer 1989). Weakfish are a valuable recreational species, with a high abundance between New York and North Carolina. The Chesapeake Bay estuary is used as seasonal foraging and nursery ground for weakfish (Chao and Musick 1977; Mercer 1989). Habitat usage within the estuary varies by age of the fish, time of year, and vertical location within the water column. However, they predominately inhabit shallow waters with sandy to sandy mud substrates.

All populations of weakfish reach maturity at age one; however the length of mature fish varies by geographic region. Mature individuals from southern populations generally grow to a larger size at maturity than northern populations. Adults migrate between inshore and offshore waters seasonally, prompted by the increase in water temperatures during the spring and summer months. As water temperatures increase, adult weakfish will move inshore or further north from their overwintering habitats in the south Atlantic (Mercer 1989). The warm spring Continental Shelf waters stimulate the adults to return to the bays and estuaries in the spring. As the water temperatures decline in the fall, adults congregate and move offshore and southward towards oceanic waters and the wintering grounds (Chao and Musick 1977; Mercer 1989). The primary wintering grounds are hypothesized to be along the Continental Shelf from the Chesapeake Bay to the Cape Lookout, North Carolina (Mercer 1989).

Spawning occurs near the mouth of the Chesapeake Bay and the adjacent nearshore and estuarine waters shortly after their migration inshore. Preferred spawning habitat of weakfish consists of areas with high salinity, immediately adjacent to inlets or creeks (Luczkovich et al. 1999; Luczkovich et al. n.d.). Several other species of Sciaenids favor spawning habitat with similar features. In these regions where spawning habitat overlaps with other Sciaenids, weakfish occupied waters less than ten feet deep. In the Chesapeake Bay region, weakfish have an extended spawning term that stretches from approximately March to August (Chao and Musick 1977). The duration of the spawning seasons varies geographically, with southern populations having earlier and longer seasons than northern populations. Multiple spawning events can occur during one spawning season (Mercer 1989).

Larvae are found throughout the lower bay in the late summer and young begin to appear in low salinity habitats in August (Chao and Musick 1977). By October, juveniles begin to move down river to higher salinity waters and eventually into the ocean. Fish two years and older appear in the lower Chesapeake Bay in April and May with yearlings becoming more abundant in the summer.

9.7 White Perch (*Morone americana*)

White perch are found along the Atlantic coast from New Brunswick, Nova Scotia, and Prince Edward Island, Canada to South Carolina, USA (Stanley and Danie 1983). White perch are very common throughout the Chesapeake Bay and the James River. White perch habitat primarily consists of the upper tributaries of the Chesapeake Bay, along the fresh water and salt water interface zone. Juvenile white perch favor shallow areas at and above the tidal freshwater interface (Fay et al. 1983). Spawning occurs between April and June, with migrations to spawning areas triggered by seasonal temperature changes (Hewitt et al. n.d.). Spawning occurs in fresh or brackish marshes, rivers, lakes, or estuaries with low salinities (under 4.2 parts per thousand) (Hardy 1978). Spawning occurs in freshwater areas from April to May, but in estuarine environments spawning occurs between May and July. Spawning habitat substrate consists of gravel, clay, sand, or crushed shell (Stanley and Danie 1983). Some white perch spawn in their resident body of water, while others migrate up to 90 kilometers. Adults and juveniles move to deeper waters (30 to 40 feet) as winter approaches. Overwintering habitat is typically in waters averaging 40 to 60 feet, but can reach depths in excess of 130 feet.

As white perch grow, they gradually move down stream. At two years of age, regardless of sex, most white perch are considered adults. Any remaining juveniles will reach maturity no later than age four. Growth and development of white perch is most rapid during the first year, but is dependent on availability of food, population density, and water temperature (Stanley and Danie 1983).

White perch are a widespread, abundant, commercially important species in the Chesapeake Bay region. White perch are able to survive in a large variety of habitats and environmental conditions. They feed on a diverse array of prey, including: zooplankton, insects, crustaceans, amphipods, snails, crayfish, and other fish species. As a result of the great flexibility and adaptability, the white perch has become highly prolific in the James River and the Chesapeake Bay.

10.0 POTENTIAL IMPACTS TO ESSENTIAL FISH HABITAT AND MANAGED SPECIES

This section will discuss the potential impacts associated with implementation of the action alternatives, Alternative 1 or Alternative 2, on EFH and associated managed species. Impacts to water quality and habitat will be described, as well as potential impacts caused by entrainment and trawling captures, vessel/equipment strikes, underwater noise, and unexploded ordinance (UXO). Following this section, best management practices/mitigation measures that reduce potential impacts to EFH and managed species will be described as well as potential cumulative impacts that could impact Essential Fish Habitat.

10.1 Potential Navigation and Dredging Impacts

Potential impacts to EFH and associated managed species from the Elizabeth River and Southern Branch Navigation Improvement Project result from dredging vessels transiting dredging locations and dredging. Dredging can impact water quality. Decreases in light penetration in the water column can result in behavioral responses from fishes due to the disturbance effect and also the potential limited visibility. Increased depths from dredging in estuarine environments also has the potential to alter salinity levels within the dredging footprint and also can result in changes in Dissolved Oxygen (DO) levels. Dredging can result in burial and/or smothering of some managed species, and has the potential to release nutrients and/or contaminants in the sediment which can impact fishes, prey, and their habitat. Additional effects to EFH and managed species may occur when fish and prey are entrained or struck by dredging vessels/equipment. Managed species can be impacted by noise disturbances which may cause species to flee the area of impact or potentially alter other behaviors, such as foraging success. Essential Fish Habitat and managed species, including Atlantic sturgeon, may be impacted by releases of UXO although this would be highly unlikely. The extent of impacts depend on hydraulic processes, sediment texture and composition, chemical content of the sediment, and the behavior or life stages of the managed species.

10.1.1 Potential Water Quality Impacts

The temporary increase in total suspended solids (TSS) and turbidity in the water column at dredging areas has the potential to directly impact EFH and managed species. The impacts to protected species from TSS and turbidity are directly related to: the species tolerance, exposure rate, duration of the exposure, and life stage. Deposition of suspended sediments may induce impacts to fish eggs and larvae through deposition, abrasion, and/or smothering, especially in the dredging and placement areas (Wilbur and Clarke, 2001). However, in species, such as the white perch, the deposition of particulate matter on eggs does not demonstrate any adverse effects. White perch eggs can tolerate concentrations of 500 mg/L of particulate matter without any adverse effects (Stanley and Danie, 1983). In addition, non-motile sessile benthic prey species have the potential to be buried and smothered during dredging and dredged material placement.

Increases in TSS and turbidity can impact prey species' predator avoidance response due to visual impairments caused by decreased clarity in the water column (Gregory and Northcote, 1993; Wilbur and Clarke, 2001). Turbid waters can also visually impair predator species that rely on sight to forage. Increased TSS and turbidity alters the ability for light to penetrate the water column; this impairs both physical and biological processes in the affected area (Johnston, 1981; Wilbur and and Clarke, 2001). Increased turbidity can impact primary productivity and respiration of organisms within the project area. By limiting light availability in the water column, the rate of primary productivity has the potential to drop. As a result in declined primary productivity, there may be an overall reduction in DO availability. If DO levels drop significantly, anoxic conditions may ensue, which can result in stress induced illness or mortality. However, dredging operations have occurred in the Elizabeth River and Southern Branch channels for more than 30 years, and no dredging operation has been recorded to result in an anoxic fish kill or harmful algal bloom. Therefore, anoxia, hypoxia, or harmful algal blooms following dredging operations are unlikely with implementation of either Alternative 1 or Alternative 2.

Dredging has the potential to disperse and potentially release nutrients and contaminants in the sediment to the water column. Contaminant dispersal and release has the potential to negatively impact managed fish species and their prey by causing illness or mortality by uptake of contaminants in their tissue. The uptake of contaminated sediments may result in sickness or mortality to affected fish populations. Sediment contaminant testing has not been conducted to the planned depth of sediment dredging anticipated with this project. Therefore, additional testing will be required during the Preconstruction, Engineering, and Design Phase of the project and will also be conducted approximately every three years or as otherwise agreed to with the Environmental Protection Agency.

The behavioral response of estuarine fish species to TSS and turbidity has been documented in a number of studies; it has been found that the suspension of fine particles hinders gas exchange with the water by coating the respiratory epithelia of juvenile and adult fish (Clarke and Wilbur 2000). The larger suspended particles can be trapped in the gill filaments and fill the opercular cavity, which may lead to asphyxiation by prohibiting the passage of water through the gills (Johnston, 1981; Clarke and Wilbur, 2000). Even so, increased sediment loading in the water column is predicted to be temporary, with the effects subsiding within a few days or weeks of dredging. Another behavioral response will be for fish and/or prey species to move away from the disturbance and visual effects. We would anticipate that demersal species, especially those that could be foraging in the project area, such as flounder, to be most affected.

While dredging operations will temporarily increase TSS and turbidity, these impacts will be minor when compared to background levels. The variable flushing rate (due to the water exchange and tidal fluctuations) within the Elizabeth River and Southern Branch channels will affect the dispersion of potential TSS/turbidity plumes. High flushing rates, minimize long term impacts to water quality, while low flushing rates increase the residence time of TSS/turbidity plumes. Understanding the flushing rate, combined with the operational controls on the dredge will help to minimize impact to non-motile demersal organisms (Wilbur & Clarke, 2001). Overall, adverse impacts to EFH and associated managed species, including Atlantic sturgeon, resulting from water quality impacts would range from negligible to minor and would be temporary in duration. Based on VIMS modeling conducted to date for the project, we would anticipate salinity and Dissolved Oxygen impacts to range from negligible to minor in intensity.

10.1.2 Potential Impacts to Benthic Habitats

Dredging will alter benthic habitats by direct removal of sediment. Benthic habitats will be disturbed, making them temporarily unsuitable for some sessile and/or benthic organisms. There may be indirect effects on managed fish that utilize these benthic habitats.

Direct removal of suitable benthic substrate by dredging may impact EFH by removing important prey species (i.e. benthic organisms), food species (i.e. macroalgae), or by alteration of nursery and spawning areas. Re-colonization of the newly exposed substrate after dredging is not only a function of site-specific characteristics (i.e. bathymetry, tidal energy), but also of the substrate requirements of the larvae of re-colonizing species (Rhoads & Germano, 1982). Any deviation from the existing benthic floor changes the complexion for smaller species that utilize the area for foraging and living space. Additionally, some demersal species require specific substrates for foraging and spawning. Therefore, dredging will likely result in the temporary loss of some benthic habitat and foraging grounds.

It is anticipated that impacts to benthic habitats will involve the potential loss and displacement of non-motile benthic organisms. McCauley et al. (1977) documented that the total abundance of benthic organisms at a dredging site returned to pre-dredging levels seven to 28 days after dredging was completed. In a similar study conducted on the nearby James River, Diaz (1994) revealed that almost all species of benthic organisms had re-colonized the disturbed areas within three weeks of dredging. Diaz (1994) also demonstrated that benthic organisms continued to sustain pre-disturbance population densities three months after a dredging event. This study also revealed similar population dynamics and species of benthic organisms in both the disturbed and undisturbed areas.

As described in the Potential Water Quality Impact Section, we do not anticipate that the Elizabeth River and Southern Branch Navigation Improvement Project would cause any substantial impacts to salinity or DO and therefore, no substantial long-term shifts in benthic species community composition are anticipated.

In summary, once dredging is complete, impacted benthic areas will likely begin to re-colonize with organisms similar to those from adjacent non-impacted areas. Therefore, the adverse effects to EFH and associated managed species, including Atlantic sturgeon, are expected to be negligible to minor and range from temporary to permanent impacts. However, benthic organisms and habitats are expected to recover to near pre-construction conditions following a dredging event

10.1.3 Potential Entrainment Impacts

Entrainment is defined as the direct uptake of aquatic organisms by the suction field generated at the suction intake. We are also referring to the capture of organisms that could occur with dredging as “entrainment”. Entrainment can occur with either hydraulic cutterhead/pipeline or mechanical dredges. The entrainment of various animal species during dredging operations can lead to direct injury and/or mortality of the entrained animal.

During dredging, a possible impact to fish species is the entrainment of eggs, larvae, juveniles, and adult life stages. Life stages with limited or no swimming ability, especially eggs and larvae have a higher potential to be entrained. Active dredging operations have a higher potential to entrain demersal fish species or species that spawn in or near the area. Foraging, rearing, and spawning habitat preferences impact the potential for various species to be entrained, but other criteria also play an important role.

The size and suction power of the dredge, the dimensions and extent of construction of the channel being dredged, and the method of operation of the dredge all relate to the potential and the ability of the dredge to entrain fishes (Reine and Clarke 1998). The suction power generated from the dredge and the diameter of the cutterhead pipe are the primary physical parameters that dictate the ability to entrain aquatic organisms. The risk of entrainment for many fish species is higher within a radius of 1.5 to two meters of the cutterhead, with one meter (from the cutterhead) posing the highest potential for entrainment (Boysen and Hoover 2009). Suction velocities decrease to less than 30 centimeters per second beyond two meters. The size of the pipe diameter also impacts the possibility of entrainment of fishes. By reducing the size of the pipe diameter, the corresponding flow field is reduced, thus reducing the risk of entrainment. Reducing the diameter of a dredge pipe by 20 centimeters can reduce the flow field by at least 0.25 meters (Hoover et al. 2011).

Burton, Weisberg, and Jacobson (1992) used modeling software to predict the rate of entrainment of striped bass (*Morone saxatilis*), herring (*Alosa* spp.), and white perch (*Morone americana*) larvae. This simulation involved the continuous use of four hydraulic dredges, to try and determine a conservative estimate of mortality and entrainment. Despite the large amount of material being dredged in this simulation, the authors concluded that less than one percent of the total larval fish population would be lost. In a separate study involving 15 species of commercial and sport fish, entrainment rates varied from 0.001 to 0.135 fish per cubic yard for both cutterhead and hopper dredging operations (Armstrong et al. 1982). Out of the entrained fish, approximately 37.6 percent of the fish were mortally entrained. Over a four year period, Larson and Moehl (1990) observed entrainment rates ranging from less than 0.001 to 0.341 fish entrained per cubic yard of material dredged, distributed among fourteen species of fish. As expected, the majority of the fish entrained during this study were demersal species and we expect this to be the case with local EFH species that could be in the project ROI.

Calculating entrainment rates for individual species with EFH within the Elizabeth River and Southern Branch channels is difficult due to the limited entrainment data available for respective species within the project area. Because life stages and species abundance can vary depending on location, it is important to calculate potential entrainment rates based on data collected within or near the affected area. In summary, we would anticipate that there could be some entrainment with implementation of either Alternative 1 or Alternative 2, but we would not anticipate this level of take to result in any population-level impacts of any EFH species at any life stage.

The other remaining factor influencing potential entrainment is based upon the swimming stamina and size of the individual fish at risk (Boysen and Hoover 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger finfish is unlikely due to the increased swimming performance and the relatively small size of the cutterhead opening. Egg, larvae, and juvenile entrainment of fish species with such life stages present in the project ROI is possible, depending on the location of the dredging operations and the time of year in which dredging occurs. Typically major concerns of juvenile entrainment relate to fish below 200 mm (Hoover et al. 2005; Boysen and Hoover 2009).

Fish entrainment rates for hydraulic cutterhead/pipeline dredging or mechanical dredging are anticipated to be low; however, some level of entrainment is anticipated with the dredging of the Elizabeth River and Southern Branch channels. Fishes not able to move away from the dredge and located in the vicinity of the dredging area may be entrained. Overall, impacts to any life stage of fish are anticipated to be negligible to minor and temporary in duration.

10.1.4 Potential Dredging Vessel/Equipment Strike Impacts

Due to the environment of the Elizabeth River and Southern Branch, the likelihood of vessel strikes to fish species is possible, but is not anticipated to be a substantial threat due to the limited amount of time the dredging vessels/equipment will be operating and the ability of motile fishes to move away from dredging impacts. Species and life stages with limited swimming ability would be at highest risk of strike impacts. Effects to fish species, from dredging vessel equipment/strikes is anticipated to be negligible to minor and temporary.

10.1.5 Potential Underwater Noise Impacts

Underwater soundscapes are of vital importance to numerous species of estuarine and coastal fishes. Soundscapes are characterized by the ambient sound created by both the physical and biological processes at a specific location – the soundscape of an oyster reef is considerably different than that of a seagrass bed or an open expanse of sand (Lillis et al. 2014). In shallow water communities, soundscapes are affected by a variety of factors, such as bathymetry, waves, and animal activities (intra specific and defense communications, foraging, etc.) (Lillis et al. 2014). Sound is particularly important to aquatic communities due to its efficient transmission through water; studies have proven that sound plays a role in a multitude of ecological processes, including reproductive behavior, navigation, defense, territoriality displays, foraging, and orientation and timing of larval settlement (Cotter 2008; Nichols, Anderson, & Sirvic 2015; Lillis et al. 2014). Over the past century, as human maritime and coastal activity has increased exponentially, oceanic noise pollution has also risen.

Noise pollution can be described as the disruption of a naturally occurring soundscape by anthropogenic, or human, inputs. Sounds created by human activities fall into two categories: sounds that are an unintentional byproduct and sounds that are used as a measurement tool (Slabbekoorn et al. 2010). The first category includes low-frequency noises from small or large water craft (e.g. container shipping, public transportation, and fishing/recreation) (Slabbekoorn et al. 2010). The second category of anthropogenic noise is generated largely by sonar, which enables humans to map the benthos and locate objects/resources (e.g. sunken ships, oil, natural gas, etc.) in the ocean; this generates both low and high frequency sound (Slabbekoorn et al. 2010). Although there are a variety of noise inputs, it is hypothesized that motorized vessels, particularly in coastal environments, produce the largest proportion of noise pollution generated by humans (Slabbekoorn et al. 2010; Nichols et al. 2015).

For the Elizabeth River and Southern Branch Channel Deepening Project, mechanical and hydraulic cutterhead/pipeline dredges may be used. Dredging vessels produce, on average, continuous, broadband sound frequencies varying from 20 – 1000 Hz that usually diminish below ambient noise levels within about 25 km of the dredges (Todd et al. 2015; Richardson et al. 1995). Throughout the dredging process low frequency noise is produced, however, the highest level of noise occurs during the loading of dredged material onto the ship (Richardson et al. 1995).

Underwater sounds generated from hydraulic cutterhead/pipeline dredges are typically low in intensity and frequency, but in some instances can emit higher frequencies (CEDA Position Paper, 7 November 2011). Hydraulic cutterhead/suction dredging generally produces sound below 1,000 Hertz in frequency, with estimated source sound pressure levels ranging between 168 to 186 decibels (re 1 micro-Pascals) at one meter below the surface. The CEDA (2011) reported that cutterhead suction dredge estimated source sound pressure levels ranging between 172 to 185 decibels (re 1 micro-Pascals) at one meter below the surface. The majority of the sound produced by cutterhead suction dredges occur at the 70 Hertz to 1,000 Hertz range and peaks in the 100 to 110 decibel range (Clarke et al., 2002).

Clarke et al. (2002) recorded sounds from a 10,000 horsepower, 24 inch cutterhead suction dredge during maintenance dredging operations in Mississippi. The findings from this study demonstrated that sounds emitted from hydraulic cutterhead suction dredges were rather muted when compared to other sound sources in the aquatic environment. In this example, the sounds attributed to the cutterhead suction dredge operation were virtually undetectable at 500 meters from the source (Clarke et al. 2002).

For the construction and maintenance dredging of the Elizabeth River and Southern Branch there are channels with different dredging needs. Therefore, the exact type of dredge and its size and specifications may vary. However, the size of dredges used in the past has ranged between approximately 18 to 36 inches. The aforementioned study from Mississippi, while not identical in size of the cutterhead suction dredges operating in Elizabeth River and Southern Branch, is of comparable size to the dredges being utilized. Therefore, it is anticipated that the underwater sound levels associated with hydraulic cutterhead/pipeline dredging on the

Elizabeth River and Southern Branch will be equal to or slightly more than the levels discussed in the Clarke et al. study (2002).

Underwater noise generated by dredging may impact EFH and managed fish species in the project area, however, population-level impacts are not anticipated. Anthropogenic sources of underwater sound, and specifically dredging, have recently become the source of concern for regulatory agencies. However, 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. So, the influence of noise pollution on aquatic organisms, including fishes, is poorly understood. Research has predominantly looked at the potential impacts of dredging sound on marine mammals, with limited studies examining potential impacts to fish species. However, preliminary research has provided valuable insight regarding the effect of disturbed marine soundscapes on spatially associated fish populations.

Of the marine fish species studied, nearly all fall within the spectrum of auditory sensitivity from 20 – 1000 Hz (outliers can sense up to 4000 Hz); there is a considerable amount of spectral overlap between the noise produced from dredging activities and fish auditory sensitivity (Kasumyan 2005; Nichols et al. 2015). Results from a study conducted by Nichols et al. (2015), provide evidence suggesting that random, intermittent noise, rather than continuous noise, produced by water craft raised the levels of cortisol, a stress hormone, in a coastal fish species. Elevated cortisol levels in fishes, and especially in juvenile fishes, are correlated with a variety of negative effects, including increased susceptibility to infection, decreased growth rates, and reduced predator avoidance (McCormick et al. 1998; Nichols et al. 2015).

The impact to Atlantic sturgeon from dredging equipment and the associated noise has not been well documented. However, existing studies demonstrate no impact to behavior, spawning, feeding, or movement of any Atlantic sturgeon within the vicinity of active dredging operations (Moser and Ross 1995). Moser and Ross (1995) concluded that Atlantic sturgeon showed no difference in habitat preference or behavior between the dredged and undisturbed areas during dredging operations.

Although the studies linking potential noise impacts to managed fish species from navigation, dredging, and dredged material placement are limited, implementation of the Elizabeth River and Southern Branch Deepening Project is not anticipated to substantially increase noise levels as they relate to impacts to fish species. Also, all impacts would be temporary in duration. Therefore, we would anticipate noise impacts to managed fish species or their prey to range from negligible to minor.

10.1.6 Potential Unexploded Ordinance Impacts

Another potential threat to managed fish species is injury or incidental take resulting from UXO detonation or contact with contaminants leaching from UXO that occur in the project area. However, we would not anticipate this to be a substantial threat as the USACE deploys UXO screening devices on dredges where there is risk of UXO detonation. Therefore, we would not anticipate impacts to managed species from release of UXO.

11.0 Best Management Practices/Mitigation Measures

Depending on the method of dredging, measures can be implemented to minimize disturbances to the environment. For example, agitation and operation of the cutterhead of a dredge will not begin until the cutterhead is in immediate contact with the substrate. By lowering the cutterhead to the bottom, before starting the agitation and suction of water and sediment, potential impacts and losses of fish species in the vicinity of the dredge are minimized. The USACE deploys UXO screening devices on dredges where there is risk of UXO detonation.

11.1 Cumulative Impacts to Essential Fish Habitat and Managed Species

With implementation of either of the Action Alternatives, the size of commercial vessels using the Harbor for commerce may increase, but the overall vessel traffic is not anticipated to increase from implementation of Alternative 1 or Alternative 2 alone. However, Virginia Port growth is anticipated to increase throughout the next 50 years, and a new port facility is planned, which may increase the number of vessels transiting area. Additional development, including construction of the Third Crossing and expansion of the Chesapeake Bay Bridge Tunnel is planned. Continued development could increase impacts to the managed species occurring in the project area, however; implementation of either Alternative 1 or Alternative 2, along with other past, present, and future actions, is not anticipated to significantly contribute to those increased impacts.

Potential cumulative threats to managed species includes entrainment and exposure to contaminants. Another potential cumulative impact to consider is impacts that occur from fishery entanglement. While some of these threats have the potential to impact fish populations, implementation of either Alternative 1 or Alternative 2 is not anticipated to significantly contribute cumulatively to injuries and mortalities resulting from these impacts.

Global climate change has the potential to affect fish populations that occur or could occur in the project area in the future. Sea level rise may cause an increase in salinity in upstream areas that could affect breeding sites and survival of early life stages (eggs, larvae, and young of the year). There could be shifts in breeding habitat availability and timing and the effects of this change on fish populations could be detrimental although relatively uncertain at this time. Changes in salinity, temperature, and sea level rise all have the potential to result in shifts in prey species availability which could also detrimentally affect fish populations. While continued development and climate change has the potential to impact fishes, implementation of either Alternative 1 or Alternative 2 is not anticipated to substantially contribute cumulatively to injuries and/or mortalities resulting from these impacts.

12.0 CONCLUSIONS

Implementation of either of the Action Alternatives may have potential adverse impacts to water quality and habitat and have the potential to impact managed species from entrainment and trawling captures, vessel/equipment strikes, underwater noise, and unexploded ordinance release.

Total Suspended Solids and turbidity would be anticipated to temporarily increase within the affected area following dredging events, although TSS and turbidity levels would rapidly resume background concentrations following dredging. Benthic impacts from the maintenance dredging activities may have negligible to minor effects on EFH, but it is likely that species would quickly re-colonize the area following dredging events. These impacts would not affect the long-term survival or reproduction of managed species. We would anticipate impacts to managed species resulting from entrainment, trawling captures, and vessel/equipment strikes; however, impacts are anticipated to be negligible to minor and temporary in nature. Although impacts of underwater noise to managed species is largely uncertain, we would not anticipate the underwater noise level to increase from current noise levels, and all noise impacts would be temporary. There could be some potential risk of contaminant release or release of unexploded ordinance, however this would be highly unlikely and mitigated with the use of UXO screening on dredging equipment where applicable. Impacts at the population-level for managed species is not anticipated.

Individually, or in sum, implementation of the Elizabeth River and Southern Branch Navigation Improvement Project is not anticipated to significantly adversely affect EFH. The effect of implementing the project is so minor to EFH that mitigation is not anticipated for EFH and has not been required per previous consultation with NMFS for the previously implemented project, Norfolk Harbor and Channels (USACE 2002). The USACE concludes that implementation of either Alternative 1 or Alternative 2 is anticipated to result in negligible to minor adverse impacts to EFH and managed species. Impacts would be temporary. No substantial adverse impacts to EFH or managed species are anticipated, and no impacts to the population level of any managed species or any associated prey species are anticipated. The implementation of our proposed best management practices/mitigative measures will help to avoid and minimize impacts to managed species to the maximum, practical extent.

13.0 RECENT ENVIRONMENTAL STUDIES AND REPORTS

- **2009** – Final Environmental Impact Statement – for the proposed dredging of the Norfolk Harbor Channel, Portsmouth and Norfolk, Virginia. U.S. Navy Mid-Atlantic region.
- **2002**– Final Limited Reevaluation Report Norfolk Harbor and Channels, Virginia, 50-Foot Channel Project, 50-Foot Inbound Element. U.S. Army Corps of Engineers, Norfolk District. October.
- **1995** – Webb, D. W. Ship Navigation Simulation Study, Southern Branch of the Elizabeth River, Gilmerton and Interstate 64 Bridges, Norfolk, Virginia. U.S Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.
- **1992** – Final Environmental Impact Statement for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Norfolk Virginia. U.S. Environmental Protection Agency, Region III office. November.
- **1985** – Final Supplement I to the Final Environmental Impact Statement: Norfolk Harbor and Channels, Virginia; Deepening and Disposal.
- **1981** – Addendum to Final Environmental Impact Statement: Norfolk Harbor and Channels, Virginia; Deepening and Disposal.
- **1980** – Final Environmental Impact Statement: Norfolk Harbor and Channels, Virginia; Deepening and Disposal

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