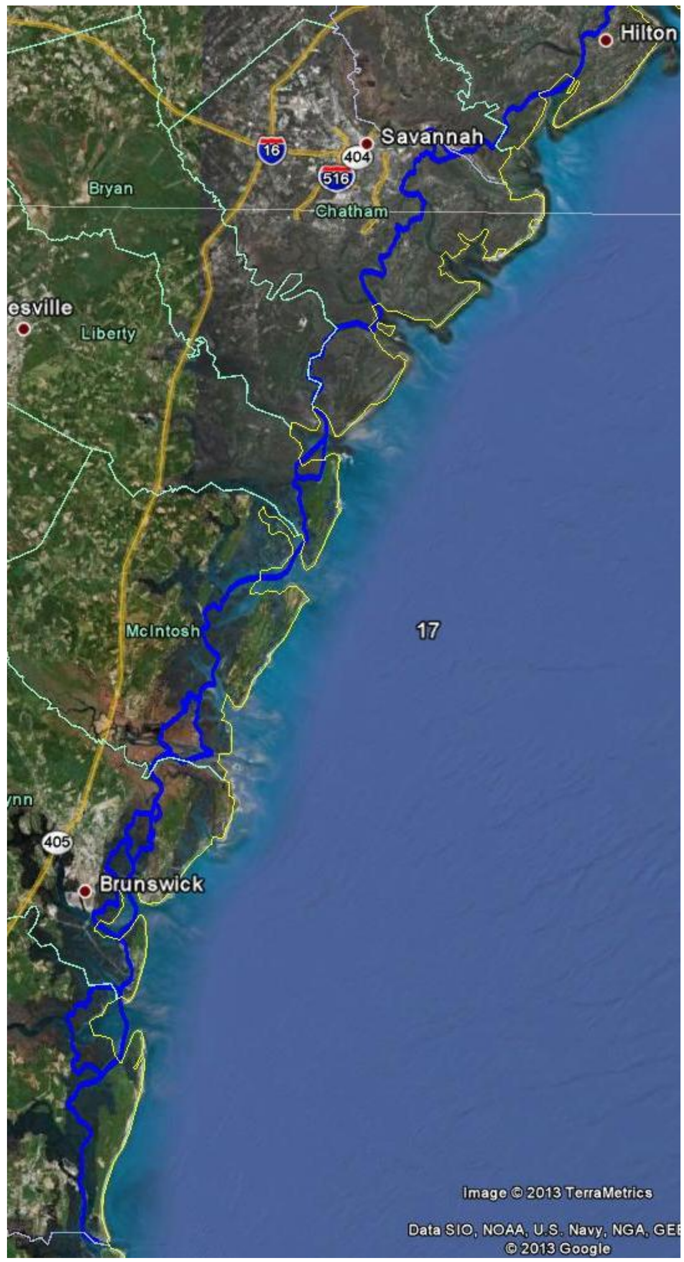
Dredged Material Management Plan
Atlantic Intracoastal Waterway

Port Royal Sound, South Carolina to Cumberland Sound, Georgia

November 2015

Appendix B: Biological Assessment of Threatened and Endangered Species (BATES)



US Army Corps of Engineers®
South Atlantic Division
Savannah District

DRAFT
Biological Assessment of Threatened And Endangered Species (BATES)

Maintenance Dredging Atlantic Intracoastal Waterway (AIWW)

Jasper and Beaufort Counties, South Carolina

Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden Counties, Georgia

US Army Corps of Engineers
Savannah Planning Division
Savannah, Georgia

August 2013

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1.0 Proposed Action (Preferred Alternative)

1.1 Dredges Used on the AIWW in Savannah District

Hydraulic cutterhead dredges have historically performed the dredging work on the AIWW, since the disposal sites were next to the reaches being dredged. This dredge type is the most efficient for placing material in upland (or saltmarsh) disposal sites. Mechanical dredges with scows would be used to dredge reaches where the disposal site is located farther (> 6 miles) than a cutterhead dredge can efficiently pump the material. Typically, material is pumped through a 16 inch pipeline to the disposal site. Small hopper dredges would be used where the dredge material is suitable for beneficial use and for near shore beach re-nourishment. Hopper dredges and mechanical dredges would be used when dredged material is to be transported to Ocean Dredged Materials Disposal Sites (ODMDS).

1.2 Scope of Savannah District AIWW

The Atlantic Intracoastal Waterway (AIWW) is a 739-mile inland waterway system between Norfolk, Virginia, and St. John's River, Florida, which offers a continuous, sheltered passage between these two destinations. The portion of the AIWW within Savannah District is situated between Port Royal Sound, South Carolina, (mile 552) on the north and Cumberland Sound (mile 713) on the South, which is located at the Georgia-Florida border. Thus, Savannah District's portion of the waterway constitutes approximately 22 percent of the AIWW. A map of the waterway is shown below in Figures 1 - 6. The 161-mile section of the AIWW within Savannah District is comprised of a 24-mile section in the State of South Carolina with the remaining 137 miles located in the State of Georgia.

Figure 1. Savannah District AIWW

In 1937, the first piece of legislation that would create the waterway with the dimensions authorized today was passed. The River and Harbor Act of August 26, 1937, provided for a 7-foot protected route around St. Andrew Sound (Senate Committee Print, 74th Congress, 1st Sess.) and for a 12-foot channel between Beaufort, South Carolina, and Savannah, Georgia (Rivers and Harbors Committee Doc. No. 6, 75th Congress, 1st Sess.). On 20 June 1938, a 12-foot channel between Savannah, Georgia, and Fernandina, Florida, with various cut-offs, and an anchorage basin at Thunderbolt was authorized (House Doc. No. 6liB, 75th Congress, 3d Sess.). The widths of the AIWW were to be 90 feet in land cuts and narrow streams and 150 feet in open waters. Dredging of the 12-foot channel between Beaufort, South Carolina, and Fernandina, Florida, was initiated in 1940 with the excavation of 507,275 cubic yards (CY) and completed in 1941 with the removal of 6,168,556 CY.

In addition to the main route and the protected route around St. Andrews Sound, the project provides for two other alternate channels. An alternate and more protected route of 7 feet deep MLW from Doboy Sound to Brunswick, Georgia, was incorporated into the project in 1912. The River and Harbor Act of March 2, 1945, approved an alternate route 9 feet deep and 150 feet wide in Frederica River. This alternate route did not require dredging since it had formerly been the main route prior to its abandonment in 1938 for a new route via Mackay River. Although all three of these routes are part of the AIWW project today, maintenance dredging has only been performed in the protected route around St. Andrews Sound.

1.3 Maintenance Dredging on the AIWW

Since the AIWW within Savannah District is quite long (161 miles), the waterway has been divided into operational reaches (36) to facilitate discussion. Figures 1 - 6 show these various operational reaches as well as the location of the disposal areas that are used to deposit the material from maintenance dredging activities. Each section of the waterway is discussed in regard to its shoaling areas, shoaling rates, maintenance requirements (for the next 20 years) and disposal areas, and the impacts that have occurred from using those disposal areas. Maintenance of the AIWW is usually accomplished using a hydraulic pipeline dredge. In most reaches, the dredged material is discharged onto existing disposal mounds in undiked disposal areas. For the most part, these undiked disposal areas are located in wetlands. The head section (discharge pipe) of the dredge is generally placed on existing dredged material deposits. The heavier material (sand) tends to settle in the area of the existing deposits while the fines (silt, mud) filter through the marsh. Some of this fine-grain material remains in the disposal tract while some of it reenters the waterway. On some occasions, fine-grain material from AIWW dredging operations has encroached on marsh areas outside of the disposal easements. There are several reaches where the material is discharged into diked disposal areas or into open water disposal sites.

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FIGURE 1
SAVANNAH DISTRICT AIWW OVERVIEW
HILTON HEAD ISLAND, SC (AIWW MILE 552) TO
TYBEE ISLAND, GA (AIWW MILE 575)

Legend
Dredge Material Disposal Sites
AIWW Stationing
AIWW Channel

Date: December 2012
Created by: Piper Bazemore
(SAS-EN-GS)
1 in = 1 Mile
0 0.5 1 2 Miles

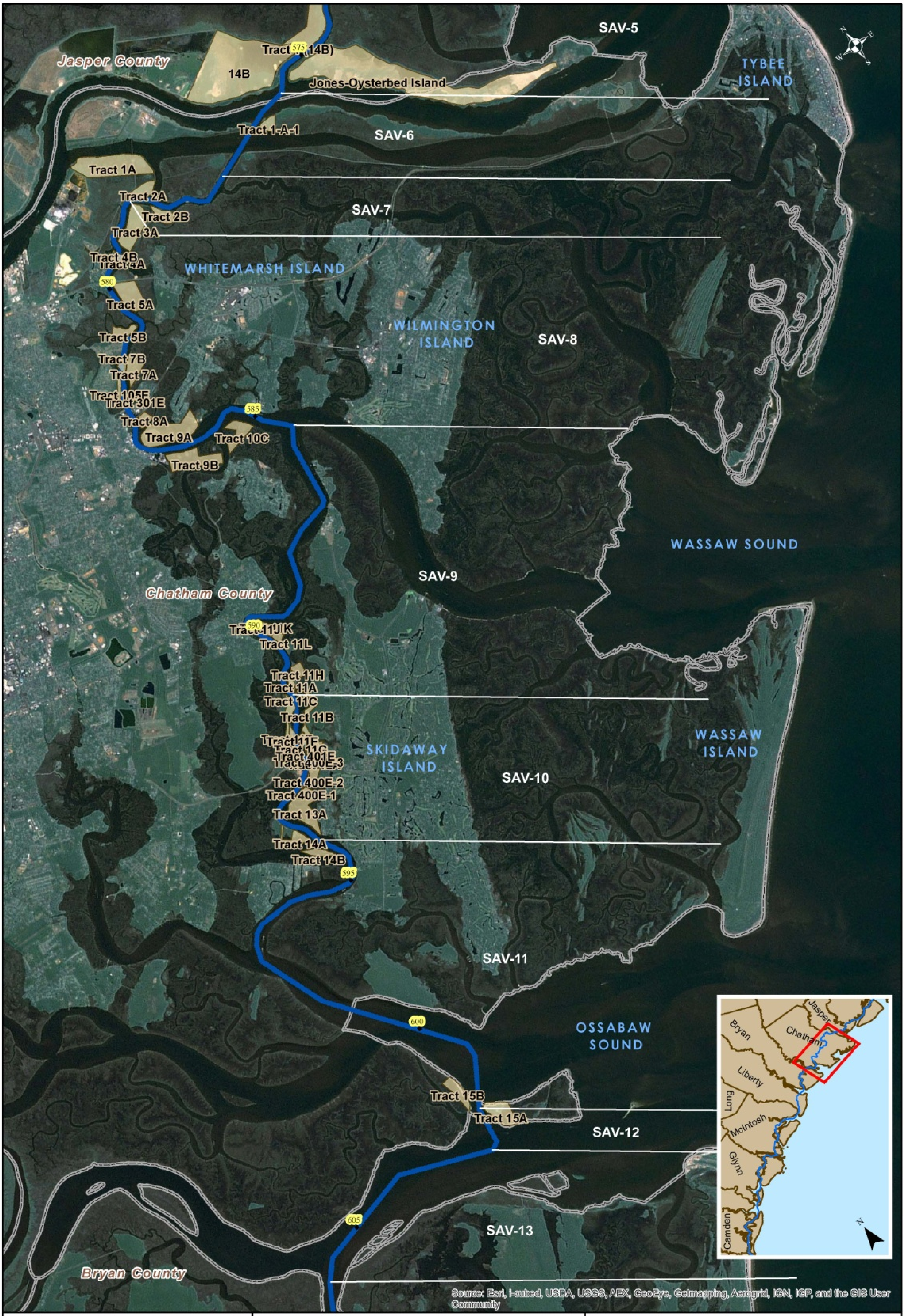

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FIGURE 2
SAVANNAH DISTRICT AIWW OVERVIEW
TYBEE ISLAND, GA (AIWW MILE 575) TO
OSSABAW SOUND, GA (AIWW MILE 605)

Legend
Dredge Material Disposal Sites
AIWW Stationing
AIWW Channel

Date: December 2012
Created by: Piper Bazemore
(SAS-EN-GS)
1 in = 1 Mile
0 0.5 1 2 Miles

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FIGURE 3
SAVANNAH DISTRICT AIWW OVERVIEW
OSSABAW ISLAND, GA (AIWW MILE 605) TO
SAPELO SOUND, GA (AIWW MILE 630)

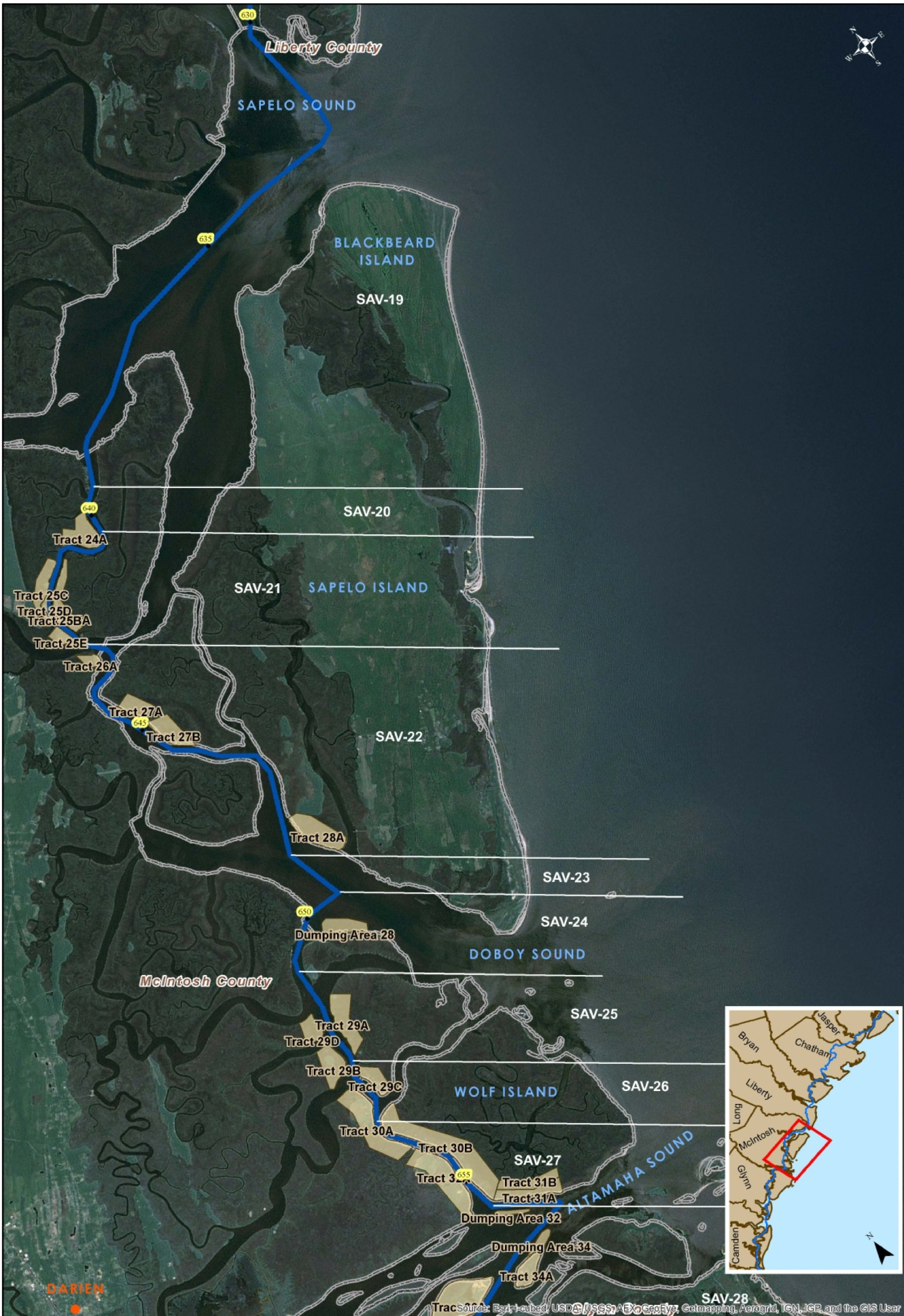

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FIGURE 4
SAVANNAH DISTRICT AIWW OVERVIEW
SAPELO SOUND, GA (AIWW MILE 630) TO
ALTAMAHA SOUND, GA (AIWW MILE 655)

Legend
Dredge Material Disposal Sites
AIWW Stationing
AIWW Channel

Date: December 2012
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(SAS-EN-GS)
1 in = 1 Mile
0 0.5 1 2 Miles

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FIGURE 5
SAVANNAH DISTRICT AIWW OVERVIEW
JEKYLL ISLAND, GA (AIWW MILE 680) TO
CUMBERLAND ISLAND, GA (AIWW MILE 705)

Legend
- Dredge Material Disposal Sites
- AIWW Stationing
- AIWW Channel

Date: December 2012
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(SAS-EN-GS)

1 in = 1 Mile
0 0.5 1 2 Miles

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FIGURE 6
SAVANNAH DISTRICT AIWW OVERVIEW
CUMBERLAND ISLAND, GA (AIWW MILE 700) TO
CUMBERLAND SOUND, GA (AIWW MILE 710)

Legend
Dredge Material Disposal Sites
AIWW Stationing
AIWW Channel

Date: December 2012
Created by: Piper Bazemore
(SAS-EN-GS)

1 in = 1 Mile
0 0.5 1 2 Miles

A Maintenance Evaluation Study for the AIWW within Savannah District was completed in 1983. As part of this study, impact determination evaluations were conducted to assess the effects of depositing dredged material into the undiked disposal areas. These evaluations were conducted through the analysis of color infrared photography and site inspections of the most heavily used disposal tracts.

A similar study to the one described in the preceding paragraph was completed in 2011 (Wetland and Upland Assessment of Dredged Material Placement Areas Atlantic Intracoastal Waterway). In addition to determining the impacts of the past disposal of dredged material in the undiked disposal areas, the 2011 report referenced also evaluated the potential for recovery of lost wetland functions with or without enhancement activities. An Estuarine Wetland Rapid Assessment Procedure (E-WRAP) analysis was conducted for these undiked disposal sites which utilized a standardized matrix that assists in evaluating wetland habitats and their landscape setting, and in determining the potential for recovery of any lost wetland function with or without enhancement activities. The matrix established a numerical ranking for individual ecological factors that can strongly influence the recovery of wetlands. Wildlife utilization of upland and wetland areas on each site was scored. Vegetative cover for each site was analyzed, including presence of desirable canopy, shrub, and ground cover vegetation. Adjacent land use that would affect the recovery of the site was categorized and scored. The ability of the site to recover lost wetland functions was determined.

The 1983 and 2011 reports are used in the following discussion of impacts to determine how vegetation in some of the disposal areas has changed in response to either additional dredged material deposition or non-use since the 1983 report.

1.4 Description of Existing Operational Reaches and Associated Disposal Areas

Operational Reach SAV-1. Port Royal Sound, SC to Ramshorn Creek, SC (AIWW Mile 552.-568.5)
The first 16.5 miles of the AIWW within the Savannah District traverses Skull Creek from Port Royal Sound to Calibogue Sound, thence Cooper River to Ramshorn Creek. This reach of the waterway affords sheltered, naturally deep waters. No dredging has been required since construction of the 12-foot channel. No disposal areas have been acquired for this reach of the AIWW.

Operational Reach SAV-2. Ramshorn Creek, SC (AIWW Mile 568.5-569.9)
This reach of the waterway has only been dredged two times (1966, 1980) since completion of the 12-foot channel when about 54,000 and 34,000 CY (CY) of material (sand) were dredged and deposited in SC Tract 3 which is undiked. SC Tract 3 (about 278 acres) consists of 12 small created upland islands surrounded by tidal marsh. Although the small islands only occupy 6.6 acres of the tract, approximately 107.5 acres (38.7%) of the tract appear to have been impacted by dredged material deposition. Based on the small amount of maintenance material that has been placed in the site and the maturity of some of the trees on the islands in SC Tract 3, most of the impacts in this site can be attributed to construction of the 12-foot channel. Most of SC Tract 3 (187.89 acres) remains tidal wetlands.

Operational Reach SAV-3. New River, SC (AIWW Mile 569.9-572.2)
This reach of the AIWW has not required any maintenance dredging. No disposal areas have been designated for this reach.

Operational Reach SAV-4. Walls Cut, SC (AIWW Mile 572.2-572.6)
Maintenance dredging in Walls Cut has been conducted on three occasions (1964, 1980, 2001) when about 90,000, 24,000 and 19,000 CY of material (sand) respectively were removed. SC Tract 2 which is undiked was designated to receive material dredged from this reach of the AIWW. Although it was probably used for placement of dredged material resulting from construction of the 12-foot project and early maintenance dredging cycles, it has not been used in the recent past. Material removed during the 1980 cycle was probably placed in SC Tract 1 while material removed during the 2001 cycle was placed in an existing diked disposal area (DMCA 14-B) adjacent to Fields Cut which is designated to receive dredged material from both the Savannah Harbor and AIWW projects. SC Tract 2 is located on Turtle Island. Turtle Island is a South Carolina Department of Natural Resources Wildlife Management Area.
An evaluation of SC Tract 2 (58.6 acres) indicates that it consists of one small upland island (1.73 acres) surrounded by tidal marsh. Although deposition of dredged material has resulted in the direct loss of 1.73 acres of marsh, the actual acreage of impacts is about 22.45 acres.

Operational Reach SAV-5 Fields Cut, SC (AIWW Mile 572.6-576.2)
Fields Cut has been dredged 11 times since completion of the 12-foot project. Approximately 555,890 CY of material (fine silt) have been dredged and placed in three disposal areas. SC Tract 1 is located on the western side of Fields Cut. Part of SC Tract 1 was included within DMCA 14-B when it was constructed for Savannah Harbor. Thus dredged material from Fields Cut can be placed into this fully diked site. The remaining portion of SC Tract 1 is diked only on the front side adjacent to Fields Cut. This part of SC Tract 1 received much of the maintenance material from the AIWW until more recent maintenance dredging cycles when the material was placed into DMCA 14-B. The existing Jones Oysterbed Island DMCA for Savannah Harbor is also available for dredged material from the lower end of Fields Cut.

SC Tract 1 (480 acres) consists of 267 acres of tidal wetlands, 40 acres of upland islands, and a one- acre freshwater wetland on one of the upland islands. The remaining 172 acres of SC Tract 1 are included within the dikes of DMCA 14-B for Savannah Harbor. The acreage of impacts for this site is 398 acres.

Operational Reach SAV-6 Elba Cut-McQueens Cut (AIWW Mile 576.2-577.4).
Most of the maintenance requirements for this reach of the waterway have been in Elba Cut. Elba Cut-McQueens Cut has been dredged on seven occasions with the last maintenance performed in 2009. Approximately 546,000 CY of material (fine silt) have been dredged and placed in several disposal areas. Tract 1-A-1 which is undiked received most of the dredged material from this reach. Tract A (not shown on the project maps) was briefly used through a Special Use Permit from the National Park Service. However, this permit was terminated in 1973, and Tract A is no longer a disposal area. Tract 1-A (204.9 acres, not shown on Figure 2A) has only a few small disposal mounds totaling 11.43 acres that probably date to the construction of the 12-foot channel in the 1940s and has not been used for maintenance of the waterway. This tract was used prior to construction of Elba and McQueens cuts.

Site 1-A-1 (38.7 acres) is comprised of 22.09 acres of wetlands and 16.61 acres of upland islands. All of the site has been impacted to some extent by the deposition of dredged material. The wetland survey of the site in 1983 indicated that dredged material disposal had already impacted 100% of the site by that time.

Operational Reach SAV 7-St. Augustine Creek (AIWW Mile 577.4-578.2)
This reach of the waterway has been dredged six times since completion of the 12-foot project with the last maintenance occurring in 2009. Approximately 534,000 CY of material (mud, silt) was dredged and deposited into Disposal Areas 2-A, 2-B, and 3-A. Site 2-A (43.44 acres) which is undiked consists of 40.38 acres of tidal wetlands and 3.06 acres of upland islands. Approximately 39.77 acres of this site have been impacted. Field studies conducted for the 1983 study indicated that Tract 2-A had already been fully impacted (100%) by that time.

Disposal Site 2-B shows evidence of past diking, but some of the dike appears to have eroded. At one time, tractss 2-B and 3-A were fully diked and joined together to form a large diked containment area. Site 2-B (36.4 acres) consists of 33.45 acres of tidal wetlands and 2.95 acres of upland islands. Total impacts for this site are 35.31 acres. Disposal site 3-A (119.0 acres) consists of about 68 acres of tidal wetlands and a 22-acre upland island. The site also includes a 29-acre freshwater wetland area. A dike surrounds the upland island and freshwater wetland and extends southward into the tidal wetland. The original diked area encompassed 107 acres. Total impacts for this site are 121.21 acres. Field studies conducted in 1983 indicated both Tracts 2-B and 3-A had been fully impacted at that time. Aerial photography from 1994 indicates that Tract 3-A was probably last used in 1989. Tract 2-B probably saw its last use in 1972.

Operational Reach SAV 8-Wilmington River (AIWW Mile 578.2-585.5)
Maintenance dredging has been performed in this reach of the AIWW on 16 occasions between 1950 and 1992. Approximately 5,000,000 CY of material (mud, silt) has been removed and placed in seven disposal areas. All of these disposal areas are undiked with the exception of a 26-acre diked area located within Tract 9-A. This diked site is also used by a vessel repair business for the maintenance of its yacht basin. This private user is required to maintain 130,000 CY of capacity within this diked disposal site for Federal use under terms of its agreement with the Corps.

Tract 2-A. Some of the material dredged from the upper portions of the Wilmington River has been placed into this disposal site. The impacts to this site were discussed in a preceding paragraph.

Tract 5-A. Tract 5-A (128.7 acres) consists of nine upland islands surrounded by tidal marsh. A highway (US 80) bisects the northern portion of the site, with a total right-of-way of 11.0 acres not counted as part of the disposal easement. Tidal wetlands (116.63 acres) make up most of the site with upland islands (12.07 acres) comprising the rest of the site. The acreage of impacts for this site is 105.82 acres. The field surveys for the 1983 report indicated that about 105.7 acres of the tract had been affected by dredged material disposal. Field surveys for the 2011 report indicate that impacts totaled 105.82, indicating that the tract has not been used since the 1983 survey for disposal. The site has also been impacted by the construction of ditches to control mosquitoes, but not as part of the dredging and disposal of AIWW sediments. Mosquito ditches are not counted in the impacts due to dredging and disposal.

Tract 5-B. Tract 5-B (30 acres) consists of one upland island surrounded by tidal wetlands. Tidal wetlands comprise about 29 acres with the upland island comprising the remaining acreage of the site. The acreage of impacts for this site is 6.62 acres. Based on the small area of impacted marsh in the tract and the maturity of the trees on the island, it does not appear to have been used in the recent past. This site was not evaluated during the 1983 field work because of its limited use.

Tract 7-A. Tract 7-A (52.47 acres) consists of seven upland islands surrounded by tidal marsh. Tidal wetlands comprise about 40 acres of the site with 12.47 acres of upland islands comprising the remainder of the site. The acreage of impacts for this site is 37.31 acres which is about 71% of the site. Studies conducted during the field work for the 1983 report indicate that about 59% of the site was impacted at that time. Consequently, maintenance dredging (1985, 1987, 1989) conducted since that time appears to have further impacted wetlands in the tract.

Tract 8-A. Tract 8-A (about 46.6 acres) consists of one small upland island surrounded by tidal marsh. Approximately 50% of the wetland area is bare ground. Tidal wetlands make up about 42.1 acres of the site while the remaining 4.5 acres are upland island. The acreage of impacts for this site is 16.10 acres (about 34.5% of the site). This corresponds closely to the acreage of impacts (17.2 acres-36.9%) identified in the 1983 study which indicates the tract has not been used in the recent past.

Site 9-A. Site 9-A (about 133.5 acres) consists of 2 small upland islands and one 26-acre, circular diked disposal area surrounded by tidal marsh. Tidal wetlands make up about 126.5 acres of the site, with 7 acres of upland islands comprising the remainder of the site. The acreage of impacts for this site is 88.8 acres, including about 9.0 acres outside the easement. This compares to impacts of about 90.7 acres, including about 10.0 acres outside the easement, identified in the 1983 study. Consequently, it appears that no additional disposal occurred outside the diked area since 1980.

Site 9-B. Site 9-B is approximately 24 acres in size and consists of one 0.48-acre upland island surrounded by tidal marsh. Tidal wetlands comprise about 23.71 acres of the site. The acreage of impacts for this site is 6.33 acres. The site was not assessed in the 1983 study because it was not being routinely used for maintenance dredging.

Tract 10-C (about 57.6 acres) is also located along this reach of the AIWW. Tract 10-C is undiked and has never been used.

Operational Reach SAV-9-Skidaway River (AIWW Mile 585.5-591.0)

Maintenance dredging has only been conducted once in this reach of the AIWW (1992-16,800 CY) since completion of the 12-foot channel in the 1940s. Dredged material from this reach has been deposited into four undiked disposal sites which are designated Tracts 11-B, 11-H, 11-K and 11-L.

Tract 11-K (24.7 acres) consists of 23.88 acres of tidal wetlands, with about 0.82 acres of upland islands. The acreage of impacts for this site is 7.42 acres or about 30% of the tract. Impacts determined in the 1983 study showed about 14.4 acres or about 58.5% of the tract had been impacted by that time. This tract has not been used in the recent past, and it appears that some of the impacted marsh in this tract has recovered. In 1983, 1.5 acres of impacts were recorded outside the easement; no such impacts were noted in 2011.

Tract 11-L (39.6 acres) consists of 39.12 acres of tidal wetlands and 0.48 acres of upland islands. The acreage of impacts for this site is 1.83 acres. This tract also apparently shows signs of marsh recovery as the field work for the 1983 study indicated that about 6.0 acres or 15.1% of the tract had been impacted at that time.

Disposal Tract 11-H (19.5 acres) which is undiked is also located along this reach of the waterway. It contains one small deposit (1.91 acres) of dredged material in the front portion of the disposal easement as a result of material from the construction of the 12-foot project.

Operational Reach SAV-10-Skidaway Narrows (AIWW Mile 591-594)
No maintenance of this reach of the AIWW has been required since completion of the 12-foot channel. Undiked Tract 12-A (67.9 acres) was used to place dredged material from the construction of the 12-foot project. This site also received dredged material in 1974 as a result of dredging to straighten the channel. Tract 12-A is also crossed by the Diamond Causeway to Skidaway Island (State Highway 204) which also impacted wetlands. Tidal wetlands make up approximately 50.41 acres of the tract with upland islands comprising the remaining 17.49 acres. The total acreage of impacts for this site is 11.87 acres (17.5%). This tract also seems to show some signs of marsh recovery from not having been used since 1974. Marsh impacts identified in the 1983 study indicated that about 21.2 acres or about 31.2% of the tract had been impacted at that time.

Tract 11-B (undiked) is also located along this reach of the AIWW. Tract 11-B (48.8 acres) has 5.15 acres of dredged material dating from initial channel construction and one maintenance dredging cycle in 1974. Undiked Tracts 13-A (162.1 acres) and 14-A (44.5 acres) are located at the confluence of the Skidaway Narrows and Burnside River. Tract 13-A contains deposits of dredged material (5 small upland islands totaling 7.24 acres) from the construction of the 12-foot project and/or early maintenance dredging. Tract 14-A appears to have never been used.

Operational Reach SAV-11-Burnside River to Hells Gate (AIWW Mile 594-600.8)
This reach of the AIWW has not required any maintenance since completion of the 12-foot channel. Tract 14-B (32.8 acres) is an undiked marsh island disposal easement that has never been used.

Operational Reach SAV-12-Hells Gate (AIWW Mile 600.8-602.4)
Maintenance dredging in this reach of the AIWW has been conducted 22 times with the last maintenance dredging occurring in 2009. Approximately 2,815,925 CY of maintenance material (mostly sand, with some silt and clay) has been removed. The dredged material has been deposited into either undiked Tract 15-A (109 acres) on the western end of Raccoon Key or undiked Tract 15-B (66.6 acres).

Tract 15-A consists of one large upland island adjacent to a freshwater wetland area surrounded by tidal marsh. Tidal wetlands make up about 88 acres of the tract while the remainder of the tract consists of the freshwater wetland (2.61 acres) and the upland island (18.39 acres). The total acreage of impacts for this site is 57.95 acres (about 53.1% of the tract). Use of this tract has resulted in additional wetland impacts since the 1983 report which showed total impacts of about 43.1 acres or 39.5% of the tract.

Tract 15-B consists of tidal marsh. The largest vegetative community present onsite is bare ground area in the tidal marsh areas. The total acreage of impacts for this site is 30.86 acres which is about 46.3% of the tract. Additional impacts have occurred to wetlands in the tract since the 1983 report which indicated about 25 acres or 37.4% had been impacted at that time.

Tracts 15-A and 15-B have been extensively used for maintenance material from Hells Gate. However, several agencies expressed concern over the damage occurring to several finger streams in Tract 15-A. In response to this concern, the Corps began to also use open water disposal on the north and south sides of Raccoon Key for material that is mostly sand.

Operational Reach SAV-13-Hells Gate to Florida Passage (AIWW River Mile 602.4-605.9)
Maintenance dredging in this section of the AIWW has only been required on one occasion (2009) when about 56,000 CY of material (mud, silt) were removed. Depending on the location of the shoaling area, the material would have been placed in either Tract 15-A or 15-B which were discussed in the preceding paragraph, or in Tract 16-A which is discussed in the following paragraph.

Operational Reach SAV-14-Florida Passage (AIWW Mile 605.9-608.5)
The Florida Passage has been dredged on five occasions since completion of the 12-foot channel, having been last dredged in 2009. Approximately 268,000 CY of dredged material (mud, silt) have been removed and placed in undiked Tract 16-A (131 acres). The site consists of two upland islands surrounded by tidal marsh. Tidal wetlands make up 126.57 acres of the site while the upland islands comprise the remaining 4.43 acres. The total acreage of impacts for this site is 17.43 acres or about 13.3% of the tract. Tract 16-A has only been used once (2009) since completion of the 1983 report. Consequently, the existing, adverse impacts to marsh are similar to those in the 1983 report which indicated about 15.4 acres or 11.7% of the tract had been impacted.

Operational Reach SAV-15-Bear River (AIWW Mile 608.5-617.5)
Maintenance dredging has been conducted in Bear River on four occasions since completion of the 12-foot project with the last being conducted in 1977. The dredged material (mud, silt) has been placed in undiked Tract 17-A. Tract 17-A (244.7 acres) consists of tidal wetlands with four impacted areas. The total acreage of impacts at this site is 7.75 acres or 3.2% of the site. This tract has only been used once (2009) since completion of the 1983 study. Since this tract was last used for the 1977 maintenance dredging cycle, overall marsh recovery has occurred in the site. The field surveys for the 1983 study indicated about 24.1 acres or 9.9% of the site had been impacted by dredged material disposal placement at that time.

Operational Reach SAV-16-St. Catherines Sound to North Newport River (AIWW Mile 617.5-620.5)
From Bear River, the AIWW crosses St. Catherines Sound to the mouth of the North Newport River. No maintenance of this reach of the AIWW has been required, and no disposal areas are located along this portion of the waterway.

Operational Reach SAV-17 North Newport River (AIWW Mile 620.5-623.9)
Maintenance dredging has only been performed in this section of the AIWW on one occasion (1964). About 67,110 CY of material was placed into Tract 805 E-2 (not shown on Figure 2B), resulting in 3.43 acres of dredged material in one mound. Track 805 E-1 (not shown on Figure 2B) was also designated for dredged material from the North Newport River but was never used for placement of dredged material. The Corps had only 10-year easements on these sites, and the right to dispose on them was terminated in 1974.

Operational Reach SAV-18 Johnson Creek (AIWW Mile 623.9-629.3)
Maintenance dredging in Johnson Creek has only been conducted on one occasion (1973) when about 141,537 CY of material was removed. Two undiked disposal areas (Tracts 19-A and 20-A) have been used for the dredged material removed from this reach of the waterway. Tract 19-A (97.8 acres) consists of two small upland islands surrounded by tidal marsh. Most of the site (97.59 acres) is comprised of tidal marsh while the remaining 0.21 acres is upland islands. The acreage of impacts for this site is 12.78 acres or about 13% of the site. The lack of use of this site is evidenced by the apparent recovery of some the marsh within the tract. Field surveys conducted for the 1983 report indicated that about 25.7 acres or about 26.2% of the tract had been impacted at that time.

Tract 20-A (71.9 acres) consists of tidal marsh. About 10.35 acres or about 14.4% of the site have been impacted by dredged material disposal. This site shows some evidence of marsh recovery as the 1983 report indicates that about 13.2 acres or 18.4% of the tract had been impacted at that time.

Tract 21-A (34.6 acres) is located just upstream of Tracts 19-A and 20-A. It appears to have never been used for disposal of dredged material.

Operational Reach SAV-19 Sapelo Sound-Front River (AIWW Mile 629.3-639)
No maintenance dredging has been required in this reach of the AIWW. There are no disposal areas in this portion of the AIWW.

Operational Reach SAV-20-Front River (AIWW Mile 639-640)
No maintenance dredging has been required in Front River. Disposal Tract 24-A (128.6 acres) shows evidence of deposition of a small amount of material from construction of the 12-foot project. Tract 24-A has probably also received some material from maintenance dredging of the upper end of Creighton Narrows which is discussed in the following paragraph.

Operational Reach SAV-21-Creighton Narrows (AIWW Mile 640-642.9)
Creighton Narrows has been dredged on 11 occasions since completion of the 12-foot project, with the last event in 1999. Approximately 1,629,509 CY of material (silt, clays) has been

removed and deposited in four undiked disposal areas located adjacent to the waterway. Disposal Tract 24-A (128.6 acres) consists of six small upland islands on the southern portion of the site surrounded by tidal marsh. The site is almost entirely tidal wetlands with the exception of the six upland islands which are 0.69 acres (total). The total acreage of impacts for this site is 14.54 acres or about 11.3% of the tract. The 1983 report indicated that about 9.5 acres or 7.4% of the tract had been impacted at that time.
Tract 25-A (104.2 acres) consists of 6 upland islands surrounded by tidal marsh. Tidal wetlands make up most of the site with the exception of 3.55 acres which are upland islands. The total acreage of impacts for this site is 32.72 acres or about 31.4% of the tract. This tract has apparently been used very little during recent maintenance dredging cycles as evidenced by the comparison to site impacts in the 1983 report which indicated that about 42.6 acres or 40.9% of the tract had been impacted.

Tract 25-C (133.8 acres) consists of five upland islands surrounded by tidal marsh. Tidal wetlands make up most of the site except for 2.38 acres of upland island. The total acreage of impacts for this site is 33.97 acres (25.4%). This tract also shows evidence of marsh recovery as the 1983 report indicates that about 55.5 acres or 41.5% of the tract was impacted at that time.

Tract 25-E (43.13 acres) consists of 3 upland islands surrounded by tidal marsh. The tidal marshes account for 40.05 acres of the site while the upland islands constitute 3.08 acres. The total acreage of impacts for this site is 31.39 acres which is about 72.8% of the site. The 1983 report showed a similar extent of impacts (31.6 acres-73.3%).

Operational Reach SAV-22-Old Teakettle Creek (AIWW Mile 642.9-648.2)
Maintenance dredging has not been required in Old Teakettle Creek. There are three undiked disposal tracts along Old Teakettle Creek which are designated to receive dredged material from this reach of the waterway. Tract 26-A (31 acres) and Tract 27-B (101.9 acres) show evidence of deposits associated with construction of the 12-foot project. Tract 26-A has 7.42 acres and Tract 27-B has 2.36 acres of dredged material, respectively. Tract 27-A (80.2 acres) appears to have never been used.

Operational Reach SAV-23-Doboy Sound (AIWW Mile 648.2-649.5)
Doboy Sound has been dredged on six occasions since completion of the 12-foot project with the last dredging event occurring in 1979. Approximately 199,312 CY of material (mud, silt) have been removed and deposited into open water on the north side of Commodore Island (Dump Area 28). Tract 28-A (155.6 acres) is located on Little Sapelo Island adjacent to the waterway. This site has never been used for the deposition of dredged material. The Sapelo Island National Estuarine Reserve is located on the western perimeter of Sapelo Island. The Center is dedicated to research, education, stewardship, and sound management of coastal resources in Georgia. The reserve is administered by the National Oceanic and Atmospheric Administration and managed by the Georgia Department of Natural Resources.

Operational Reach SAV-24-North River Crossing (AIWW Mile 649.5-651.4)
Maintenance dredging has been performed on five occasions in the North River Crossing since completion of the 12-foot project, with the last maintenance occurring in 1980. Approximately 238,596 CY of dredged material (mud) has been removed and placed in an undiked disposal area

adjacent to this reach of the waterway. Most of the maintenance material from the North River Crossing has been deposited into undiked Tract 29-B. Tract 29-B (120 acres) consists of one upland island surrounded by tidal marsh. Tidal wetlands make up about 116 acres of this site while the upland island is located on the other four acres of the tract. The total acreage of impacts on this tract is 47.83 acres (30.2% of the site). Additional impacts to wetlands have occurred since completion of the 1983 study which indicated that about 35.9 acres or 30% of the site had been impacted at that time.

Undiked Tract 29-A (158.3 acres) consists of a large tidal wetland with no upland areas present. Some dredged material (probably from construction or early maintenance dredging) has been deposited in this site. The total acreage of impacts is 11.94 acres (7.5%) . Since this site has not been used for recent dredged material disposal, it shows some signs of marsh recovery. The 1983 report indicated that about 19.2 acres or 12.1% of the tract had been impacted at that time.

Undiked Tract 29-C (92.6 acres) is located at the confluence of the North River Crossing and the Rockdedundy River. The site consists of two upland islands surrounded by tidal wetlands. The total acreage of impacts for this tract is about 46.76 acres or 50.5% of the area. There appears to be some marsh recovery within the site as evidenced by the impact shown in the 1983 report which was 53.5 acres (57.8%)

Operational Reach SAV-25- Rockdedundy River (AIWW Mile 651.4-652.7)
Maintenance of this portion of the AIWW has only been performed on four occasions since 1980 with the last dredging occurring in 1996. The material (mud) has been placed in either Tract 29-B or 30-A which are undiked. Tract 29-B was discussed in the preceding section addressing the North River Crossing.

Tract 30-A (230.1 acres) consists of one upland island surrounded by tidal marsh. The upland island is approximately 27.59 acres while the remainder of the tract is tidal marsh. The total acreage of impacts for this tract is 163.81 acres. This tract shows a substantial increase in impacts (mainly because of maintenance requirements in the South River and Little Mud River) over those reported in the 1983 report which indicated that about 88.9 acres or 38.7% of the tract had been impacted. The aerial photographs used in the 1983 study and the 2011 study indicate impacts have occurred outside of the easement.

Operational Reach SAV-26-South River (AIWW Mile 652.7-653.5)
South River has required extensive maintenance (mud, silt) as it has been dredged 22 times between 1952 and 1999. Approximately 1,362,623 CY have been removed and placed in Tract 30-A which was discussed in the preceding paragraph.

Operational Reach SAV-27-Little Mud River (AIWW Mile 653.5-656.4)
Little Mud River has also required extensive maintenance as it has been dredged 19 times between 1963 and 2001. Approximately 4,947,674 CY of material (mud, silt) has been removed and placed in undiked Tracts 30-A, 30-B, or 32-A. Tract 30-A has been discussed in previous paragraphs. Tract 30-B was used for construction and some of the early maintenance material; however the easement for this tract was terminated in 1973 when it became part of Wolf Island National Wildlife Refuge.

Tract 32-A (228.9 acres) consists of one upland island surrounded by tidal marsh. The upland island takes up about 10.03 acres of the tract with the rest being tidal marsh. The total acreage of impacts for this tract is 195.52 acres including impacts that extend beyond the boundary of the easement. Much of the impacts to wetlands have occurred during maintenance dredging cycles since the 1983 report which showed impacts to about 58.3 acres of marsh (25.5%) and no impacts outside of the easement.

Operational Reach SAV-28-Altamaha Sound (AIWW Mile 656.4-660.1)
Maintenance dredging of the Altamaha Sound portion of the AIWW has been performed on 16 occasions between 1960 and 2009. Approximately 1,724,315 CY of material (sand, silt) has been removed and placed in undiked disposal tracts 31-A, 31-B, 34-A, and 36-A. On occasion, open water disposal sites 32 (located adjacent to Tract 31-A) and 34 (adjacent to Tract 34-A) have been used.

Tracts 31-A and 31-B are located on the southern end of Wolf Island. Tract 31-A was used for two dredging cycles in 1963 and 1969. The easements for these two tracts were terminated in 1973 when they became part of Wolf Island National Wildlife Refuge.

Tract 34-A (80.9 acres) consists of two upland islands surrounded by tidal marsh. The upland islands comprise about 12.35 acres of the site while tidal marsh constitutes the remainder. The total acreage of impacts for this site is 28.77 acres (35.6%). Tract 34-A has been used very little since the 1983 report which showed impacts to 28.9 acres of the site.

Tract 36-A (260.4 acres) consists of three upland island surrounded by tidal marsh. The three upland islands comprise about 42.68 acres of the tract while the tidal wetlands comprise about 217.72 acres. The total acreage of impacts for this tract is 107.19 acres. This tract shows a substantial increase in impacts over that reported in the 1983 study which indicated that about 60.1 acres or 23.0% had been impacted at that time.

Operational Reach SAV-29-Buttermilk Sound (AIWW Mile 660.1-664.5)
Buttermilk Sound has required extensive maintenance. It has been dredged 22 times between 1952 and 2009. Approximately 4,042,151 CY of material (sand, silt) have been removed and placed into undiked tracts 42-C, 42-B, 43-A, 43-B, 44-A, and 44-B. Open water disposal areas are located adjacent to Tract 42-C, 43-A, 43-B and downstream of Tract 42-B.

Tract 42-B (65 acres) consists of an upland area adjacent to tidal marsh. The upland area is about 9.96 acres. The total acreage of impacts for this site is 42.04 acres (64.7%). This is a substantial increase in marsh impacts over that reported in the 1983 study which indicated that about 17.7 acres or 27.2% of the tract had been impacted.

Tract 42-C (14.5 acres) is made up entirely of tidal wetlands. There have been minor impacts to 1.60 acres of these wetlands. Tract 42-C was not surveyed for the 1983 report because it was not regularly used as a disposal site.

Tract 43-B (176.4 acres) consists of one upland island surrounded by tidal marsh. The site is mostly tidal wetlands with the upland island occupying 4.87 acres. The total acreage of impacts for this tract is 14.05 acres. This is a slight increase in wetland impacts over that reported in the 1983 study which indicated that about 7.5 acres or 4.2% of the tract had been impacted by dredged material disposal.

Tract 44-A (76.4 acres) consists of 6 upland islands surrounded by tidal marsh. The island occupies about 5.05 acres of the site while tidal wetlands comprise the other 71.35 acres. The acreage of impacts for this site is 22.51 acres. This tract has not been used in the recent past as indicated by the 1983 report which showed that about 22.7 acres of the tract had been impacted at that time.

Tract 43-A (138.3 acres) was used for some of the early maintenance dredging, but the easement was terminated in 1972, and it is no longer a disposal site.

Tract 45-B (167.6 acres) has not been used for maintenance, but contains a 14-acre, mature hammock-like upland island resulting from disposal of material from the initial construction of the 12-foot channel in the 1940s. Tract 45-C (59.5 acres) has never been used.

One of the open water sites, (42), was an experimental marsh development site. The Georgia Department of Natural Resources in conjunction with the US Army Corps of Engineers Waterways Experiment Station conducted research relative to marsh establishment as part of the Corps of Engineers Dredged Material Research Program.

Operational Reach SAV-30-Mackay River (River Mile 664.5-674)
This section of the AIWW has not required maintenance dredging. Six undiked disposal tracts are located along this reach of the AIWW. Tract 46-A (96.7 acres) contains a small (0.77-acre) deposit of dredged material from construction of the 12-foot project. Tract 48-B (52.1 acres) has never been used. Tract 48-A (52.1 acres) contains one upland island surrounded by tidal marsh. The tidal marsh occupies most of the track with the upland island occupying about 3.31 acres. The total acreage of impacts for this tract is 12.46 acres. Tract 48-A was not surveyed for the 1983 report because it was not heavily used as a disposal site. Tracts 49-A (69.5 acres), 49-B (103.5 acres) and 49-C (68.2 acres) appear to have never been used.

Operational Reach SAV-31-Frederica River (AIWW Mile 674-677)
No maintenance dredging has been required in the Frederica River. Track 47-A (167.3 acres) contains some dredged material deposits (6.06 acres) from initial construction of the 12-foot channel in the 1940s.

Operational Reach SAV-32-St. Simon Sound (AIWW Mile 677-680.8)
Maintenance dredging St. Simon Sound has been conducted on two occasions in 1963 and 1969. Tract 51-A (67.6 acres) is available, but it does not appear to have ever been used. The material (silts, clays) from this reach of the waterway was probably deposited in Open Water Site No. 51 located near the confluence of the Frederica River and St. Simon Sound.

Operational Reach SAV-33-Jekyll Creek (AIWW Mile 680.9-685.9)
Jekyll Creek has by far required the most maintenance of any reach of the AIWW within Savannah District. It has required maintenance dredging 20 times between 1952 and 1999. Approximately 10,842, 893 CY of material (mud, silt) has been removed during these maintenance dredging cycles. It should be noted that additional maintenance would have been performed between 1999 and 2011 had acceptable disposal options been available. Material is usually placed in three undiked disposal areas which are 52-A (115.7 acres), 52-B (95 acres) and 53-A (180.4 acres). On occasion, an overboard disposal site located in the Brunswick River adjacent to Tract 52-A has been used. Much of the material from Jekyll Creek has reentered the waterway after being discharged into Tracts 52-A, 52-B and 53-A.

Tract 52-A (115.7 acres) consists of 6 upland islands surrounded by tidal marsh. Most of the site remains a tidal marsh with the exception of 8.94 acres comprised of the upland islands. All 115.7 acres of the tract have been impacted by dredged material disposal. In addition, dredged material has spread over approximately 12 acres outside the easement boundaries. The 1983 report indicated that about 105.4 acres or 91.1% of the tract had already been impacted by that time.

Tract 52-B (95 acres) consists of tidal marsh with no uplands on site. This site has been completely impacted by the disposal of dredged material as determined by the survey for the 1983 report.

Tract 53-A (180.4 acres) consists of tidal marsh with no uplands present. The acreage of impacts for this site is 97.02 acres (53%.8%). This is in close agreement with the findings of the 1983 report which found that about 107.1 acres or 59.4% of the site had been impacted. The apparent marsh recovery in Tract 53-A indicates that it has not been used for dredged material disposal in the recent past.

Operational Reach SAV-34-Jekyll Creek to Cumberland River (AIWW Mile 685.9-692)
This section of the AIWW traverses deep water in St. Andrews Sound and has not required maintenance. There are no disposal tracts designated for use for this portion of the waterway.

Operational Reach SAV-35-Cumberland River to Cumberland Sound (AIWW Mile 692-707)
This section of the AIWW has been dredged in 1965, 1995, and 2001. Approximately 92,300 CY of material (sand, silt) has been removed during these dredging cycles. Some of the material was deposited in Tract Parcel B2-3 which is a fully diked disposal area. Tract Parcel B2-3 (now known as Tract 1700-L or Big Crab Island) was transferred to the Department of the Army Military Ocean Terminal Kings Bay in 1974 for use in maintaining that facility. It is currently owned by the US Navy and used to deposit dredged material from maintenance of channels associated with the Naval Submarine Base Kings Bay. Through an agreement with the Navy, maintenance material dredged from the AIWW in 1995 and 2001 was placed into this disposal site. In 1965, some of the dredged material from this reach of the AIWW was also discharged into open water at a site east of Tract Parcel B2-3. Four other disposal tracts used for this section of the AIWW were also transferred to the Department of the Army Military Ocean Terminal Kings Bay in 1974. Parcel No.1 (54.64 acres), Parcel No. 5 (1199.1 acres), Parcel No. 6 (139

acres), and Parcel No. 7 were also transferred to the Kings Bay facility. The Corps reserved a perpetual spoil disposal easement in Parcels 5, 6, and 7. Parcel No. 4 was also available for dredged material disposal for this reach of the AIWW. However, this disposal easement was not used since it is located on Cumberland Island National Seashore.

Operational Reach SAV-36-Cumberland River to Cumberland Sound (AIWW Mile 707-713)
This section of the AIWW required maintenance dredging on one occasion in 1965. It is currently maintained by the US Navy as part of the Naval Submarine Base Kings Bay.

Alternate Route Around St. Andrews Sound
An alternate route (7 feet deep, 75 feet wide) around St. Andrews Sound was completed in 1940. This alternate route extends from the main channel of the AIWW in Jekyll Creek through Jekyll Sound, Little Satilla River, Umbrella Cut, Umbrella Creek and its south branch, through Dover Cut to Dover Creek, thence up Dover Creek and through a narrow neck of land to Satilla River, thence through a land cut south of Todd Creek and through Floyd Creek to the main route of the waterway in Cumberland River. Almost all the shoaling problems have occurred in Umbrella Cut and Umbrella Creek with some minor shoaling in Floyd Creek. Maintenance dredging has not been performed in this alternate route in many years.

There are two disposal tracts that have been used for maintenance material from this alternate AIWW route. Tract 1 (140 acres) is located in Camden County, Georgia. It has received very little dredged material. Consequently, it is comprised entirely of tidal marsh. The total acreage of impacts for this disposal area is 9.32 acres.

Tract 3 (673.0 acres) which is also located in Camden County has received most of the dredged material from this section of the waterway. Tract 3 consists of one small upland island (0.58 acres) surrounded by tidal marsh. The total acreage of impacts for this disposal tract is 75.83 acres.

1.5 Summary of Impacts - Maintenance Dredging - AIWW Savannah District

The preceding discussion has provided information on the impacts that have occurred over the past 70-odd years associated with the construction and maintenance of the Savannah District's portion of the AIWW. Defining both the nature and extent of impacts is extremely important since this information can be used to develop a 20-year DMMP for the AIWW. The goal is to develop a DMMP that provides a plan that allows for maintenance of the waterway while avoiding or minimizing impacts to the aquatic environment. The following summarizes the above discussion:

1. The existing project (12-foot channel) was completed in the early 1940s. The Corps was provided disposal easements which were predominately located in tidal marsh adjacent to the waterway.

2. Most of the dredged material resulting from both construction of the project and subsequent maintenance of the project was deposited into these easements in an unconfined manner, i.e., no

dikes were constructed within these easements to confine the dredged material. More than likely, this was done to eliminate the costs associated with constructing large diked disposal areas along numerous reaches of the waterway. Also in view of the instability of the substrate in these marsh areas, it is highly questionable how feasible it would have been to construct diked areas in these wetlands. Diked dredged material containment areas constructed in these wetlands would have been subject to failure because of their exposure to extreme high tides and storm events.

3. Disposal of dredged material from construction of the project adversely impacted tidal marsh. Much of the material from construction of the 12-foot channel was sand which raised the elevation of the marshes to the extent that upland vegetation replaced the wetland species present in the marsh. This is evidenced by the presence of mature hammock-like upland islands in many of the disposal easements that only received dredged material from the initial channel construction in the 1940s.

4. Disposal of dredged material from maintenance dredging cycles has also adversely affected tidal marsh. As evidenced by information presented in the above discussion, areas of impacted marsh were observed in many of the disposal tracts during the field surveys for the 1983 report and the 2011 report.

5. Some of the disposal tracts have been totally impacted for many years since construction and early maintenance of the waterway. These tracts are located in heavy maintenance areas and include such sites as Tract 1-A-1 (Elba Cut-McQueens Cut), Tracts 2-A, 2-B, and 3-A (St. Augustine Creek-upper Wilmington River), and Tracts 52-A and 52-B (Jekyll Creek).

6. Maintenance of the AIWW continues to have impacts on tidal wetlands in disposal tracts that are used for those areas of the waterway requiring maintenance. Since completion of the 1983 impact study, additional marsh impacts have been observed in Tracts 5-A and 7-A (Wilmington River), 15-A and 15-B (Hells Gate), 16-A (Florida Passage), 24-A (Creighton Narrows), 29-B (North River Crossing), 32-A (Little Mud River), 36-A (Altamaha Sound) and 42-B and 42-A (Buttermilk Sound). Although some of the tracts have already been totally impacted by the deposition of AIWW maintenance material (see paragraph 5 above), continued use of these sites prevents any chance of marsh recovery.

7. For those tracts that have not been used or received very little use in the recent past, some evidence of marsh recovery has been observed. These tracts include 11-K and 11-L (Skidaway River), 12-A (Skidaway River), 17-A (Bear River), 19-A and 20-A (Johnson Creek), 25-A and 25-C (Creighton Narrows), 29-A and 29-C (North River Crossing), 30-A (Rockdedundy River), and 53-A (Jekyll Creek).

8. There are 12 disposal tracts along the AIWW that appear to have never been used including 10-C (Wilmington River), 14-A (Skidaway River), 14-B (Burnside River), 21-A (Johnson Creek), 27-A (Old Teakettle Creek), 28-A (Doboy Sound), 45-C (Buttermilk Sound), 48-B, 49-A, 49-B, 49-C (Mackay River), and 51-A (St. Simon Sound). These unused tracts total 721.7 acres.

9. Although use of undiked disposal in tidal wetlands has impacted marsh, these impacts would have been much worse had the disposal tracts been diked. If the disposal tracts provided to the Corps in the 1940s had been diked, these dikes would have been more than likely constructed to encompass the entire easement. Subsequently, wetlands within the dikes would have been cut off from tidal flow and completely destroyed with little to no chance to recover from dredged material deposition.

10. Disposal of dredged material into wetland areas has created additional wildlife habitat. The 2011 study included use of the Estuarine Wetland Rapid Assessment Procedure which evaluated wildlife utilization of upland and wetland areas on the disposal tracts. Based on the results of this analysis, most of the tracts showed minimal to moderate wildlife utilization of the uplands or wetlands on the disposal tracts.

11. Although undiked disposal has impacted wetlands, much of the remaining wetlands on the disposal tracts have retained most of their wetland functions. The Estuarine Wetland Rapid Assessment Procedure was also used to determine the potential for recovery of any lost wetland function with or without enhancement activities. For most disposal tracts, this assessment was able to conclude: "Most of the wetland areas onsite show minor adverse impacts to aquatic functions and likely would recover without enhancement activities".

1.6 Proposed Disposal Sites for Future Maintenance of the AIWW

Based on the information developed in Section 4.0 above, the discharge of dredged material into undiked tidal wetlands associated with the maintenance of the AIWW within the Savannah District has had significant adverse impacts on these wetlands. In addition to impacts to tidal wetlands, undiked disposal can adversely affect water quality in the vicinity of the discharge. While the heavy material (sand) tends to remain in the disposal area, the fine grain material (mud, silt, clay) can leave the disposal area during the disposal process resulting in an increase in turbidity and suspended solids in adjacent waterways. The fine grain material that remains in the disposal area is also subject to enter adjacent waterways due to the influence of high tides and storm events. The tendency of some of the fine grain materials to leave the disposal area has also been observed in several tracts along the AIWW where dredged material has spilled into adjacent marshes outside of the easement.

The South Carolina Department of Natural Resources (SCDNR) and the Georgia Department of Natural Resources (GADNR) have requested that the practice of discharging dredged material into undiked disposal areas in wetlands be discontinued along the AIWW. The SCDNR has also expressed general opposition to open water disposal of dredged material unless that material is being placed into an approved offshore dredged material disposal site (ODMDS) or onto a seriously eroding beach. The GADNR has stated that it would consider open water disposal of dredged material in certain areas provided that material is sand.

In view of the adverse effects associated with undiked disposal of dredged material along the AIWW and the requests of the SCDNR and GADNR, the Corps is preparing a new 20-year DMMP for the AIWW. The main objective of the is 20-year DMMP is to identify alternative disposal methods for those sections of the AIWW that will require maintenance over the next 20 years that will meet the dredged material disposal requirements of the project while minimizing impacts to the aquatic environment and addressing the requests of the State resource agencies.

In view of the adverse effects of undiked disposal into tidal marshes and the comments and concerns of the GADNR and SCDNR, the following conclusions can be reached relative to the consideration of disposal alternatives for Savannah District's portion of the AIWW:

1. For the long term, continued discharge of dredged material into undiked tidal wetlands is not a viable alternative in either state.

2. The SCDNR does not usually approve open water disposal of dredged material. If the material is suitable for beach nourishment, the SCDNR will consider approving the material to be placed on a severely eroding beach.

3. The GADNR would prefer that open water disposal of dredged material be discontinued. However, they have indicated that they would consider this alternative if the material is clean sand (at least 80% sand).

4. The construction of high ground diked disposal areas in the vicinity of some of the high shoaling areas would be a preferred method of disposal versus the existing practice of undiked disposal into wetlands. However, an evaluation of potential high ground disposal sites along Savannah District's portion of the AIWW indicates several logistical problems in many reaches of the AIWW that would be associated with the construction of such areas. First, much of the high ground along the ocean side of the waterway is located on property that is in a protected status, ie., Wassaw Island, Ossabaw Island, Blackbeard Island, St. Catherine's Island, Sapelo Island,etc. Much of the land on the mainland side of the waterway has been or is being developed or is too far from the waterway to serve as a feasible disposal area.

5. Disposal of some of the material from the AIWW into an approved or new ODMDS is a viable alternative. However, this potential disposal alternative presents problems relative to both logistics and costs. All of the District's that maintain the AIWW from Norfolk to Jacksonville have approved ODMDSs. However, these disposal sites are used to maintain entrance channels to various other deep draft navigation projects, and none of them are designated to receive dredged material from maintenance of the AIWW. Problems encountered in considering the ODMDSs for maintenance of the AIWW include access for hopper dredges to the shallow channel of the AIWW, and moving large amounts of silty material from portions of the AIWW channel to the ODMDS.

With the above stipulations taken into consideration, the following disposal alternatives were developed for the 35 reaches of the AIWW within Savannah District that may require maintenance dredging to provide a 20-year DMMP.

Disposal options under consideration for the 20-year DMMP for the AIWW include:

1. Use of existing diked disposal areas where available. Implementation of this alternative where possible eliminates the need to discharge dredged material into undiked disposal tracts

along various reaches of the waterway. The DMMP utilizes existing diked disposal areas to the maximum extent practicable.

2. Beneficial use of suitable material (beach nourishment) . Suitable material for beach nourishment was identified in two reaches in the South Carolina portion of the waterway. This material could be placed on the beaches on either Hilton Head Island or Daufuskie Island. However, the State of South Carolina normally only approves beach nourishment projects for severely eroding beaches. Various environmental documents (EA, etc.) would have to be prepared and environmental clearances would have to be obtained. Considering the small amount of material that would be available for beach nourishment, this option is probably not economically practicable when considering placement costs and the costs to obtain required environmental clearances. However, the State of South Carolina will be notified of any future maintenance in Ramshorn Creek or Walls Cut to determine if there is an interest in using the material for shore protection.

3. Construction of new, high ground, diked diposal areas. Implementation of this alternative would reduce the use of the undiked disposal areas located in tidal marsh along the AIWW. Several potential sites were located where diked disposal areas could be constructed. However, when the total costs (land acquisition, site preparation and dike construction, site maintenance, environmental clearances, mitigation etc.) were considered along with potential impacts to wildlife habitat, this alternative was eliminated.

4. Construction of diked disposal areas within the existing disposal easements. Implementation of this alternative would reduce the disposal of dredged material into undiked disposal areas in tidal marsh. However, this alternative would have significant adverse impacts on tidal marsh. Many of the disposal tracts have large expanses of functioning tidal marsh. Large amounts of functioning marsh would be enclosed within the dikes since most of the easement would require diking to provide sufficient capacity for the dredged material. Based on observations of the impacts of undiked disposal on tidal marsh, implementation of this alternative would have even greater adverse impacts on the aquatic ecosystem. After considering the adverse impacts to tidal marsh and the associated mitigation costs, this alternative was eliminated from consideration.

5. Ocean dumping of dredged material into the existing ODMDS sites for the Savannah Harbor and Brunswick Harbor projects as well as the establishment of two new dredged material ocean disposal sites off Sapelo Sound and Altamaha Sound. The dredged material would be placed onto barges by bucket dredge. The material would be unloaded onto an ocean-going dump scow which would take it to the designated ODMDS. Although this “triple handling” of the dredged material greatly increases costs when compared to other dredging and disposal methods, it also eliminates other costs such as dike construction and maintenance, wetland mitigation, etc. This disposal method also totally removes the dredged material from both the channel and the aquatic ecosystem. There are several shallow draft hopper dredges which could possibly be used in lieu of the bucket dredge. If available and practical to use within the Savannah District’s portion of the AIWW, this type of dredged would allow the material to be taken directly to the ODMDS in lieu of having to use the barges and dump scows.

6. Use of existing open water disposal sites within the State of Georgia. The Georgia Department of Natural Resources has indicated they would consider continued use of some of the existing open water disposal sites provided the material is at least 80% sand. Three reaches (Hells Gate, Altamaha Sound and Buttermilk Sound) were identified where at least some of the maintenance material would meet that criterion. However, some of the material in those reaches would not meet the 80% requirement. Consequently, the suitable material to be removed from three reaches would be placed in existing open water disposal sites. Material not meeting this criterion would be placed on existing dredged material deposits within the current disposal easements for that reach of the waterway. Some of the material would be used to fill geo-tubes (or some other similar technology) which in turn would serve as the containment dikes to keep the material confined to existing deposits within the disposal area.

Table 1 below shows future anticipated dredging requirements as well as the preferred disposal alternatives for each reach.

Table 1: Alternatives Considered by Reach

Dredging Reach Name	Operational Name	20-yr Capacity Required	Alternative 1 (Proposed Action)	Alternative 2	Alternative 3	Alternative 4
Port Royal to Ramshorn Creek	SAV-1	0	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B
Ramshorn Creek, SC	SAV-2	72,900	Sav Harbor DMCA14-B	Beach Placement	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B
New River	SAV-3	0	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B
Walls Cut	SAV-4	34,800	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B
Fields Cut, SC	SAV-5	348,000	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B
Elba/McQueens Cut	SAV-6	298,350	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B
St. Augustine Creek	SAV-7	1,785,000	Sav Harbor DMCA14-B	Sav Harbor DMCA14-B	DMCA 3-A and 9-A[1]	Sav Harbor DMCA14-B
Wilmington River	SAV-8	345,000	Sav Harbor DMCA 14-B	Sav Harbor DMCA 14-B	DMCA 3-A and DMCA in Tract 9-A[1]	Partially diked Tract 3-A and DMCA in Tract 9-A[1]
Skidaway River	SAV-9	0	DMCA in Tract 9-A	DMCA in Tract 9-A	DMCA in Tract 9-A	DMCA in Tract 9-A
Skidaway Narrows	SAV-10	0	DMCA in Tract 9-A	DMCA in Tract 9-A	DMCA in Tract 9-A	DMCA in Tract 9-A
Burnside River to Hells Gate	SAV-11	0	DMCA in Tract 9-A	DMCA in Tract 9-A	DMCA in Tract 9-A	DMCA in Tract 9-A
Hells Gate	SAV-12	1,540,050	Open Water (coarse); confined Tracts 15-A and 15-B (fines)	Open Water (coarse); confined Tracts 15-A and 15-B (fines)	Savannah ODMDS	Open water (coarse); Undiked Tract 15-A (silt)
Hells Gate to Florida Passage	SAV-13	0	Savannah ODMDS	New 100-acre Upland DMCA	Dike Tract 16-A (New DMCA)	Undiked Tracts 15-A and 16-A[1]
Florida Passage	SAV-14	95,400	New ODMDS @ Sapelo Sound	New 100-acre Upland DMCA	Dike Tract 16-A (New DMCA)	Undiked Tract 16-A
Bear River	SAV-15	79,050	New ODMDS @ Sapelo Sound	New 100-acre Upland DMCA	Dike 17-A (New DMCA)	Undiked Tract 17-A
St. Catherines Sound - North Newport River	SAV-16	0	New ODMDS @ Sapelo Sound	New ODMDS @ Sapelo Sound	Dike Tract 19-A if Needed (New DMCA)	Undiked Tract 19-A
North Newport River	SAV-17	0	New ODMDS @ Sapelo Sound	New ODMDS @ Sapelo Sound	Dike Tract 19-A if Needed (New DMCA)	Undiked Tract 19-A
Johnson Creek	SAV-18	0	New ODMDS @ Sapelo Sound	New ODMDS @ Sapelo Sound	Dike Tract 19-A if Needed (New DMCA)	Undiked Tract 19-A
Sapelo Sound - Front River	SAV-19	0	New ODMDS @ Sapelo Sound	New 350-acre Upland DMCA	New DMCAs on 24-A	Undiked Tract 24-A
Front River	SAV-20	0	New ODMDS @ Sapelo Sound	New 350-acre Upland DMCA	New DMCAs on 24-A	Undiked Tract 24-A
Creighton Narrows	SAV-21	1,361,250	New ODMDS @ Sapelo Sound	New 350-acre Upland DMCA	New DMCAs on 24-A, 25-C, 25-E[2]	Undiked Tract 24-A, 25-C, and 25-E[2]
Old Teakettle Creek	SAV-22	0	New ODMDS @ Sapelo Sound	New 350-acre Upland DMCA	New DMCAs on 25-E	Undiked Tract 25-E
Doboy Sound	SAV-23	0	New ODMDS @ Altamaha Sound	New 350-acre Upland DMCA	New ODMDS @ Altamaha Sound	Open Water North Side Commodore Island
North River	SAV-24	480,000	New ODMDS @ Altamaha Sound	Brunswick ODMDS	New ODMDS @ Altamaha Sound	Undiked Tract 29-B and 30-A
Rockedundy River	SAV-25	351,000	New ODMDS @ Altamaha Sound	Brunswick ODMDS	New ODMDS @ Altamaha Sound	Undiked Tract 29-B and 30-A
South River	SAV-26	870,000	New ODMDS @ Altamaha Sound	Brunswick ODMDS	New DMCA on Tract 30-A	Undiked Tract 30-A
Little Mud River	SAV-27	3,907,500	New ODMDS @ Altamaha Sound	Brunswick ODMDS	Dike Tract 32-A (New DMCA)	Undiked Tract 32-A
Altamaha Sound	SAV-28	1,080,000	New ODMDS @ Altamaha Sound	Open Water Sites 32 and 34 (coarse); confined Tracts 34-A and 36-A (fines)	Open Water Sites 32 and 34 (coarse); confined Tracts 34-A and 36-A (fines)	Open water (coarse); Undiked Tracts 34-A and 36-A (silt)
Buttermilk Sound	SAV-29	2,170,050	Open Water Sites 43and 44 (coarse); confined Tracts 42-B	Open Water Sites 43and 44 (coarse); confined Tracts 42-B	New ODMDS @ Altamaha Sound	Open water (coarse); Undiked Tract 42-B (silt)
Mackay River	SAV-30	0	Andrews Island DMCA	Andrews Island DMCA	Andrews Island DMCA	Undiked Tracts 46-A and 48-A[1]
Frederica River	SAV-31	0	Andrews Island DMCA	Andrews Island DMCA	Andrews Island DMCA	Undiked Tract 48-A
St. Simons Sound	SAV-32	0	Andrews Island DMCA	Andrews Island DMCA	Andrews Island DMCA	Andrews Island DMCA
Jekyll Creek	SAV-33	9,230,000	Brunswick ODMDS	Brunswick ODMDS	Dike Tract 52-A[3]	Undiked Tract 52-A[3]
Jekyll Creek to Cumberland River	SAV-34	0	Brunswick ODMDS	Brunswick ODMDS	Dike Tract 52-A[3]	Diked Disposal in tract 1700L (Crab Island)
Cumberland River to Cumberland Sound	SAV-35	77,550	Diked Disposal in tract 1700L (Crab Island)	Diked Disposal in tract 1700L (Crab Island)	Diked Disposal in tract 1700L (Crab Island)	Diked Disposal in tract 1700L (Crab Island)
Cumberland River to Cumberland Sound	SAV-36	0	Diked Disposal in tract 1700L (Crab Island) Maintained by U.S. Navy	Diked Disposal in tract 1700L (Crab Island) Maintained by U.S. Navy	Diked Disposal in tract 1700L (Crab Island) Maintained by U.S. Navy	Diked Disposal in tract 1700L (Crab Island) Maintained by U.S. Navy

[1]Placement would be in the tract closest to the portion of the reach being dredged.
[2]All three tracts would be needed to handle the anticipated volumes to be dredged from Creighton Narrows (SAV-21).
[3]Tract 52-A does not provide adequate volume and would be used only on a temporary basis while a long term solution is investigated for Jekyll Creek (SAV-33).

1.7 Proposed Disposal Methods by Reach

Based on the preceding discussion of alternatives, the following disposal alternatives are proposed for the future maintenance requirements of the AIWW within Savannah District. The alternative discussion includes information on the amount of material that would have to be dredged and the type of material that is removed. Due to the bulking factor involved with dredged material, the amount of storage capacity required is generally one a-and-a-half to two times the amount of the material that is removed during maintenance dredging.

Operational Reach SAV-1 Port Royal to Ramshorn Creek (mile 552-568.5)
No previous maintenance dredging has been required in this reach of the AIWW, and no maintenance is anticipated to be required during the 20-year life of the DMMP. If maintenance is required in this reach of the waterway, the material would be placed in existing DMCA 14-B.

Operational Reach SAV-2 Ramshorn Creek (mile 568.5-569.9)
Approximately 49,000 cubic yards of material (sand) would be removed during the 20-year life of the DMMP. This reach of the water way is projected to require 66,000 CY of storage capacity.
The preferred method for disposal of dredged material from this reach of the AIWW is to use existing DMCA 14-B which is designated to receive material from Savannah Harbor and the AIWW. Although the costs of adding sufficient booster pumps to move the material approximately seven miles or taking the material to DMCA 14-B by barge would be great, it would be cheaper than building a diked disposal area in SC Tract 3 (especially considering the wetland mitigation costs for impacts in SC Tract 3).

Operational Reach SAV-3-New River (AIWW Mile 569.9-572.2)
Maintenance dredging has not been required in this reach of the AIWW. If the need arises to conduct maintenance dredging in New River, the material could be deposited into existing DMCA 14-B which is designated to receive dredged material from Savannah Harbor and the AIWW.

Operational Reach SAV-4-Walls Cut (AIWW Mile 572.2-572.6)
It is estimated that Walls Cut will have to be dredged once (23,000 CY of sand) during the 20-year life of the DMMP which would require 35,000 CY of storage capacity. SC Tract 2 is designated to receive dredged material form Walls Cut, however, this disposal tract has not been used in many years. SC Tract 2 is located on Turtle Island which is a South Carolina Department of Natural Resources Wildlife Management Area.

Maintenance was last performed in 2001, and the material was last placed in existing DMCA 14-B. This is the preferred method of dredged material disposal for this reach of the AIWW for future maintenance.

Operational Reach SAV-5-Fields Cut-AIWW Mile 572.6-575.3)
It is estimated that approximately 298,000 CY of storage capacity would be required during the 20-year life of the DMMP to handle the estimated 232,000 cubic yards of maintenance material (fine silt).

Tract 1 was designated to receive dredged material from this reach of the AIWW. Approximately 172 acres of Tract 1 were included within the dikes of DMCA 14-B. Future maintenance material would be placed in DMCA 14-B. No further dredged material would be placed into the remainder of SC Tract 1 which is diked on the front side (Fields Cut).

Operational Reach SAV-6-Elba Cut-McQueens Cut (AIWW Mile 575.3-577.4)
Estimates indicate that about 299,000 CY of storage capacity would be required to handle the 199,000 cubic yards of maintenance material (fine silt) for the 20-year life of the DMMP. Most of the material removed from this section of the AIWW has been placed into Tract 1-A-1. Future maintenance material would be placed into DMCA 14-B which is designated to receive dredged material from Savannah Harbor and the AIWW.

Operational Reach SAV-7-St.Augustine Creek (AIWW Mile 577.4-578.2)
It is estimated that about 1,190,000 cubic yards of dredged material (mud and silt) would be removed during the 20-year life of the DMMP. Approximately 1,785,000 CY of storage capacity would be required to handle this material. In the past, maintenance material from this reach of the AIWW has been placed in either Tract 2-A or Tracts 2-B/3-A. All future maintenance material would be placed in DMCA14-B.

Operational Reach SAV-8-Wilmington River (AIWW Mile 578.2-585.0)
Approximately 345,000 CY of storage capacity would be needed to meet the requirements since about 230,000 cubic yards of material (mud and silt) would be removed during the 20-year life of the DMMP.

Some sections of the Wilmington River (especially the upper portion) have high maintenance requirements. Consequently, substantial amounts of maintenance material have been placed into Tracts 2-A, 2-B/3-A, 5-A, 7-A, and 9-A. Disposal of dredged material into undiked Tracts 2-A, 5-A, 7-A and the undiked portion of Tract 9-A would be discontinued. Tracts 2-B/3A were fully diked to form one 155.4-acre disposal area. However, no maintenance dredging has been conducted in the Wilmington River since 1989, and the dike has apparently gone into disrepair.

Tracts 2-B and 3-A have been totally impacted by dredged material disposal as evidenced by field studies conducted in 1983 and 2011. Tidal wetlands in these two tracts have also been degraded by being diked which removed them from tidal influence. Tidal wetlands (about 96 acres) are still evident in these areas, and a 29-acre freshwater wetland has formed in Tract 3-A. Consequently, restoring the dike around Tracts 2-B/3-A will result in impacts to these wetlands. Costs of restoring and maintaining the dikes around Tracts 2-B and 3-A and mitigating for loss of tidal wetlands within the dikes make this option more expensive than sending the material from the northern portion of this reach to DMCA 14-B. Consequently, the preferred plan for this reach is to use DMCA 14-B.
In addition to DMCA 14-B which can be used for maintenance of the upper Wilmington River, some disposal capacity will be required for the anticipated shoaling in the lower Wilmington River. The preferred disposal option for the lower section of the Wilmington River is to use the diked containment area in Tract 9-A. A small (26-acre) diked area has already been constructed in Tract 9-A. It is used by a local vessel repair business to maintain depths at their facilities. As a requirement for their use of the disposal area, this business must maintain 130,000 CY of capacity within the diked disposal area for use by the Government, if required.

Operational Reach SAV-9 Skidaway River (AIWW Mile 585.0-591.0)
This reach of the AIWW within Savannah District has not required maintenance. If any future maintenance dredging is required, the material could be placed into the diked area in Tract 9-A previously discussed.

Operational Reach SAV-10-Skidaway Narrows (Mile 591.0-594.0)
No maintenance dredging has been required for this reach of the AIWW. If any future maintenance dredging is required, the material could be placed into the diked area in Tract 9-A previously discussed.

Operational Reach SAV-11-Burnside River to Hells Gate (AIWW Mile 594.0 to 600.8)
This reach of the AIWW has not required maintenance dredging. If any future maintenance dredging is required, the material could be placed into the diked area in Tract 9-A previously discussed.

Operational Reach SAV-12 Hells Gate (AIWW Mile 600.8 to 602.4)

Hells Gate is a major shoaling area, and it is estimated that 1,540,000 CY of storage capacity will be required for the 20-year life of the DMMP to provide sufficient capacity for the estimated maintenance dredging quantity (1,027,000 cubic yards). Hells Gate was last dredged in 2009. The material removed from Hells Gate has been discharged into undiked tracts 15-A and 15-B while some of the material was discharged into open water disposal sites on the north and south sides of Raccoon Key. Both tracts 15-A and 15-B showed additional marsh impacts during the field surveys for the 2011 study versus those observed in the 1983 study. The need for open water disposal on the north and south sides of Raccoon Key was previously identified based on damage to finger streams that was occurring in Tract 15-A.

Dredged material from this reach of the AIWW can vary from silt and clay to sand. For future maintenance dredging, some of the material (sand) could be discharged into the open water sites on the north and south sides of Raccoon Key as has been the practice. However, the river bottoms and the estuarine water column are essential fish habitat that must be considered in evaluating the impacts of open water disposal. Sediment sampling and grain size analysis would be required before each dredging cycle to ascertain how much of the material would be suitable for open water disposal. The State of Georgia has indicated that the material would have to be at least 80% sand before they would consider it suitable for open water disposal.

Disposal of the material unsuitable for open water disposal would involve confining it on the existing deposits within Tracts 15-A and 15-B. Instead of constructing traditional earthen dikes within the disposal area, the material would be placed in geo-tubes (or other similar technology) which would serve as the confining structure. This would reduce the amount of additional marsh that would be impacted by the construction of traditional dikes in the disposal tracts.

If the use of geo-tubes proves infeasible, the unsuitable material would be placed in the existing ODMDS for Savannah Harbor provided the material was determined to be suitable for ocean disposal per the stipulations of the Section 103 Guidelines.

Operational Reach SAV-13-Hells Gate to Florida Passage (AIWW Mile 602.4-605.9)
No maintenance of this reach of the AIWW has been required. If maintenance is required over the 20-year life of the DMMP, the material would be placed in the Savannah Harbor ODMDS or disposed of in accordance with the procedures prescribed for the Florida passage described below.

Operational Reach-14-Florida Passage (AIWW Mile 605.9 to 608.5)

It is estimated that approximately 95,400 CY of storage requirement would be required for this reach of the waterway for the 20-year life of the DMMP. Approximately 63,600 cubic yards of material (mud and silt) would be removed during this time.

This reach of the waterway was last dredged in 2009, and the material was discharged into undiked disposal Tract 16-A. This is the only time this tract has been used since the 1983 report. Consequently the amount of the tract that was observed during the field studies for the 2011 report to have been impacted by dredged material disposal (13.3%) is very similar to that observed (11.7%) during the field work for the 1983 study.

The preferred disposal alternative is to place the material into a new ODMDS located offshore of Sapelo Sound. The establishment of a new ODMDS at this location would require site designation studies per the requirements of Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA) and site designation approval by the US Environmental Protection Agency (USEPA).

Operational Reach SAV-15- Bear River (AIWW Mile 608.5-617.5)

The 20-year storage requirement for this reach of the AIWW is 79,000 CY (dredging requirements-about 53,000 cubic yards of mud and silt). Past maintenance dredging and disposal involves placing the material into undiked Tract 17-A. Tract 17-A has been used only once since completion of the 1983 study, and the field work for the 2011 study suggests marsh recovery has occurred in this tract. The 2011 study indicates that about 8 acres of this 244-acre tract have been impacted by dredged material disposal compared to 24 acres observed in the 1983 study.

Material removed from Bear River would be handled in the same manner as that discussed for the Florida Passage above, i.e., placed into the ODMDS to be established off Sapelo Sound.

Operational Reach SAV-16-St. Catherines Sound (AIWW Mile 617.5-620.5)
Maintenance dredging has not been required for this reach of the AIWW. If maintenance is required in this reach during the 20-year life of the DMMP, the material would be placed in the new ODMDS off Sapelo Sound.

Operational Reach SAV-17-North Newport River (AIWW Mile 620.5-623.9)
Maintenance dredging has not been required in the North Newport River. If maintenance dredging is required in this reach of the AIWW in the future, the material would be placed in the new ODMDS off Sapelo Sound.

Operational Reach SAV-18-Johnson Creek (Mile 623.9-629.3)

In the past, dredged material from Johnson Creek has been deposited into either Tract 19-A (97.8 acres) or Tract 20-A (71.9 acres). This reach of the AIWW has not required maintenance dredging since 1973. Consequently, the field surveys for the 2011 report indicate that some marsh recovery is occurring in these tracts.

Although maintenance dredging has not been required in Johnson Creek since 1973, it is estimated that about 106,500 CY of dredged material disposal capacity could be needed for the 20-year life of the DMMP to handle the 71,000 cubic yards of mud and silt that would be removed. The preferred alternative is to place the material from Johnson Creek in the new ODMDS off Sapelo Sound.

Operational Reach SAV-19-Sapelo Sound-Front River (AIWW Mile 629.3-639)
This reach of the AIWW has not required maintenance dredging. If maintenance dredging is required in the future, the material would be placed in the new ODMDS that would be established off Sapelo Sound.

Operational Reach SAV-20-Front River (AIWW Mile 639-640)
This reach of the AIWW has not required maintenance dredging. If maintenance dredging is required in the future, the material would be placed into the new ODMDS off Sapelo Sound.

Operational Reach SAV-21-Creighton Narrows (AIWW Mile 640-642.9)
This reach of the AIWW has not been dredged since 1999, however, it is anticipated that the 20-year storage capacity to meet project needs is about 1,361,000 CY. About 908,000 cubic yards of material (silts and clays) would be removed during the 20-year life of the DMMP. Four disposal tracts have been used to deposit dredged material. These disposal tracts are Tract 24-A (128.6 acres), Tract 25-A (104.2 acres), Tract 25-C (133.8 acres), and Tract 25-E (43.13 acres). The preferred disposal alternative is to place the maintenance material from this reach of the waterway into the new ODMDS off Sapelo Sound.

Operational Reach SAV-22- Old Teakettle Creek (AIWW Mile 642.9-648.2)
This reach of the AIWW has not required maintenance dredging. If maintenance dredging is required, the material would be disposed of at the new ODMDS off Sapelo Sound.

Operational Reach SAV-23- Doboy Sound (AIWW Mile 648.2-649.5)
This reach of the AIWW has not been dredged since 1978. When it has been dredged, the material has placed into an open water disposal area adjacent to Commodore Island. Although the material has some sand, it also contains silts and clays. If maintenance is required in Doboy Sound in the future, the material would be placed into a new ODMDS off Altamaha Sound.

Operational Reach SAV-24-North River Crossing (AIWW Mile 649.5-651.4)
Maintenance dredging has not been conducted in the North River Crossing since 1980. In the past, material has been deposited into undiked tracts 29-A, 29-B, and 29-C. For purposes of the DMMP, it is estimated that about 480,000 CY of storage capacity will be required to handle about 320,000 cubic yards of material (mud). If future maintenance is required, the material would be deposited into the new ODMDS off Altamaha Sound.

Operational Reach SAV-25-Rockdedundy River (AIWW Mile 651.4-652.7)

Maintenance dredging was last performed in the Rockdedundy River in 1996. Material dredged from this portion of the AIWW has been placed in either undiked Tracts 29-B or 30-A. It is estimated that approximately 351,000 CY of storage would be required for the 20-year life of the DMMP to handle about 2,340,000 cubic yards of dredged material (mud). Future maintenance material from this portion of the AIWW would be deposited into the new ODMDS off Altamaha Sound.

Operational Reach SAV-26-South River (AIWW Mile 652.7-653.5)
This reach of the AIWW was last dredged in 1999. The material has normally been placed in undiked Tracts 29-C or 30-A. Approximately 870,000 CY of storage capacity would be needed to meet the requirements of the DMMP. Future maintenance material (about 580,000 cubic yards of mud and silt) from the South River would be placed into the new ODMDS off Altamaha Sound.

Operational Reach SAV-27-Little Mud River (AIWW Mile 653.5-656.4)
Little Mud River has required extensive maintenance having been dredged 19 times between 1963 and 2001. It is estimated that about 3,908,000 CY of storage capacity would be required for the 20-year life of the DMMP to handle about 2,605,000 cubic yards of mud and silt. In the past, material has been discharged Tracts 30-A, 30-B, or 32-A. The preferred alternative is to place future maintenance material from Little Mud River into the new ODMDS off Altamaha Sound.

Operational Reach SAV-28-Altamaha Sound (**AIWW Mile 656.4-660.1)**
This reach of the AIWW was last dredged in 2009. It is estimated that about 1,080,000 CY of dredged material storage capacity would be required to meet the requirements of the 20-year DMMP. The maintenance material to be removed (about 720,000 cubic yards) varies from silt to sand. In the past, dredged material has been placed into Tracts 34-A and 36-A. Open water sites 32 and 34 have also been used to dispose of the course grained sediments. The preferred alternative is to place future maintenance material from this reach into the new ODMDS off Altamaha Sound.

Operational Reach SAV-29-Buttermilk Sound (AIWW Mile 660.1-664.5)
Buttermilk Sound has been dredged 22 times between 1952 and 2009. The dredged material has been placed into undiked tracts 42-C, 42-B, 43-A, 43-B, 44-A and 44-B as well as open water disposal sites located adjacent to Tracts 42-C, 43-A, 43-B and downstream of Tract 42-B. It is estimated that about 2,171,000 CY of storage capacity will be needed to satisfy the requirements of the 20-year DMMP. The maintenance material (about 1,447,000 cubic yards) to be removed varies from silt to sand.

The DMMP provides for the continued use of the open water sites for coarse grain material. The material that is unsuitable for open water disposal would be placed in geo-tubes to provide a contained disposal area in tract 42-B. The intent is to confine the newly placed dredged material to the portions of this tract already impacted by disposal activities in the past. If this method of disposal proves infeasible, the material would be placed into the new ODMDS off of Altamaha Sound.

Operational Reach SAV-30-Mackay River (AIWW Mile 664.5-674.0)
This reach of the AIWW has not required maintenance dredging. If dredging is required in Mackay River, the material would be placed into the diked disposal area (Andrews Island) designated for the maintenance of Brunswick Harbor.

Operational Reach SAV-31-Frederica River (AIWW Mile 674-677)
No maintenance dredging has been required for this reach of the AIWW. If maintenance is necessary, the material would be placed into the existing diked Andrews Island disposal area.

Operational Reach SAV-32-St. Simon Sound (AIWW Mile 677-680.9).
Maintenance dredging St. Simon Sound has been conducted on two occasions in 1963 and 1969, and no future maintenance dredging in St. Simon Sound is anticipated to be necessary. However, should maintenance dredging be required in St. Simon Sound, the material would be placed into the existing Andrews Island disposal area.

Operational Reach SAV-33-Jekyll Creek (AIWW Mile 680.9-685.9)
It is estimated that approximately 9,230,000 CY of dredged material storage capacity would be required to maintain Jekyll Creek for the 20-year life of the DMMP. The maintenance material to be removed (about 4,615,000 cubic yards) is predominantly silts and clays.

In the past, most of the dredged material from Jekyll Creek has been discharged into undiked Tracts 52-A (115.7 acres) and 52-B (95 acres) which have been completely impacted by this activity although most of these tracts remain tidal wetlands. Tract 53-A (180.4 acres) has also been used. In addition to impacts to marsh within the disposal tracts, past dredged material disposal into Tracts 52-A and 52-B has been characterized by material running through the disposal areas and back into Jekyll Creek.

A thorough alternatives analysis was conducted for this reach of the AIWW in regards to the construction of a diked disposal area within Tracts 52-A and 52-B. There have been dike stability problems with past attempts to partially dike these sites. There has also been opposition expressed to constructing diked disposal areas in Tracts 52-A and 52-B based on aesthetic impacts to the viewshed of the nearby Jekyll Island National Historic District. There is insufficient high ground in the vicinity of Jekyll Creek to construct an upland diked disposal area large enough to handle the anticipated 20-year volume of material in this reach.

Based on these previous studies, the preferred alternative is to deposit dredged material from Jekyll Creek into the existing ODMDS for the Brunswick Harbor Navigation Project.

Operational Reach SAV-34-Jekyll Creek to Cumberland River (AIWW Mile 685.9-692)
This section of the AIWW has not required maintenance dredging, and there are no designated disposal areas for this reach. Should this reach require dredging in the future, the material would be placed into the existing ODMDS for the Brunswick Navigation project.

Operational Reach SAV-35-Cumberland River to Cumberland Sound (AIWW Mile 692-707)
This reach of the AIWW was dredged in 1965, 1995, and 2001. The Corps has an agreement with the US Navy to use their diked disposal area (Tract 1700-L or Crab Island) for any future maintenance requirements for this reach of the AIWW.

Operational Reach SAV- 36-Cumberland River to Cumberland Sound (AIWW Mile 707-713)
This reach of the AIWW is maintained by the US Navy as part of the channel for the Naval Submarine Base Kings Bay.

Alternate Route Around St. Andrews Sound. Maintenance of the alternate route around St. Andrews Sound is not included in the DMMP.

1.7 Summary of Proposed Disposal Methods

The proposed project, including the amount and characteristics of the dredged material to be removed from the various reaches of the AIWW within Savannah District during the 20-year life of the DMMP have been described in preceding paragraphs. In the past, much of the maintenance material from the AIWW has been placed in undiked disposal areas located adjacent to the waterway. Many of these disposal areas are located in tidal wetlands. Disposal of dredged material into these undiked disposal sites within the tidal wetlands is no longer a viable disposal alternative for maintenance of the AIWW. Consequently, this disposal alternative will not be addressed in this BATES.

In summary, the following three disposal alternatives are proposed in the DMMP for the portion of the AIWW within the Savannah District:

1. Use of existing diked disposal areas where available.

This method of disposal is proposed for the following reaches of the AIWW within Savannah District:
Reach SAV-1 Port Royal to Ramshorn Creek (DMCA 14-B)
Reach SAV-2 Ramshorn Creek (DMCA 14-B)
Reach SAV-3 New River (DMCA 14-B)
Reach SAV-4 Walls Cut (DMCA 14-B)
Reach SAV-5 Fields Cut (DMCA 14-B)
Reach SAV-6 Elba/McQueens Cut (DMCA 14-B)
Reach SAV-7 St. Augustine Creek (DMCA 14-B)
Reach SAV-8 Wilmington River (DMCA 14-B and diked area within Tract 9-A)
Reach SAV-9 Skidaway River (Diked areas within Tract 9-A)
Reach SAV-10 Skidaway Narrows (Diked areas within Tract 9-A)
Reach SAV-11 Burnside River to Hells Gate (Diked areas within Tract 9-A)
Reach SAV-30 Mackay River (Andrews Island DMCA)
Reach SAV-31 Frederica River (Andrews Island DMCA)
Reach SAV-32 St. Simons Sound (Andrews Island DMCA)
Reach SAV-35 Cumberland River to Cumberland Sound (Kings Bay Crab Island Disposal Area)

2. Ocean disposal of dredged material.

Much of the maintenance material that would be dredged from the AIWW in the future would be placed into USEPA approved ODMDSs. Ocean disposal would involve use of two existing ODMDSs (Savannah Harbor and Brunswick Harbor) and the establishment of two new ODMDSs off Sapelo Sound and Altamaha Sound. Establishment of the two new ODMDSs and use of the existing ODMDSs for the Savannah Harbor and Brunswick Harbor Projects for material from the AIWW would require site designation studies and USEPA approval per the requirements of Section 103 of the Marine Protection, Research and Sanctuaries Act. Ocean disposal of dredged material is proposed for the following reaches of the AIWW:

Reach SAV-13 Hells Gate to Florida Passage (Savannah Harbor ODMDS)
Reach SAV-14 Florida Passage (ODMDS Sapelo Sound)
Reach SAV-15 Bear River (ODMDS Sapelo Sound)
Reach SAV-16 St. Catherines Sound to North Newport River (ODMDS Sapelo Sound)
Reach SAV-17 North Newport River (ODMDS Sapelo Sound)
Reach SAV-18 Johnson Creek (ODMDS Sapelo Sound)
Reach SAV-19 Sapelo Sound to Front River (ODMDS Sapelo Sound)
Reach SAV-20 Front River (ODMDS Sapelo Sound)
Reach SAV-21 Creighton Narrows (ODMDS Sapelo Sound)
Reach SAV-22 Old Teakettle Creek (ODMDS Sapelo Sound)
Reach SAV-23 Doboy Sound (ODMDS Altamaha Sound)
Reach SAV-24 North River (ODMDS Altamaha Sound)
Reach SAV-25 Rockdedundy River (ODMDS Altamaha Sound)
Reach SAV-26 South River (ODMDS Altamaha Sound)
Reach SAV-27 Little Mud River (ODMDS Altamaha Sound)
Reach SAV-28 Altamaha Sound (ODMDS Altamaha Sound)

Reach SAV-33 Jekyll Creek (ODMDS Brunswick Harbor)
Reach SAV-34 Jekyll Creek to Cumberland River (ODMDS Brunswick Harbor)

3. Open Water Disposal in Conjunction with Confined Disposal

Reach SAV-12 Hells Gate (Open water north and south of Raccoon Key, Tracts 15-A and 15-B)
Reach SAV-29 Buttermilk Sound (Open Water Sites 34 and 44, Tract 42-B)

1.8 Timing and Duration of Discharge

Maintenance dredging is performed on the AIWW on an annual basis provided the work is funded. To minimize impacts to sea turtles, use of a hopper dredge would be restricted to December 15 – March 31 of any year. The number of times a particular reach is dredged during the 20-year life of the DMMP will depend on the shoaling rate in that reach. Many of the reaches along will only be dredged 1-2 times while other reaches will require no dredging.

1.9 Beneficial Use of Dredged Sediment

Because fine-grained materials are incompatible with native beach sediments, beach placement remains a limited option throughout most of the AIWW. Potential construction purposes of the dredged material include fill to build or expand land for airports, ports, residential, or commercial development. Other examples of one-time beneficial use options include shoreline stabilization and environmental enhancement by the creation or restoration of wetland, marsh, or upland habitat (earlier identified as unconfined open water disposal).

Only one reach within Savannah District's AIWW, Ramshorn Creek SC (SAV-2) contains beach-quality sand. This could be made available for re-nourishment of nearby beaches (Hilton Head Island and Daufuskie Island). Pipeline distances to these beaches would be 4.1 miles and 2.75 miles, respectively, if laid over marsh and uplands; a floating pipeline would need to be through New River to Daufuskie Island or through Cooper River to Hilton Head Island, increasing the pumping distance to 7.0 miles and 4.3 miles, respectively. The anticipated 20-yr requirement is 88,000 CY, a relatively small amount to be considered for beach re-nourishment. The historic dredging frequency for this reach is every 14 years. Only 1 alternative to beach re-nourishment was presented in the Draft DMMP - placement in DMCA 14-B (Savannah Harbor Navigation Project). USACE would coordinate with the appropriate natural resource agencies prior to placement in an area other than DMCA 14-B.

1.10 Relationship of the Proposed Action to Other Federal Projects

The northern portion of the proposed action would occur in the general vicinity of the proposed Savannah Harbor Deepening Project (SHEP), and assumes that SHEP as well as the features associated with the Long Term Management Strategy (LTMS) (USACE 1996), Bank Protection for DMCAs 13-A, 13-B, 14-A, and 14-B have been completed.

2.0 Affected Environment

The AIWW is a 739-mile inland waterway system between Norfolk, Virginia, and the St. John's River, Florida. The Savannah District portion of the AIWW starts at Port Royal, SC (Beaufort County) and continues to Cumberland Sound at the GA/FL border (Figure 1-1), which consist of 161 miles. The South Carolina portion consists of 24 miles (reaches 1 through 5) within Beaufort and Jasper County. The portion of the AIWW within Georgia consists of 137 miles within 6 counties (Chatham, Bryan, Liberty, Glynn, McIntosh, and Camden).

This 161-mile stretch is composed entirely of saltwater riverine and estuarine ecosystems.
The drainage basins that drain into the Savannah District portion of the AIWW project are the Savannah River, Ogeechee, Altamaha, Satilla, and St. Mary's basins.

2.1 Natural Resources

The AIWW is contained entirely within the Coastal Plain geological province. As indicated by Johnson, et al., (1974) the Coastal Plain is overridden by many sedimentary strata tilted towards the sea. These deposits were formed during the many changes in sea level associated with glaciations during the Tertiary and Quaternary periods. The thickest deposits are in the coastal area (about 6,000 feet at Savannah), tapering to a thin edge at the Fall Line (the approximate location of which extends in a diagonal line across the state from the city of Columbus, Georgia through Macon to the city of Augusta), where the oldest (Cretaceous) sediments are exposed. Limestone of Tertiary and Quaternary age underlies the Coastal Plain to form one of the most productive aquifer systems in the United States. The Tertiary limestone is several thousand feet thick, ranging in age from the Paleocene to the Pliocene. As indicated by Johnson, et al., (1974) the chain of barrier islands extending from the South Carolina border into the State of Florida were formed during the last 10,000 years probably as a result of dune ridges and sea level dropping; they formed at low stands of the sea and were inundated when sea level rose again. Barrier beaches formed on the islands from littoral sands. Windblown sand from the beaches became trapped by pioneering vegetation to form the dune ridges which were ultimately stabilized by salt tolerant vegetation. The dunes protected the island from sea winds, salt spray and storm tides and allowed the establishment of forest vegetation. The major habitats of the island interior are live oak forests, pine forests, fields and sloughs. The lagoonal systems behind the barrier island become filled with sediments to form marshes. Deposition on the marsh continues as the waters spill onto the marsh at high tide, but increases in marsh elevation due to deposition are nearly offset by rising sea levels. Few plant species can withstand the stress imposed by high salinity and daily inundation by tidal waters, and marsh vegetation is monotonously uniform. The tidal marsh is predominantly smooth cordgrass (*Spartina alterniflora*), although there is a zonation of species related to gradients in salinity and elevation.

The wetlands through which the Atlantic Intracoastal Waterway passes are feeding and nursery grounds for birds, mammals and fishes. The water-soil-plant complex forms a nutrient processing area where important phases of the carbon, nitrogen, phosphorous and sulfur cycles take place. Wetlands are sources of organic compounds in detrital food webs. Wetlands act as metering systems, controlling the output of nutrients in non-point source runoff to aquatic systems. Wetlands are buffers between storm driven water and adjacent high ground and help to reduce shoreline erosion.

Wetlands have a study value as they provide valuable wildlife habitat. Primary production activity measurements for many areas along the coastal salt marshes in Georgia range from an average of 3,108 grams per square meter for *Spartina alterniflora* (tall form) to 913 grams per square meter for black needlerush (*Juncus roemarianus*). Primary productivity ranges from 3,990 grams per square meter per year for *Spartina alterniflora* to 2,261 grams per square meter per year. Other freshwater marsh areas in Georgia vegetated by cattail (*Typha latifolia*) have net primary productivity of approximately 680 grams per square meter per year measured as a standing crop biomass. These values indicate that marsh areas, depending on the species of vegetation present, are some of the most productive areas in the world.

2.2 Hydrology

The tides and currents in the waterway proper vary since the waterway traverses rivers, sounds, estuaries and land cuts in winding its way along the coast between the barrier islands of Georgia and the mainland. Generally, the waterway can be considered to have semidiurnal tides; high tide usually varies between 6 and 10 feet above MLW. Most of the salt marshes that lie adjacent to the waterway are covered twice daily by tidal waters. The few areas that are not covered by normal tides are saturated by seasonal high tides.

The Georgia Bight, consisting of the curvature of the Atlantic Ocean from Cape Romain, South Carolina, to Cape Canaveral, Florida, represents an area of significant mixing of freshwater from the upland rivers and the sea water brought to the area by the Gulf Stream that flows along the east coast of North America. The flow from most of the coastal rivers, including the Savannah River and the Altamaha River, constitutes a large source of turbid freshwater, which mixes in the coastal area and slows in velocity. The sediment loads, upon slowing, tend to be deposited and moved according to the tidal regime into the salt marsh areas. This provides a substrate for the vegetation present as well as part of the nutrient supply.

Sediment and elutriate test analyses were performed at sampling locations along the AIWW in 1974. The major constituents considered in this study were mercury, lead, zinc, total Kjeldahl nitrogen, volatile solids and chemical oxygen demand. Bulk analysis of the 10 sediment samples indicated that only 4 of the sampling areas (Site 2 at Thunderbolt, Site 4 near Sapelo Island, Site 6 at Wolf Island and Site 8 at Jekyll Island) contained moderate concentration volatile solids, chemical oxygen demand, total Kjeldahl nitrogen, oil and grease. However, the disposal of dredged material in these areas would not be open water disposal also known as overboard disposal disposal, also known as open water disposal. In areas where overboard disposal methods could be used, the sediments contained low concentrations of pollutants. Bulk analyses in all instances indicated that the sediments were relatively free of heavy metals.

2.3 Climate

The climate of southeast South Carolina and Georgia through which the AIWW extends is considered to be of a temperate nature. Summers are warm and humid and winters are mild. Rainfall is abundant and most of the soils are moist or saturated during most of the year. The total annual rainfall is 50.1 inches ranging from a monthly precipitation of 3.18 in January to 8.94 inches in August. The average annual temperature is 66.4° F with an average temperature of 44.1° F in January and 81.4° F in August.

2.4 Barrier Islands

Barrier island formation has given Georgia and South Carolina both their expansive salt marshes and the "Golden Isles" beaches. Varying mean sea level elevations, sedimentation and the hydraulics of the nearshore area have produced a succession of roughly parallel barrier island shores. The three most evident and geologically have the most recent formation are the eastern edge of the mainland, the seaward sides of the intermediate line of barrier islands, and the shores of the Golden Isles. Because of the wide salt marshes, access to the islands has been difficult and expensive. The lack of easy access and a history of large land holdings on the islands have left the majority of them nearly untouched. At present extensive development has occurred only on Tybee Island, St. Simons Island and Jekyll Island. The biggest existing problem of the more inaccessible islands is overgrazing, the biggest potential problem is over-development. Federal and state acquisitions of much of these coastal lands provided some protection against over-development.

The total acreage of the six coastal Georgia counties is 1,974,480 acres; of this 358,198 acres are estimated by the U.S. Department Agriculture, Soil Conservation Service to be salt marshes. Another 1,023,700 acres or 51 percent is forested and about 300,000 acres are agricultural land.

2.5 Ecological Zones

There are four predominant ecological zones adjacent to the AIWW within the study area. These are the low marsh zone, the high marsh zone, the shrub zone, and an upland community, the oak-juniper-palm forest.

The low marsh zone is regularly flooded by high tides and is generally found below the mean high water (mhw) line. This community is dominated nearly pure stands of smooth cordgrass (*Spartina alterniflora*). Smooth cordgrass marshes are considered to be the most productive type of the saltmarsh communities. This community occurs throughout the tidal lands along the AIWW. The upper margin of this community grades into the high marsh community. In areas with less tidal action or in areas with high evaporation rates (thus high salt concentrations) the smooth cordgrass is shorter and less productive and other plant species also occur. In salt pan areas short-form smooth cordgrass is found with glasswort (*Salicornia* sp.) dominant.

The high marsh zone, beginning at the marsh/land line is regularly flooded by spring tides and is infrequently flooded during abnormal high tides. The dominant vegetation in this zone consists of saltmeadow (*Spartina patens*) and saltgrass (*Distichlis spicata*). The high marsh zone often has several intermixed plant communities, including the salt panne association and stands of black needle rush (*Juncus roemarianus*), sea lavender (*Limonium nashii*) and salt bulrush (*Scirpus robustus*). In the high marsh zone areas which are only occasionally flooded, shrub zone type vegetation is frequently present and forms an ecotone or transitional community.

The shrub zone, which is located at elevations which are only occasionally flooded by high spring tides or abnormally high storm tides, forms the border between the high marsh zone and the terrestrial vegetation. This zone contains a variety of herbaceous and woody plant species with shrubs being dominant. The characteristic shrub vegetation present in this zone includes marsh elder (*Iva frutescens*), sea ox-eye (*Borrichia frutescens*), groundsel bush (*Baccharis halimifolia*), Florida privet (*Forestiera porulosa)*, wax myrtle (*Myrica cerifera*) and yaupon (*Ilex vomitoria*). Herbaceous vegetation occurring in this zone consists of black needle rush, saltmeadow cordgrass, saltgrass and sea lavender.

In areas above the shrub zone exists an upland community called oak-juniper-palm forest. This association is essentially a forest border or an upland forest area. These communities are best developed on peninsulas of high ground in the salt marsh zone with an elevation of 5 feet (Hillestad, 1975). Oak-juniper-palm forest can also be found on dredged disposal sites. The dominant canopy vegetation found in these areas consists of live oak (*Quercus virginiana*), southern red cedar (*Juniperus silicicola*) and cabbage palm (*Sabal palmetto*) with a wide variety of understory vegetation. Commonly, shrubs and vines associated with this vegetation type consist of wax myrtle, Florida privet, and sawtooth palmetto (*Serenoa repens*).

Some marshland areas along the AIWW have been altered by maintenance dredging of the channel. The vegetative changes which have resulted are varied depending upon disposal techniques and the material dredged. In unconfined disposal areas where the elevation has not precluded tidal action, smooth cordgrass has revegetated the area. However, small upland islands locally known as hammocks have formed in disposal sites which have been used often enough to build up the elevation above the mean high water level. Vegetation on hammock areas is similar to high marshland shrub marsh zones previously discussed, depending on elevation and the sediments dredged. Along the edge of the hammocks, where flooding duration is about one hour each day, vegetation commonly found consists of glasswort, saltgrass and sea ox-eye. In areas with higher elevations, wax myrtles, marsh elder and southern red cedars have become established. In some areas where the dredged material consists mostly of sterile sands with little organic material, the area is unable to support any vegetation. Recently diked disposal areas form hammocks similar to high and shrub marsh zones; however, some old diked disposal areas which do not undergo the shrub marsh phase are occasionally revegetated with broomsedge (*Andropogon* sp.), prickly pear cactus (*Opuntia* sp.) and other upland type vegetation. In most instances, diked disposal sites form a shrub zone and may later develop into an oak-juniper-palm forest community. This type of community is usually found in areas with an elevation above five feet. The benefits of these created uplands are discussed in both the Fish and Wildlife Coordination Act Report and the attached EIS.

Because of the large number and diversity of invertebrates occurring in salt marshes and estuarine areas, only the most common invertebrate forms have been identified in this study. Jacobs (1968) reported three species to be common among the zooplankton found in Doboy Sound and the waters near Sapelo Island. These were *Acartia tonsa*, *Pseudodioptomus caronaius,* and *Paracalanus parvus*. Windom, et al., (1974), investigating the impacts of dredging on benthic organisms for the U.S. Army Corps of Engineers, identified over 70 species of benthic organisms found within the estuarine waters of the State of Georgia.

The most extensively studied invertebrates are the macroinverbrates of commercial importance, namely oysters, blue crab and shrimp species. The American oyster (*Crassostrea virginica*) harvested along the Atlantic Coast has diminished in the past due primarily to pollution and human development along coastal areas. The blue crab, harvested in coastal waters of the AIWW, consists of two similar species, *Callinectes sapidus* and *C. ornatus*.

3.0 Prior Coordination

The National Marine Fisheries Service (NMFS) Southeast Regional Office, St. Petersburg, FL., issued a Regional Biological Opinion (RBO) on September 25, 1997, concerning the continued hopper dredging of channels and borrow areas in the Southeastern United States. That opinion was written to amend their 1995 opinion and supersede the 1997 interim opinion. It set an annual (FY) documented incidental take for the region of seven Kemp's ridleys, seven greens, two hawksbills, thirty-five loggerheads, and 5 Shortnose sturgeon, and clarified monitoring requirements for beach nourishment projects. Furthermore, the hopper dredge windows, as established in the 1995 opinion, were incorporated into the 1997 RBO for hopper dredging along the South Atlantic coast, provided that USACE continued to minimize sea turtle takes by refining the turtle deflecting dragheads, work in the cool water months to the maximum extent practicable, and shut down operations when high numbers of turtle takes occur before approaching the incidental take limit for a given species. Work is presently underway to update that RBO.

The protected species list for the counties within the AIWW was obtained from the USFWS on May 17, 2012. The USFWS letter (Appendix C) of May 18, 2012, outlined the concerns and issues that the agency would like addressed in the Draft EIS.

4.0 Species Considered In This Assessment

4.1 Species Potentially Present in the Project Area.
Updated lists of Federally Threatened and Endangered (T&E) species for the project area were obtained from NMFS (Southeast Regional Office, St. Petersburg, FL) and the USFWS (Field Offices in Charleston, SC; and Brunswick, GA). These were combined to develop the following composite list for the coastal counties in Georgia and South Carolina that contain the AIWW, thus includes Federally-listed T&E species that could be present in the area based upon their geographic range (see Table 4-1). However, the actual occurrence of a species in the area would depend upon the availability of suitable habitat, the season of the year relative to a species' temperature tolerance, migratory habits, and other factors. A comprehensive list of Federal and State listed Threatened and Endangered (T&E) species is in Appendix A.

Table 4-1. Federally Threatened and Endangered Species Potentially Present in the following SC and Georgia Counties: Jasper, Beaufort, Chatham, Bryan, Liberty, Long, Glynn, and Camden

Species Common Names	Scientific Name	Federal Status
Marine Turtles		
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Green sea turtle	*Chelonia mydas*	Threatened
Mammals		
North Atlantic right whale	*Eubaleana glacialis*	Endangered
Blue whale	*Balaena musculus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Finback whale	*Balaenoptera physalus*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
West Indian Manatee	*Trichechus manatus*	Endangered
Anadromous and Marine Fish		
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered
Shell Fish		
Altamaha spinymussel	*Elliptio spinosa*	Endangered
Vertebrates		
Kirtlands warbler	*Dendroica kirtlandii*	Endangered
Bachman's warbler	*Vermivora bachmanii*	Endangered
Piping plover	*Charadrius melodus*	Threatened
Red-cockaded woodpecker	*Picoides borealis*	Endangered
Wood stork	*Mycteria americana*	Endangered
Eastern indigo snake	*Drymarchon corais couperi*	Threatened
Flatwoods salamander	*Ambystoma cingulatum*	Threatened
Gopher Tortoise	*Gopherus polyphemus*	Candidate
Vascular Plants		
Pondberry	*Lindera melissifolia*	Endangered
Chaffseed	*Schwalbea americana*	Endangered
Canby's dropwort	*Oxypolis canbyi*	Endangered

[1]Green turtles are listed as threatened, except for breeding populations in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

5.0 Dredging Methods

For the purposes of this assessment, dredging methods discussed will be those, which lend themselves capable of placing sediment within the DMCAs and ODMDS identified within this proposed action.

5.1 Hydraulic Dredges

Hydraulic dredges are characterized by their use of a centrifugal pump to excavate sediment and transport a slurry of dredged material and water to identified discharge areas. The ratio of water to sediment within the slurry mixture is controlled to maximize efficiency. The main types of hydraulic dredges are pipeline and hopper dredges.

5.1.1 Pipeline Dredges - Cutterhead Suction Dredge

Pipeline dredges are designed to handle a wide range of materials including clay, hardpan, silts, sands, gravel, and some types of rock formations without blasting. They are used for new work and maintenance in projects where suitable placement areas are available and operate in an almost continuous dredging cycle resulting in maximum production, economy, and efficiency. Pipeline dredges are capable of dredging in shallow or deep water and have accurate bottom and side slope cutting. Limitations of pipeline dredges include relative lack of mobility, long mobilization and demobilization, inability to work in high wave action and currents, and are impractical in high traffic areas.

Pipeline dredges are rarely self-propelled and; therefore, must be transported to and from the dredge site. Pipeline dredge size is based on the inside diameter of the discharge pipe, which commonly range from 6" to 36." They require an extensive array of support equipment including pipeline (floating, shore, and submerged), boats (crew, work, survey), barges, and pipe handling equipment. Most pipeline dredges have a cutterhead on the suction end. A cutterhead is a mechanical device that has rotating teeth to break up or loosen the bottom material so that it can be sucked through the dredge. Some cutterheads are rugged enough to break up rock for removal (Figure 5-1).

During the dredging operation a cutterhead suction dredge is held in position by two spuds at the stern of the dredge, only one of which can be on the bottom while swinging. There are two swing anchors some distance from either side of the dredge, which are connected by wire rope to the swing wenches. The dredge swings to port and starboard alternately, passing the cutter through the bottom material until the proper depth is achieved. The dredge advances by "walking" itself forward on the spuds. This is accomplished by swinging the dredge to the port, using the port spud and appropriate distance, then the starboard spud is dropped and the port spud raised. The dredge is then swung an equal distance to the starboard and the port spud is dropped and the starboard spud raised.

Cutterhead pipeline dredges work best in large areas with deep shoals, where the cutterhead is buried in the bottom sediment. A cutterhead removes dredged sediment through an intake pipe and then pushes it out the discharge pipeline directly into the disposal site. Most, but not all, pipeline dredging operations involve upland disposal of the dredged sediment. Therefore, the discharge end of the pipeline is connected to shore pipe. When effective pumping distances to the disposal site become too long, a booster pump is added to the pipeline to increase the efficiency of the dredging operation (USACE 1993).

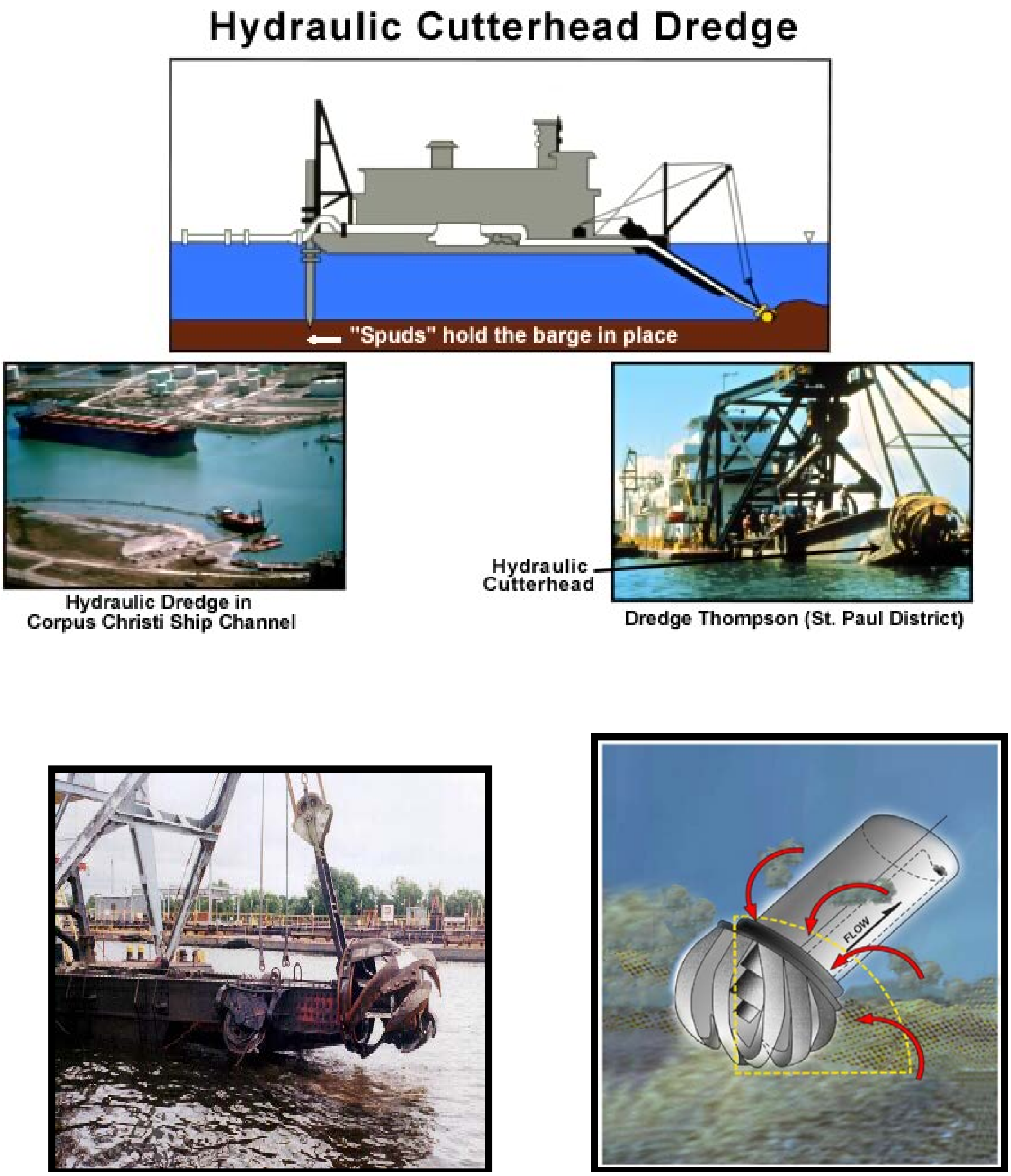

Figure 5-1. Cutterhead pipeline dredge schematic.

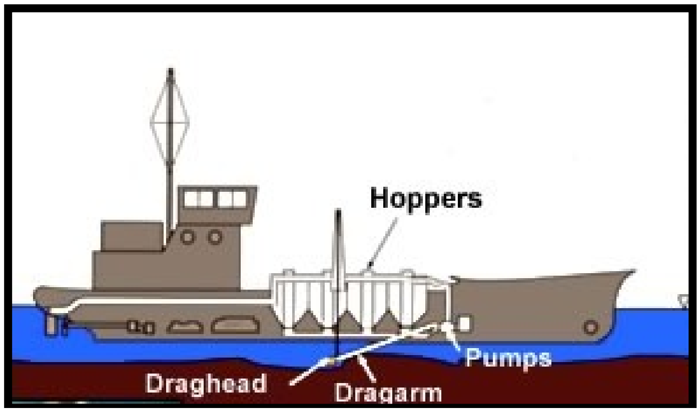

Figure 5-2 Hopper dredge schematic

Figure 5-3. Photograph taken from Manson Construction Company, Hopper Dredge Bayport

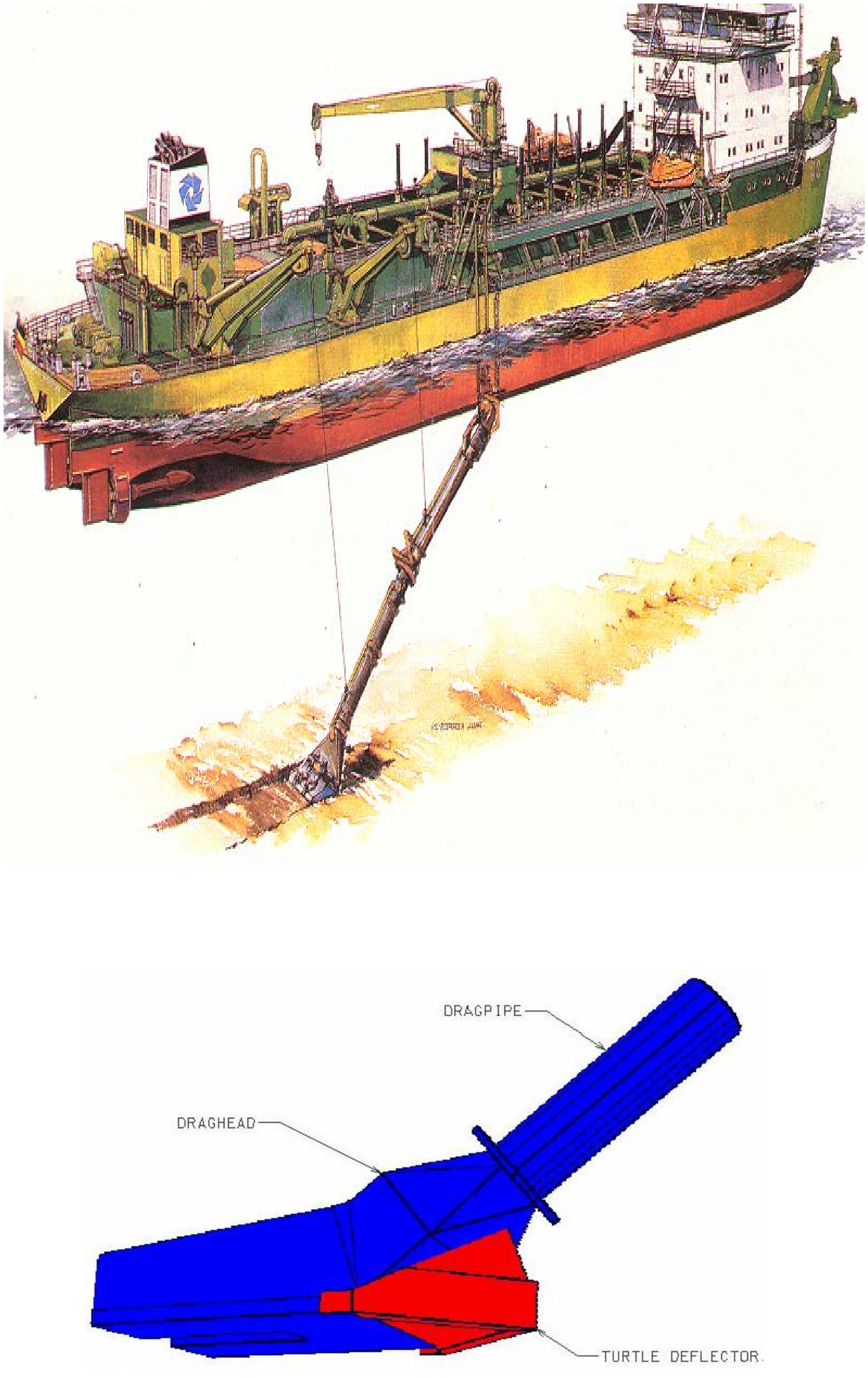

Figure 5-4. Hopper dredge in operation and figure of draghead with turtle deflector

5.2 Mechanical Dredges

Mechanical dredges are characterized by the use of some form of bucket to excavate and raise the bottom sediment. They remove sediment by scooping it from the bottom and then placing it onto a waiting barge or directly into a placement area. Mechanical dredges work best in consolidated, or hard-packed, materials and can be used to clear rocks and debris. Dredging buckets have difficulty retaining loose, fine materials, which can be washed from the bucket as it is raised. Special buckets have been designed for controlling the flow of water and sediment from buckets and are used when dredging contaminated sediments. Mechanical dredges are rugged and can work in tightly confined areas. They are mounted on a large barge and are towed to the dredging site and secured in place by anchors or spuds. They are often used in harbors, around docks and piers, and in relatively protected channels, but are generally not well suited for areas of rough seas.

Dipper dredges and clamshell dredges, named for the scooping buckets they employ, are the two most common types. A bucket dredge begins the digging operation by dropping the bucket in an open position from a point above the sediment. The bucket falls through the water and penetrates into the bottom material. The sides of the bucket are then closed and sediment is sheared from the bottom and contained in the bucket compartment. The bucket is raised above the water surface, swung to a point over the barge, and then released into the barge by opening the sides of the bucket. Usually two or more disposal barges, called dump scows, are used in conjunction with the mechanical dredge. While one barge is being filled, another is being towed to the placement site by a tug and emptied. If a diked disposal area is used, the sediment must be unloaded using mechanical or hydraulic equipment. Using numerous barges, work can proceed continuously, only interrupted by changing dump scows or moving the dredge. This makes mechanical dredges particularly well suited for dredging projects where the placement site is many miles away. The dipper dredge is essentially a power shovel mounted on a barge. It can dig hard materials and has all the advantages of the bucket dredge, except for its deep digging and sea state capabilities. Similar to the bucket dredge operation, the dipper dredge places sediment into a barge, which is towed to a disposal area (USACE, 1993).

Photograph taken from Great Lakes Dredge & Dock Company, Dredge No. 52


Figure 5-5. Mechanical dredge (clamshell bucket and barge)

5.4 Impacts of Hydraulic and Mechanical Dredges

General Impacts. Dredging and placement of sediment have the potential to adversely affect animals and plants in a variety of ways. These include actions of the dredging equipment (i.e., cutting, suction, sediment removal, hydraulic pumping of water and sediment, and noise); physical contact with dredging equipment and vessels (i.e., impact); physical barriers imposed by the presence of dredging equipment (i.e., pipelines); and placement of excavated sediment in various placement locations (i.e., covering, suffocation). Potential impacts vary according to the type of equipment used, the nature and location of sediment discharged, the time period in relation to life cycles of organisms that could be affected, and the nature of the interaction of a particular species with the dredging activities.

Hydraulic cutterhead dredges have historically performed the work on the AIWW, since the disposal sites were next to the reaches been dredged. This type is the most efficient for placing material in upland disposal sites. Mechanical dredges with scows would be used to dredge reaches where the upland confined placement site is farther than a cutterhead dredge can efficiently pump the material. Small hopper dredges would be used where the dredge material is suitable for beneficial use and for near shore beach re-nourishment (if feasible). Hopper dredges and mechanical dredges would be used for placing material into EPA approved Ocean Dredged Material Disposal Sites (ODMDS).

Lighting During Construction. Dredge plants and associated tugs and barges are required to meet USACE, US Coast Guard, and OSHA lighting standards for safety. With regard to sea turtles, lighting is only an issue during hatching. The hatchlings may be disoriented by bright lights and head toward those lights instead of toward the ocean. However, since hatching only occurs during the warmer months and no dredging operations near the beaches are proposed during that period, lighting on dredge equipment will not affect sea turtles. During this dredging project, additional lighting impacts may occur on the CDFs, floating pipeline (near the dredge and placement area) and associated heavy equipment working on the site to move anchors, etc. Ample lighting on a hopper dredge is specifically required for the observers on board to provide safe access at night to the inflow boxes and screens.

6.0 Impacts to Federally Listed Threatened and Endangered Species

6. 1 Primary and Secondary Impacts.

The proposed continuation of maintenance of the AIWW Navigation Project will primarily affect saltwater estuarine and marine habitats. Some short term direct impacts are expected to occur to shallow water benthic communities; and some minor temporary impact to saltwater marsh from the temporary placement of hydraulic dredge pipelines. Some direct impacts to saltmarsh wetlands from dredged material disposal activities may occur from alternatives involving repair of dikes at existing DMCAs (that may have wetlands within the dikes) or from continuing to use existing undiked saltmarsh disposal areas with the mitigative features (geotubes or other confinement methods) discussed previously in Section 2. Coordination is ongoing to determine appropriate mitigation for these impacts to saltmarsh wetlands.

The majority of disposal occurring on uplands would take place at the existing DMCAs, which USACE uses regularly for the placement of maintenance sediments. Under DMMP Option 2, new upland DMCAs would be constructed in Bryan County (100-acre site) and on Creighton Island in McIntosh County (350-acre site), that if implemented may involve impacts to palustrine freshwater wetlands. Before any of these actions impacting freshwater wetlands are implemented, a separate NEPA document (and appropriate mitigation) would be completed to address these issues.

6.2 General Impacts from Dredging Operations

Dredging operations and placement of sediments within the existing DMCAs or the ODMDS have the potential to adversely affect animals and plants in a variety of ways. These include actions of the dredging equipment (i.e., cutting, suction, sediment removal, hydraulic pumping of water and sediment); physical contact with dredging equipment and vessels (i.e. impact); physical barriers imposed by the presence of dredging equipment (i.e. pipelines); and placement of dredged sediment in various locations (e.g. covering, compaction, etc.). Potential impacts vary according to the type of equipment used, the nature and location of sediment discharged, the time period in relation to life cycles of organisms that could be affected, and the nature of the interaction of a particular species with the dredging activities. Dredging and sediment placement methods associated with the proposed action are similar to current maintenance dredging methods.

All the proposed maintenance dredging activities would occur within the existing AIWW Project and designated disposal areas. Any potential dredging impacts on Federally listed threatened and endangered species would primarily be limited to those species that occur in habitats occurring in those areas (e.g., within estuarine and marine habitats).

Most of the activities under the proposed action would not affect any listed species that generally reside in forested, moist pine flatwoods, well drained sandy soils, freshwater, or bottomland hardwood habitats, which would include the red-cockaded woodpecker, Altamaha spinymussel, American chaffseed, Pondberry, Canby’s dropwort, Kirtland’s warbler, Bachman’s warbler, eastern indigo snake, and flatwoods salamander. Some of the DMMP options involve the potential construction of upland DMCAs, which may involve impacts to palustrine freshwater wetlands. Before any of these actions impacting freshwater wetland systems are implemented, a separate NEPA document would be prepared to address these issues.

Species that have the potential to be present near the project impact area during implementation of the proposed action are the finback whale, humpback whale, right whale, sei whale, blue whale, sperm whale, West Indian manatee, piping plover, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, Shortnose sturgeon, Atlantic sturgeon, piping plover, and wood stork. Although the whales would only have the potential to be present on the disposal options involving ODMDS sites. The accounts, which follow, will summarize information about these species as it applies to the proposed action.

6.2 Species Accounts

6.2.1 Red-cockaded woodpecker, American chaffseed, Pondberry, Canby's dropwort, Kirtland's warbler, Bachman's warbler, Eastern indigo snake, Altamaha spinymussel, and Flatwoods salamander.

a. Status. Red-cockaded woodpecker is Endangered, American chaffseed is Endangered, Pondberry is Endangered, Canby's dropwort is Endangered, Kirtland's warbler is Endangered, Bachman's warbler is Endangered, Eastern indigo snake is Threatened, and Flatwoods salamander is Threatened.

b. Background. The proposed project would not affect these species for the following reasons:

Red-cockaded woodpecker. This species requires forested habitat of at least 50 percent pine that is 30 years or older. There is not any habitat that could potentially be used by this species that could be impacted by this project. There are no known colonies of this species located along the AIWW. This project would not destroy or modify any habitat determined critical for the species' survival.

American chaffseed. This species occurs in sandy (sandy peat, sandy loam), acidic, seasonally moist to dry soils. It is generally found in habitats described as open, moist pine flatwoods, fire-maintained savannas, ecotonal areas between peaty wetlands and xeric sandy soils, and other open grass-sedge systems (Source: *Endangered and Threatened Species of the Southeastern United States (The Red Book)* FWS Region 4 -- As of 1/95). No habitat that could potentially be used by this species is anticipated to be impacted by the project.

Pondberry. This species occurs in freshwater wetland habitats such as interior bottomland hardwoods, and the margins of sinks, ponds and other depressions in the more coastal sites (Source: *Endangered and Threatened Species of the Southeastern United States (The Red Book)* FWS Region 4 -- As of 2/91). No habitat that could potentially be used by this species is anticipated to be impacted by the project.

Canby's dropwort is a herbaceous perennial with tuberous roots and pale, fleshy rhizomes. Its habitat is moist areas in the coastal plain and sandhills such as Carolina bays, wet meadows, and wet pineland savannas. Best occurrences are in open bays and ponds with minimal cover that are wet for most of the year. No habitat that could potentially be used by this species is expected to be impacted by the project.

Kirtland's warbler. The endangered Kirtland's warbler is one of the rarest members of the wood warbler (Parulidae) family. It nests in just a few counties in Michigan's northern Lower and Upper peninsulas, in Wisconsin and the province of Ontario. The winter range of the Kirtland's warbler was discovered in 1879 when a specimen was collected on Andros Island in the Bahama Islands archipelago. All sightings or collections of wintering Kirtland's warblers since then have been in the Bahamas and in the Turks, Caicos, and Hispaniola islands. Kirtland's warblers are one of more than 200 neo-tropical migratory species that nest in North America and winter in the tropics. No habitat that could potentially be used by this species is expected to be impacted by the project.

Bachman's warbler. Historic records indicate the Bachman's warbler nest in low, wet forested areas containing variable amounts of water, but usually with some water that was permanent. These areas were described in general as being forested with sweet gum, oaks, hickories, black gum, and other hardwoods; and where there was an opening in the forest canopy, the ground being covered with dense thickets of cane, palmetto, blackberry, gallberry, and other shrubs and vines. Most authorities agree that if the Bachman's warbler still exists it is most likely in the I'On Swamp area in Charleston and Berkeley Counties, South Carolina (Source: *Endangered and Threatened Species of the Southeastern United States (The Red Book)* FWS Region 4 -- As of 6/91). No habitat that could potentially be used by this species would be impacted by the project.

Eastern indigo snake seems to be strongly associated with high, dry, well-drained sandy soils, closely paralleling the sandhill habitat preferred by the gopher tortoise. During warmer months, indigos also frequent streams and swamps, and individuals are occasionally found in flat woods (Source: *Endangered and Threatened Species of the Southeastern United States (The Red Book)* FWS Region 4 -- As of 1/91). No habitat that could potentially be used by this species would be impacted by the project.

Flatwoods salamander. Optimum habitat for the flatwoods salamander is an open, mesic (moderate moisture) woodland of longleaf/slash pine (*Pinus palustris/P. elliottii*) flatwoods maintained by frequent fires. Pine flatwoods are typically flat, low-lying open woodlands that lie between the drier sandhill community upslope and wetlands down slope (Wolfe et al. 1988). No habitat that could potentially be used by this species would be impacted by the project.

The **Altamaha spinymussel** is only found in the Altamaha Basin in southeastern Georgia. Under the ESA, an endangered species is any species in danger of extinction throughout all or a significant portion of its range. The spinymussel is being listed with critical habitat because it has suffered severe declines in population numbers and distribution over several decades, coupled with no known reproductive success in recent years. In addition, little is known about the species' host fish during reproduction and its status. Host fish help mussels form during their larval stage. However, the spinymussel's host fish could potentially be threatened by the introduction of non-native species, such as the flathead catfish and Asian clam, into the Altamaha River. Since this species habitat is far upstream (in the Altamaha basin) of any of the activities in the proposed action, no habitat that could potentially be used by this species would be impacted by this project.

c. Project Impacts. The proposed maintenance dredging of the AIWW would be in areas consisting of saltwater estuarine and/or marine habitats. Most of the dredge disposal activities would be in existing DMCAs or in designated ocean disposal sites; with some options in newly constructed DMCAs that are predominantly upland and salt marsh habitat, but some sites may contain some freshwater wetlands. The proposed plan is not expected to destroy or modify any habitat determined critical for the survival of these protected species.

d. Effect Determination. Since these nine species generally do not reside within estuarine and marine habitats, the proposed action is expected to have No Effect on the following species: Red-cockaded woodpecker, American chaffseed, Pondberry, Canby's dropwort, Kirtland's warbler, Backman's warbler, Eastern indigo snake, Altamaha spinymussel, and Flatwoods salamander - or their habitats.

6.2.2 Wood stork

a. Status. Endangered

b. Background. Wood storks are known to frequent the more protected palustrine and estuarine areas of the region for both feeding and nesting. Wood stork rookeries are located on hammocks and along the edges of the marsh behind the barrier islands. This species has been observed in numerous areas along the AIWW. They occasionally rest within the DMCAs and feed there when conditions are right. Woodstorks have been recorded in the disposal areas around Savannah Harbor from April 25 (1 in 2007) to January 27 (1 in 2007), and they are found feeding in the areas primarily from late summer to early winter (USACE 2012a). In most years, individuals are more likely to be seen flying over the areas in the spring, rather than feeding in them: (Five birds on February 28, 2001 and three birds on April 25, 2001). They are most abundant (counts over 100) from early July to late October and occasionally late November. The high count feeding in the DMCA areas was 415 recorded on October 17, 2008. A high number of 55 individuals were observed feeding in the disposal areas on 23 September 1995 (Personal Conversation, Steve Calver, USACE, Savannah District). These birds have a unique feeding technique and require higher prey concentrations than other wading birds. Optimal water regimes for the wood stork involve periods of flooding, during which prey (fish) population's increase, alternating with dryer periods during which receding water levels concentrate fish at high densities. Fish trapped in the DMCAs during maintenance dredging may provide a source of food for wood storks once dewatering of the disposal areas is near completion.

c. Project Impacts. The portion of the proposed action involving maintenance of the existing navigation channel of the AIWW would not impact any habitat critical to the Wood stork. As detailed above, continued use of upland DMCAs for sediment placement could be considered a minor benefit to Wood stork feeding habitat.

d. Effect Determination. The proposed project may affect but is not likely to adversely affect the Wood stork. Critical habitat for this species has not been designated.

6.2.3 Piping plover

a. Status. Threatened

b. Background. The Atlantic Coast Piping plover population breeds on coastal beaches from Newfoundland to North Carolina (and occasionally in South Carolina) and winters along the Atlantic Coast (from North Carolina south), the Gulf Coast, and in the Caribbean where they spend a majority of their time foraging. Since being listed as threatened in 1986, only 800 pairs were known to exist in the three major populations combined and by 1995 the number of detected breeding pairs increased to 1,350. The 2008 report cites 1848 nesting pairs for the Atlantic coast. This population increase can most likely be attributed to increased survey efforts and implementation of recovery plans.

Piping plovers typically nest in sand depressions on un-vegetated portions of the beach above the high tide line on sand flats at the ends of sand spits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. They head to their breeding grounds in late March or early April and nesting usually begins in late April; however, nests have been found as late as July (Potter, *et al*., 1980). Feeding areas include intertidal portions of ocean beaches, washover areas, mud flats, sand flats, wrack lines, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS, 1996). Prey consist of worms, fly larvae, beetles, crustaceans, mollusks, and other invertebrates (Bent, 1928).

Loss and degradation of habitat due to development and shoreline stabilization have been major contributors to the decline of Piping plovers in southeast. The current commercial, residential, and recreational development has decreased the amount of coastal habitat available for Piping plovers to nest, roost, and feed. Furthermore, beach erosion and the abundance of predators, including wild and domestic animals as well as feral cats, have further diminished the potential for successful nesting of this species.

A majority of the existing shoreline throughout the state of Georgia is heavily developed and is experiencing significant shoreline erosion from both anthropogenic and natural causes. Habitat loss from coastal development, long-shore and cross-shore shoreline erosion, shoreline erosion impacts from hard structure protection measures (i.e. jetties, groins, etc.), and heavy public use has led to the degradation of Piping plover habitat throughout the State. As erosion and development persist throughout the coast of Georgia, Piping plover roosting and foraging habitat loss continues.

Cross-island transport of sediment and subsequent washover fan formation is considered a primary constituent element used in defining Piping plover critical habitat. These low lying sand flats contain sparse vegetation and offer optimum habitat for Piping plovers. Though eroded roosting habitat may be restored with the placement of beach fill, an increase in the width and height of the constructed berm, as well as the potential incorporation of a protective dune, hard structure, etc., may function as a barrier to cross island transport of sediment during significant erosion events resulting in long-term washover foraging habitat loss.

The formation of sand bars and emergent sand spit islands within inlet complexes serve as valuable habitat for Piping plovers and other shorebird species. In many cases these sites contain the important mosaic of habitat types including algal flats, sand flats, mud flats, etc. Though these formations are highly dynamic, they are often protected and isolated from human development pressures and associated disturbances; thus, they offer valuable roosting and foraging habitat. The size and frequency of occurrence is dependent on the sediment budget within an individual inlet complex and the interval period for inlet bypassing of sediment. Inlet bypassing of accreted sediments within inlet complexes is intended to mitigate down-drift erosion, and subsequent habitat loss, resulting from the interruption of longshore transport of sediments from hard structures and deep navigation channels. However, the resultant habitat from the bypassing of sediment on down-drift beaches is, in some cases, dependent on the removal of sediment accretion within the inlet. Bypassing of sediment to down-drift beaches may help mitigate lost intertidal foraging grounds for Piping plovers and other shorebirds. Similarly, placement of sediments in the nearshore area which either protect the existing shore or make their way to the adjacent shore would benefit Piping plovers by stabilizing their intertidal foraging habitat.

Piping plovers feed along beaches and intertidal mud and sand flats. Primary prey includes polychaete worms, crustaceans, insects, and bivalves. Literature dating back to the early 1970's along the southeast coast indicate that opportunistic infauna species (ex. *Emerita, Donax, Haustorius spp., etc.*) found in the nearshore areas are subject to direct mortality from burial; however, recovery often occurs within 1-3 years, (Hayden and Dolan, 1974; Saloman, 1984; Van Dolah *et al*., 1992; Van Dolah *et al*., 1993; Jutte, P.C. *et al*., 1999) especially if compatible material is placed on the beach (Hayden and Dolan, 1974; Reilly and Bellis, 1978; Saloman, 1984; Nelson and Dickerson, 1989; Van Dolah *et al*., 1992; Van Dolah *et al*., 1993; Hackney *et al*., 1996; Jutte, P.C. *et al*., 1999; Peterson *et al*., 2000). A literature review of polychaete annelid species affected by beach placement activities, performed by Hackney *et. al.* (1996), indicates that sediment disturbance has a strong negative effect on tube-building and sedentary polychaetes; however, minimal effects and, in some cases, enhancing effects of some mobile taxa. Some studies indicate that following beach placement activities, a population shift may occur as an enhanced abundance of some polychaete species occurs within disturbed areas (Coastal Science Associates, 2003; Lindquist and Manning, 2001; Peterson and Manning, 2001).

Critical Habitat for Wintering Piping Plover Designation

Critical habitat receives protection under Section 7 of the Endangered Species Act through the prohibition against destruction or adverse modification of critical habitat. This prohibition applies to actions carried out, funded, or authorized by a Federal agency. Section 7 requires consultation on Federal actions that are likely to result in the destruction or adverse modification of critical habitat.

The Piping Plover is a fairly common winter resident along the Atlantic Coast of Georgia and South Carolina where they spend a majority of their time foraging. When not foraging, plovers can be found roosting, preening, bathing, in aggressive encounters, and moving among available habitat locations (Zonick and Ryan, 1996). On July 10, 2001, the USFWS designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as critical habitat for the wintering population of the Piping plover where they spend up to 10 months of each year on the wintering grounds. Piping plovers begin arriving on the wintering grounds in July, with some late-nesting birds arriving in September. A few individuals can be found in the wintering grounds throughout the year, but sightings are rare in late May, June, and early July. Constituent elements for the Piping plover wintering habitat are those habitat components that are essential for the primary biological needs of foraging, sheltering, and roosting, and only those areas containing these primary constituent elements within the designated boundaries are considered critical habitat. The primary constituent elements are found in coastal areas that support intertidal beaches and flats (mud flats, sand flats, algal flats, and washover passes) and associated dune systems and flats above annual high tide. Important components of intertidal flats include sand and/or mudflats with no or very sparse emergent vegetation. Adjacent non- or sparsely-vegetated sand, mud, or algal flats above high tide are also important, especially for roosting Piping plovers. Important components of the beach/dune ecosystem include surf cast algae, sparsely vegetated back beach and salt pans, spits, and washover areas. Designated critical habitat does not include existing developed sites consisting of buildings, marinas, paved areas, boat ramps, exposed oil and gas pipelines, and similar structures (Federal Register/Vol. 66, No 132, July 10, 2001). The USFWS designated the north end of Tybee Island, Georgia (Georgia Unit GA -1, see Figure 6-1 below) as critical habitat for the wintering Piping plover. The major threat to the birds use of the area during the winter months would be continued degradation of beach foraging habitat. Daufuskie Island has not been designated as critical habitat for the wintering Piping plover.

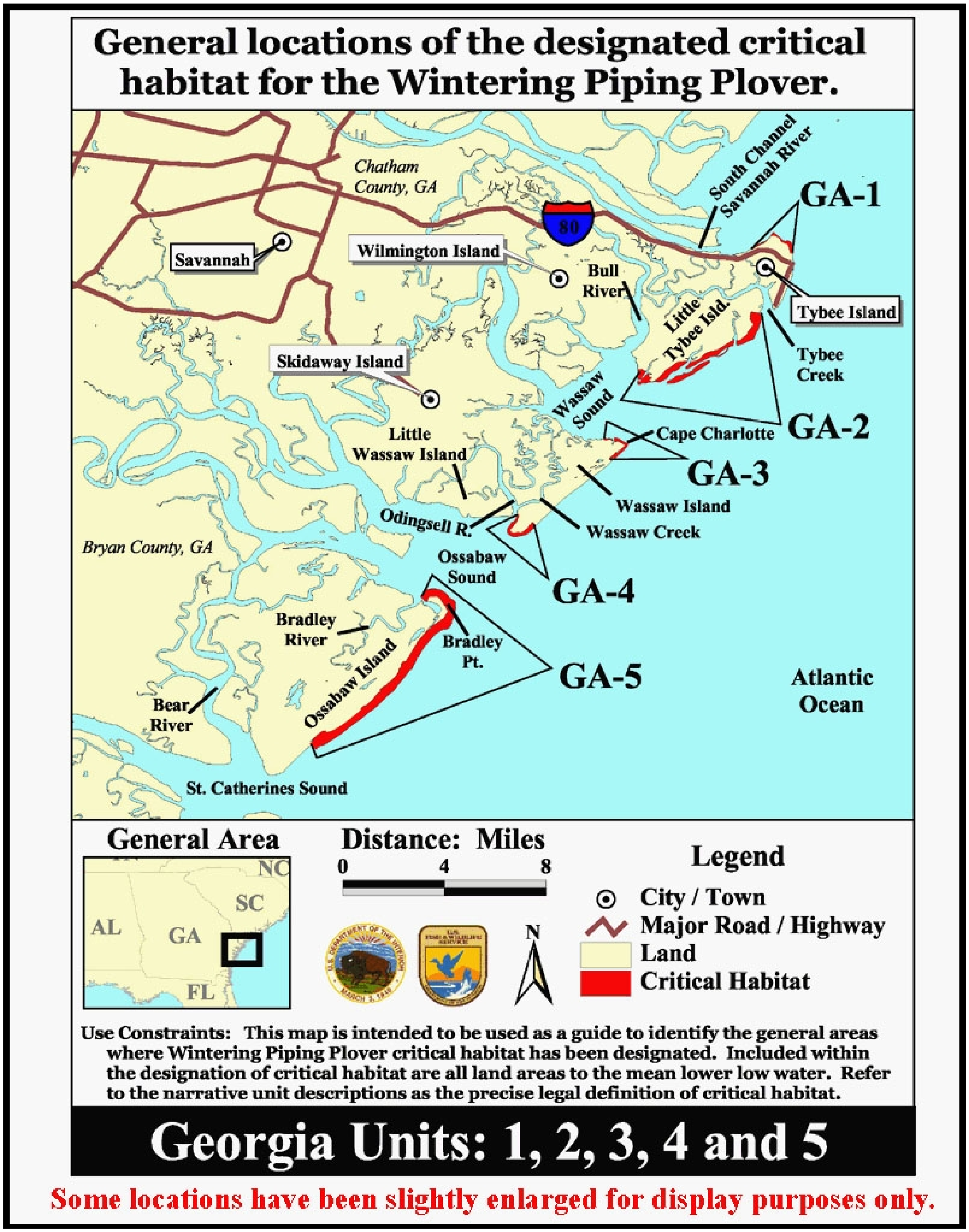

Figure 6-1. Piping plover critical habitat (GA Units 1-5)

Figure 6-2. Piping plover critical habitat (GA Units 6-10)

Figure 6-3. Piping plover critical habitat (GA Units 11-14)

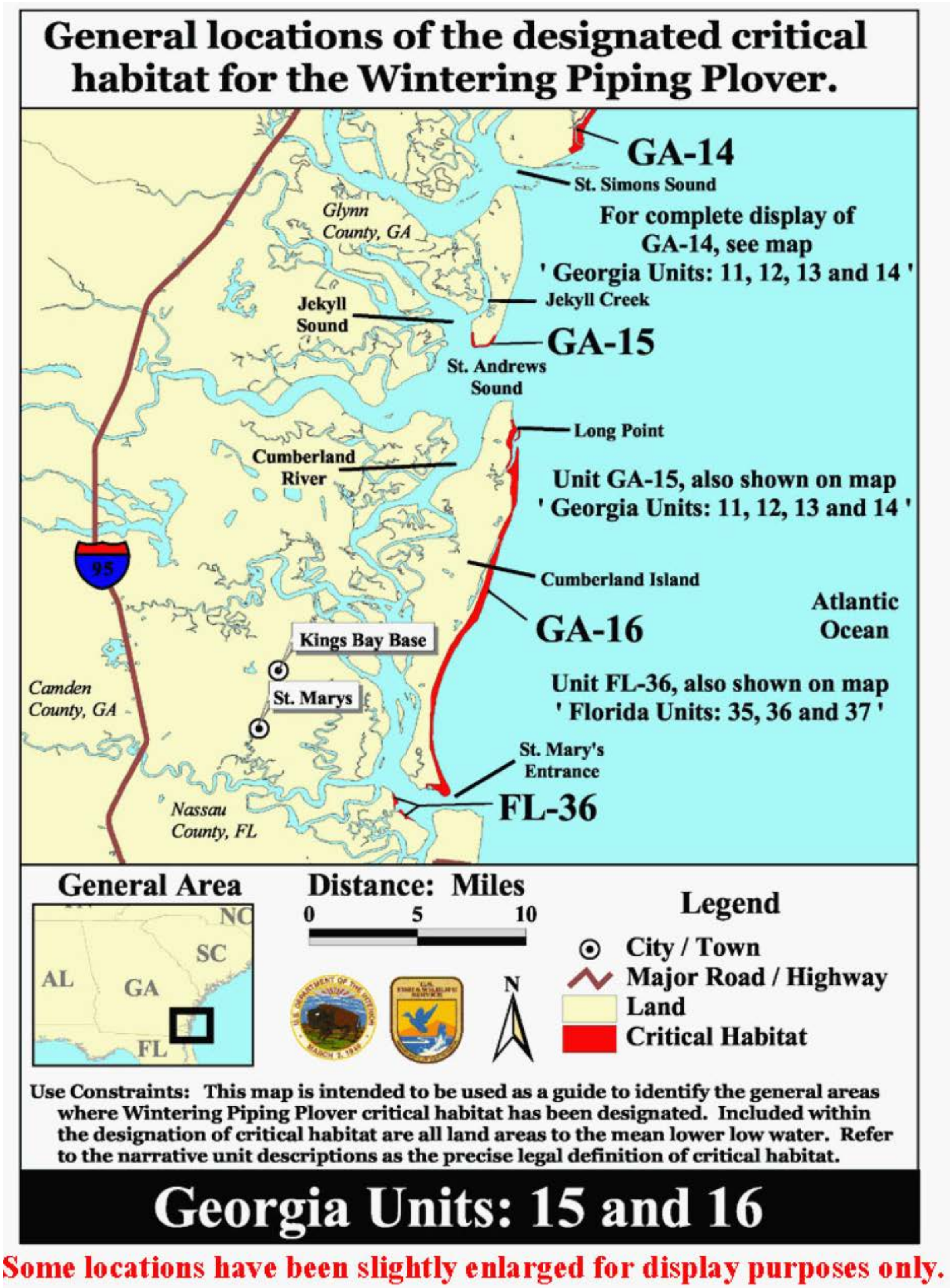

Figure 6-4. Piping plover critical habitat (GA Units 15 & 16)

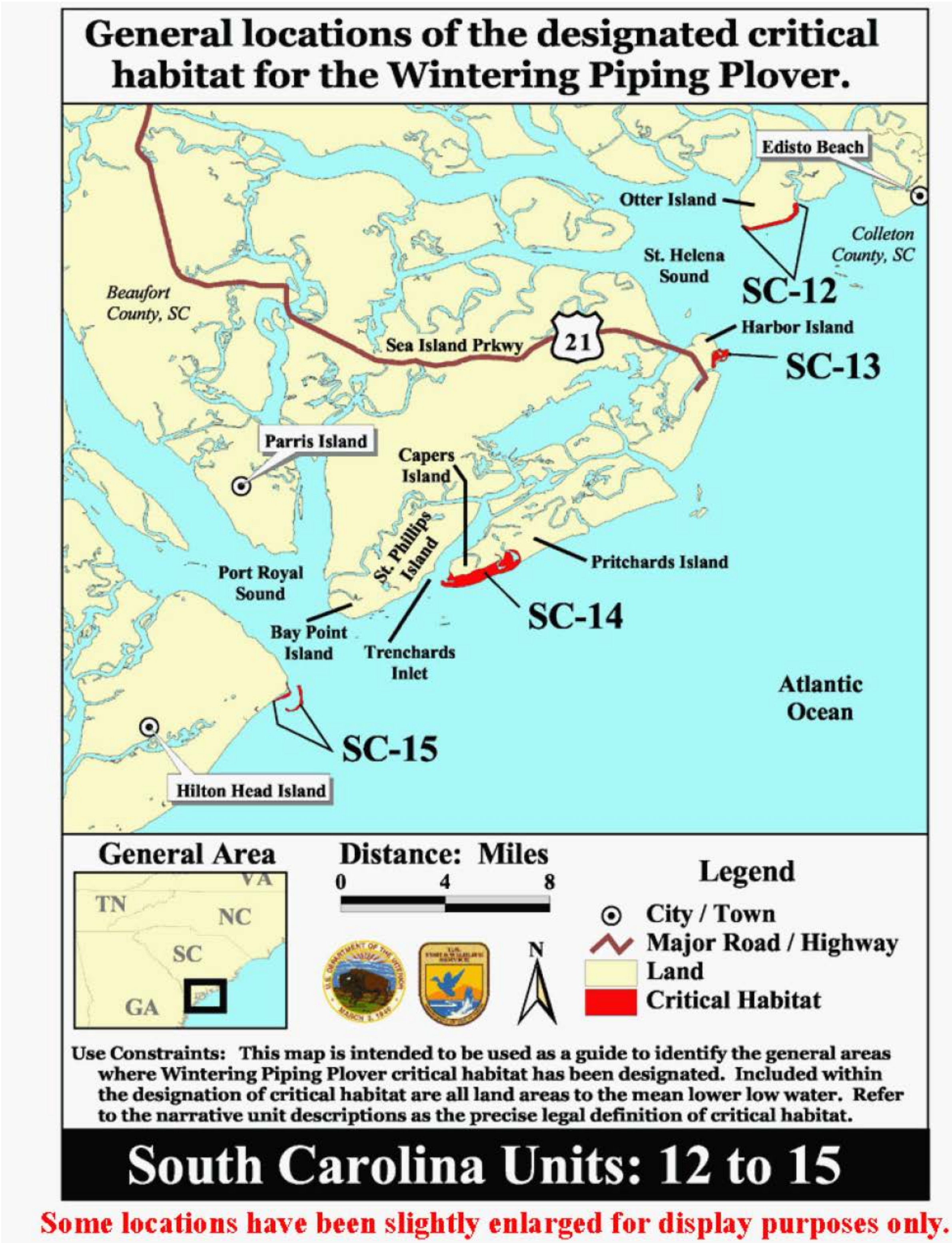

Figure 6-5. Piping plover critical habitat (SC Units 12, 13, 14, & 15)

The USFWS has defined textual unit descriptions to designate areas within the critical habitat boundary. These units describe the geography of the area using reference points, include the areas from the landward boundaries to the MLLW, and may describe other areas within the unit that are utilized by the Piping plover and contain the primary constituent elements (Federal Register/Vol. 66, No 132, July 10, 2001).

c. Project Impacts.

(1) Habitat

The proposed action is not expected to involve the placement of dredged material into Piping plover habitat.

(2) Critical Habitat

Within the Savannah District AIWW boundaries, the USFWS has designated specific areas on the barrier islands (Figures 6-1 to 6-5). The maintenance activities associated with the AIWW would not be near the critical habitat (GA Units 1-15 and SC Units 14-15).

Reach 2 in South Carolina is the only area of the AIWW that contains material suitable for beach re-nourishment; and this material may potentially be used for re-nourishment at the south end of Hilton Head Island and/or Daufuskie Island, or DMCA 14B (for later use in dike construction). These areas are not designated critical habitat for Piping plover (Figures 6-1 and 6-5).

d. Effect Determination.

The proposed action may affect, but is not likely to adversely affect the Piping plover or its critical habitat.

6.2.4 West Indian Manatee

a. Status. Endangered.

b. Background. The West Indian manatee (*Trichechus manatus*), also known as the Florida manatee, is a Federally-listed endangered aquatic mammal protected under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), the Marine Mammal Protection Act of 1972, as amended (16 U.S.C 1461 et seq.), and the Florida Manatee Sanctuary Act of 1978, as amended. Manatees inhabit both salt and fresh water and can be found in shallow (5 ft to usually <20 ft), slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas (USFWS, 1991) throughout their range. The West Indian manatee is herbivorous and eats aquatic plants such as hydrilla, eelgrass, and water lettuce.

During the cooler months between October and April, Florida manatees concentrate in areas of warmer water. Manatees are thermally stressed at water temperatures below 18ºC (64.4ºF) (Garrott *et al*., 1995); therefore, during winter months, when ambient water temperatures approach 20ºC (68ºF), the US manatee population confines itself to the coastal waters of the southern half of peninsular Florida and to springs and warm water industrial outfalls as far north as southeast Georgia. Records in Georgia are primarily random sightings and carcass finds and are not the result of systematic research. Systematic aerial surveys were initiated in 1976, and sight records have been increasing in south Georgia in recent years. The US Fish and Wildlife Service has reported that several were observed in the Savannah Harbor in the summer of 1987. The Georgia population is primarily migratory in nature and, therefore, fluctuates with season. The majority are sighted southward along the Georgia coast from Chatham County toward Florida. Manatees have been observed infrequently in the Savannah River as far upstream as the King's Island Turning Basin (Rathbun et al., 1981). The occurrence of manatees in the Savannah River estuary is characterized as a small summer resident population. Manatees are found in Georgia and South Carolina mainly during the warmer months of the year.

Severe cold fronts have been known to kill manatees when the animals did not have access to warm water refuges. During summer months, they may migrate as far north as coastal Virginia on the east coast and the Louisiana coast on the Gulf of Mexico and appear to choose areas based on an adequate food supply, water depth, and proximity to fresh water (USFWS, 1983). Annual migratory circuits of some individuals through the intracoastal waterway of the Atlantic Coast are 1,700 km round trips at seasonal travel rates as high as 50 km/day (Reid *et al*., 1991)

Manatee population trends are poorly understood, but deaths have increased steadily. A large percent of mortality is due to collisions with watercrafts, especially of calves. Another closely related factor in their decline has been the loss of suitable habitat through incompatible coastal development, particularly destruction of sea grass beds by boating facilities (USFWS, 2001).

From 1974 through 1994, 2,456 manatee carcasses were recovered in the southeastern U.S. Eight hundred and two (33 percent) were attributed to human-related causes. Of these, 613 were caused by collisions with watercraft, 111 were flood gate/canal lock-related, and another 78 were categorized as other human-related (USFWS, 2000). By email September 6, 2008, representatives from the Georgia Department of Natural Resources, Nongame Conservation Section indicated that they had recovered three male manatee carcasses in the Savannah River. All three were located at the downtown Savannah waterfront and apparently died from ship propeller lacerations (e.g. one was cut in half). Field necropsies were conducted on each.

Critical Habitat

The USFWS has designated critical habitat for the manatee beginning at the intersection of the AIWW and the St. Marys River at the Florida border and running southward into Florida. No critical habitat is designated within the Savannah District’s portion of the AIWW.

c. Project Impacts.

(1) Habitat.

Any possible direct effects on manatees from the project implementation should be minor (see Section 5.0). Additionally, the project would not adversely affect any site-specific conditions relating to habitat requirements such as sea grass beds and critical habitat designations.

Vessel traffic, including crew boats, tugs, barges, etc., will be a component of all dredging operations and; therefore, the potential for collision may exist. To ensure that dredging does not affect manatees, Savannah District has adopted and would implement on this project the "Standard State and Federal Manatee Protection Conditions." Those standard operating procedures are described as follows:

Manatee Protection Conditions:

1. The Contractor shall instruct all personnel associated with the project of the potential presence of manatees, the need to avoid collisions with these animals and the need to be on constant lookout for manatees during all phases of operation.

2. All construction personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing manatees and right whales which are protected under the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and the Florida Manatee Sanctuary Act. The Contractor shall be held responsible for any manatee harmed, harassed, or killed as a result of construction activities.

3. If siltation barriers are used, they shall be made of material in which manatees cannot become entangled, are properly secured, and are regularly monitored to avoid manatee entrapment. Barriers must not block manatee entry to or exit from essential habitat.

4. All vessels associated with the project shall operate at "no wake/idle" speeds at all times while in waters where the draft of the vessel provides less than a four foot clearance from the bottom and vessels shall follow routes of deep water whenever possible. Boats used to transport personnel shall be shallow-draft vessels, preferably of the light-displacement category where navigational safety permits.

5. If a manatee(s) is sighted within 100 yards of the project area, all appropriate precautions shall be implemented by the Contractor to ensure protection of the manatee. These precautions shall include the operation of all moving equipment no closer than 50 feet of a manatee. If a manatee is closer than 50 feet to moving equipment or the project area, the equipment shall be shut down and all construction activities shall cease to ensure protection of the manatee. Construction activities shall not resume until the manatee has departed the project area.

6. Prior to commencement of construction, each vessel involved in construction activities shall display at the vessel control station or in a prominent location, visible to all employees operating the vessel, a temporary sign at least 8 1/2" x 11" reading, "Caution: Manatee Habitat/Idle Speed is Required in Construction Area." In the absence of a vessel, a temporary 3' x 4' sign reading "Caution: Manatee Area" will be posted adjacent to the issued construction permit. A second temporary sign measuring 8½" X 11" reading "Caution: Manatee Habitat. Equipment Must Be Shut down Immediately If A Manatee Comes Within 50 Feet Of Operation" will be posted at the dredge operator control station and at a location prominently adjacent to the displayed issued construction permit. The Contractor shall remove the placards upon completion of construction.

7. Any collisions with a manatee or sighting of any injured or incapacitated manatee shall be reported immediately to the US Army Corps of Engineers. The order of contact within the Savannah District shall be as follows:

Table 6-1. Order of Contact of USACE Personnel for Dredging Contractor to Report Manatee Death or Injury

Title	Order of Contact	Telephone Numbers	
		Work	After Hours
Dredge Inspector (CESAS-OP-[])	*1*	*On Site*	*Lodging Location*
Contracting Officer's Representative, (CESAS-OP-[ ])	*2*	*TBP*	*TBP*
Environmental Team Member (CESAS-PD)	*3*		
Project Manager (CESAS-PM-C)	*4*		*TBP*

The Contractor shall also immediately report any take of a manatee to Georgia Nongame-Endangered Wildlife Program coastal office at (800) 272-8363 during work hours or (800) 241-4113 after hours or on weekends as well as the U.S. Fish and Wildlife Service, [Charleston Field Station at Phone 843-727-4707x211; Townsend Field Station at Phone 912-832-8739)

8. The Contractor shall maintain a daily log detailing sightings, collisions, or injuries to manatees occurring during the contract period. The data shall be recorded on forms provided by the Contracting Officer (sample form is appended to the end of this section). All data in original form shall be forwarded directly to the Chief of Environment and Resources Branch within 10 days of collection and copies of the data will be supplied to the Contracting Officer. Within 15 days, following project completion, a report summarizing the above incidents and sightings, including a list and addresses of all observers utilized during the construction will be submitted to the following:

Georgia Nongame-Endangered Wildlife Program

Chief, Planning Division
U.S. Army Corps of Engineers (CESAS-PD)

Contracting Officer's Representative
U.S. Army Corps of Engineers (CESAS-OP-[ ]

U.S. Fish and Wildlife Service
Brunswick, GA

Furthermore, during hopper dredge operations, National Marine Fisheries Service-approved observers will be on board 24 hours a day and will serve as a lookout to alert the vessel pilot of the occurrence of manatees in the project areas. If a manatee is observed, collisions shall be avoided either through reduced vessel speed, course alteration, or both. During the evening hours, when there is limited visibility due to fog, or when there are sea states of greater than Beaufort 3, the dredge must slow down to 5 knots or less when transiting between areas if manatees have been spotted within 15 nm of the vessel's path within 24 previous hours.

d. Effect Determination.

Considering that the "Manatee Protection Conditions" will be adhered to and NMFS-approved observers will be on board all hopper dredge operations, the proposed action may affect, but is not likely to adversely affect the manatee or any of its presently designated critical habitat.

6. 2.5 North Atlantic Right Whale, Finback Whale, Humpback Whale, Sei Whale, Blue Whale, and Sperm Whale

Of the six species of large whales being considered under this assessment, the North Atlantic right whale, sperm, and humpback whale would not normally be expected to occur within the AIWW during the periods of dredging activities; however, these three whales could be within the area of transport of dredged material for the ODMDS disposal options. The blue, finback, and sei whales are not discussed in detail in this assessment as they are unlikely to be within the vicinity of the coastal action area since they are typically offshore species, residing in deep water, and the activities conducted by USACE are coastal in nature. Additional information on blue, finback, and sei whales can be found in Blaylock *et al*. 1995; Waring *et al*. (1997, 1998, 1999, 2000, 2001, 2002, 2003, 2006, and 2007). Due to the rarity of sightings of these three whale species in the project impact area, USACE believes that any effects to them by the proposed dredging operations are discountable. Discountable effects under Section 7 of the ESA are those "extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur."

In support of this determination, USACE has reviewed recent consultations conducted by NMFS on Naval, Coast Guard and USACE operations and for those consultations, NMFS has also found that vessel operations and naval ordnance operations were likely to have a discountable effect on the blue, finback, and sei whales (NMFS, 2003b; NMFS, 2002; NMFS, 2000a; NMFS, 1998a, NMFS 1997c) within the Savannah Harbor Expansion Project consultation boundaries. The maintenance of the AIWW would be expected to have similar potential for impacts to these whales from the options involving sediment disposal in the ODMDS. Therefore, the proposed action may affect, but is not likely to adversely affect the Finback Whale, Sei Whale, and Blue Whale or any of their presently designated critical habitats.

a. Species Biology for the Humpback Whale, Sperm Whale, and North Atlantic Right Whale

1. Humpback Whale *(Megaptera novaeangliae)*

Life History and distribution

Humpback whales typically migrate between tropical/sub-tropical and temperate/polar latitudes. Humpback whales feed on krill and small schooling fish on their summer grounds. The whales occupy tropical areas during winter months when they are breeding and calving and polar areas during the spring, summer, and fall, when they are feeding, primarily on small schooling fish and krill.

In the Atlantic Ocean, humpback whales feed in the northwestern Atlantic during the summer months and migrate to calving and mating areas in the Caribbean. Six separate feeding areas are utilized in northern waters after their return. These areas are within the biologically important area defined by the 200-m (656-ft) isobath on the North American east coast. These areas are outside of the project's potential impact area. Humpback whales also use the mid-Atlantic as a migratory pathway and apparently as a feeding area, at least for juveniles. Since 1989, observations of juvenile humpbacks in that area have been increasing during the winter months, peaking January through March (Swingle *et al.* 1993). Biologists theorize that non-reproductive animals may be establishing a winter-feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean.

Humpback whale reproductive activities occur primarily in winter. They become sexually mature at age four to six. Annual pregnancy rates have been estimated at about 0.40-0.42 (NMFS unpublished and Nishiwaki, 1959). Cows will nurse their calves for up to 12 months. The age distribution of the humpback whale population is unknown, but the portion of calves in various populations has been estimated at about 12% (Chittleborough 1965, Whitehead 1982, Bauer 1986, Herman *et al.* 1980, and Clapham and Mayo 1987).

The information available does not identify natural causes of death among humpback whales or their number and frequency over time, but potential causes of natural mortality are believed to include parasites, disease, entrapment in ice, and predation (killer whales, false killer whales, and sharks). Other causes of mortality include: biotoxins, ship strikes, and entrapment in fishing or other gear.

Humpback whales exhibit a wide range of foraging behaviors, and feed on a range of prey types including small schooling fishes (particularly sand lance and Atlantic herring), euphausiids, and other large zooplankton. Fish prey in the North Pacific include herring, anchovy, capelin, pollack, Atka mackerel, eulachon, sand lance, pollack, Pacific cod, saffron cod, arctic cod, juvenile salmon, and rockfish. In the waters west of the Attu Islands and south of Amchitka Island, Atka mackerel were preferred prey of humpback whales (Nemoto 1957). Invertebrate prey includes euphausiids, mysids, amphipods, shrimps, and copepods. They target fish schools and filter large amounts of water for the associated prey. Humpback whales have also been observed feeding on krill.

Diving and social behavior

In Hawaiian waters, humpback whales remain almost exclusively within the 1820 m isobath and usually within 182 m. Maximum diving depths are approximately 150 m (492 ft) (but usually <60 m [197 ft]), with a very deep dive (240 m [787 ft]) recorded off Bermuda (Hamilton *et al.* 1997). They may remain submerged for up to 21 min (Dolphin 1987). Dives on feeding grounds ranged from 2.1-5.1 min in the north Atlantic (Goodyear unpubl. manus.). In southeast Alaska average dive times were 2.8 min for feeding whales, 3.0min for non-feeding whales, and 4.3 min for resting whales (Dolphin 1987). In the Gulf of California humpback whale dive times averaged 3.5 min (Strong 1989). Because most humpback prey is likely found above 300 m depths, most humpback dives are probably relatively shallow.

Clapham (1986) reviewed the social behavior of humpback whales. They form small unstable groups during the breeding season. During the feeding season they form small groups that occasionally aggregate on concentrations of food. Feeding groups are sometimes stable for long periods of times. There is good evidence of some territoriality on feeding grounds (Clapham 1994, 1996), and on wintering ground (Tyack 1981). On the breeding grounds males sing long complex songs directed towards females, other males or both. The breeding season can best be described as a floating lek or male dominance polygyny (Clapham 1996). Inter-male competition for proximity to females can be intense as expected by the sex ratio on the breeding grounds that may be as high as 2.4:1.

Humpbacks produce a wide variety of sounds. During the breeding season males sing long, complex songs, with frequencies in the 25-5000 Hz range and intensities as high as 181 dB (Payne 1970; Winn *et al.* 1970a; Thompson *et al.* 1986). Source levels average 155 dB and range from 144 to 174 dB (Thompson *et al.* 1979). The songs appear to have an effective range of approximately six to 12 miles (10 to 20 km). Animals in mating groups produce a variety of sounds (Tyack 1981; Tyack and Whitehead 1983, Silber 1986). Sounds are produced less frequently on the summer feeding grounds. Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz, with median durations of 0.2-0.8 sec and source levels of 175-192 dB (Thompson *et al.* 1986). These sounds are attractive and appear to rally animals to the feeding activity (D=Vincent *et al.* 1985; Sharpe and Dill 1997). In summary, humpback whales produce at least three kinds of sounds: 1) complex songs with components ranging from at least 20Hz B 4 kHz with estimated source levels from 144 B 174 dB, which are mostly sung by males on the breeding grounds (Payne 1970; Winn *et al.* 1970a; Richardson *et al.* 1995); 2) social sounds in the breeding areas that extend from 50Hz B more than 10 kHz with most energy below 3kHz (Tyack and Whitehead 1983, Richardson *et al.* 1995); and 3) Feeding area vocalizations that are less frequent, but tend to be 20Hz B 2 kHz with estimated sources levels in excess of 175 dB re 1 µPa-m (Thompson *et al.* 1986; Richardson *et al.* 1995). Sounds often associated with possible aggressive behavior by males (Tyack 1983; Silber 1986) are quite different from songs, extending from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz. These sounds appear to have an effective range of up to 9 km (Tyack and Whitehead 1983). Humpback whales respond to low frequency sound. They have been known to react to low frequency industrial noises at estimated received levels of 115 B 124 dB (Malme *et al.* 1985), and to conspecific calls at received levels as low as 102dB (Frankel *et al.* 1995). Humpback whales apparently reacted to 3.1 B 3.6 kHz sonar by changing behavior (Maybaum 1990 1993). Malme *et al.* (1985) found no clear response to playbacks of drill ship and oil production platform noises at received levels up to 116dB re 1 µPa. Studies of reactions to airgun noises were inconclusive (Malme *et al.* 1985).

Humpback whales on the breeding grounds did not stop singing in response to underwater explosions (Payne and McVay 1971). Humpback whales on feeding grounds did not alter short-term behavior or distribution in response to explosions with received levels of about 150dB re 1 µPa/Hz at 350Hz (Lien *et al.* 1993; Todd *et al.* 1996). However, at least two individuals were likely killed by the high intensity, impulse blasts and had extensive mechanical injuries in their ears (Ketten *et al.* 1993; Todd *et al.* 1996). The explosions may also have increased the number of humpback whales entangled in fishing nets (Todd *et al.* 1996). Frankel and Clark (1998) showed that breeding humpbacks showed only a slight statistical reaction to playback of 60 B 90 Hz bounds with a received level of up to 190 dB. While these studies have shown short-term behavioral reactions to boat traffic and playbacks of industrial noise, the potential for habituation, and thus the long-term effects of these disturbances are not known.

Population and Listing Status

Humpback whales were listed as endangered under the ESA in 1973. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for the species.

As of March 2007, NMFS' Stock Assessment report on the North Atlantic population (including the Gulf of Maine stock) of humpback whales, the stock is currently estimated to be 4,894 males (95% CI=3,374-7,123) and 2,804 females (95% CI=1,776-4,463) (Waring *et al*, 2007). The minimum population estimate for the Gulf of Maine stock is 647. According to the stock assessment, current data suggests that the Gulf of Maine stock is steadily increasing in size. PBR for the Gulf of Maine humpback whale is calculated to be 1.3 whales.

More detailed information on humpback whales can be located in the NMFS Stock Assessment reports under the MMPA (http://www.nmfs.noaa.gov/pr/sars/species.htm) and the Recovery Plan for Humpback Whale (*Megaptera novaeangliae)* (http://www.nmfs.noaa.gov/pr/pdfs/recovery/whale_humpback.pdf).

Impacts of human activity on this species

In the 1990s, no more than 3 humpback whales were killed annually in U.S. waters by commercial fishing operations in the Atlantic and Pacific Oceans. Between 1990 and 1997, no humpback whale deaths have been attributed to interactions with groundfish trawl, longline and pot fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska (Hill and DeMaster 1999). Humpback whales have been injured or killed elsewhere along the mainland U.S. and Hawaii (Barlow *et al.* 1997). In 1991, a humpback whale was observed entangled in longline gear and released alive (Hill *et al.* 1997). In 1995, a humpback whale in Maui waters was found trailing numerous lines (not fishery-related) and entangled in mooring lines. The whale was successfully released, but subsequently stranded and was attacked and killed by tiger sharks in the surf zone.

Humpback whales seem to respond to moving sound sources, such as whale-watching vessels, fishing vessels, recreational vessels, and low-flying aircraft (Beach and Weinrich 1989, Clapham *et al.* 1993, Atkins and Swartz 1989). Their responses to noise are variable and have been correlated with the size, composition, and behavior of the whales when the noises occurred (Herman *et al.* 1980, Watkins *et al.* 1981, Krieger and Wing 1986). Several investigators have suggested that noise may have caused humpback whales to avoid or leave feeding or nursery areas (Jurasz and Jurasz 1979b, Dean *et al.* 1985), while others have suggested that humpback whales may become habituated to vessel traffic and its associated noise. Still other researchers suggest that humpback whales may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle *et al.* 1993; Wiley *et al.* 1995).

Humpback whales are killed by ship strikes along both coasts of the US. On the Atlantic coast, 6 out of 20 humpback whales stranded along the mid-Atlantic coast showed signs of major ship strike injuries (Wiley *et al.* 1995). Almost no information is available on the number of humpback whales killed or seriously injured by ship strikes outside of US waters.

Critical Habitat

No critical habitat has been designated for humpback whales under the ESA.

2. **Sperm Whale (*Physeter macrocephalus*)**

Life History and distribution

There are estimated to be approximately two million sperm whales worldwide. In the western North Atlantic they range from Greenland to the GOM and the Caribbean. The sperm whales that occur in the eastern US EEZ are believed to represent only a portion of the total stock (Blaylock, et al. 1995). Sperm whales generally occur in waters greater than 180 meters in depth. While they may be encountered almost anywhere on the high seas their distribution shows a preference for continental margins, sea mounts, and areas of upwelling, where food is abundant (Leatherwood and Reeves 1983). Waring, et al. (1993) suggest sperm whale distribution is closely correlated with the Gulf Stream edge. Like swordfish, which feed on similar prey, sperm whales migrate to higher latitudes during summer months, when they are concentrated east and northeast of Cape Hatteras. Bull sperm whales migrate much farther poleward than the cows, calves, and young males. Because most of the breeding herds are confined almost exclusively to warmer waters many of the larger mature males return in the winter to the lower latitudes to breed.

In the Atlantic Ocean, NMFS' most recent stock assessment report notes that sperm whales are distributed in a distinct seasonal cycle, concentrated east-northeast of Cape Hatteras in winter and shifting northward in spring when whales are found throughout the Mid-Atlantic Bight. Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in summer and then south of New England in fall, back to the Mid-Atlantic Bight. There is also a very large population of sperm whales found in the Gulf of Mexico near the Mississippi River delta.

Female sperm whales take about 9 years to become sexually mature (Kasuya 1991, as cited in Perry *et al.* 1999). Male sperm whales take between 9 and 20 years to become sexually mature, but will require another 10 years to become large enough to successfully compete for breeding rights (Kasuya 1991). Adult females give birth after about 15 month's gestation and nurse their calves for 2 - 3 years. The calving interval is estimated to be about four to six years (Kasuya 1991). The age distribution of the sperm whale population is unknown, but sperm whales are believed to live at least

60 years (Rice 1978). Estimated annual mortality rates of sperm whales are thought to vary by age, but previous estimates of mortality rate for juveniles and adults are now considered unreliable (IWC 1980, as cited in Perry *et al.* 1999). Sperm whales are known for their deep foraging dives (in excess of 3 km). They feed primarily on mesopelagic squid, but also consume octopus, other invertebrates, and fish (Tomilin 1967, Tarasevich1968, Berzin 1971). Perez (1990) estimated that their diet in the Bering Sea was 82% cephalopods (mostly squid) and 18% fish. Fish eaten in the North Pacific included salmon, lantern fishes, lancetfish, Pacific cod, pollack, saffron cod, rockfishes, sablefish, Atka mackerel, sculpins, lumpsuckers, lamprey, skates, and rattails (Tomilin 1967, Kawakami 1980, Rice 1986b). Sperm whales taken in the Gulf of Alaska in the 1960s had fed primarily on fish. Daily food consumption rates for sperm whales ranges from 2 - 4% of their total body weight (Lockyer 1976b, Kawakami 1980).

Population Dynamics and Status

Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). Sperm whales were listed as endangered under the ESA in 1973. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for sperm whales.

As of the NMFS December 2005 Stock Assessment Report on the North Atlantic Stock of sperm whales population is currently estimated at approximately between 3,539 and 4,804 (CV=0.38). According to the stock assessment, there is insufficient data to determine the population trend for the species. Potential Biological Removal (PBR) for the western North Atlantic sperm whale is calculated to be 7.0 whales.

More detailed information on sperm whales can be located in the NMFS Stock Assessment reports under the MMPA (http://www.nmfs.noaa.gov/pr/sars/species.htm) and the *Draft Recovery Plan for Sperm Whale* ***(***Physeter macrocephalus***)***.
(http://www.nmfs.noaa.gov/pr/pdfs/recovery/draft_spermwhale.pdf).

Threats

Potential sources of natural mortality in sperm whales include killer whales and papilloma virus (Lambertson *et al.* 1987). In US waters in the Pacific, sperm whales are known to have been incidentally taken only in drift gillnet operations, which killed or seriously injured an average of 9 sperm whales per year from 1991-1995 (Barlow *et al.* 1997). Interactions between longline fisheries and sperm whales in the Gulf of Alaska have been reported over the past decade (Rice 1989, Hill and DeMaster 1999). Observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on fish caught in longlines in the Gulf of Alaska. During 1997, the first entanglement of a sperm whale in Alaska’s longline fishery was recorded, although the animal was not seriously injured (Hill and DeMaster 1998). The available evidence does not indicate sperm whales are being killed or seriously injured as a result of these interactions, although the nature and extent of interactions between sperm whales and long-line gear is not yet clear.

Critical Habitat

No critical habitat has been designated for sperm whales under the ESA.

3. North Atlantic Right Whale (*Eubaleana glacialis*)

Effective April 7, 2008, the NMFS listed the endangered northern right whale (*Eubalaena spp*.) as two separate, endangered species, North Pacific right whale (*E. japonica*) and North Atlantic right whale (*E. glacialis*). Therefore, for the purposes of this assessment, the right whale will be discussed as the North Atlantic right whale and all references to critical habitat designations will be for the North Atlantic right whale as set forth on June 3, 1994 (59 FR 22805).

Life History and Distribution

North Atlantic right whales (NARW) are highly migratory, summering in feeding and nursery grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf (Waring *et al*, 2001). They migrate southward in winter to the northeastern coast of Florida. The breeding and calving grounds for the right whale occur off of the coast of southern Georgia and north Florida and have been designated as critical habitat (Figure 7-6) under the ESA in 1994 (59 FR 28793). The critical habitat does not extend into the most of the impact area for this project; however, it does extend into the Brunswick ODMDS area (Figure 1-2). During the winter months, right whales are routinely seen close to shore in the critical habitat area. There have been two sightings of northern right whales that migrated into the Gulf of Mexico. The first was a mother-calf pair (#2360 and calf – New England Aquarium Right Whale Database) sighted north of the Port of Miami on January 30, 2004, swimming toward the south and was later seen on several occasions that spring in the Gulf of Mexico off Panama City, Florida. These two animals were re-sighted in the Great South Channel near Massachusetts in May 2004. In December 2005, a mother/calf pair right whale that was seen off central Florida and later documented in the Corpus Christi ship channel, Corpus Christi, Texas in January 2006. This animal was also confirmed as being a member of the north Atlantic stock, NARW # 2503 and her calf. These two animals were re-sighted in the Bay of Fundy in the summer of 2006 (Amy Knowlton, New England Aquarium, 2008 pers. Comm.). These sightings mean that these two right whales and their calves passed by several very active east coast ports not once, but twice during their transit to and from the Gulf of Mexico. While North Atlantic right whales have been historically reported in south Florida and the Gulf of Mexico, these sightings are extremely rare (USACE, 2012; New England Aquarium North Atlantic right whale Catalog, accessed January 2008).

Kraus et al. (1993) has found the area around the Florida/Georgia border and Jacksonville, Florida, in the widest area of the shallow-water shelf in the Georgia Bight, to be the primary and probably only calving ground for western North Atlantic right whales. They found cow/calf pairs to be primarily limited to the coastal waters between latitudes 27 degrees 30 minutes N and 32 degrees N. They also report right whales to be concentrated between Daytona Beach, Florida and Brunswick, Georgia. Highest densities are around Jacksonville, Florida, and the Florida/Georgia border. Most whale sightings occur between December and February within 15 miles of shore (but can be seen between November and late March). A few sightings have been reported as early as September and as late as June. This study documents six right whale sightings between Brunswick and Savannah. They quote an earlier estimate that no more than 350 right whales survive in the western North Atlantic and state that there have been 272 sightings of 87 identified non-calf right whales and 66 calves between 1980 and 1992. They further state that 74 percent of the known reproducing females have been documented off the southeast coast for the period 1980 to 1992.

In a Wildlife Trust report that was prepared for NOAA, Schulte and Taylor (2009) reported, "*A total of 56 surveys were flown from November 15, 2008, to April 15, 2009, and extended from North Myrtle Beach, South Carolina (33.82ºN) to St. Catherine's Island, Georgia (31.58ºN). Preliminarily, 49 right whale sightings consisting of 121 right whales were documented (including resights of 21 individuals and two individuals sighted three times). Sightings consisted of 19 cow/calf pairs, 12 single whales, and 19 groups of two or more adult/juvenile right whales (one of which also included a cow/calf pair). Preliminary photo analysis has resulted in the confirmed identification of 14 individual cow/calf pairs and 28 of the individual adult/juvenile whales. The individuals documented include 27 males, 30 females, and 38 individuals of unknown gender (including calves), for a total of 95 individual whales in the study area. Of the 30 females seen, 21 gave birth to new calves this season, although only fourteen were seen with their calves within the study area. The remaining seven females were seen while pregnant prior to giving birth further south. Preliminary sightings of note include sixteen individuals that were unique to the study area and not sighted by other survey teams to the south. Other notable sightings include the first cow/calf pair of the season; eleven surface active groups; and a sighting of Ruffian (EGNO 3530), a whale with prior severe injuries.*" Using a photo-identification technique to estimate the minimum population size of individual whales, Kraus et al. (2001) identified 291 right whales in 1998. Based on this estimated population size, current models suggest that, if current trends continue, the population could go extinct in less than 200 years (Caswell et al., 1999). Ship strikes are a major cause of mortality and injury to right whales within several major shipping corridors on the eastern U.S. and southeastern Canadian coasts. From 1997-2001 the average reported mortality and serious injury due to ship strikes was 0.8 whales per year (Kraus 1990; Knowlton and Kraus 2001). According to Jensen and Silber (2003), a total of 292 large whale ship strikes have occurred worldwide from 1975-2002 of which 38 (13%) were right whales (~1.4 whales per year). Based on the data provided for each strike, the average ship speed was 18.1 knots. Ship strikes are responsible for over 50 percent of known human-related right whale mortalities and are believed to be one of the principal causes for the lack of recovery of the population (Federal Register/Vol. 69, No. 105).

Known occurrences of right whales in the Savannah area

a. 1992 (Dec 1992 to Mar 1993). Aerial surveys for right whales were conducted by the Savannah District during Savannah Harbor bar channel dredging. During the December 1992 bar channel dredging, aerial surveys were conducted by Christopher Slay, New England Aquarium, from November 30 to December 20, 1992. Surveys were flown on all but one day, December 19, 1992. One right whale was spotted during the survey (December 8, 1992). These data indicate that 5 percent of the survey days resulted in detection of a right whale.

b. 1993 (Dec 1993 to Mar 1994). Two right whales were spotted by a pilot boat and the pre-dredge turtle survey crew on December 4, 1993. Aerial surveys were flown every day that weather permitted from 12/12/93 to 2/22/94 (58 days flown out of 73 possible). Whales were spotted on 12/12/93 (3 subadults), 12/18/93 (cow/calf pair), 01/23/94 (cow/calf pair). These data indicate that 5 percent of the survey days resulted in detection of right whales. However, 2 out of 19 survey days in December (11 percent) resulted in detection of right whales.

c. 1994 (Dec 1994 to Mar 1995). Aerial surveys were conducted as weather allowed between December 1 and 31, 1994. Twenty complete surveys were flown and one whale was spotted on December 5, 1994 (5 percent of survey days).

d. 1995 (Dec 1995). No aerial survey was conducted. No whales were sighted from the dredge during the Bar Channel dredging performed from December 5 to 26, 1995.

e. Analyses by Kraus et al., 1993, on the mean latitude of whale sightings by week, indicate that areas at or north of Savannah fall within one standard deviation of the mean for December 1 to January 4. This is also true for the weeks of March 16 through April 5. In other words, sightings data at that time indicated right whales were most likely to be encountered in the Savannah area during those timeframes.

Ship strikes are known to be a major cause of anthropogenic mortality in the right whale (NMFS, 1991), although there are no documented strikes by ships associated with any southeastern dredging project (NMFS, 1991). Most right whales spotted in the southeast are found from 1 to 15 nautical miles from shore (Kraus et al., 1993, Ellis et al., 1993). Kraus et al. 1993, found that swimming speeds of cow-calf pairs averaged 0.41 km/hr and whales not accompanied by calves averaged 0.51 km/hr. Movements of individual cow-calf pairs ranged from less than 1 km/day to 38.8 km/day. One statistical test found that non-cow right whales travel significantly farther and faster than right whales accompanied by a calf. They also found that cows with calves are more active at the surface than other classes of right whales in the region. It appears that the behavior of this species, including its swimming speed, makes it particularly susceptible to impact from collisions with ships. A review of the “Large Whale Ship Strike Database” (Jensen and Silber, 2003) found five recorded ship strikes of NARW’s offshore of Florida, all between Fernandina and Jacksonville from 1975 - 2002. There have been at least two additional ship strikes (one in 2003 and one in 2006) in that same area since 2002.

Available data indicate that right whales can be expected to transit the Savannah entrance channel primarily during the month of December for the fall migration and for the spring migration to begin transit in mid-March.

The current distribution and migration patterns of the eastern North Atlantic right whale population are not completely defined. However, sighting surveys from the eastern Atlantic Ocean suggest that right whales are rarely present in this region. Based on a census of individual whales identified using photo-identification techniques and the assumption that whales not seen for 7 years are dead, the western North Atlantic stock size was estimated to be 295 individuals in 1992 (Knowlton *et al*., 1994); an updated analysis using the same method gave an estimate of 299 animals in 1998 (Kraus *et al*., 2001).

The National Recovery Plan for the Northern right whale, dated May 2005 (NMFS, 2005) , defines the coastal waters of the southeastern United States and, especially, the shallow waters from Savannah, Georgia, south to Cape Canaveral, Florida, as the wintering ground for a small but significant part of the North Atlantic right whale population. According to the Recovery Plan, most records of sighting involve adult females, many of them accompanied by very young calves, although a few juveniles and males have been sighted in the region. The majority of individuals in the western North Atlantic population range from wintering and calving areas in coastal waters off the southeastern United States to summer feeding and nursery grounds in New England waters and north to the Bay of Fundy and Scotian Shelf. Five areas of "high use" were identified by NMFS in 1991, reconfirmed in the 2005 Recovery Plan and are still key habitat areas for right whales:

1. Coastal Florida and Georgia (Sebastian Inlet, Florida to the Altamaha River, Georgia)
2. The Great South Channel (east of Cape Cod)
3. Massachusetts Bay and Cape Cod Bay
4. The Bay of Fundy, and
5. The Scotian Shelf, including Browns and Baccaro Banks, Roseway Basin and areas to the east

While recent data may indicate other calving locations (RWC, 2007), Kraus et al. (1993) found the area around the Florida/Georgia border and Jacksonville, Florida, in the widest area of the shallow-water shelf in the Georgia Bight, to be the primary calving ground for western North Atlantic right whales. They found cow/calf pairs to be primarily limited to the coastal waters between latitudes 27 degrees 30 minutes N and 32 degrees N. They also report North Atlantic right whales to be concentrated between Daytona Beach, Florida and Brunswick Georgia. Highest densities are around Jacksonville, Florida, and the Florida/Georgia border. Most whales occur between December and February within 15 miles of shore (but can be seen between November and late March). A few sightings have been reported as early as September and as late as June.

Population Dynamics and Status

Right whales are one of the most critically endangered whale species in the world and are protected under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). The North Atlantic right whale was listed as endangered under the Endangered Species Conservation Act in June 1970, the precursor to the ESA. The species was subsequently listed as endangered under the ESA in 1973, and designated as depleted under the MMPA.

The official population of north Atlantic right whales stated in the Annual NMFS Marine Mammal Stock Assessment (Waring *et al*, 2007) is listed as 205 animals in 2001. More recent data from the North Atlantic Right Whale Consortium in 2006 and 2007 states that the minimum estimated population within the north Atlantic Region is between 179 and 176 animals (NARC, 2006; NARC, 2007). This estimate is based solely on the whales cataloged as alive in 2005 and 2006 in the New England Aquarium's right whale identification catalog. The conservative middle estimate of population is between 296 and 393 individual whales. This is based on the 2005 and 2006 survey data which is the sum of the cataloged whales presumed alive in 2005/06, the intermatch whales that were likely to be added to the catalog, calves from 2004 to 2006 that were also likely to be added to the catalog. The high estimate of the current population of North Atlantic right whales is between 591 and 579 individuals. This is a sum, based on 2005 and 2006 survey data, of the cataloged whales, minus known dead individuals; active intermatch animals without calves and calves (2004 – 2006 calves) minus the known dead. These numbers are based on completed analysis of 2005/06 survey data and were presented at the annual Right Whale Consortium meeting held in New Bedford, Ma November 2006 and 2007

(http://www.rightwhaleweb.org/papers/pdf/NARWC_Report_Card2006.pdf and http://www.rightwhaleweb.org/papers/pdf/NARWC_Report_Card2007.pdf)

As of the NMFS March 2007 Stock Assessment report on the NARW, the minimum population size is currently estimated at approximately 306 animals known alive in 2001 (based on the NE Aquarium sighting catalog) (Waring *et al*, 2007). No estimate of abundance with an associated coefficient of variability is available. There is disagreement in the literature over whether the population is growing, stagnant or in decline. Potential Biological Removal (PBR) for the western Atlantic right whale is calculated to be zero whales.

Threats and Outlook

Based on the current estimated population size, current models suggest that, if current trends continue, the population could go extinct in less than 200 years (Caswell *et al.*, 1999). Ship strikes are known to be a major anthropogenic cause of mortality for North Atlantic right whales within several major shipping corridors on the eastern U.S. and southeastern Canadian coasts (NMFS, 1991c). The number of deaths from natural causes is unknown at the present time.

Most North Atlantic right whales spotted in the southeast are found from 1 to 15 nautical miles from shore (Kraus *et al*., 1993; Ellis *et al.*, 1993). Kraus *et al*. 1993, found that swimming speeds of cow-calf pairs averaged 0.41 km/hr and whales not accompanied by calves averaged 0.51 km/hr. Movements of individual cow-calf pairs ranged from less than 1 km/day to 38.8 km/day. One statistical test found that non-cow North Atlantic right whales travel significantly farther and faster than North Atlantic right whales accompanied by a calf. They also found that cows with calves are more active at the surface than other classes of North Atlantic right whales in the region. It appears that the behavior of this species, including its swimming speed, makes it particularly susceptible to impact from collisions with ships. From 1997-2001 the average reported mortality and serious injury due to ship strikes was 0.8 whales per year (Kraus 1990; Knowlton and Kraus, 2001). According to Jensen and Silber's (2003) large whale ship strike database, a total of 292 large whale ship strikes have occurred worldwide from 1975-2002 of which 38 (13%) were North Atlantic right whales (~1.4 whales per year). Based on the data provided for each strike, the average ship speed was 18.1 knots. Ship strikes are responsible for over 50 percent of known human-related North Atlantic right whale mortalities and are believed to be one of the principal causes for the lack of recovery of the population (Federal Register/Vol. 69, No. 105). It should be noted that a review of Jensen and Silber, as well as USACE records has not found any ship strike attributed to a USACE-owned or USACE-contracted vessel. The number of deaths from natural causes is unknown at the present time.

Additional threats to North Atlantic right whales may include habitat degradation, contaminants, climate and ecosystem change, and predators such as large sharks and killer whales. Disturbance from such activities as whale watching and noise from industrial activities may affect the population. These impacts would be expected to continue to increase even if the proposed project is implemented.

A complete assessment of NARW recovery efforts and activities is reviewed in the Recovery Plan for the "North Atlantic Right Whale (Eubalaena glacialis)" (NMFS, 2005) http://www.nmfs.noaa.gov/pr/pdfs/recovery/whale_right_northatlantic.pdf.

Speed Restrictions

***Final Rule - Speed Restrictions**:* Federal Register / Vol. 73, No. 198/ Friday, October 10, 2008; RIN 0648-AS36

On October 10, 2008, the NMFS implemented regulations for mandatory vessel speed restrictions of 10 knots (about 11 mph) or less on vessels 65 feet or greater in overall length in certain locations and at certain times of the year along the east coast of the US Atlantic seaboard. The purpose of this rule is to reduce the likelihood of deaths and serious injuries to endangered North Atlantic right whales that result from collisions with ships. Under an agreement between NMFS, US Coast Guard, US Navy and USACE, vessels operated by Federal agencies, or are under contract to Federal agencies are exempt from the proposed regulations; however, operation of these vessels will be subject to guidance provided through consultations under the ESA.

The rule divides the US east coast into three large sub-areas: Southeast US, Mid-Atlantic US, and Northeast US. Within each, NMFS seasonal rules restrict vessels speed to 10 knots or less. The areas, and the times in which they would be in effect, are as concisely and specifically defined as possible to reflect the known occurrences or right whales.

Mandatory Speed Restriction Areas

(1) Southeast U.S.: Vessels shall travel at a speed of 10 knots or less during the period of November 15 to April 15 each year in the area bounded by: the shoreline, 31º 27'N lat, 29º 45'N lat., and 80º 51.6'W long. (Figure 7-6)

(2) Mid-Atlantic U.S.: Vessels shall travel 10 knots or less in the period November 1 to April 30 each year (Figure 7-7).

(i) Within 30 nautical mile radius at the:
- (A) Ports of New York/New Jersey
- (B) Delaware Bay (Ports of Philadelphia and Wilmington);
- (C) Entrance to the Chesapeake Bay (Ports of Hampton Roads and Baltimore);
- (D) Ports of Morehead City and Beaufort, NC;
- (E) Port of Wilmington, NC
- (F) Port of Georgetown, SC;
- (G) Port of Charleston, SC;
- (H) Port of Savannah, GA; and

(ii) In Block Island Sound, in the area with a 30 nm width extending south and east of the mouth of the sound.

District-Specific Information on Speed Restrictions

The Savannah District has been engaged in efforts to protect the Right Whale for many years. The District has participated in Southeast Regional Implementation Plan meetings and has helped to fund the Early Warning System aerial surveys. The District views the aerial surveys as both a means of lessening the potential for vessel collisions but more importantly as a means of assessing Right

Whale abundance and population health in the southeast. In accordance with past Regional Opinions, the District also requires endangered species observers on all hopper dredges contracted by the District.

In accordance with past practices regarding efforts to protect the North Atlantic Right Whale, the Savannah District intends to conduct the proposed project maintenance activities in accordance with the terms of the South Atlantic Region Biological Opinion (SARBO) that is in effect at that time. The District participated in and reviewed the draft South Atlantic Region Biological Assessment provided to the NMFS by CESAD as part of the consultation process for the new Biological Opinion. The District intends to comply with the new SARBO (and subsequent versions) once it is finalized and implemented.

Savannah District reviewed data from the FY09/10 hopper dredging maintenance contract for the Savannah Harbor entrance channel – the most recent contract. No whales were spotted in the Savannah entrance channel during that contract performance period. In that contract, the small hopper dredge (5,000 CY capacity) made 150 trips to the ODMDS to remove 623,000 CY of sediment. The average distance to the ODMDS was 3.25 miles. The maximum speed of the dredge was 12 knots. Assuming the dredge needed to comply with a 10-knot speed restriction, sailing time will increase by approximately 1 day and incur approximately $22,000 in additional annual dredging costs.

USACE and NOAA Fisheries are jointly developing a new SARBO to replace the 1997 version. NOAA Fisheries has expressed a desire to include additional speed restrictions in the new SARBO for hopper dredges that operate during the right whale calving season of 15 November through 15 April. In the event that construction of this project is initiated prior to the resolution of the region-wide speed restriction issue, USACE agrees to implement a non-precedential, interim measure during implementation of this project as follows: hopper dredges will comply with a 10-knot speed limit during calving season in accordance with recent NMFS recommendations. The District would abide by the terms of new SARBOs when they are finalized.

Right Whale "Early Warning System (EWS)"

Aerial surveys and photo-identification of right whales have been conducted in the Southeast at least since 1984 (Kraus, 1985). In 1988, right whales were observed on two separate occasions (February 6, 1988 and April 11, 1988) by hopper dredges in transit to the offshore disposal area while dredging the Kings Bay entrance channel (NMFS BO for Brunswick Harbor channel deepening, included with May 8, 1991 NMFS letter to the Savannah District). NMFS stated in the BO that, "during the February 6, 1988, encounter, the whale exhibited unexpected behavior when the vessel approached to within 100 yards. The animal oriented itself facing the vessel head on. If this behavior is the normal defense mechanism of this species, the possibilities of night collisions between vessels and right whales are greatly increased because the animals may take no action to avoid approaching vessels." That BO also contained the following language: "NMFS concludes that the proposed activities are not likely to jeopardize the continued existence of the right whale (*Eubalaena glacialis*). This conclusion is based on assurances that measures will be taken to ensure that whales are not impacted by this activity." This position by NMFS encouraged development of methods by which whales could be detected.

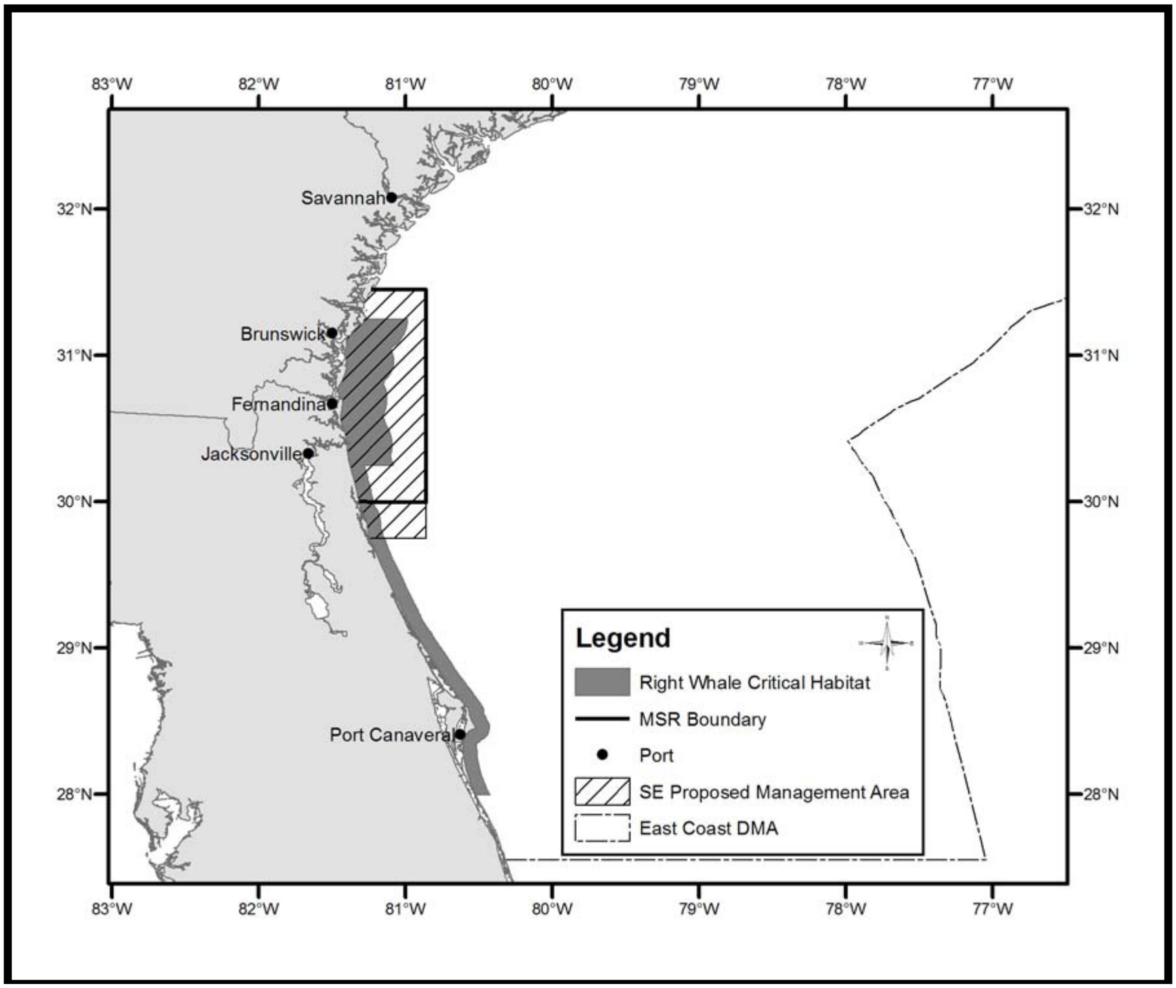

Figure 6-6 Proposed Southeastern US area mandatory speed restrictions November 15th through April 15th (calving and nursery grounds).

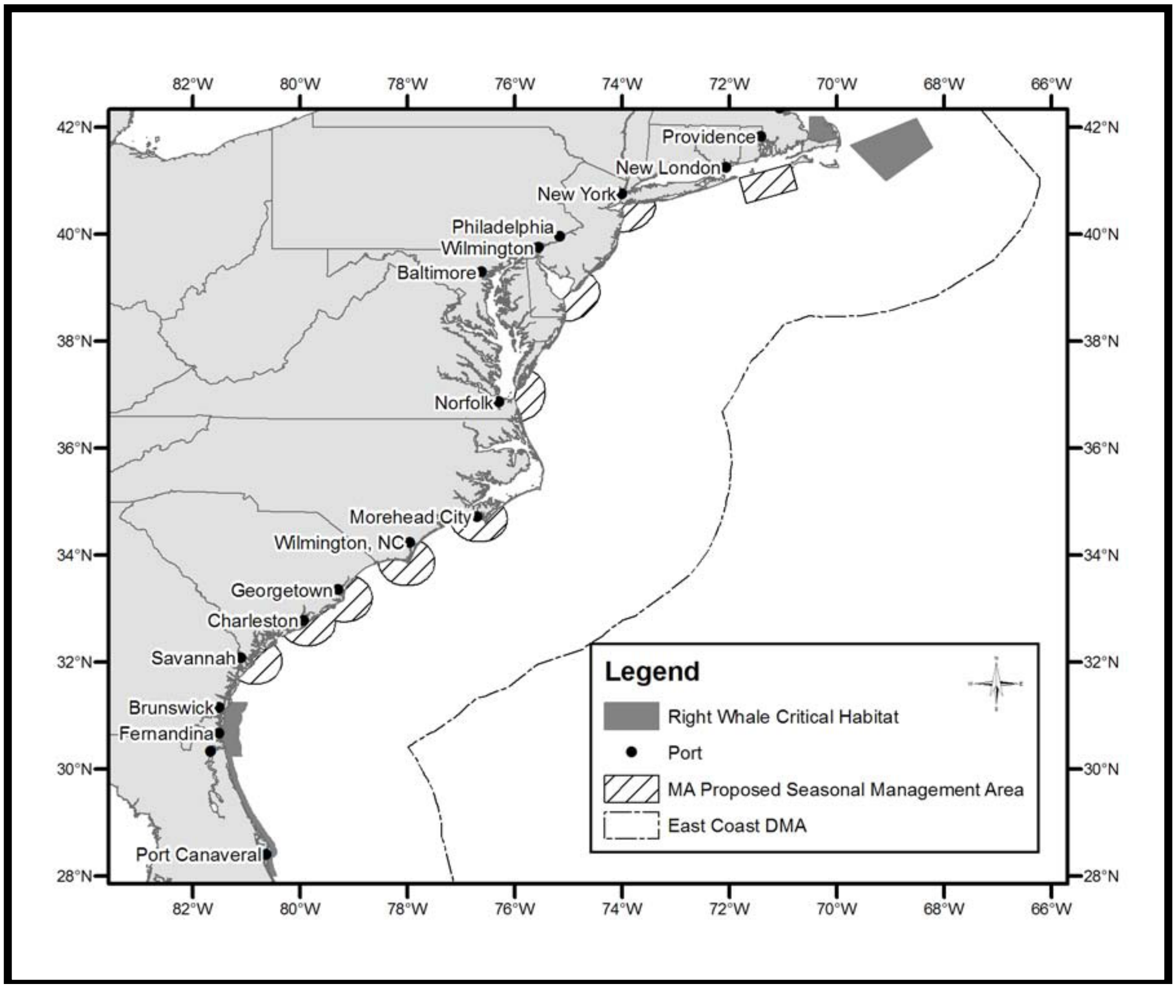

Figure 6-7. Proposed Mid-Atlantic US area mandatory speed restriction November 1 through April 30 (migratory route)

The Savannah District required its hopper dredging contractors to conduct aerial surveys during dredging work during the winter of 1992-1993. During the summer of 1993, the NMFS organized meetings through which agreement was reached under a Memorandum of Understanding between USACE, Navy, Coast Guard, and NMFS to conduct coordinated aerial surveys. Due to an inability of NMFS to accept funding from USACE in time for the 1993-1994 dredging season, USACE was forced to fund aerial surveys associated only with its dredging projects. An expanded program funded jointly by the four agencies was established by the 1994-1995 dredging season. This expanded program of aircraft surveys for right whales was renamed the right whale "Early Warning System (EWS)." (M. Brown in Kraus and Rolland, 2007) (Figure 20). The original focus area of the EWS was limited to the coastal waters from Jacksonville, Florida north to Brunswick, Georgia. The funding for the aerial surveys continues to be provided by both the Savannah and Jacksonville Districts of USACE, the Coast Guard, and the Navy, and for FY2008 is approximately $180,000 per agency. Based on the current contract between NOAA and the New England Aquarium this annual cost is expected to climb to as high as $200,000 before the current contract expires on September 30, 2011. Since FY 1999, USACE has provided approximately $1.4 million to the EWS and the Jacksonville District has contributed an additional $200,000 toward the volunteer sighting network run by the Marineland Right Whale project and Associated Scientists of Woods Hole, which contributes right whale sighting information to the EWS.

The original Early Warning System was modified in 2003, splitting the main survey area into three survey areas and expanding the survey areas further offshore (Figure 7-8). This modification emphasized the dual nature of the survey efforts as focusing on ship strike avoidance and demographic surveys. The three survey areas are now known as the Central, Southern and Northern EWS areas. The Northern and Southern survey areas are not paid for by USACE funding.

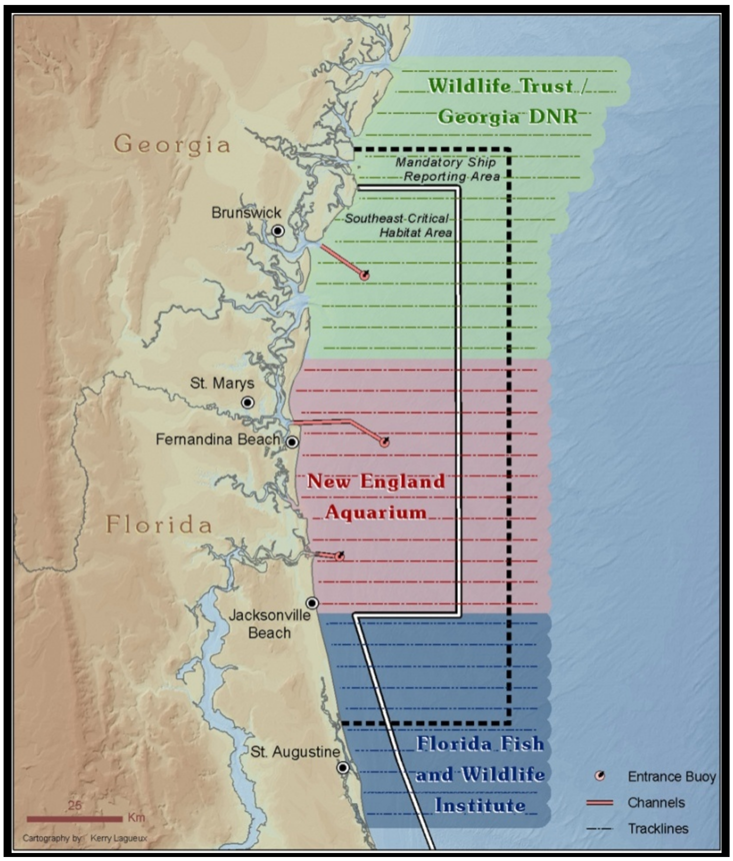

Figure 6-8. The three aerial early warning system zones – Northern, Central and Southern denoted by color changes (north – green; central – red, and southern – blue)

The Central EWS surveys are flown daily, weather permitting, from the beginning of December through the end March, covering over 1000 square miles of ocean encompassing the St. Mary's and St. John's rivers, which cover the Kings Bay, Fernandina, Mayport and Jaxport project areas and any shore protection projects in that area. The Brunswick and Savannah entrance channels area covered by Northern EWS. The survey team is comprised of two observers, and two pilots. A 1000' grid pattern over the water is used searching for right whales and documenting the presence of commercial, military and dredge vessel traffic. Right whale locations are radioed to the team's ground station that relays the information to the FASFACSJAX EWS system – Navtex, etc for locations to the vessels in the area so that course and speed changes may be made, as needed to avoid whales (Zani *et al.*, 2006).

All of the aerial surveys are flown by a contractor to detect right whales in the calving grounds and relay their locations immediately via a digital pager system to the funding agencies, harbor pilots, mariners in the area of sightings, Georgia and Florida state agencies, and others. Through this communication, vessel captains avoid collisions and can maintain an efficient speed into and out of the ports. It has also facilitated the gathering of important behavioral data on calf production, movement and other habitat related data. Furthermore, it has been suggested that monitoring the population on the wintering/calving grounds may be the best way to assess the population size and trends, thus the surveillance data is vitally important for several reasons.

Detailed EWS reports and right whale sighting information can be found at: -
http://rwhalesightings.nefsc.noaa.gov/
http://whale.wheelock.edu/Welcome.html.

Savannah District Contract Specifications

Beyond the aerial surveys funded by the Savannah District, the District has a specific set of specifications that deal with large whale (and sometimes specifically right whale) protection measures. These specifications require a NMFS-approved Endangered Species Observer approved for whale monitoring be onboard each hopper dredge during the time that right whales may be in the area. Savannah District's specification language is included below.

WHALES

a. No incidental take of right whales is authorized. Normal vessel speeds may be used at the Contractor's discretion, except as noted below, for the duration of this Contract during daylight hours (sunrise to sunset). However, the Contractor shall restrict dredge and attendant vessel speeds to 5 knots or less (or minimum safe speed) during night (sunset to sunrise) operations unless there is no information from the right whale early warning system (RWEWS) or any other observations/information that reveals any right whales within 15 nautical miles of the project area. If aerial surveys for right whales show no sightings on a particular day, the vessel speeds will be unrestricted during the following nighttime operations. If a right whale is determined through any means to be in the project area on a particular day, negative results from any other type of survey on that same day shall not serve to cancel that night's restriction of dredge and attendant vessel speeds. For the AIWW, the project area would consist of the designated offshore disposal areas shown on the Contract drawings, and transit routes. If right whale occurrence/distribution information is not available from the RWEWS due to severe weather restrictions, then vessel speeds will be restricted to 5 knots (or minimum safe speed) during night operations. It is currently expected that the RWEWS will be in effect from December through March for the AIWW. No aerial survey is required when the RWEWS is not in effect. Nighttime speeds will still be restricted to 5 knots or less (or minimum safe speed) when the RWEWS is not in effect if other information indicates right whales are in the project area.

b. The requirement for nighttime speed restrictions are available from the COR (OP-NN) or the RWEWS on a daily basis. Previous right whale monitoring along the Georgia coast indicates that for Savannah Harbor the Contractor might expect up to 8 nights of reduced speed operations between 1 December and 31 March. For Brunswick Harbor, the Contractor might expect up to 13 nights of reduced speed operations between 1 December and 31 March. Contractor should also expect at least 22 days of additional reduced speed operations between the period of 1 December and 31 March due to weather restricting RWES aerial surveys.

c. During daylight hours, the dredge operator shall take necessary precautions to avoid whales. If whales have been spotted within 15 nautical miles of the project area in the previous 24 hours, then the dredge shall slow down to 5 knots or less (or minimum safe speed) when transiting to and from the dump site during evening hours or during daylight hours when there is limited visibility due to fog or sea states of greater than Beaufort 3.

d. The hopper dredge shall not get closer than 500 yards to right whales.

Critical Habitat

Published in the Federal Register on 03 June, 1994, NMFS designated critical habitat for the Northern right whale (Figure 7-9). By this final rule, NMFS designated areas essential for the reproduction, rest and refuge, health, continued survival, conservation and recovery of the northern right whale population. The following areas are designated as critical habitat:

Great South Channel: The area designated as critical habitat in these waters is bounded by the following coordinates: 41 deg.40'N/ 69 deg.45'W; 41 deg.00'N/69 deg.05'W; 41 deg.38'N/68 deg.13'W; 42 deg.10'N/68 deg.31'W.

Cape Cod Bay: The area designated as critical habitat in these waters is bounded by the following coordinates: 42 deg.04.8'N/ 70 deg.10.0'W; 42 deg.12'N/70 deg.15'W; 42 deg.12'N/70 deg.30'W; 41 deg.46.8'N/70 deg.30'W; and on the south and east, by the interior shoreline of Cape Cod, MA.

Southeastern United States: The area designated as critical habitat (Figure 7-9) in these waters encompasses waters between 31 deg.15'N (approximately located at the mouth of the Altamaha River, GA) and 30 deg.15'N (approximately Jacksonville, FL) from the shoreline out to 15 nautical miles offshore; and the waters between 30 deg.15'N and 28 deg.00'N (approximately Sebastian Inlet, FL) from the shoreline out to five nautical miles.

For the purposes of this assessment, critical habitat is found within the southern portion of the AIWW.

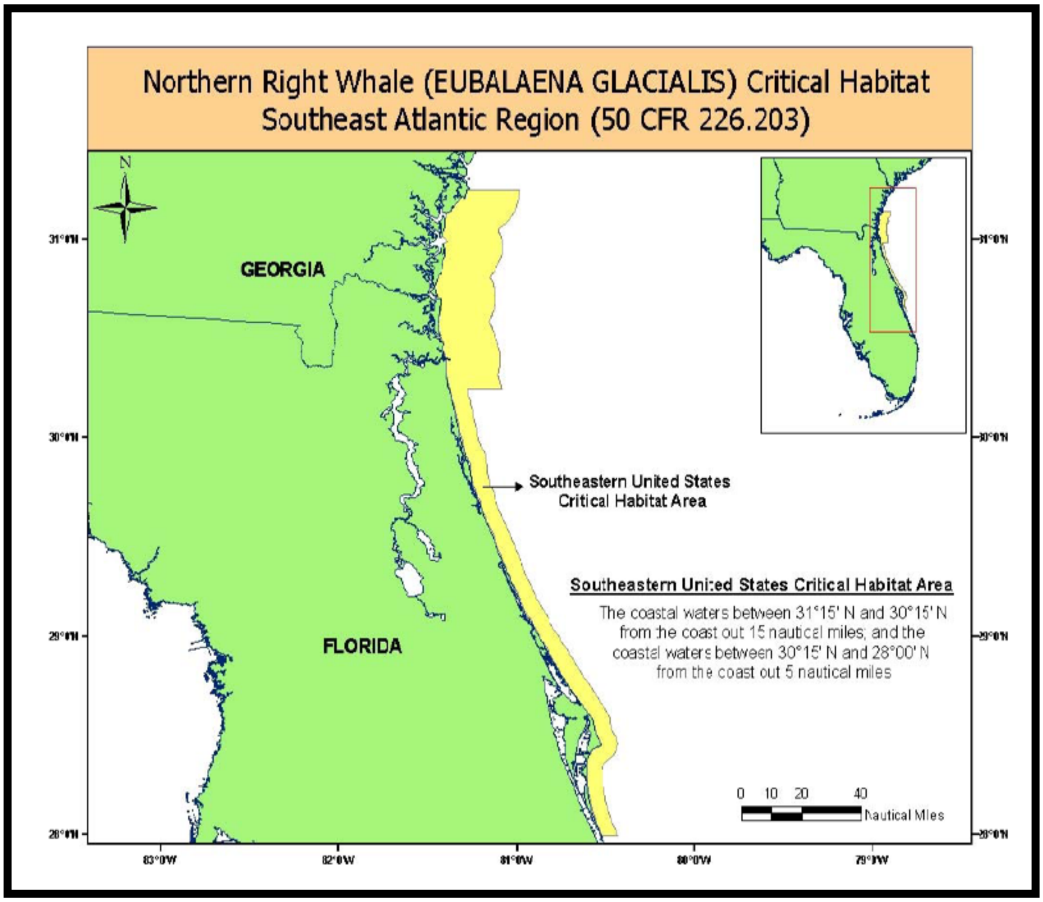

Figure 6-9. Northern right whale critical habitat areas defined for the Southeastern United States

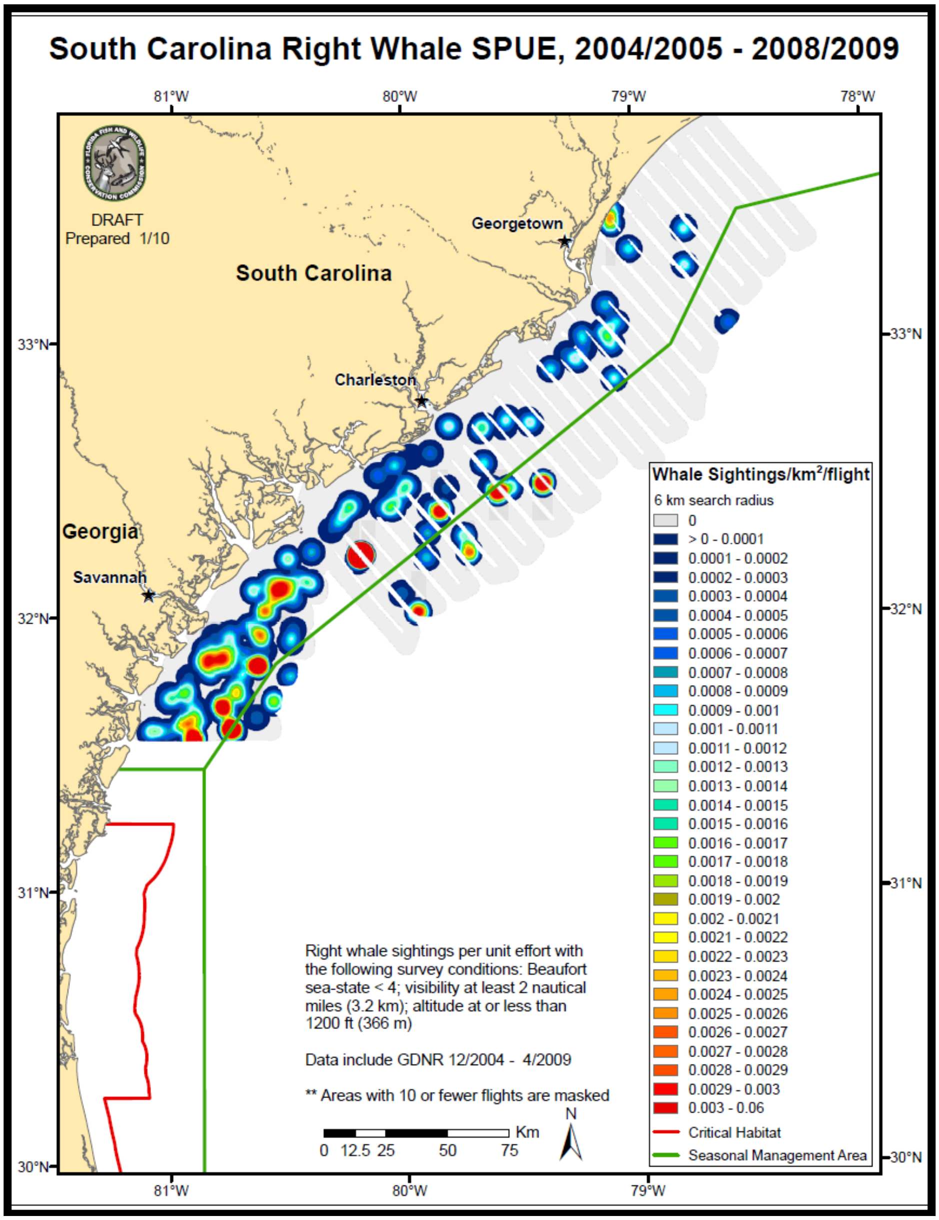

Figure 6-10. Right whale sightings per unit effort (SPUE).

As illustrated in Figure 7-10, there are several areas off the coast of Georgia that trend toward the yellow, orange and red colors. A review of the data sets used to derive this analysis suggest that the numbers of whales observed at one site during one aerial survey (i.e., the numerator of the SPUE calculation) is the principle factor in determining the intensity of the output. That is, it is the number of whales observed at one point in time and location, *and not the frequency (i.e., reoccurring event) of observation at any one site*, that determines the intensity of the results in Figure 7-10. The raw data for the 2007-2008 and 2008-2009 clearly illustrate that point (Sayre and Taylor, July 2008; Schulte and Taylor, 2009). During the 2007-2008 survey period, 3 cow/calf pairs, 12 single whales, and **21 groups of two or more** adult/juvenile right whales were documented. Similarly, in the 2008-2009 timeframe, 19 cow/calf pairs, 12 single whales, and **19 groups of two or more** adult/juvenile right whales were documented (Figure 7-11 and 7-12) (Sayre and Taylor, July 2008; Schulte and Taylor, 2009). When comparing Figures 7-11and 7-12 with Figure 7-10, it is clear that the red intensity colors indicating greater SPUE correlate with a larger numbers of whales (red triangles) recorded during a single observation.

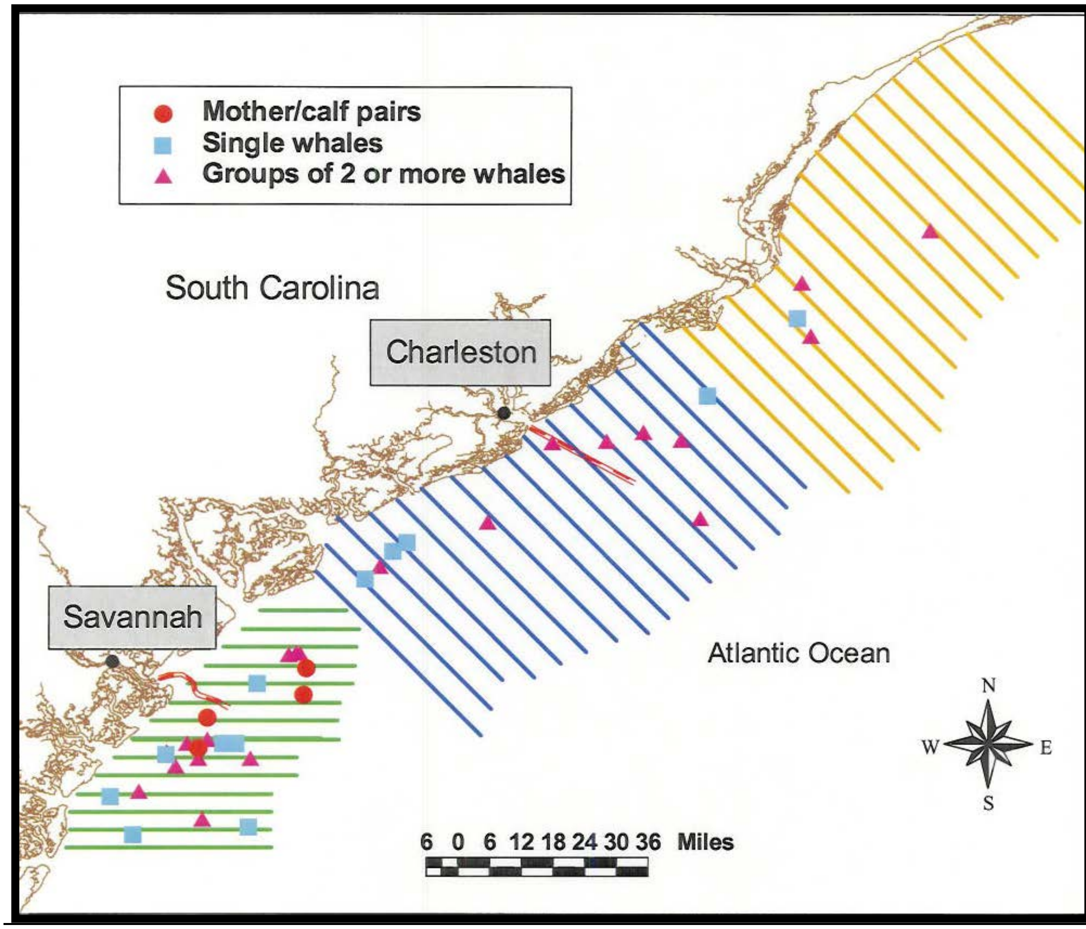

Figure 6-11. 2007-2008 Right whale calving season data.

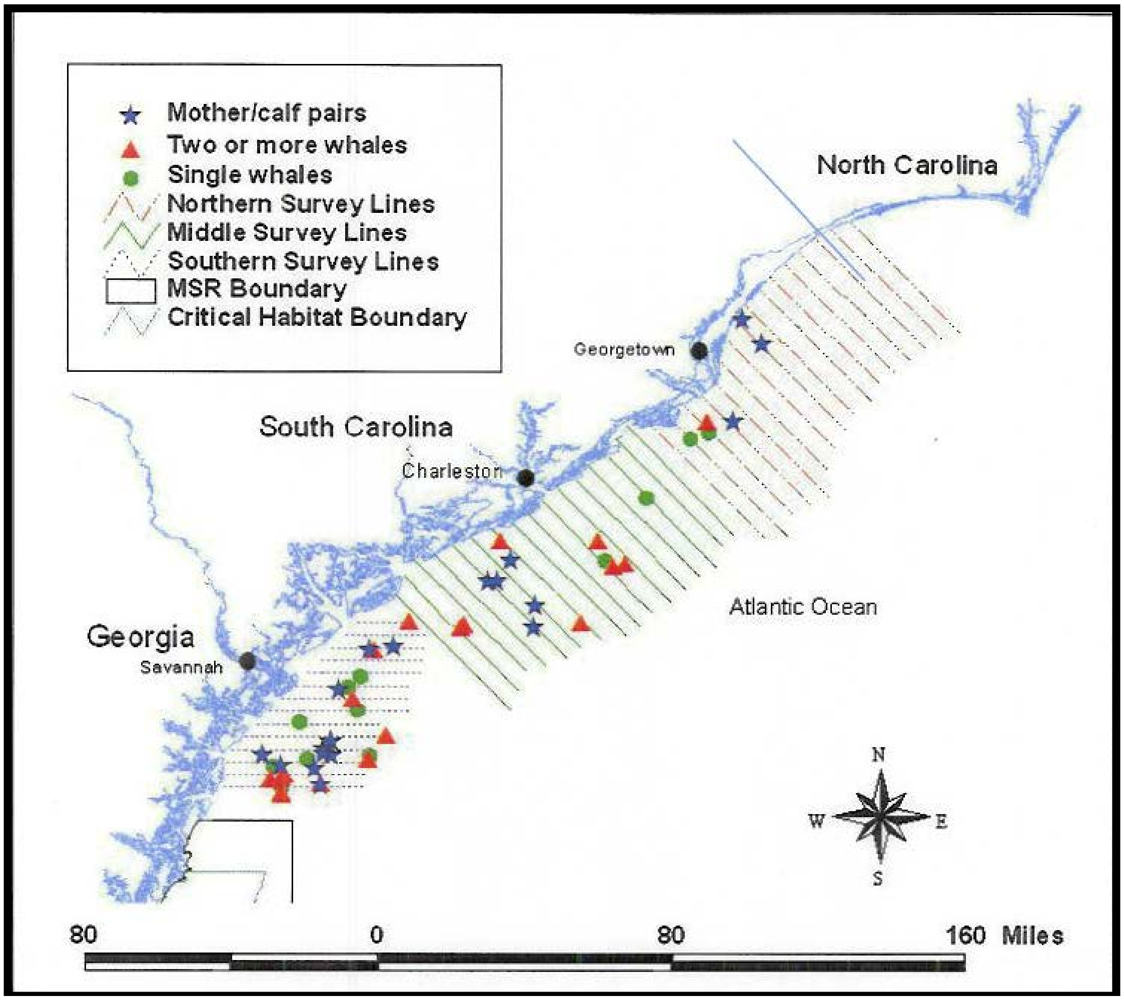

Figure 6-12. 2008-2009 Right whale calving season data.

Raw data from the two reports also confirm that as many as 13 and 12 different whales were observed at a single latitude/longitude location *and* at the same time during the 2007-2008 and 2008-2009 calving season, respectively. This fact is important since the data do not demonstrate a reoccurrence of right whale sightings at a single point over time (i.e., many observations at the same location over several time periods). If numerous sightings are not recorded at the same position over time, then the data set illustrated in Figure 7-10 provides no conclusive way to identify "hot spot" locations where whales may transit during their migration to and from the calving grounds. That is, there is no evidence to suggest that the intensity values illustrated in Figure 7-10 are indicative of locations that right whales would frequent on a re-occurring basis. The randomness of observations is also validated upon inspection of data points observed in Figure 7-11 and 7-12. When compared to Figures 7-11 and 7-12, data obtained as recently as March 2010 also illustrate the randomness of whale sightings with respect to time and spatial occurrence (Figure 7-14). Figure 7-13 also illustrates the number of sightings that occurred relative to the channel extension/alignment. To date, the sightings that have occurred during the 2009-2010 calving season are a considerable distance from the project site (Figure 7-12). In addition, the frequency of whale sightings/distribution is weighted more heavily in the area of the Georgia/Florida border, which has been identified as critical habitat.

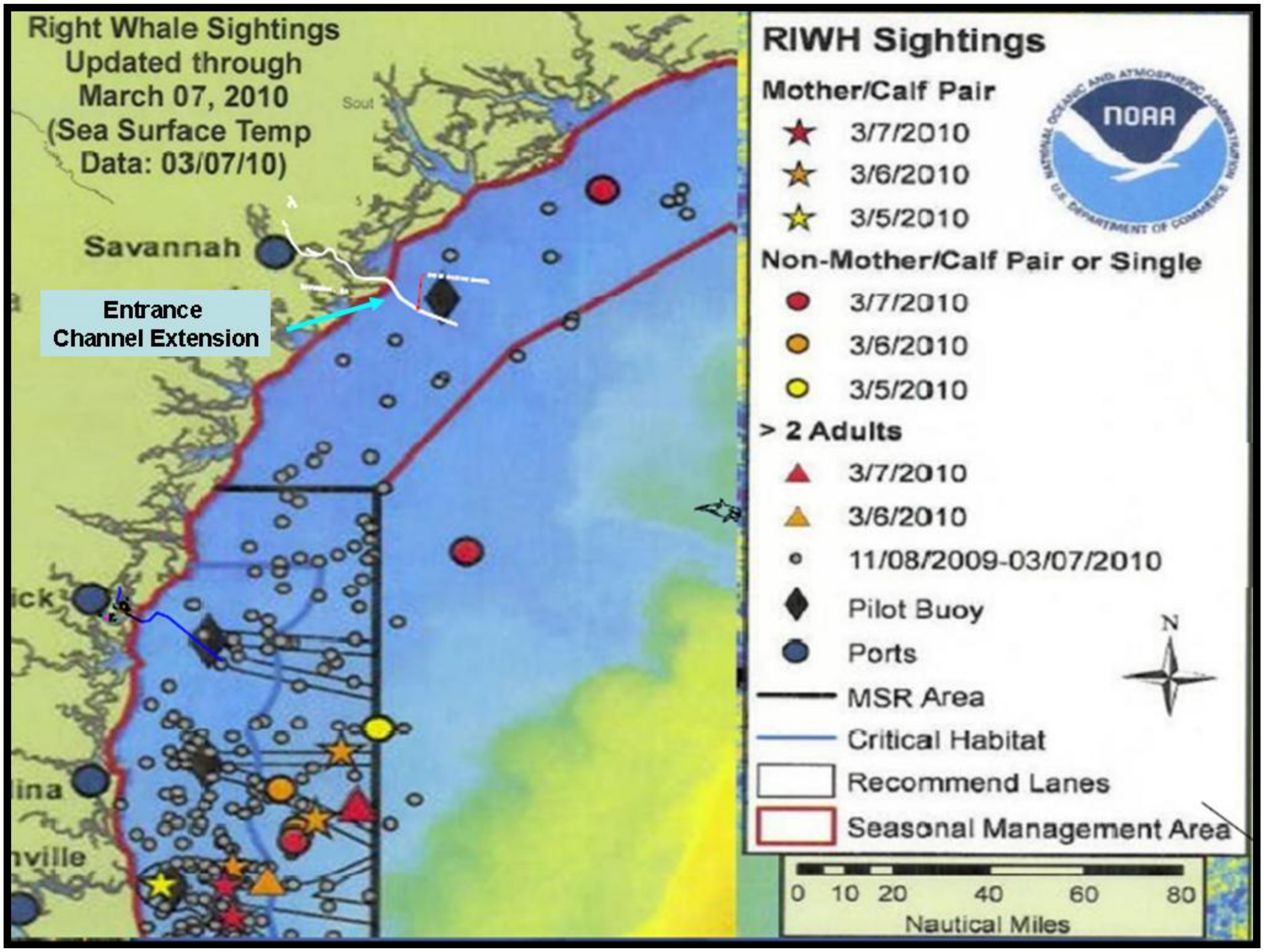

Figure 6-13. Right whale sightings through March 2010.

There is also no evidence to suggest that the number of whales historically recorded per observation (individual, mother/calf pair, or group) at a given location would remain the same from year to year. The association of these groupings with a given location is highly variable as illustrated in a comparison of Figures 7-9, 7-10 and 7-11. In order to evaluate the *frequency* of actual sighting events (independent of individual, mother/calf pair, or group numbers) occurring at a given location and time, USACE plotted the historical data obtained from the 2007-2008 and 2008-2009 calving season. If more than one whale was observed at a specific time and location, then only one data point was plotted. Figure 7-12 illustrates the results of the analysis. Within the box, four independent observations of whales occurred within the vicinity of the proposed channel extension over a four year period, and the distance between those sightings and the channel varied from 3,000 to 10,460 feet (Figure 7-10).

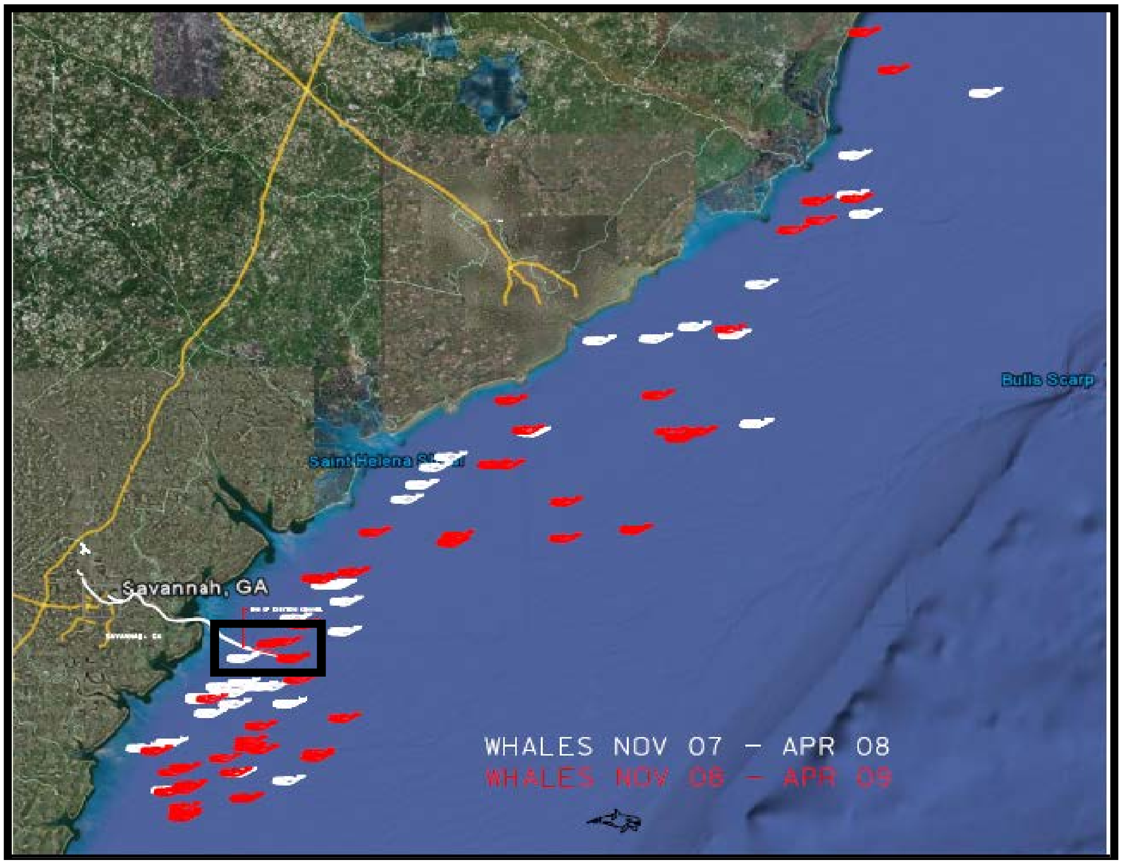

Figure 6-14. Plotted frequency of Right whale sighting events.

In summary, USACE believes the previously identified data and analysis demonstrates: (1) the randomness of whale movements and sightings; (2) the high variability (i.e., infrequency) associated with observed spatial locations over time; and (3) the location of the proposed channel extension is far removed from a more dense profile of whale sightings significantly south of the project area. Thus, maintenance of the AIWW project would have minimal impact on right whale movements or migration patterns during the calving season.

EFFECTS OF PROPOSED ACTION ON SPECIES AND CRITICAL HABITAT

Dredging Methods and Associated Impacts for the Humpback Whale, Sperm Whale, and North Atlantic Right Whale

Direct Impacts

Impacts from dredging operations, whether it be a hopper dredge, cutterhead/clamshell with tug/scow transport to offshore disposal area are expected to be consistent with previous findings by NMFS in 1991a and 1995a. Since these consultations were completed; (1) the estimated number of Right whales has increased based on the data presented in the NMFS annual stock assessments and the numbers of whales reported by the New England Aquarium in their annual "Right Whale Report

Card", (2) the implementation of the Early Warning System associated with operations near or within the calving grounds has been solidified by Memorandum of Agreement and has been in place for 21 years (beginning in the Jacksonville District in 1989), and (3) the USACE involvement with and awareness of Right whale issues has increased significantly. Based on these factors, USACE expects that dredging operations will have a minimal effect on Right whales. Additionally, a review of the NMFS large whale strike database does not indicate any records of large whale ship strikes associated with any dredging equipment. There is an account of a dredge/whale interaction observed in 1988 when a dredge approached within 100 yards of a Right whale. This situation is unlikely to occur in the future, since dredges now maintain a distance of 500 yards from the known position of Right whales, consistent with federal marine mammal approach regulations. USACE has been a key partner in Right whale protection, and as a carry over, all large whales observed in the vicinity of project areas. By requiring observers, as well as being a partner in aerial surveys of high use whale areas, USACE continues to demonstrate significant successful efforts to greatly diminish the potential interactions between large baleen whales and dredging equipment.

Indirect Impacts

Within any harbor or open water coastal environment, there are a number of underwater ambient noise sources such as: commercial and recreational vessel traffic, dredges, wharf/dock construction (pile driving, etc.), natural sounds (storms, biological, etc.), etc. There have been many studies on the potential underwater noise associated effects of vessels on cetaceans; however, until recently few data existed that adequately characterized sounds emitted by dredge plants.

To better assess potential species impacts (i.e. disturbance of communication among marine mammals) associated with dredge-specific noise from navigation maintenance or deepening operations, Clarke *et al*. (2002) performed underwater field investigations to characterize sounds emitted by bucket, hydraulic cutterhead, and hopper dredge operations. A summary of results from this study are presented below and are a first step towards the development of a dredge sounds database which will encompass a range of dredge plant sizes and operational features:

Cutterhead Suction Dredge

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

Hopper Dredge

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

Bucket Dredge

Bucket dredges are relatively stationary and produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket emptying. The underwater noise generated from a mechanical dredge entails lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge. Based on the data collected for this study, which included dredging of coarse sands and gravel, the maximum noise spike occurs when the bucket hits the bottom (120 dB peak amplitude). A reduction of 30 dB re 1 µPa/m occurred between the 150 m and 5,000 m listening stations with faintly audible sounds at 7-km. All other noises from this operation (i.e., winch motor, spuds, etc.) were relatively insignificant (Clarke *et al*., 2002).

According to Richardson *et al.* (1995) the following noise levels may be detrimental to marine mammals:

Prolonged Exposure of 140 dB re 1 µPa/m (continuous manmade noise), at 1 km may cause Permanent Hearing Loss

Prolonged Exposure of 195 to 225 dB re 1 µPa/m (intermittent noise), at a few meters or tens of meters, may cause Immediate Hearing Damage

According to Richardson *et al.* (1995), “Many marine mammals would avoid these noisy locations, although it is not certain that all would do so.” In a study evaluating specific reaction of bowhead whales to underwater drilling and dredge noise, Richardson *et al*. (1990) also noted that bowhead whales often move away when exposed to drillship and dredge sound; however, the reactions are quite variable and may be dependent on habituation and sensitivity of individual animals. According to Richardson *et al* (1995), received noise levels diminish by about 60 dB between the noise source and a radius of 1 km. For marine mammals to be exposed to a received level of 140 dB at 1 km radius, the source level would have to be about 200 dB re 1 micro Pa-m. Furthermore, few human activities emit continuous sounds at source levels greater than or equal to 200 dB re 1 micro Pa-m; however, supertankers and icebreakers may exceed the 195 dB noise levels.

According to Clarke *et al*. (2002), hopper dredge operations had the highest sustained pressure levels of 120-140 dB among the three measured dredge types; however, this measurement was taken at 40 m from the operating vessel and would likely attenuate significantly with increased distance from the dredge. Based on: (1) the predicted noise impact thresholds noted by Richardson *et al.* (1995), (2) the background noise that already exists within the marine environment, and (3) the ability of marine mammals to move away from the immediate noise source, noise generated by bucket, cutterhead, and hopper dredge activities will not affect the migration, nursing/breeding, feeding/sheltering or communication of large whales. Although behavioral impacts are possible (i.e., a whale changing course to move away from a vessel), the number and frequency of vessels present within a given project area is small and any behavioral impacts would be expected to be minor. Furthermore, for hopper dredging activities, endangered species observers (ESOs) will be on board and will record all large whale sightings and note any potential behavioral impacts.

Conservation Measures

To ensure that maintenance dredging operations do not adversely affect the North Atlantic right whale, humpback whale, or the sperm whale, USACE has fully adopted the Terms and Conditions (T&C) set forth in the 1991 (T&C #2) and 1995 (T&C's #'s 6-9) SARBO's, and reiterated in the 1997 SARBO.

USACE has established precautionary collision avoidance measures to be implemented during dredging and sediment placement operations that take place during the time North Atlantic right whales are present in waters offshore near the two ODMDS (Figure 1-2) designated for use in this project. These include:

a. Before the initiation of the project, at the pre-construction/partnering meeting, USACE briefs the contractor on the presence of the species, and reviews the requirements for right whale protection.

b. Each contractor will be required to instruct all personnel associated with the dredging/construction project about the possible presence of endangered North Atlantic right whales in the area and the need to avoid collisions. Each contractor will also be required to brief his personnel concerning the civil and criminal penalties for harming, harassing or killing species that are protected under the Endangered Species Act of 1973 and the Marine Mammal Protection Act of 1972. Dredges and all other disposal and attendant vessels are required to stop, alter course, or otherwise maneuver to avoid approaching the known location of a North Atlantic right whale. The contractor will be required to submit an endangered species watch plan that is adequate to protect North Atlantic right whales from the impacts of the proposed work.

c. Monitoring by endangered species observers with at-sea large whale identification experience to conduct daytime observations for whales between December 1 and March 31. During daylight hours, the dredge operator must take necessary precautions to avoid whales. During evening hours or when there is limited visibility due to fog or sea states of greater than Beaufort 3, the dredge must slow down to safe navigable speed when transiting between areas if whales have been spotted within 15 nm of the vessel's path within the previous 24 hours. (Contractors will be required to use daily available information on the presence of North Atlantic right whales in the project area.) If the Early Warning System (EWS) is operational at the time of the project, it will be deemed to provide adequate information on the presence of whales during dredging operations.

USACE will notify the program manager for the EWS of projects that are likely to take place during calving season, likely beginning, ending and duration of the proposed projects.

Effect Determination

Potential hopper dredging activities for these projects will continue to be accomplished under the Terms and Conditions (T&C's) set forth in the 1991, 1995 and 1997 NMFS South Atlantic Regional Biological Opinions and the SAD Hopper Dredging Protocol, which address North Atlantic right whale interactions. These T&C's and protocols have been more than protective of large whales and specifically North Atlantic right whales for 19 years. USACE believes that continued adherence to these protective measures will continue to afford the whales the needed protections while not preventing USACE from completing projects in a timely, cost effective and environmentally protective manner. Based on the implementation of these terms and conditions, as well as the conservation measures outlined above, the proposed activities may affect, but are not likely to adversely affect the North Atlantic right, humpback, or sperm whales; or the critical habitat of the North Atlantic right whale.

6.2.6 Sea Turtles

a. Status.

Leatherback	*Dermochelys coriacea*	Endangered
Loggerhead	*Caretta caretta*	Endangered
Kemp's Ridley	*Lepidochelys kempii*	Endangered
Hawksbill	*Eretmochelys imbricata*	Endangered
Green	*Chelonia mydas*	Threatened[1]

[1]Green turtles are listed as threatened, except for breeding populations in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

Leatherback

The leatherback sea turtle was listed as endangered throughout its global range on June 2, 1970. Leatherbacks are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans (Ernst and Barbour, 1972). Leatherback sea turtles are the largest living turtles and range farther than any other sea turtle species. The large size of adult leatherbacks and their tolerance to relatively low temperatures allows them to occur in northern waters such as off Labrador and in the Barents Sea (NMFS and USFWS, 1995). Adult leatherbacks forage in temperate and sub-polar regions from 71ºN to 47ºS latitude in all oceans and undergo extensive migrations to and from their tropical nesting beaches. Estimates for Leatherback turtle populations are not precise. In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard, 1982). That number, however, is probably an overestimation as it was based on a particularly good nesting year (1980) (Pritchard, 1996). By 1995, the global population of adult females had declined to 34,500 (Spotila *et al*. 1996). Pritchard (1996) also called into question the population estimates from Spotila *et al*. (1996), and felt they may be somewhat low, because it ended the modeling on data from a particularly bad nesting year (1994) while excluding nesting data from 1995, which was a good nesting year. However, the most recent population estimate for leatherback sea turtles from just the North Atlantic breeding groups is a range of 34,000-90,000 adult individuals (20,000-56,000 adult females) (TEWG, 2007).

In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS SEFSC, 2001a). Female leatherbacks nest from the southeastern United States to southern Brazil in the western Atlantic and from Mauritania to Angola in the eastern Atlantic. The most significant nesting beaches in the Atlantic, and perhaps in the world, are in French Guiana and Suriname (NMFS SEFSC, 2001a). Previous genetic analyses of leatherbacks using only mitochondrial DNA (mtDNA) resulted in an earlier determination that within the Atlantic basin there are at least three genetically different nesting populations; the St. Croix nesting population (U.S. Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana), and the Trinidad nesting population (Dutton *et al*., 1999). Further genetic analyses using microsatellite markers in nuclear DNA along with the mtDNA data and tagging data has resulted in Atlantic Ocean leatherbacks now being divided into seven groups or breeding populations: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG, 2007). When the hatchlings leave the nesting beaches, they move offshore but eventually utilize both coastal and pelagic waters. Very little is known about the pelagic habits of the hatchlings and juveniles, and they have not been documented to be associated with the *Sargassum* areas as are other species. Leatherbacks are deep divers, with recorded dives to depths in excess of 1,000 m (Eckert *et al*. 1999, Hayes *et al*. 2004).

Life History and Distribution

Leatherbacks are a long-lived species, living for well over 30 years. It has been thought that they reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range from 3-6 years (Rhodin, 1985) to 13-14 years (Zug and Parham, 1996). However, some recent research using sophisticated methods of analyzing leatherback ossicles has cast doubt on the previously accepted age to maturity figures, with leatherbacks in the western North Atlantic possibly not reaching sexual maturity until as late as 29 years of age (Avens and Goshe, 2007). Continued research in this area is vitally important to understanding the life history of leatherbacks and has important implications in management of the species.

They nest frequently (up to 10 nests per year) during a nesting season and nest about every 2-3 years. During each nesting, they produce 100 eggs or more in each clutch and, thus, can produce 700 eggs or more per nesting season (Schultz, 1975). However, a significant portion (up to approximately 30 percent) of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. The eggs incubate for 55-75 days before hatching. Based on a review of all sightings of leatherback sea turtles of <145 cm curved carapace length (ccl), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26°C until they exceed 100 cm ccl.

Although leatherbacks are the most pelagic of the sea turtles, they enter coastal waters on a seasonal basis to feed in areas where jellyfish are concentrated. Leatherback sea turtles feed primarily on cnidarians (medusae, siphonophores) and tunicates.
Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between boreal, temperate, and tropical waters (NMFS and USFWS, 1992). A 1979 aerial survey of the outer continental shelf from Cape Hatteras, North Carolina, to Cape Sable, Nova Scotia showed leatherbacks to be present throughout the area with the

most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in waters where depths ranged from 1-4,151 m, but 84.4 percent of sightings were in areas where the water was less than 180 m deep (Shoop and Kenney, 1992). Leatherbacks were sighted in waters of a similar sea surface temperature as loggerheads; from 7-27.2°C (Shoop and Kenney, 1992). However, this species appears to have a greater tolerance for colder waters because more leatherbacks were found at the lower temperatures (Shoop and Kenney, 1992). This aerial survey estimated the in-water leatherback population from near Nova Scotia, Canada to Cape Hatteras, North Carolina at approximately 300-600 animals.

General differences in migration patterns and foraging grounds may occur between the seven nesting assemblages, but data are limited. Per TEWG 2007: "*Marked or satellite tracked turtles from the Florida and North Caribbean assemblages have been re-sighted off North America, in the Gulf of Mexico and along the Atlantic coast and a few have moved to western Africa, north of the equator. In contrast, Western Caribbean and Southern Caribbean/Guianas animals have been found more commonly in the eastern Atlantic, off Europe and northern Africa, as well as along the North American coast. There are no reports of marked animals from the Western North Atlantic assemblages entering the Mediterranean Sea or the South Atlantic Ocean, though in the case of the Mediterranean this may be due more to a lack of data rather than failure of Western North Atlantic turtles moving into the Sea. The tagging data coupled with the satellite telemetry data indicate that animals from the western North Atlantic nesting subpopulations use virtually the entire North Atlantic Ocean in the South Atlantic Ocean, tracking and tag return data follow three primary patterns. Although telemetry data from the West African nesting assemblage showed that all but one remained on the shallow continental shelf, there clearly is movement to foraging areas of the south coast of Brazil and Argentina. There is also a small nesting aggregation of leatherbacks in Brazil, and while data are limited to a few satellite tracks, these turtles seem to remain in the southwest Atlantic foraging along the continental shelf margin as far south as Argentina. South African nesting turtles apparently forage primarily south, around the tip of the continent.*"

Population Dynamics and Status

The status of the Atlantic leatherback population has been less clear than the Pacific population. This uncertainty has been a result of inconsistent beach and aerial surveys, cycles of erosion and reformation of nesting beaches in the Guianas (representing the largest nesting area), a lesser degree of nest-site fidelity than occurs with the hardshell sea turtle species and inconsistencies in the availability and analyses of data. However, recent coordinated efforts at data collection and analyses by the Leatherback Turtle Expert Working Group have helped to clarify the understanding of the Atlantic population status (TEWG, 2007).

The Southern Caribbean/Guianas stock is the largest known Atlantic leatherback nesting aggregation (TEWG, 2007). This area includes the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela, with the vast majority of the nesting occurring in the Guianas and Trinidad. Past analyses had shown that the nesting aggregation in French Guiana had been declining at about 15 percent per year since 1987 (NMFS SEFSC, 2001). However, from 1979-1986, the number of nests was increasing at about 15 percent annually which could mean that the current decline could be part of a nesting cycle which coincides with the erosion cycle of Guiana beaches described by Schultz (1975). It is thought that the cycle of erosion and reformation of beaches has resulted in shifting nesting beaches throughout this region. This was supported by the increased nesting seen in Suriname, where leatherback nest numbers have shown large recent increases concurrent with declines elsewhere (with more than 10,000 nests per year since 1999 and a peak of 30,000 nests in 2001), and the long-term trend for the overall Suriname and French Guiana population was thought to possibly show an increase (Girondot 2002 in Hilterman and Goverse 2003). In the past many sea turtle scientists have agreed that the Guianas (and some would include Trinidad) should be viewed as one population and that a synoptic evaluation of nesting at all beaches in the region is necessary to develop a true picture of population status (Reichart *et al*. 2001). Genetics studies have added support to this notion and have resulted in the designation of the Southern Caribbean/Guianas stock. Using both Bayesian modeling and regression analyses, the TEWG (2007) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate (using nesting females as a proxy for population). This positive growth was seen within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (TEWG 2007).

The Western Caribbean stock includes nesting beaches from Honduras to Columbia. The most intense nesting in that area occurs in Costa Rica, Panama, and the Gulf of Uraba in Columbia. The Caribbean coast of Costa Rica and extending through to Chiriqui Beach, Panama, represents the fourth largest known leatherback nesting locations in the world (Troëng *et al*., 2004). Examination of data from three index nesting beaches in the region (Tortuguero, Gandoca, and Pacuare, in Costa Rica) using various Bayesian and regression analyses indicated that the nesting population was likely not growing over the 1995-2005 time series of available data (TEWG, 2007), though modeling of the nesting data for Tortuguero indicates a possible 67.8% decline between 1995 and 2006 (Troëng *et al*. in press).

Nesting data for the Northern Caribbean stock is available from Puerto Rico, the U.S. Virgin Islands (St. Croix), and the British Virgin Islands (Tortola). In Puerto Rico the primary nesting beaches are at Fajardo, and on the island of Culebra. Nesting between 1978-2005 has ranged between 469-882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1 (TEWG, 2007). At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has fluctuated from a few hundred nests to a high of 1008 in 2001, and the average annual growth rate has been approximately 1.1 from 1986-2004 (TEWG, 2007). Nesting in Tortola is limited, but has been increasing from 0-6 nests/year in the late 1980's to 35-65/year in the 2000's, with an annual growth rate of approximately 1.2 between 1994-2004 (TEWG, 2007).

The Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance; with total nests between 800-900 per year in the 2000's following nesting totals fewer than 100 nests per year in the 1980's (Florida Fish and Wildlife Conservation Commission, unpublished data). Using data from the Index Nesting Beach Surveys, the TEWG (2007) has estimated a significant annual nesting growth rate of 1.17 between 1989 and 2005.

The West African nesting stock of leatherbacks is a large, important, but mostly unstudied aggregation. Nesting occurs in various countries along Africa's Atlantic coast, but much of the nesting is undocumented and the data is inconsistent. However, it is known that Gabon has a very large amount of leatherback nesting, with at least 30,000 nests laid along their coast in one season (Fretey *et al*. in press). Fretey *et al*. (in press) also provide detailed information about other known nesting beaches and survey efforts along the Atlantic African coast. Because of the lack of consistent effort and minimal available data, trend analyses were not possible for this stock (TEWG, 2007).

Two other small but growing nesting stocks include Brazil and South Africa. For the Brazilian stock the TEWG (2007) analyzed the available data and determined that between 1988 and 2003 there was a positive annual average growth rate of 1.07 using the regression analyses, and 1.08 using Bayesian modeling. The South African stock has an annual average growth rate of 1.06 based on regression modeling and 1.04 using the Bayesian approach (TEWG, 2007).

Estimates of total population size for Atlantic leatherbacks are difficult to ascertain due to the inconsistent nature of the available nesting data. In 1996, the entire western Atlantic population was characterized as stable at best (Spotila *et al.* 1996), with numbers of nesting females reported to be on the order of 18,800. A subsequent analysis by Spotila (USACE 2012a) indicated that by 2000, the western Atlantic nesting population had decreased to about 15,000 nesting females. Spotila *et al*. (1996) estimated that the leatherback population for the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa totaled approximately 27,600 nesting females, with an estimated range of 20,082-35,133. This is similar to the estimated figures of 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting females) determined by the TEWG (2007).

Threats

Zug and Parham (1996) pointed out that the main threat to leatherback populations in the Atlantic is the combination of fishery-related mortality (especially entanglement in gear and drowning in trawls) and the intense egg harvesting on the main nesting beaches. Other important ongoing threats to the population include pollution, loss of nesting habitat, and boat strikes.

Of sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, possibly their method of locomotion, and perhaps their attraction to the lightsticks used to attract target species in longline fisheries. They are also susceptible to entanglement in gillnets and pot/trap lines (used in various fisheries) and capture in trawl gear (e.g., shrimp trawls).

Leatherbacks are exposed to pelagic longline fisheries in many areas of their range. Unlike loggerhead turtle interactions with longline gear, leatherback turtles do not usually ingest longline bait. Instead, leatherbacks are typically foul hooked by longline gear (e.g., on the flipper or shoulder area) rather than getting mouth hooked or swallowing the hook (NMFS SEFSC, 2001). A total of 24 nations, including the U.S. (accounting for 5-8 percent of the hooks fished), have fleets participating in pelagic longline fisheries in the area. Basin-wide, Lewison *et al*. (2004) estimated that 30,000-60,000 leatherback sea turtle captures occurred in Atlantic pelagic longline fisheries in the year 2000 alone (note that multiple captures of the same individual are known to occur, so the actual number of individuals captured may not be as high). Genetic studies performed within the Northeast Distant Fishery Experiment indicate that the leatherbacks captured in the Atlantic highly migratory species pelagic longline fishery were primarily from the French Guiana and Trinidad nesting stocks (over 95 percent). Individuals from West African stocks were surprisingly absent (Roden *et al*. in press).

Leatherbacks are also susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer *et al*. 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer *et al*. 2002). Fixed gear fisheries in the mid-Atlantic have also contributed to leatherback entanglements. In North Carolina, two leatherback sea turtles were reported entangled in a crab pot buoy inside Hatteras Inlet (D. Fletcher, pers. comm. to S. Epperly in NMFS SEFSC 2001). A third leatherback was reported entangled in a crab pot buoy in Pamlico Sound near Ocracoke. This turtle was disentangled and released alive; however, lacerations on the front flippers from the lines were evident (D. Fletcher, pers. comm. to S. Epperly in NMFS SEFSC 2001). In the Southeast, leatherbacks are vulnerable to entanglement in Florida's lobster pot and stone crab fisheries. In the U.S. Virgin Islands, where one of five leatherback strandings from 1982 to 1997 was due to entanglement (Boulon, 2000), leatherbacks have been observed with their flippers wrapped in the line of West Indian fish traps (R. Boulon, pers. comm. to J. Braun-McNeill in NMFS SEFSC 2001). Because many entanglements of this typically pelagic species likely go unnoticed, entanglements in fishing gear may be much higher.

Leatherback interactions with the southeast Atlantic shrimp fishery, which operates predominately from North Carolina through southeast Florida (NMFS, 2002b), have also been a common occurrence. Leatherbacks, which migrate north annually, are likely to encounter shrimp trawls working in the coastal waters off the Atlantic coast from Cape Canaveral, Florida, to the Virginia/North Carolina border. Leatherbacks also interact with the Gulf of Mexico shrimp fishery. For many years, TEDs required for use in these fisheries were less effective at excluding leatherbacks than the smaller, hard-shelled turtle species. To address this problem, on February 21, 2003, the NMFS issued a final rule to amend the TED regulations. Modifications to the design of TEDs are now required in order to exclude leatherbacks and large and sexually mature loggerhead and green turtles.

Other trawl fisheries are also known to interact with leatherback sea turtles. In October 2001, a Northeast Fisheries Science Center observer documented the take of a leatherback in a bottom otter trawl fishing for Loligo squid off of Delaware; TEDs are not required in this fishery. The winter trawl flounder fishery, which did not come under the revised TED regulations, may also interact with leatherback sea turtles.

Gillnet fisheries operating in the nearshore waters of the Mid-Atlantic states are also suspected of capturing, injuring, and/or killing leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the NEFSC Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54 to 92 percent.

Poaching is not known to be a problem for nesting populations in the continental US. However, in 2001 the NMFS Southeast Fishery Science Center (SEFSC) noted that poaching of juveniles and adults was still occurring in the U.S. Virgin Islands and the Guianas. In all, four of the five strandings in St. Croix were the result of poaching (Boulon, 2000). A few cases of fishermen poaching leatherbacks have been reported from Puerto Rico, but most of the poaching is on eggs.

Leatherback sea turtles may be more susceptible to marine debris ingestion than other species due to their pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding areas and migratory routes (Lutcavage *et al*. 1997, Shoop and Kenney 1992). Investigations of the stomach contents of leatherback sea turtles revealed that a substantial percentage (44 percent of the 16 cases examined) contained plastic (Mrosovsky, 1981). Along the coast of Peru, intestinal contents of 19 of 140 (13 percent) leatherback carcasses were found to contain plastic bags and film (Fritts, 1983). The presence of plastic debris in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and plastic debris (Mrosovsky, 1981). Balazs (1985) speculated that the object might resemble a food item by its shape, color, size or even movement as it drifts about, and induce a feeding response in leatherbacks.

It is important to note that, like marine debris, fishing gear interactions and poaching are problems for leatherbacks throughout their range. Entanglements are common in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line and crab pot line. Leatherbacks are reported taken by many other nations that participate in Atlantic pelagic longline fisheries, including Taipei, Brazil, Trinidad, Morocco, Cyprus, Venezuela, Korea, Mexico, Cuba, U.K., Bermuda, People's Republic of China, Grenada, Canada, Belize, France, and Ireland (see NMFS SEFSC 2001, for a description of take records). Leatherbacks are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Castroviejo *et al*. 1994, Graff 1995). Gillnets are one of the suspected causes for the decline in the leatherback sea turtle population in French Guiana (Chevalier *et al*. 1999), and gillnets targeting green and hawksbill turtles in the waters of coastal Nicaragua also incidentally catch leatherback turtles (Lagueux *et al*. 1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alio-M, 2000). A study by the Trinidad and Tobago's Institute for Marine Affairs (IMA), in 2002 confirmed that bycatch of leatherbacks is high in Trinidad. IMA estimated that more than 3,000 leatherbacks were captured incidental to gillnet fishing in the coastal waters of Trinidad in 2000. As much as one half or more of the gravid turtles may be killed (Lee Lum, 2003). However, many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS SEFSC, 2001).

Summary of Leatherback Status

In the Atlantic Ocean, the scientific understanding of the status and trends of leatherback turtles is somewhat more confounded, although the overall trend appears to be stable to increasing, compared to the bleak situation in the Pacific. These data indicate increasing or stable nesting populations in all of the regions except West Africa (no long-term data are available) and the Western Caribbean (TEWG, 2007). Some of the same factors that led to precipitous declines of leatherbacks in the Pacific also affect leatherbacks in the Atlantic: leatherbacks are captured and killed in many kinds of fishing gear and interact with fisheries in state, federal, and international waters. Poaching is a problem and affects leatherbacks that occur in U.S. waters. Leatherbacks also appear to be more susceptible to death or injury from ingesting marine debris than other turtle species.

Critical Habitat

No critical habitat has been designated by the NMFS for Leatherback sea turtles in the project area.

Loggerhead Sea Turtle

The loggerhead sea turtle was listed as an endangered species throughout its global range on March 10, 2010. It was listed because of direct take, incidental capture in various fisheries, and the alteration and destruction of its habitat. Loggerhead sea turtles inhabit the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans. In the Atlantic, developmental habitat for small juveniles is the pelagic waters of the North Atlantic and the Mediterranean Sea (NMFS and USFWS, 1991). Within the continental United States, loggerhead sea turtles nest from Texas to New Jersey. Major nesting areas include coastal islands of Georgia, South Carolina, and North Carolina, and the Atlantic and Gulf of Mexico coasts of Florida, with the bulk of the nesting occurring on the Atlantic coast of Florida.

On November 16, 2007, the NMFS received a petition from Ocean and the Center for Biological Diversity requesting that loggerhead turtles in the western North Atlantic Ocean be reclassified as a Distinct Population Segment (DPS) with endangered status and that critical habitat be designated. On March 5, 2008, the NMFS position was published in the Federal Register indicating that a re-classification of the loggerhead in the western North Atlantic Ocean as a DPS and listing of the DPS as endangered may be warranted (Federal Register/Vol. 73, No. 44/Wednesday, March 5, 2008/Proposed Rules). An affirmative 90-day finding requires that the NMFS commence a status review on the loggerhead turtle. Upon completion of this review, the NMFS will make a finding on whether reclassification of the loggerhead in the western North Atlantic Ocean as endangered is warranted, warranted but precluded by higher priority listing actions, or not warranted. As of March 2010, final action on the establishment of loggerhead DPSs and uplisting the western North Atlantic DPS as endangered was temporarily delayed while some additional analysis and discussion occurs (Dennis Klemm-NOAA Protected Resource Division, Personal Communication).

In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. There are at least five western Atlantic subpopulations, divided geographically as follows: (1) A northern nesting subpopulation, occurring from North Carolina to northeast Florida at about 29ºN; (2) a south Florida nesting subpopulation, occurring from 29ºN on the east coast to Sarasota on the west coast; (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez, 1990; TEWG, 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS 2001). Additionally, there is evidence of at least several other genetically distinct stocks, including a Cay Sal Bank, Western Bahamas stock; a Quintana Roo, Mexico stock, including all loggerhead rookeries on Mexico’s Yucatan Peninsula; a Brazilian stock; and a Cape Verde stock (SWOT Report, Volume II, The State of the World’s Sea Turtles, 2007). The fidelity of nesting females to their nesting beach is the reason these subpopulations can be differentiated from one another. Fidelity for nesting beaches makes recolonization of nesting beaches with sea turtles from other subpopulations unlikely.

Life History and Distribution

Past literature gave an estimated age at maturity of 21-35 years (Frazer and Ehrhart, 1985; Frazer *et al*., 1994), with the benthic immature stage lasting at least 10-25 years. However, based on data from tag returns, strandings, and nesting surveys (NMFS 2001), NMFS estimates ages of maturity ranging from 20-38 years with the immature stage lasting from 14-32 years.

Mating takes place in late March through early June in the southeastern United States, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs. Individual females nest multiple times during a nesting season, with a mean of 4.1 nests/individual (Murphy and Hopkins, 1984). Nesting of an individual female loggerhead is usually on an interval of 2-3 years, but can vary from 1-7 years (Dodd, 1988). Generally, loggerhead sea turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years or more. Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm straight-line carapace length they begin to live in coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico, although some loggerheads may move back and forth between the pelagic and benthic (i.e., nearshore) environment (Witzell, 2002). Benthic immature loggerheads (sea turtles that have come back to inshore and nearshore waters), the life stage following the pelagic immature stage, have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in Northeastern Mexico.

Tagging studies have shown loggerheads that have entered the benthic environment undertake routine migrations along the coast that are limited by seasonal water temperatures. Loggerhead sea turtles occur year round in offshore waters off North Carolina where water temperature is influenced by the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to immigrate to North Carolina inshore waters (e.g., Pamlico and Core Sounds) and also move up the coast (Epperly *et al*., 1995a; Epperly *et al.*, 1995b; Epperly *et al*., 1995c), occurring in Virginia foraging areas as early as April and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some may remain in mid-Atlantic and Northeast areas until late fall. By December loggerheads have emigrated from inshore North Carolina waters and coastal waters to the north to waters offshore North Carolina, particularly off Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (≥ 11ºC) (Epperly *et al*., 1995a; Epperly *et al*., 1995b; Epperly *et al.*, 1995c). Loggerhead sea turtles are year-round residents of central and south Florida.

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd, 1988). Sub-adult and adult loggerheads are primarily coastal dwelling and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

Population Dynamics and Status

A number of stock assessments (TEWG, 1998; TEWG, 2000; NMFS 2001; Heppell *et al*. 2003) have examined the stock status of loggerheads in the waters of the United States, but have been unable to develop any reliable estimates of absolute population size. Based on nesting data of the five western

Atlantic subpopulations, the south Florida-nesting and the northern-nesting subpopulations are the most abundant (TEWG 2000; NMFS 2001). Between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,014 to 92,182 annually with a mean of 73,751 (TEWG 2000). On average, 90.7 percent of these nests were of the south Florida subpopulation and 8.5 percent were from the northern subpopulation (TEWG 2000). The TEWG (2000) assessment of the status of these two better-studied populations concluded that the south Florida subpopulation was increasing at that time, while no trend was evident (may be stable but possibly declining) for the northern subpopulation. A more recent analysis of nesting data from 1989-2005 by the Florida Wildlife Research Institute indicates there is a declining trend in nesting at beaches utilized by the south Florida nesting subpopulation (McRae letter to NMFS, October 25, 2006). Nesting data obtained for the 2006 nesting season are also consistent with the decline in loggerhead nests (Meylan pers. comm. 2006). It is unclear at this time whether the nesting decline reflects a decline in population, or is indicative of a failure to nest by the reproductively mature females as a result of other factors (resource depletion, nesting beach problems, oceanographic conditions, etc.).

For the northern subpopulations, recent estimates of loggerhead nesting trends in Georgia from standardized daily beach surveys showed significant declines ranging from 1.5 to 1.9 percent annually (Mark Dodd, Georgia Department of Natural Resources, pers. comm., 2006). Nest totals from aerial surveys conducted by the South Carolina Department of Natural Resources showed a 3.3 percent annual decline in nesting since 1980. Another consideration that may add to the importance and vulnerability of the northern subpopulation is the sex ratios of this subpopulation. NMFS scientists have estimated that the northern subpopulation produces 65 percent males (NMFS 2001). However, new research conducted over a limited time frame has found opposing sex ratios (Wyneken *et al*. 2004), so further information is needed to clarify the issue. Since nesting female loggerhead sea turtles exhibit nest fidelity, the continued existence of the northern subpopulation is related to the number of female hatchlings that are produced. Producing fewer females will limit the number of subsequent offspring produced by the subpopulation.

Sea turtle nesting occurs throughout the States of Georgia and South Carolina in all coastal counties. The stranding records for Chatham County, Georgia indicate that 4 turtles were stranded in the county from January 1 to June 30, 1989 and 212 stranding occurred in the State of Georgia during 1989. Approximately 95 percent of these stranding occurred from May to November. Table 7-2 shows the number of loggerhead sea turtle (*Caretta caretta*) nests in Georgia for 2006:

Table 6-2. Number of Loggerhead Sea Turtle (*Caretta caretta*) Nests in Georgia for 2006

Location	Loggerhead Nest
Tybee Island	10
Little Tybee Island	7
Wassaw Island	141
Ossabaw Island	202
St. Catherine Island	124
Blackbeard Island	227
Sapelo Island	82
Little St. Simon Island	58
Sea Island	64
St. Simon Island	1
Jekyll Island	137
Little Cumberland Island	23
Cumberland Island	323
TOTAL	**1,399**

Within the Savannah project area primarily only one species of sea turtle, the loggerhead sea turtle (*Caretta caretta*), nests regularly on the adjacent beaches of Tybee and Daufuskie Islands (USACE 2012a). According to Mr. Mark Dodd, the Georgia Sea Turtle Program Coordinator, with the Georgia Department of Natural Resources, Table 7-3 provides the sea turtle nest totals for Tybee Island, Georgia 1998-2012:

Table 6-3. Sea Turtle Nest Totals; Tybee Island, GA, 1989-2009

Year	Loggerhead Nests	Leatherback Nests	Kemp's ridley	Green Turtle	Hawksbill Turtle
1998	3	0	0	0	0
1999	8	0	0	0	0
2000	1	0	0	0	0
2001	3	0	0	0	0
2002	6	0	0	0	0
2003	6	0	0	0	0
2004	5	1	0	0	0
2005	4	0	0	0	0
2006	10	0	0	0	0
2007	10	0	0	0	0
2008	N/A	N/A	N/A	N/A	N/A
2009*	3	0	0	0	0
2010*	10	0	0	0	0
2011*	9	0	0	0	0
2012*	21	0	0	1	0

*Georgia 2009-2012 Turtle Nesting data taken from the following website: http://www.seaturtle.org/nestdb/

Ms. DuBose Griffin, South Carolina Sea Turtle Program Coordinator, SC Department of Natural Resources, Wildlife and Freshwater Fisheries Division provided the data illustrated in Table 7-4:

Table 6-4
Loggerhead Sea Turtle Nest Totals for Daufuskie and Turtle Islands

Island	Length (km)	2006	2007	2008	2009*	2010*	2011*	2012*
Daufuskie	~ 8.0	23	15	62	31	65	69	68
Turtle	~ 1.0	0	0	0	0	N/A	N/A	N/A

*South Carolina 2009-2012 Turtle Nesting Data taken from the following website: http://www.seaturtle.org/nestdb/

The remaining three subpopulations – Dry Tortugas, Florida Panhandle, and Yucatán – are much smaller, but also relevant to the continued existence of the species. Nesting surveys for the Dry Tortugas subpopulation are conducted as part of Florida's statewide survey program. Survey effort has been relatively stable during the 9-year period from 1995-2003 (although the 2002 year was missed). Nest counts ranged from 168-270 but with no detectable trend during this period (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data). Nest counts for the Florida Panhandle subpopulation are focused on index beaches rather than all beaches where nesting occurs. Currently, there is not enough information to detect a trend for the subpopulation (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Index Nesting Beach Survey Database). Similarly, nesting survey effort has been inconsistent among the Yucatán nesting beaches and no trend can be determined for this subpopulation. However, there is some optimistic news. Zurita *et al.* (2003) found a statistically significant increase in the number of nests on seven of the beaches on Quintana Roo, Mexico, from 1987-2001 where survey effort was consistent during the period.

Threats

The diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. Hurricanes are particularly destructive to sea turtle nests. Sand accretion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. For example, in 1992, all of the eggs over a 90-mile length of coastal Florida were destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton *et al*. 1994). Also, many nests were destroyed during the 2004 hurricane season. Other sources of natural mortality include cold stunning and biotoxin exposure.

Anthropogenic factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, beach armoring, and nourishment, artificial lighting, beach cleaning, increased human presence, recreational beach equipment, beach driving, coastal construction and fishing piers, exotic dune and beach vegetation, and poaching. An increase in human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs and an increased presence of native species (e.g., raccoons, armadillos, and opossums) which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (e.g., Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected high density east Florida nesting beaches from Indian River to Broward County are affected by all of the above threats.

Loggerhead sea turtles are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, and transportation, marine pollution, underwater explosions, hopper dredging, offshore artificial lighting, power plant entrainment and/or impingement, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, poaching, and fishery interactions. Loggerheads in the pelagic environment are exposed to a series of longline fisheries, which include the Atlantic highly migratory species (HMS) pelagic longline fisheries, an Azorean longline fleet, a Spanish longline fleet, and various longline fleets in the Mediterranean Sea (Aguilar *et al*. 1995; Bolten *et al.* 1996). Loggerheads in the benthic environment in waters off the coastal United States are exposed to a suite of fisheries in federal and state waters including trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries.

Summary of Status for Loggerhead Sea Turtles

In the Atlantic Ocean, absolute population size is not known, but based on extrapolation of nesting information, loggerheads are likely much more numerous than in the Pacific Ocean. NMFS recognizes five subpopulations of loggerhead sea turtles in the western north Atlantic based on genetic studies. The Northern subpopulation is the DPS that would have the most potential to be most affected by the proposed action. The South Florida subpopulation may be critical to the survival of the species in the Atlantic Ocean because of its size (over 90 percent of all U.S. loggerhead nests are from this subpopulation). In the past, this nesting aggregation was considered second in size only to the nesting aggregation on islands in the Arabian Sea off Oman (Ross, 1979; Ehrhart, 1989; NMFS and USFWS, 1991). However, the status of the Oman colony has not been evaluated recently and it is located in an area of the world where it is highly vulnerable to disruptive events such as political upheavals, wars, catastrophic oil spills, and lack of strong protections for sea turtles (Meylan *et al*., 1995). Given the lack of updated information on this population, the status of loggerheads in the Indian Ocean basin overall is essentially unknown.

All loggerhead subpopulations are faced with a multitude of natural and anthropogenic effects that negatively influence the status of the species. Many anthropogenic effects occur as a result of activities outside of U.S. jurisdiction (i.e., fisheries in international waters).

Critical Habitat

No critical habitat has been designated by the NMFS for loggerhead sea turtles within the project area.

Kemp’s Ridley Sea Turtle

The Kemp’s ridley was listed as endangered on December 2, 1970. Internationally, the Kemp’s ridley has been considered the most endangered sea turtle (Zwinenberg, 1977; Groombridge, 1982;

TEWG 2000). Kemp's ridleys nest primarily at Rancho Nuevo, a stretch of beach in Mexico, Tamaulipas State. This species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. Occasional individuals reach European waters (Brongersma, 1972). Adults of this species are usually confined to the Gulf of Mexico, although adult-sized individuals sometimes are found on the east coast of the United States.

Life History and Distribution

The TEWG (1998) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998). Nesting occurs from April into July and is essentially limited to the beaches of the western Gulf of Mexico, near Rancho Nuevo in southern Tamaulipas, Mexico. Nesting also occurs in Veracruz, Mexico, and Texas, U.S., but on a much smaller scale. The mean clutch size for Kemp's ridleys is 100 eggs/nest, with an average of 2.5 nests/female/season.

Little is known of the movements of the post-hatchling stage (pelagic stage) within the Gulf of Mexico. Studies have shown the post-hatchling pelagic stage varies from 1-4 or more years, and the benthic immature stage lasts 7-9 years (Schmid and Witzell, 1997). Benthic immature Kemp's ridleys have been found along the eastern seaboard of the United States and in the Gulf of Mexico. Atlantic benthic immature sea turtles travel northward as the water warms to feed in the productive, coastal waters off Georgia through New England, returning southward with the onset of winter (Lutcavage and Musick, 1985; Henwood and Ogren, 1987; Ogren, 1989). Studies suggest that benthic immature Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud, 1995).

Stomach contents of Kemp's ridleys along the lower Texas coast consisted of nearshore crabs and mollusks, as well as fish, shrimp, and other foods considered to be shrimp fishery discards (Shaver, 1991). Pelagic stage Kemp's ridleys presumably feed on the available *Sargassum* and associated infauna or other epipelagic species found in the Gulf of Mexico.

Population Dynamics and Status

Of the seven extant species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the Rancho Nuevo beaches (Pritchard, 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand, 1963). By the mid-1980s nest numbers were below 1,000 (with a low of 702 nests in 1985). However, observations of increased nesting with 6,277 nests recorded in 2000, 10,000 nests in 2005, and 12,143 nests recorded during the 2006 nesting season (Gladys Porter Zoo nesting database) show the decline in the ridley population has stopped and the population is now increasing.

A period of steady increase in benthic immature ridleys has been occurring since 1990 and appears to be due to increased hatchling production and an apparent increase in survival rates of immature sea turtles beginning in 1990. The increased survivorship of immature sea turtles is attributable, in part, to the introduction of turtle excluder devices (TEDs) in the United States and Mexican shrimping fleets and Mexican beach protection efforts. As demonstrated by nesting increases at the main nesting sites in Mexico, adult ridley numbers have increased over the last decade. The population model used by TEWG (2000) projected that Kemp's ridleys could reach the Recovery Plan's intermediate recovery goal of 10,000 nesters by the year 2015.

Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June (Keinath *et al*., 1987; Musick and Limpus, 1997). The juvenile population of Kemp's ridley sea turtles in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus, 1997). These juveniles frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus, 1997). Kemp's ridleys consume a variety of crab species, including *Callinectes spp*., *Ovalipes spp*., *Libinia sp*., and *Cancer spp*. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal, 1997). Upon leaving Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus, 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds, as well as smaller juveniles from New York and New England, to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus, 1997; Epperly *et al*., 1995a; Epperly *et al*., 1995b).

Threats

Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, natural predators at sea, and oceanic events such as cold stunning. Although cold stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, in the winter of 1999-2000, there was a major cold-stunning event where 218 Kemp's ridleys, 54 loggerheads, and 5 green turtles were found on Cape Cod beaches (R. Prescott, pers. comm., 2001). Annual cold-stunning events do not always occur at this magnitude; the extent of episodic major cold-stunning events may be associated with numbers of turtles utilizing Northeast waters in a given year, oceanographic conditions, and the occurrence of storm events in the late fall. Many cold-stunned turtles can survive if found early enough, but cold-stunning events can still represent a significant cause of natural mortality.

Although changes in the use of shrimp trawls and other trawl gear have helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts similar to those discussed above. For example, in the spring of 2000, five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. Cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected to have been from a large-mesh gill net fishery operating offshore in the preceding weeks. The five ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction because it is unlikely that all of the carcasses washed ashore.

Summary of Kemp's Ridley Status

The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr, 1963). The number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3 percent per year from 1985 to 1999. Current totals are 12,059 nests in Mexico in 2006 (August 8, 2006, e-mail from Luis Jaime Peña - Conservation Biologist, Gladys Porter Zoo).

Kemp's ridleys mature at an earlier age (7-15 years) than other chelonids, thus "lag effects" as a result of unknown impacts to the non-breeding life stages would likely have been seen in the increasing nest trend beginning in 1985 (NMFS and USFWS, 1992).

The largest contributors to the decline of Kemp's ridleys in the past were commercial and local exploitation, especially poaching of nests at the Rancho Nuevo site, as well as the Gulf of Mexico trawl fisheries. The advent of TED regulations for trawlers and protections for the nesting beaches has allowed the species to begin to rebound. Many threats to the future of the species remain, including interactions with fishery gear, marine pollution, foraging habitat destruction, illegal poaching of nests and potential threats to the nesting beaches from such sources as global climate change, development, and tourism pressures.

Critical Habitat

No critical habitat has been designated by the NMFS for Kemp's ridley sea turtles in the project area.

Hawksbill Sea Turtle

The hawksbill turtle was listed as endangered under the precursor of the ESA on June 2, 1970, and is considered Critically Endangered by the International Union for the Conservation of Nature (IUCN). The hawksbill is a medium-sized sea turtle, with adults in the Caribbean ranging in size from approximately 62.5 to 94.0 cm straight carapace length. The species occurs in all ocean basins, although it is relatively rare in the Eastern Atlantic and Eastern Pacific, and absent from the Mediterranean Sea. Hawksbills are the most tropical of the marine turtles, ranging from approximately 30ºN to 30ºS latitude. They are closely associated with coral reefs and other hard-bottom habitats, but they are also found in other habitats including inlets, bays and coastal lagoons (NMFS and USFWS, 1993). There are five regional nesting populations with more than 1,000 females nesting annually. These populations are in the Seychelles, Mexico, Indonesia, and two in Australia (Meylan and Donnelly, 1999). There has been a global population decline of over 80 percent during the last three generations (105 years) (Meylan and Donnelly, 1999).

Life History and Distribution

In the Western Atlantic, the largest hawksbill nesting population occurs in the Yucatán Peninsula of Mexico (Garduño-Andrade *et al*., 1999). With respect to the United States, nesting occurs in Puerto Rico, the USVI, and the southeast coast of Florida. Nesting also occurs outside of the United States and its territories in Antigua, Barbados, Costa Rica, Cuba, and Jamaica (Meylan, 1999). Outside of the nesting areas, hawksbills have been seen off of the U.S. Gulf of Mexico states and along the eastern seaboard as far north as Massachusetts, although sightings north of Florida are rare (NMFS and USFWS, 1993).

The best estimate of age at sexual maturity for hawksbill sea turtles is about 20-40 years (NMFS, 2004b). Reproductive females undertake periodic (usually non-annual) migrations to their natal beach to nest. Movements of reproductive males are less well known, but are presumed to involve migrations to their nesting beach or to courtship stations along the migratory corridor (Meylan, 1999). Females nest an average of 3-5 times per season (Meylan and Donnelly, 1999). Clutch size is larger on average (up to 250 eggs) than that of other turtles (Hirth, 1980). Reproductive females may exhibit a high degree of fidelity to their nest sites.

The life history of hawksbills consists of a pelagic stage that lasts from the time they leave the nesting beach as hatchlings until they are approximately 22-25 cm in straight carapace length (Meylan and Donnelly, 1999), followed by residency in developmental habitats (foraging areas where juveniles reside and grow) in coastal waters. Adult foraging habitat, which may or may not overlap with developmental habitat, is typically coral reefs, although other hard-bottom communities and occasionally mangrove-fringed bays may be occupied. Hawksbills show fidelity to their foraging areas over several years (Van Dam and Díez, 1998).

The hawksbill's diet is highly specialized and consists primarily of sponges (Meylan, 1988). Other food items, notably corallimorphs and zooanthids, have been documented to be important in some areas of the Caribbean (Leon and Díez, 2000).

Population Dynamics and Status

Estimates of the annual number of nests at hawksbill sea turtle nesting sites are of the order of hundreds to a few thousand. Nesting within the southeastern United States and U.S. Caribbean is restricted to Puerto Rico (>650 nests/yr), the USVI (~400 nests/yr), and, rarely, Florida (0-4 nests/yr) (Meylan, 1999; Florida Fish and Wildlife Conservation Commission; Florida Marine Research Institute's Statewide Nesting Beach Survey data 2002). At the two principal nesting beaches in the U.S. Caribbean where long-term monitoring has been carried out, populations appear to be increasing (Mona Island, Puerto Rico) or stable (Buck Island Reef National Monument, St. Croix, USVI) (Meylan, 1999).

Threats

As described for other sea turtle species, hawksbill sea turtles are affected by habitat loss, habitat degradation, fishery interactions, and poaching in some parts of their range. There continues to be a black market for hawksbill shell products ("tortoiseshell"), which likely contributes to the harvest of this species.

Summary of Status for Hawksbill Sea Turtles

Worldwide, hawksbill sea turtle populations are declining. They face many of the same threats affecting other sea turtle species. In addition, there continues to be a commercial market for hawksbill shell products, despite protections afforded to the species under US law and international conventions.

Critical Habitat

No critical habitat has been designated by the NMFS for Hawksbill sea turtles in the project area.

Green Sea Turtle

Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered. The nesting range of the green sea turtles in the southeastern United States includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina, the U.S. Virgin Islands (USVI) and Puerto Rico (NMFS and USFWS, 1991b). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward counties (Ehrhart and Witherington, 1992). Green sea turtle nesting also occurs regularly on St. Croix, USVI, and on Vieques, Culebra, Mona, and the main island of Puerto Rico (Mackay and Rebholz, 1996).

Life History and Distribution

The estimated age at sexual maturity for green sea turtles is between 20-50 years (Balazs, 1982; Frazer and Ehrhart, 1985). Green sea turtle mating occurs in the waters off the nesting beaches. Each female deposits 1-7 clutches (usually 2-3) during the breeding season at 12-14 day intervals. Mean clutch size is highly variable among populations, but averages 110-115 eggs/nest. Females usually have 2-4 or more years between breeding seasons, whereas males may mate every year (Balazs, 1983). After hatching, green sea turtles go through a post-hatchling pelagic stage where they are associated with drift lines of algae and other debris. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas (Bjorndal, 1997).

Green sea turtles are primarily herbivorous, feeding on algae and sea grasses, but also occasionally consume jellyfish and sponges. The post-hatchling, pelagic-stage individuals are assumed to be omnivorous, but little data are available. Green sea turtle foraging areas in the southeastern United States include any coastal shallow waters having macroalgae or sea grasses. This includes areas near mainland coastlines, islands, reefs, or shelves, and any open-ocean surface waters, especially where advection from wind and currents concentrates pelagic organisms (Hirth, 1997; NMFS and USFWS, 1991b). Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Doughty, 1984; Hildebrand, 1982; Shaver, 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr, 1957; Carr, 1984), Florida Bay and the Florida Keys (Schroeder and Foley, 1995), the Indian River Lagoon System, Florida (Ehrhart, 1983), and the Atlantic Ocean off Florida from Brevard through Broward counties (Wershoven and Wershoven, 1992; Guseman and Ehrhart, 1992). Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs.

Population Dynamics and Status

The vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Meylan *et al.* 1995; Johnson and Ehrhart 1994). Green sea turtle nesting in Florida has been increasing since 1989 (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index Nesting Beach Survey Database). Current nesting levels in Florida are reduced compared to historical levels, reported by Dodd (1981). However, total nest counts and trends at index beach sites during the past years suggest the numbers of green sea turtles that nest within the southeastern United States are increasing.

Although nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging and developmental grounds. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth, 1997). The summer developmental habitat for green turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus, 1997).

There are no reliable estimates of the number of immature green sea turtles that inhabit coastal areas (where they come to forage) of the southeastern United States. However, information on incidental captures of immature green sea turtles at the St. Lucie Power Plant (they have averaged 215 green sea turtle captures per year since 1977) in St. Lucie County, Florida (on the Atlantic coast of Florida) show that the annual number of immature green sea turtles captured has increased significantly in the past 26 years (FPL, 2002).

It is likely that immature green sea turtles foraging in the southeastern United States come from multiple genetic stocks; therefore, the status of immature green sea turtles in the southeastern United States might also be assessed from trends at all of the main regional nesting beaches, principally Florida, Yucatán, and Tortuguero. Trends at Florida beaches were previously discussed. Trends in nesting at Yucatán beaches cannot be assessed because of a lack of consistent beach surveys over time. Trends at Tortuguero (ca. 20,000-50,000 nests/year) showed a significant increase in nesting during the period 1971-1996 (Bjorndal *et al.* 1999), and more recent information continues to show increasing nest counts (Troëng and Rankin, 2004). Therefore, it seems reasonable that there is an increase in immature green sea turtles inhabiting coastal areas of the southeastern United States; however, the magnitude of this increase is unknown.

Threats

The principal cause of past declines and extirpations of green sea turtle assemblages has been the over-exploitation of green sea turtles for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. However, there are still significant and ongoing threats to green sea turtles from human-related causes in the United States. These threats include beach armoring, erosion control, artificial lighting, beach disturbance (e.g., driving on the beach), pollution, foraging habitat loss as a result of direct destruction by dredging, siltation, boat damage, other human activities, and interactions with fishing gear. Sea sampling coverage in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. There is also the increasing threat from green sea turtle fibropapillomatosis disease. Presently, this disease is cosmopolitan and has been found to affect large numbers of animals in some areas, including Hawaii and Florida (Herbst, 1994; Jacobson, 1990; Jacobson *et al*., 1991).

Summary of Status for Atlantic Green Sea Turtles

Green turtles range in the western Atlantic from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare in benthic areas north of Cape Hatteras (Wynne and Schwartz, 1999). Green turtles face many of the same natural and anthropogenic threats as for loggerhead sea turtles described above. In addition, green turtles are also susceptible to fibropapillomatosis, which can result in death. In the continental United States, green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart, 1979). Recent population estimates for the western Atlantic area are not available. Between 1989 and 2006, the annual number of green turtle nests at core index beaches ranged from 267 to 7,158 (Florida Marine Research Institute Statewide Nesting Database). While the pattern of green turtle nesting shows biennial peaks in abundance, there is a generally positive trend since establishment of index beaches in Florida in 1989.

Critical Habitat

No critical habitat has been designated by the NMFS for this species in the project area.

Dredging Methods and Associated Impacts for Sea Turtles

Hopper Dredge

Hopper dredging along the southeastern USA potentially impacts five species of threatened or endangered sea turtles (i.e., leatherback, loggerhead, Kemp's ridley, hawksbill, and green). In the Atlantic Coastal area, Table 7-5 indicates the total numbers of incidental takes (incidents of mortalities or injuries) of sea turtles that have been documented from hopper dredging activities within Georgia and South Carolina area.

Table 6-5. Total Incidental Sea Turtle Takes by Species for SAD (NC/VA border through Key West, FL) from 1980-2007

.

SOUTH ATLANTIC DIVISION (NC/VA BORDER - KEY WEST, FL) DREDGING RELATED SEA TURTLE INCIDENTS 1980-2007					
Southeastern Atlantic (Jacksonville USACE District)					
Dredging Location	**Loggerhead**	**Green**	**Kemp's**	**Unknown**	**Total**
Dade County Shore Protection Project Miami, FL	0	0	0	0	0
Duval County Shore Protection Project, FL	1	0	0	0	1
Palm Beach Harbor, FL	8	3	0	0	11
Jupiter Island Inlet, FL	2	0	0	0	2
Ft. Pierce, FL	0	1	0	0	1
Melbourne, FL	0	0	0	0	0
Canaveral, FL	77	22	0	50	149
Brevard County Shore Protection Project, FL	5	0	0	0	5
Hutchinson Island Shore Protection, FL	0	0	0	0	0
Melbourne, FL	0	0	0	0	0
St. Augustine Harbor, FL	0	0	0	0	0
Jacksonville Harbor, FL	2	1	0	0	3
Mayport Naval Station, FL	2	2	0	0	4
Kings Bay Entrance Channel, FL	51	6	9	2	68
Key West, FL	0	0	0	0	0
Total	**148**	**35**	**9**	**52**	**244**
South Atlantic (Savannah USACE District)					
Dredging Location	**Loggerhead**	**Green**	**Kemp's**	**Unknown**	**Total**
Brunswick Harbor, GA	41	0	6	1	48
Savannah Harbor, GA	**32**	**0**	**5**	**0**	**37**
TOTAL	**73**	**0**	**11**	**1**	**85**

South Atlantic (Charleston USACE District)					
Dredging Location	**Loggerhead**	**Green**	**Kemp's**	**Unknown**	**Total**
Port Royal, SC	2	0	0	0	2
Charleston Harbor, SC	17	1	0	0	18
Georgetown Harbor, SC	1	0	0	0	1
Myrtle Beach, SC	9	0	0	0	9
Arcadian Shores Private Shore Protection, SC	1	0	0	0	1
TOTAL	**30**	**1**	**0**	**0**	**31**
South Atlantic (Wilmington USACE District)					
Dredging Location	**Loggerhead**	**Green**	**Kemp's**	**Unknown**	**Total**
Wilmington Harbor, NC	8	1	1	0	10
Military Ocean Terminal Sunny Point (MOTSU)	4	0	0	0	4
Morehead City Channel, NC	15	1	0	0	16
Bogue Banks Beach Nourishment, NC	3	0	3	0	6
Oregon Inlet, NC	0	0	0	0	0
Indian Salter Path Beach (Morehead City), NC	0	0	0	0	0
Kure & Carolina Beach Shore Protection, NC	0	0	0	0	0
TOTAL	**30**	**2**	**4**	**0**	**36**
TOTAL SOUTH ATLANTIC DIVISION	**281**	**38**	**24**	**53**	**396**

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The take of sea turtles by hopper dredges was first identified as a potential problem in the late 1970's and NMFS requested that USACE initiate ESA Section 7 consultation on the probable impacts of maintenance and construction dredging to sea turtles residing in Canaveral Harbor. On January 22, 1980 NMFS issued a biological opinion for Canaveral Harbor concluding that "dredging may result in the loss of large numbers of loggerhead sea turtles but is not likely to result in jeopardizing either the loggerhead or Atlantic ridley sea turtle stocks." As required by this biological opinion, NMFS approved observers were required on board dredges to monitor for turtle takes. Between 11 July and 30 November 1980, a total of 71 turtle takes by hopper dredges was documented in the Canaveral channel; thus, USACE acknowledged that hopper dredging posed a problem to sea turtles and the need to modify and/or improve operations to minimize impacts was recognized. Over the last 26 years, an increasing number of navigation projects have been monitored for incidental takes. Currently, 77 project sites in the southeastern United States are monitored. Of these locations, 44 have had documented incidental takes of sea turtles. Additionally, throughout the South Atlantic, all hopper dredging operations within designated offshore borrow sites for shore protection projects are monitored by NMFS approved observers.

Since 1980, USACE and dredging industry have worked to develop protocols, operational methods, and modified dredging equipment to reduce dredging impacts to sea turtles. Engineering and biological studies were completed to develop a suite of protective tools to reduce dredging impacts on marine turtles. These investigations have included sea turtle relative-abundance, behavioral, acoustic-detection and dispersal, and dredging equipment development. In addition to gaining valuable data for understanding sea turtle biology, these studies helped to establish environmental windows, draghead modifications, and draghead turtle deflectors. Furthermore, the USACE has established, and continues to update and improve an internet-based database to centralize and archive historical and future data regarding sea turtle impacts from dredging activities for long-term continuity and evaluation of these data (http://el.erdc.usace.army.mil/seaturtles/index.cfm). In a report to the World Dredging Conference in 2004, Dickerson *et. al.* reviewed the hopper dredge take history and the reduction of take over time, including the measures implemented by USACE to reduce hopper dredge impacts to sea turtles. Although the overall impacts to sea turtles from dredging activities is relatively small, the USACE and dredging industry are committed to the continued pursuit of efforts to further reduce dredging impacts on sea turtles. Current conservation measures implemented by USACE to reduce impacts to sea turtles during hopper dredging operations are discussed in Section 4.2.5, above.

Hydraulic Cutterhead

The potential impacts of hydraulic cutterhead dredging on sea turtles have been considered by NMFS in their 1991, 1995, and 1997 SARBOs. Under each Biological Opinion the NMFS determined that cutterhead pipeline dredging may affect but is not likely to adversely affect sea turtles. In contrast to hopper dredges, pipeline dredges are relatively stationary and therefore act on only small areas at any given time. The cutterhead works most efficiently buried within thick sediment deposits and moves relatively slowly across the channel floor. Turtles can avoid the slow moving cutterhead. Therefore, for a turtle to be taken with a pipeline dredge, it would have to approach the cutterhead within the sediment and be caught in the suction. This type of behavior is unlikely but may be possible if the turtle is cold stunned or brumating. On 29 December 2004, while conducting maintenance dredging of the Brownsville Entrance Channel in Texas, a live stranded green sea turtle was discovered outside of the dredge discharge area with a cracked plastron and carapace. This stranding was one of 42 cold-stunned green sea turtle strandings in the area relative to an arctic cold front that swept through South Texas on December 22. Though it is unlikely that this turtle was taken by the pipeline dredge, it is possible that an increased potential for take may occur if dredging is being conducted where cold-stunned turtles are present.

In the 1980s, observer coverage was required by the NMFS at pipeline outflows during several dredging projects that used pipeline dredges along the Atlantic coast. No turtles or turtle parts were observed in the outflow areas. Additionally, the USACE South Atlantic Division (SAD) office in Atlanta, Georgia, charged with overseeing the work of the individual U Districts along the Eastern Seaboard from North Carolina through Florida, provided documentation of hundreds of hours of informal observation by USACE inspectors during which no takes of listed species were observed. Additional monitoring by other agency personnel, conservation organizations or the general public has never resulted in reports of turtle takes by pipeline dredges (NMFS, 1991a).

Mechanical Dredging - Clamshell (Bucket) Dredge

The impacts of mechanical dredging operations on sea turtles have been previously assessed by the NMFS (NMFS, 1991a; NMFS, 1995a; NMFS 1997b; NMFS, 2003b) in the various versions of the SARBO. The 1991 SARBO states that “clamshell dredges are the least likely to adversely affect sea turtles because they are stationary and impact very small areas at a given time. Any sea turtle injured or killed by a clamshell dredge would have to be directly beneath the bucket. The chances of such an occurrence are extremely low…”. NMFS also determined that “Of the three major dredge types, only the hopper dredge has been implicated in the mortality of endangered and threatened sea turtles.” This determination was repeated in the 1995 and 1997 SARBO’s (NMFS, 1995a and 1997). No new information is available that suggests increased risk of sea turtle take by clamshell dredges since the 1991, 1995, and 1997 SARBOs were received.

Lighting

Potential impacts from lighting would apply to all types of dredging and associated construction equipment. The presence of artificial lighting on or within the vicinity of nesting beaches is detrimental to critical behavioral aspects of the nesting process, including nesting female emergence, nest site selection, and the nocturnal sea-finding behavior of both hatchlings and nesting females. Sea turtles rely on vision to find the sea upon completion of the nesting process and use a balance of light intensity within their eyes to orient towards the brightest direction (Ehrenfeld, 1968); thus, misdirection by lighting may occur resulting in more time being spent to find the ocean. Hatchlings rely almost exclusively on vision to orient to the ocean and brightness is a significant cue used during this immediate orientation process after hatch out (Mrosovsky and Kingsmill, 1985; Verheijen and Wilschut, 1973; Mrosovsky and Shettleworth, 1974; Mrosovsky *et al*., 1979). Hatchlings that are mis-oriented (oriented away from the most direct path to the ocean) or disoriented (lacking directed orientation or frequently changing direction or circling) from the sea by artificial lighting may die from exhaustion, dehydration, predation, and other causes. Though hatchlings use directional brightness of a natural light field (celestial sources) to orient to the sea, light from artificial sources interferes with the natural light cues resulting in misdirection (Witherington and Martin, 2003).

Female sea turtles approaching nesting beaches and neonates (i.e., hatchlings) emerging from nests and exiting their natal beaches, may be adversely affected by lighting associated with dredges and equipment operating in the nearshore (0-3 nmi) environment. Females approaching the beach to nest could be deterred from nesting by bright lights in the nearshore environment. Hatchlings emerging from their nests could be attracted away from the shortest path to the water and instead crawl or swim toward the bright lights of a nearshore dredge or associated anchored equipment (instead of crawling or swimming seaward toward the open horizon), thus increasing their exposure time to predation. Though the risk of disorientation from dredge associated lighting has been documented, as identified in a survey conducted in 2006 by the Florida Fish and Wildlife Conservation Commission on percentages of light sources contributing to disorientation events in Florida, boats (dredges were not specifically identified) were identified as contributing to 0.07% (N=1) of the total disorientation events recorded in the state (http://myfwc.com/seaturtle/Lighting/Light_Disorient.htm).

For dredging vessels, appropriate lighting is necessary to provide a safe working environment during nighttime activities on deck (endangered species observers, etc.). In compliance with the USACE Safety and Health Requirements Manual (USACE, 2003), a minimum luminance of 30 lm/ft^2 is required for outside work performed on board the dredge during nighttime dredge operations. To reduce potential disorientation effects on female sea turtles approaching the nesting beaches and sea turtle hatchlings making their way seaward from their natal beaches, while still adhering to minimum luminance requirements, light emanating from offshore equipment will be minimized through reduced wattage, shielding, lowering, and/or use of low pressure sodium lights to the extent practicable. Shielded low-pressure sodium vapor lights have been identified by the FWCC as the best available technology for balancing human safety and security, roadway illumination, and endangered species protection. They provide the most energy efficient, monochromatic, long-wavelength, dark sky friendly, environmentally sensitive light of the commercially available street lights and will be highly recommended for all lights on the beach or on offshore equipment (Gallagher, 2006). Removal of the use of the nearshore dredged material placement sites off Tybee Island for new work placement has eliminated much of this concern.

Conservation Measures

Hopper dredges working in the Savannah District will implement the following conservation measures prior to any work being accomplished:

a. Draghead Deflector

The sea turtle deflecting draghead evolved from engineering studies performed in the 1980's to modify draghead designs to minimize sea turtle takes (Figure 7-15).

Since its conception, turtle deflecting dragheads have been used on almost all hopper dredging projects in the South Atlantic and have significantly minimized the risk of sea turtle take (Nelson and Shafer 1996; Clausner et al. 2004; Dickerson et al. 2004). Specifically, Contractors are required to equip dragheads with rigid sea turtle deflectors which are rigidly attached to the draghead. In order to assure that the turtle deflecting draghead is engineered and installed correctly, the Contractor provides USACE with drawings and calculations for the project depth to be dredged. These submittals are approved by USACE prior to project commencement.

Specifically, the leading V-shaped portion of the deflector must have an included angle of less than 90 degrees. Internal reinforcement must be installed in the deflector to prevent structural failure of the device. The leading edge of the deflector must be designed to have a plowing effect of at least 6" depth when the drag head is being operated so that turtles located in front of the draghead are pushed away by the resultant sand wave. The dragtender must have the appropriate instrumentation on board the dredge to assure that the critical "approach angle" is maintained during dredging operations. The design "approach angle" or the angle of lower drag head pipe relative to the average sediment plane is very important to the proper operation of a deflector. If the lower drag head pipe angle in actual dredging conditions varies tremendously from the design angle of approach used in the development of the deflector, the 6" plowing effect does not occur and the risk of sea turtle interactions increases. As a component of the Contractor's pre-project submittal to USACE, approach angle calculations (relative to dredge specific draghead configurations and project specific dredging depths) are provided.

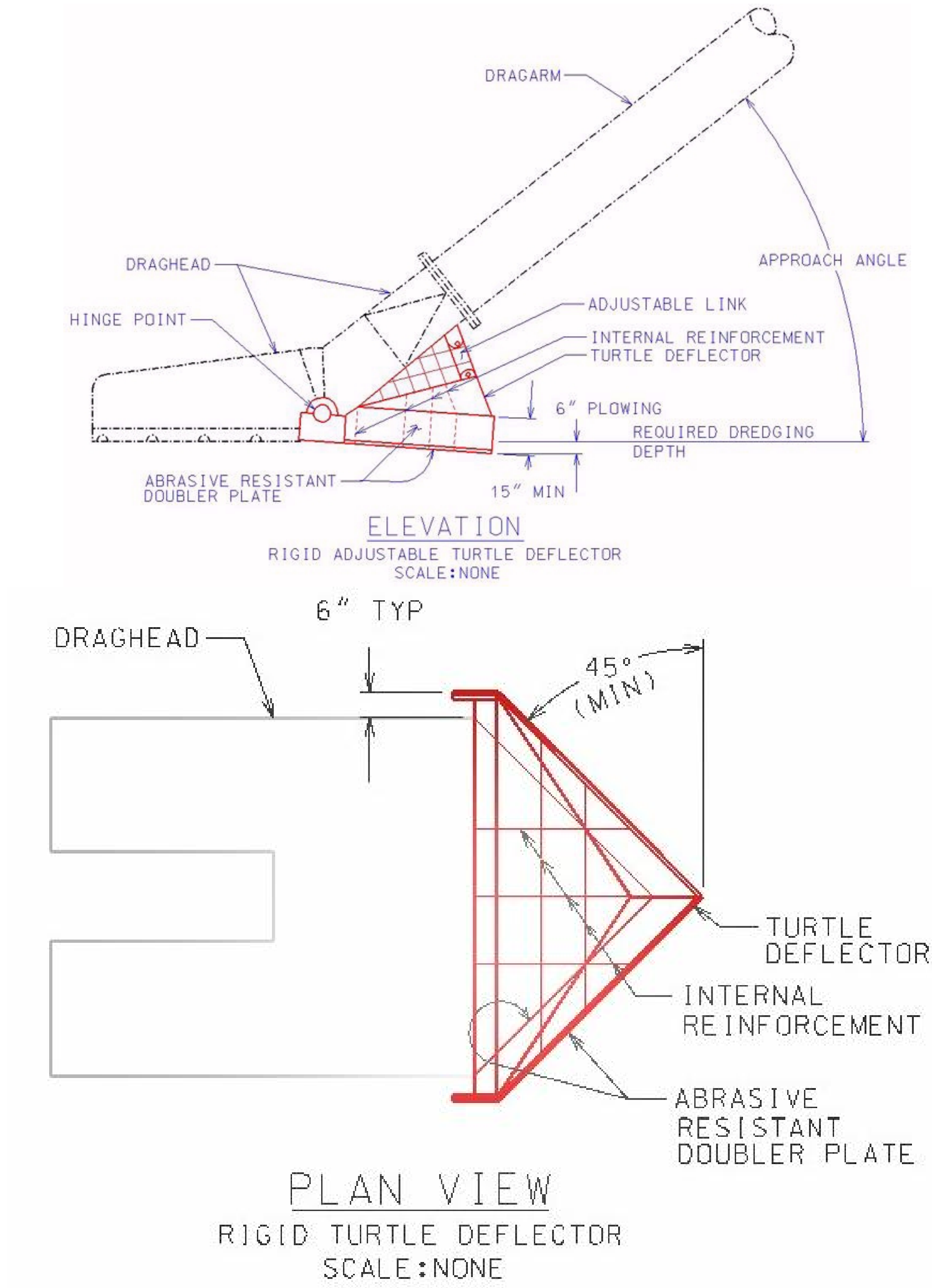

Figure 6-15. Example design drawings of rigid adjustable turtle deflector.

Studies from US dredging projects have demonstrated that, due to the mode of operation for the trailing suction draghead, sea turtles most at risk for entrainment are those that are on or actually nestled into the sea floor sediment. If the dragtender allows the draghead to rise up or bounce along the bottom during suction dredging, turtles that are on or in the sea floor can become trapped underneath the draghead and suctioned into the pumps. Turtles swimming in the water column are not at risk for entrainment, primarily due to the extremely small area of suction influence around the draghead (< ½ meter). However, a turtle might be entrained if it happened to swim directly underneath (within ½ meter) a draghead suspended in the water column with the suction pumps still engaged.

To minimize the risk of impingement or entrainment of sea turtles in the open water column, hopper dredge contract specifications require that dredge pumps not be operated when the dragheads are not firmly on the bottom, to the maximum extent practicable. Furthermore, pumping water through the drag heads is not allowed while maneuvering or during travel to/from the disposal area. During turning operations the pumps must either be shut off or reduced in speed to the point where no suction velocity or vacuum exists. If the required dredging section includes compacted fine sands or stiff clays, a properly configured arrangement of teeth is recommended to enhance dredge efficiency, which reduces total dredging hours and "turtle takes." Pipe plugging shall not be corrected by raising the drag head off the bottom to increase suction velocities; therefore, dredge operators are required to configure and operate their equipment to eliminate the potential for low level suction velocities. An example recommendation for providing additional mixing water to the suction line is through the configuration of water ports openings on top of the drag head or on raised stand pipes above the drag head. All waterport configurations are required to be screened before they are utilized on the dredging project.

To assure that these conditions are understood and implemented by the Contractor, USACE requires that the Contractor develop a written operational plan to minimize turtle takes and submit it as part of the Environmental Protection Plan for approval prior to project commencement. Furthermore, in order to assure contractor compliance with all sea turtle protection measures during hopper dredge operations, detailed quality assurance inspections are performed by USACE personnel on each hopper dredge contract as well as after each sea turtle take.

b. Environmental Windows

To minimize risk of sea turtle incidental takes by dredges, environmental windows were established by NMFS, and further refined by USACE, which restrict dredging to periods when turtles are least abundant or least likely to be affected by dredging. The environmental windows for turtle-safe dredging have targeted the winter months since sea turtle abundance is dramatically reduced at water temperatures below 13°C and typically absent during temperatures below 11°C (Matthew Godfrey, personal communication; Moon *et al*., 1997; STAC, 2006; USACE Sea Turtle Data Warehouse (http://el.erdc.usace.army.mil/seaturtles/allowed.cfm)). The recommended environmental window for most navigation hopper dredging activities (where sea turtle presence is controlled by water temperature) within the project area is from 1 December through 31 March of any year as indicated in the Biological Opinion.

No dredged material would be placed into the nearshore area or on any of the beaches near the AIWW (with the possible exception of Hilton Head south end and Daufuskie Island). In accordance with USFWS directives, placement of dredged material into these areas would be restricted to 1 August to 30 April of any year.

c. Inflow/Overflow Screening and Observers

Inflow/Overflow Screening

In accordance with the Reasonable and Prudent Measures (RPM's) outlined in previous (1995 and 1997) NMFS SARBO's, all SAD hopper dredging contracts require 100% inflow screening throughout the duration of each contract. If possible, 100% overflow screening is also recommended; however, the configuration of the overflow for each hopper dredge is different and 100% overflow screening, in some cases, may not be possible. Nonetheless, if 100% inflow screening is not possible, 100% overflow screening is enforced.

The configuration of inflow and overflow screening is hopper dredge specific, resulting in multiple Contractor configurations to meet USACE contract screening requirements. USACE hopper dredging contracts require a 4"x 4" screen mesh size for both inflow screening to allow biotic and abiotic debris to be screened and evaluated by endangered species observers before being allowed into the hopper (Figure 7-16). The same screen mesh size is used for overflow screening. The efficacy of this inflow and overflow screening mechanism depends on the dredge specific configuration. Some configurations are more prone to clogging with debris; thus, resulting in reduced monitoring efficiency and coverage. In some cases, debris accumulation in the inflow boxes is so significant that effective observer coverage is not possible and USACE must replace the inflow screening with 100% overflow screening. Depending on the type of debris encountered, overflow screening may become clogged with floating debris and compromise the safety of the vessel. USACE has consulted with the NMFS on a case-by-case basis to address these site specific circumstances.

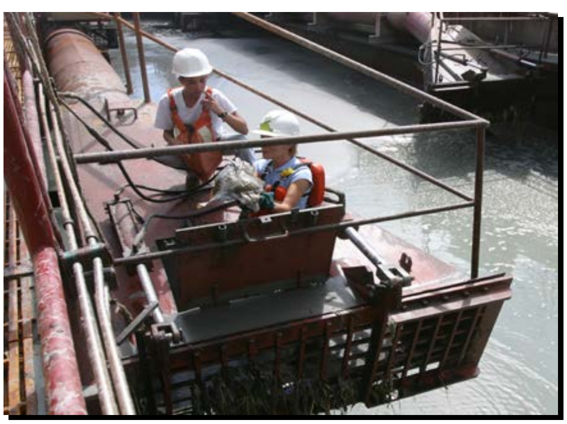

Figure 6-16 Photographs of hopper dredge inflow (left) and overflow (right) screening

Observers

During hopper dredging operations, observers approved by NMFS for sea turtles, sturgeon, and whales are required to be aboard the hopper dredge to monitor for the presence of the species where appropriate. Specific observer requirements throughout the South Atlantic are outlined in Table 3 of the 1997 SARBO; however, the USACE SAD currently encourages a more stringent protocol of one hundred percent (24hr/day) observer coverage conducted year round for hopper dredge operations. During transit to and from offshore borrow or placement areas, the observer monitors from the bridge during daylight hours for the presence of endangered species, especially the right whale, during the period December through March. During dredging operations, while dragheads are submerged, the observer continuously monitors the inflow and/or overflow screening for turtles and/or turtle parts. Upon completion of each load cycle, dragheads are monitored as the draghead is lifted from the sea surface and is placed on the saddle in order to assure that sea turtles that may be impinged within draghead are properly accounted. Physical inspections of dragheads and inflow and overflow screening/boxes for threatened and endangered species take are performed to the maximum extent practicable.

d. Dredging Quality Management (DQM) Program (Formerly known as Silent Inspector)

The DQM program is an automated dredge monitoring system comprised of both hardware and software developed by USACE. USACE developed the DQM as a low cost, repeatable, impartial system for automated dredge monitoring. Currently, DQM is required for all USACE hopper and scow contracts; however, it is not on all Government-owned dredges yet. The DQM system integrates various automated systems to record digital dredging and disposal activities for both government-owned and contract dredges. Both DQM systems collect and record measurements from shipboard sensors, calculate the dredging activities, and display this information using standard reports and graphical displays.

On hopper dredges, DQM monitors the operating conditions of the dredge in near real time. Once loaded in to the DQM database, graphical displays can be generated to help assure contractor compliance with the draghead operating requirements, as outlined in Section 4.02.5, in order to minimize sea turtle take risk. Visual graphs can be used (Figure 7-17) to display dredging data variables such as draghead elevation, slurry density, slurry velocity, etc. Specifically, if a sea turtle take occurs, these data can be used to generate graphs that may help in developing risk assessments to assess what the conditions of the dragheads were during any given load cycle (See paragraph (g) of Section 4.02.5). If a sea turtle take can be correlated to incompliance with contract specification requirements through DQM, it is possible to correct the Contractor of his actions in order to minimize the risk of taking another turtle.

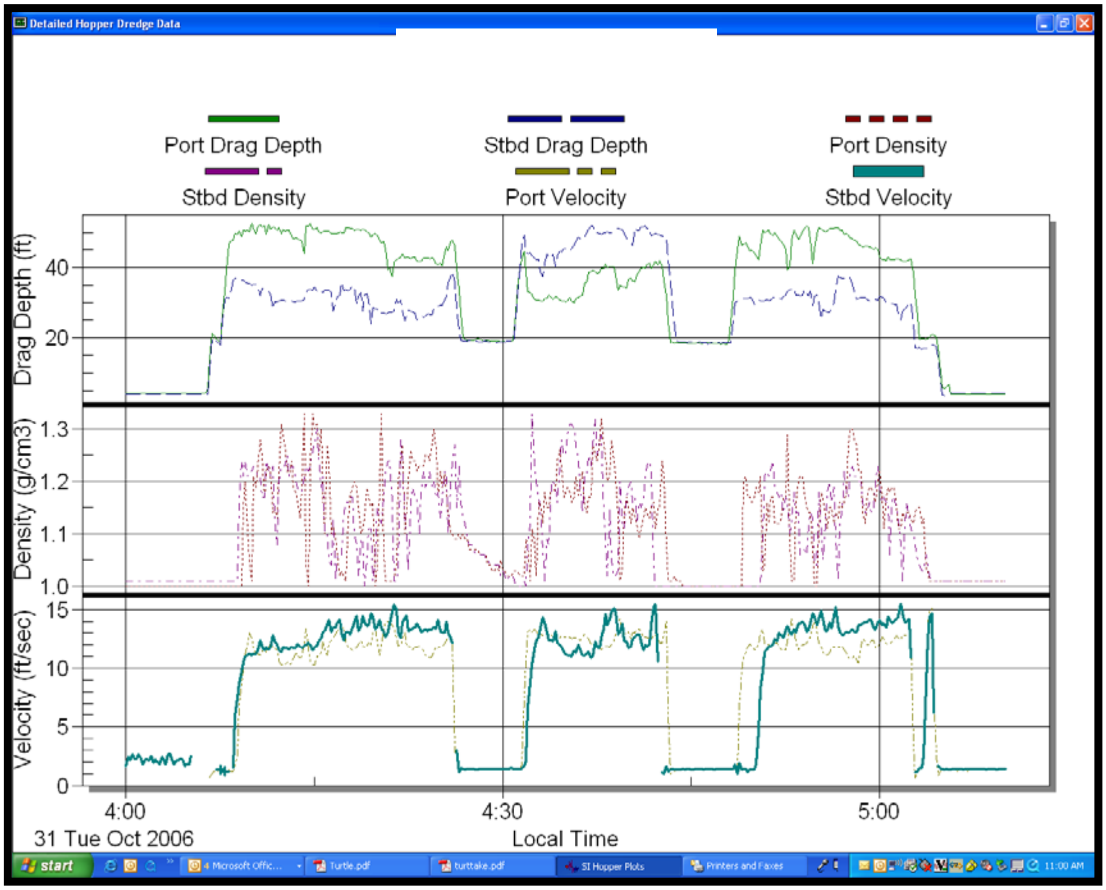

Figure 6-17. Example graphic generated by DQM to help assess contractor compliance with sea turtle operating condition requirements during hopper dredging operations. Specific time periods when the dragheads are off the bottom with the pumps still on can be identified using this DQM tool.

Effect Determination

A. Hydraulic Hopper Dredge

Small hopper dredges (i.e. Wilmington District hopper dredges) may be used where the dredge material is suitable for beneficial use and for near shore beach re-nourishment. However, reach 2 in South Carolina is the only area of the AIWW that contains material suitable for beach re-nourishment; and this material would only be used for re-nourishment at the south end of Hilton Head Island and/or Daufuskie Island, or DMCA 14B (for later use in dike construction). Hopper dredges and mechanical dredges may also be used when dredge material is to be transported to EPA approved ODMDS. All hopper dredging will be generally scheduled for 1 December through 31 March, and the following conditions will apply*:

1. One hundred percent inflow screening is required, and 100 percent overflow screening is recommended when sea turtle observers are required on hopper dredges in areas and seasons when

sea turtles may be present. If conditions disallow 100 percent inflow screening, inflow screening can be reduced, but 100 percent overflow screening is required, and an explanation must be included in the preliminary dredging report.

2. The sea turtle deflecting draghead is required for all hopper dredging.

3. To prevent impingement of sea turtles within the water column, every effort should be made to keep the dredge pumps disengaged when the dragheads are not firmly on the bottom.

4. A trained turtle observer will be placed on the hopper dredges to monitor for sea turtles for 100 percent of the period from 1 through 31 March.

5. The water intake ports on the top of the draghead shall be screened with metal elliptical cages, or other suitable means to exclude sea turtles from entering the drag arm. No dredging shall be performed by a hopper dredge without a turtle deflector device in place.

6. Dredging shall be suspended upon the taking of more than two turtles in any 24-hour day, the taking of one hawksbill turtle, or once three turtles are taken. Dredging operations will not commence, again, until coordination with South Atlantic Division and the NMFS has taken place and any remediation requirements are implemented, such as relocation trawling with a shrimp boat, to ensure compliance with the Endangered Species Act.

7. A report summarizing the take of sea turtles will be submitted to the NMFS immediately following completion of the project.

NOTE: *These are the conditions currently being followed in accordance with the NMFS 1997 Biological Opinion for Navigation Channels in the Southeast, and additional guidance provided by South Atlantic Division. Should a new Regional Biological Opinion be issued, the District would consider the conditions listed here void, and would abide by the conditions as stated in that opinion and any further guidance provided by South Atlantic Division.

B. Other Hydraulic and Mechanical Dredging Operations

Though the potential exists for impacts to loggerhead, Kemp's ridley, hawksbill, and green sea turtles from other dredging operations such as mechanical dredging and cutterhead (pipeline) dredging, no sea turtle species are known to have been specifically taken by these operations. Therefore, they continue to be considered as dredging alternatives which may affect, but are not likely to adversely affect sea turtle species.

With maintenance dredging, the total number of vessels in the AIWW would not be expected to change (when comparing With and Without Project conditions). Therefore, post project ship traffic in the AIWW is not expected to impact sea turtles more than under existing conditions.

Summary of Critical Habitat for Sea Turtles in the Project Area

NMFS has not designated any critical habitat designation for leatherback, loggerhead, Kemp's ridley, hawksbill, and green sea turtle species in the project area. Therefore, the proposed activities will not adversely modify designated critical habitat for leatherback, loggerhead, Kemp's ridley, hawksbill, and green sea turtle species.

Summary Effect Determination

With implementation of the conservation measures and construction windows mentioned above, the use of hopper, pipeline, and mechanical dredges in the project area "may affect, but is not likely to adversely affect" the leatherback, loggerhead, Kemp's ridley, hawksbill, and green sea turtles.

6.2.7 Atlantic Sturgeon and Shortnose Sturgeon

The Shortnose and Atlantic sturgeon are different species. However, considering their similarities in habitat use, distribution throughout the proposed action area, foraging behavior and prey base, and subsequent risk of take relative to dredging and trawling operations (based on documented incidental take records), this assessment will consider impacts from the proposed activity to Shortnose and Atlantic sturgeon together. Information on these species can be obtained from the following link and other sources: http://sero.nmfs.noaa.gov/pr/sturgeon.htm
On February 6, 2012, NOAA Fisheries Service issued a final determination to list the South Atlantic and Carolina population sement of Atlantic sturgeon as endangered under the Endangered Species Act (effective date of April 6, 2012). NOAA Fisheries Service recently conducted status reviews for five Atlantic sturgeon distinct population segments off the US East Coast (New York Bight, Chesapeake Bay, Carolinas, Gulf of Maine and South Atlantic). In February 2012, NOAA also reached decisions about the other East Coast population segments, listing the New York Bight and Chesapeake Bay populations as endangered, and the Gulf of Maine population as threatened.

Shortnose Sturgeon

Life History and Distribution

Life History

The Shortnose sturgeon is an anadromous species restricted to the east coast of North America. Throughout its range, Shortnose sturgeon occur in rivers, estuaries, and the sea. It is principally a riverine species and is known to use three distinct portions of river systems: (1) non-tidal freshwater areas for spawning and occasional overwintering; (2) tidal areas in the vicinity of the fresh/saltwater mixing zone, year-round as juveniles and during the summer months as adults; and (3) high salinity estuarine areas (15 parts per thousand (ppt.) salinity or greater) as adults during the winter. The majority of populations have their greatest abundance and are found throughout most of the year in the lower portions of the estuary and are considered to be more abundant now than previously thought (NMFS, 1998a).

The Shortnose sturgeon is a suctorial feeder and its preferred prey is small gastropods. Sturgeon forage by slowly swimming along the bottom, lightly dragging their barbels until they feel something that may resemble food, at which time they suck it up in their protrusible mouths. The non-food items are expelled through their gills. Juveniles may be even more indiscriminate, and just vacuum their way across the bottom. Soft sediments with abundant prey items such as macroinvertebrates are thought to be preferred by Shortnose sturgeon for foraging, so established benthic communities are important. They are thought to forage for small epifaunal and infaunal organisms over gravel and mud. A few prey studies have been conducted and prey include small crustaceans, polychaetes, insects, and mollusks (Moser and Ross 1995; NMFS, 1998a), but they have also been observed feeding off plant surfaces and on fish bait (Dadswell *et al.* 1984). Hall et al., 1991, mention the small clam Corbicula as being a possible prey item for the Shortnose sturgeon in the lower Savannah River. Three sites just upstream of the project upper limit were identified as feeding areas River Mile 24.6, 22.4, and 22.2 (rkm 39.6, rkm 36, and rkm 35.7).

The species' general pattern of adult seasonal movement (spawning) involves an upstream migration from late January through March when water temperatures range from 9º C to 12º C. Post-spawning fish begin moving back downstream in March and leave the freshwater reaches of the river in May. Juvenile and adult sturgeon use the area located 1 to 3 miles from the freshwater/saltwater interface throughout the year as a feeding ground. During the summer, this species tends to use deep holes at or just above the freshwater/saltwater boundary (Flournoy *et al*., 1992; Rogers and Weber; 1994, Hall *et al.*, 1991). Juvenile Shortnose sturgeon generally move upstream for the spring and summer seasons and downstream for fall and winter; however, these movements usually occur above the salt- and freshwater interface of the rivers they inhabit (Dadswell *et al.* 1984, Hall *et al.* 1991). Adult Shortnose sturgeon prefer deep, downstream areas with soft substrate and vegetated bottoms, if present. Because they rarely leave their natal rivers, Kieffer and Kynard (1993) considered Shortnose sturgeon to be freshwater amphidromous (*i.e.* adults spawn in freshwater but regularly enter saltwater habitats during their life).

As with most fish, southern populations of Shortnose sturgeon mature earlier than northern ones: females reach sexual maturity at approximately 6 years, and males reach it at 3 years. In early February to late March, Shortnose sturgeon spawn far upstream in freshwater. In most population segments, sturgeon spawn at the uppermost river reaches that are accessible. Damming rivers has blocked passage to many spawning grounds as a result; fortunately, the Savannah River is not dammed until just below the fall line. Hall et al. (1991) identified potential spawning sites at river kilometer (RKM) 179 to 190 and 275 to 278. Spawning habitat is well upstream of the project influence, in channels and curves in gravel sand, and log substrate in the Savannah River (Hall et al. 1991). Other suitable substrates include riffles near limestone bluffs with gravel to boulder-sized substrate (Rogers and Weber 1995). Spawning lasts for about 3 weeks, beginning when water temperatures are at about 8 to 9° C, and ending when it reaches approximately 12 to 15° C. The spent fish migrate downriver from March to May, and spend the summer from June to December in the lower river (Hall et al. 1991). Females likely do not spawn every year, while males may do so. Adult Shortnose sturgeon have been found at the base of the New Savannah Bluff Lock and Dam (the lowest dam on the Savannah River) during the spring months. The demersal, adhesive eggs hatch in freshwater, and develop into larvae within 9 to 12 days. Larvae start swimming and initiate their slow downstream migrations at about 20 mm in length (Richmond and Kynard, 1995).

Shortnose sturgeon in the northern portion of the species' range live longer than individuals in the southern portion of the species' range (Gilbert, 1989). The maximum age reported for a Shortnose sturgeon in the St. John River in New Brunswick is 67 years (for a female), 40 years for the Kennebec River, 37 years for the Hudson River, 34 years in the Connecticut River, 20 years in the

Pee Dee River, and 10 years in the Altamaha River (Gilbert 1989 using data presented in Dadswell *et al.* 1984). Male Shortnose sturgeon appear to have shorter life spans than females (Gilbert, 1989).

The current best estimate (Collins et al 2001 and Collins et al. 2002) is that adult sturgeon can be expected throughout the year somewhere within the area from River Mile 3.4 to 29.5 (river kilometers 5.5 to 47.5) and juvenile sturgeon from River Mile 19.3 to 29.5 (river kilometers 31.2 to 47.5), respectively.

Adult Life Stage

Adult Shortnose sturgeons migrate extensively throughout an individual river system and may also migrate between different river basins (Wrona *et al*., 2007; Cooke and Leach, 2004). In 1999 and 2000, Collins *et al.* (2001) tracked adult and juvenile sturgeon in the Savannah River and identified distinct summer and winter habitats in terms of location and water quality (Table 7-6). Observations indicate that they seek relatively deep, cool holes upriver for sanctuary from warm temperatures (and possibly to escape low dissolved oxygen coupled with salinity stress), and in the winter, they migrate downstream to the estuary, perhaps to feed or escape extreme cold. When temperatures are below 22° C, it appears that both adult and juvenile sturgeon stay in the lower river. During warmer periods when temperatures exceed 22° C, telemetry observations and gill net surveys indicate that sturgeon use the upper estuary. While they are known to occur in 4 to 33° C, sturgeon show signs of stress at temperatures above 28°, and this stress may be exacerbated by low dissolved oxygen conditions during summer critical months. Sturgeon may seek thermal refuges during these periods, deep cool waters where salinity conditions are appropriate and food is available with minimal foraging movements. For example, Flournoy *et al*. (1992) found that sturgeon may use spring-fed areas for summer habitat in the Altamaha River system. The synergistic effects of high temperatures and low dissolved oxygen should be considered in any impact analysis, and the analysis for this project included these parameters. Based on work done in the Chesapeake Bay, sturgeon may suffer an "oxygen squeeze" in the summer when they seek deep cool areas that also have low dissolved oxygen (Secor and Niklitschek, 2001).

Table 6-6. Mean Water Temperature, Salinity, and Dissolved Oxygen (D.O.) by Season at Locations where Adult Shortnose Sturgeon were Found (reproduced from Collins *et al*. 2001)

Season	°C	Salinity (ppt)	D.O. (mg/L)
Spring	19.9	1.4	7.84
Summer	27.3	2.0	6.36
Fall	21.1	3.3	7.06
Winter	12.3	5.4	8.36

Juvenile Life Stage

Juvenile Shortnose sturgeon mature at approximately 3 to 6 years of age, and they live in the salt/fresh interface in most rivers. After spending their first year in the upper freshwater reaches, they adopt the adult migratory lifestyle and go upriver in the summer and down in the winter. Like adults, they need sand or mud substrate for foraging (Hall *et al.* 1991). They are less tolerant of low dissolved oxygen and high salinity than the adults and appear to migrate accordingly within the river system. According to Collins *et al.* (2001), when temperatures exceeded 22° C in the Savannah River, juveniles spent the summer in deep (5 to 7 m) holes with 0 to 1 ppt salinity levels (Table 7-7). During the winter, they use the warmer estuarine-influenced lower river. For example, they move into more saline areas (0 to 16 ppt) when temperatures dropped below 16° C in the Ogeechee River. Warm summer temperatures over 26° limit movement of juveniles who may not be able to forage extensively during summers. Tolerance to both dissolved oxygen and salinity is thought to increase with age; very young sturgeon are known to be extremely sensitive to both (Jenkins *et al*., 1993). Jenkins *et al* (1993) reported that in a 6-hour test, fish 64 days old exhibited 86% mortality when exposed to dissolved oxygen concentrations of 2.5 mg/L. However, sturgeon >100 days old were able to tolerate concentrations of 2.5 mg/L with <20% mortality. Jenkins also reported that dissolved oxygen at less than 3 mg/L causes changes in sturgeon behavior: Fish hold still and pump water over their gills, an apparent adaptation to survive low dissolved oxygen conditions. If fish spawn in the spring, it is believed that late age individuals encounter these low dissolved oxygen conditions in the lower estuary. The Environmental Protection Agency (Chesapeake Bay Program Office) recently revised its D.O. criteria for living resources in Chesapeake Bay tributaries from 2.0 mg/L to 3.5 mg/L to be protective of sturgeons (Secor and Gunderson, 1998; Niklitschek and Secor, 2001). It is possible that 3.5 mg/L may be acceptable, but 4.0 mg/L would be safer for the higher temperatures in this southern river. As with adults, temperatures above 28° reduce tolerance to low dissolved oxygen (Flournoy *et al*. 1992).

Table 6-7. Mean Water Temperature, Salinity, and Dissolved Oxygen by Season at Locations where Juvenile Shortnose sturgeon were Found (reproduced from Collins *et al*. 2001)

Season	°C	Salinity	D.O.
Spring	20.4	2.4	7.58
Summer	28.5	0.3	6.80
Fall	21.7	4.7	6.45
Winter	12.5	8.6	8.63

Egg and Larval Life Stages

The demersal, adhesive eggs hatch in freshwater, and develop into larvae within 9 to 12 days. Larvae start swimming and initiate their slow downstream migrations at about 20 mm in length. It is generally agreed that Shortnose sturgeon larvae are not in the project impact area. No Shortnose sturgeon larvae (including ichthyoplankton and ichthyofauna) were found in the 2-year study in the Savannah River estuary ("Temporal and Spatial Distribution of Estuarine-Dependent Species in the Savannah River Estuary") conducted by UGA for this project. However, an Atlantic sturgeon (*A. oxyrinchus*) larva was found at approximately RKM 41 during a recent ichthyoplankton study (Reinert et al. 1998). The maintained harbor extends up to RKM 34.3. In addition to existing information, an extensive monitoring study in the SE US is being funded by NOAA on the Atlantic and Shortnose sturgeon. This effort began in the spring of 2011 and is scheduled to last for 5 years. The work in the Savannah River is being conducted by SC DNR. (http://www.nmfs/noaa.gov/pr/conservation/states/funded.htm). As information becomes available, USACE and NOAA Fisheries will consider it.

Present Conditions. Based on the known effects of dissolved oxygen, temperature, and salinity during the critical summer months, a safe threshold for suitable habitat for Shortnose sturgeon appears to be approximately 4.0 mg/L in the bottom meter of the water column when temperatures exceed 26°C and 3.5 mg/L when they do not exceed that temperature threshold (Secor and Gunderson, 1998; Niklitschek and Secor, 2001; and Flournoy *et. al*. 1992). Prolonged exposure to low oxygen levels may not produce acute impacts to fish health, but would result in extended periods of stress that would likely result in chronic or delayed complications to fish health that could influence condition, reproduction or survival.

Salinity criteria are more complicated due to the migration patterns of sturgeon and various tolerance levels by life stage. For juveniles at age 1, salinity levels between 0 and 4 ppt could be considered suitable habitat. For adults, salinity from 0 to 17 ppt could be considered appropriate. However, for both juveniles and adults, salinity tolerances are likely related to temperature.

During the winters of 1999-2000, juvenile Shortnose sturgeon consistently utilized a deep hole in Middle River near the confluence with the Front River. These juveniles enter and exit the Middle River area through its connection with the Front River.

The Fisheries Interagency Coordination Team (composed of representatives from USFWS, NOAA Fisheries, South Carolina DNR, Georgia DNR, and USACE) developed criteria for acceptable Shortnose sturgeon habitat in the Savannah Harbor for impact evaluation purposes on the SHEP project. Those criteria are indicated in Table 6-8.

Table 6-8. Summary of Shortnose sturgeon Habitat Suitability Criteria in the Savannah River Estuary

Life Stage	Adults	Adults	Juveniles
Time of Year	Winter	Summer	Winter
Salinity	<= 25 ppt	<= 10 ppt	<= 4 ppt
D.O. Exceedance	10 %	Same	Same
Dissolved Oxygen	3.5 mg/L	4.0 mg/L	3.5 mg/L
D.O. Exceedance	5 %	Same	Same
Dissolved Oxygen	3.0 mg/L	3.0 mg/L	3.0 mg/L
D.O. Exceedance	1 %	Same	Same
Dissolved Oxygen	2.0 mg/L	2.0 mg/L	2.0 mg/L
Temperature	Normal January	Normal August	Normal January
River Flow	Normal January	Normal August	Normal January
Location – depth	Bottom layer	Same	Same
Location – width	Where Hydrodynamic Model is 3 cells wide, use deepest cell; where >3 cells wide, use deepest 2 cells	Same	Same

Species' Description, Distribution, and Population Structure

Shortnose sturgeon occur within most major river systems along the Atlantic Coast of North America, from the St. John River in Canada to the St. Johns River in Florida. In the southern portion of the range, they are found in the St. Johns River in Florida; the Altamaha, Ogeechee, and Savannah Rivers in Georgia; and, in South Carolina, the river systems that empty into Winyah Bay and the Santee/Cooper River complex that forms Lake Marion. Data are limited for the rivers of North Carolina. In the northern portion of the range, Shortnose sturgeon are found in the Chesapeake Bay system, Delaware River from Philadelphia, Pennsylvania to Trenton, New Jersey; the Hudson River in New York; the Connecticut River; the lower Merrimack River in Massachusetts and the Piscataqua River in New Hampshire; the Kennebec River in Maine; and the St. John River in New Brunswick, Canada (http://www.nmfs.noaa.gov/pr/species/fish/Shortnosesturgeon.htm#distribution). The Shortnose sturgeon recovery plan describes 20 Shortnose sturgeon population segments that exist in the wild. Two additional, geographically distinct populations occur behind dams in the Connecticut River (above the Holyoke Dam) and in Lake Marion on the Santee-Cooper River system in South Carolina (above the Wilson and Pinopolis Dams). Although these populations are geographically isolated, genetic analyses suggest that individual Shortnose sturgeon move between some of these populations each generation (Quattro *et al.* 2002, Wirgin *et al.* 2005) (Table 7-8).

At the northern end of the species' distribution, the highest rate of gene flow (which suggests migration) occurs between the Kennebec and Androscoggin Rivers. At the southern end of the species' distribution, populations south of the Pee Dee River appear to exchange between 1 and 10 individuals per generation, with the highest rates of exchange between the Ogeechee and Altamaha Rivers (Wirgin *et al.* 2005). Wirgin *et al.* (2005) concluded that rivers separated by more than 400 km were connected by very little migration, while rivers separated by no more than 20 km (such as the rivers flowing into coastal South Carolina) would experience high migration rates. Coincidentally, at the geographic center of the Shortnose sturgeon range, there is a 400 km stretch of river with no known populations occurring from the Delaware River, New Jersey to Cape Fear River, North Carolina (Kynard, 1997) (Table 7-9). However, Shortnose sturgeon are known to occur in the Chesapeake Bay, and may be transients from the Delaware River via the Chesapeake and Delaware Canal (Skjeveland *et al.* 2000, Welsh *et al.* 2002) or remnants of a population in the Potomac River.

Several authors have concluded that Shortnose sturgeon populations in the southern end of the species geographic range are extinct. Rogers and Weber (1994), Kahnle *et al.* (1998), and Collins *et al.* (2000) concluded that Shortnose sturgeon are extinct from the St. Johns River in Florida and the St. Marys River along the Florida and Georgia border. Historical distribution has been in major rivers along the Atlantic seaboard from the St. John River in Canada, south to the St. Johns River in Florida and rarely in the off-shore marine environment. Currently, Shortnose sturgeon are more prominent in northern river systems and severely depleted in southern river systems.

Table 6-9. Known Shortnose Sturgeon Population Densities (table adapted from NMFS 2007 Biological Opinion for the issuance of Permit #1447)

Population/ Subpopulation	Distribution	Datum	Estimate	Confidence Interval	Authority
Neuse River	NC	2001-2002	Extirpated		Oakley 2003
Cape Fear River	NC	1997	>100		Kynard 1997, NMFS 1998
Winyah Bay	NC, SC	No data			
Waccamaw - Pee Dee River	SC	No data			
Santee River	SC	No data			
Cooper River	SC	No data			
ACE Basin	SC	No data			
Savannah River	SC,GA		1,000-3,000		Bill Post, SCDNR 2003
Ogeechee River	GA	1990s	266		Bryce *et al.* 2002
		1993	266	236-300	Kirk *et al.* 2005
		1993	361	326-400	Rogers and Weber 1994
		1999/2000	195		Bryce *et al.* 2002
		2000	147	105-249	Kirk *et al.* 2005
		2004	174	97-874	Kirk *et al.* 2005
Altamaha River	GA	1988	2,862	1,069-4,226	NMFS 1998
		1990	798	645 – 1, 45	NMFS 1998
		1993	468	315 – 903	NMFS 1998
		2003-2005	6,320	4,387-9,249	DeVries 2006
Satilla River	GA		Extirpated		Kahnle *et al.* 1998
Saint Mary's River	FL		Extirpated		Kahnle *et al.* 1998, Rogers and Weber 1994
Saint Johns River	FL		Extirpated		Rogers and Weber 1994; FWC 2007

Population Dynamics and Status

Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001) pursuant to the Endangered Species Preservation Act of 1966. Shortnose sturgeon remained on the list as endangered with the enactment of the ESA in 1973. Shortnose sturgeon were first listed on the International Union for Conservation of Nature and Natural Resources Red List in 1986 where it is still listed as vulnerable and facing a high risk of extinction based in part on: an estimated range reduction of greater than 30% over the past three generations, irreversible habitat losses, effects of habitat alteration and degradation, degraded water quality and extreme fluctuations in the number of mature individuals between rivers.

Despite the longevity of adult sturgeon, the viability of sturgeon populations are highly sensitive to juvenile mortality that result in reductions in the number of sub-adults that recruit into the adult, breeding population (Anders *et al.,* 2002; Gross *et al.,* 2002; Secor *et al.,* 2002). Sturgeon populations can be grouped into two demographic categories: populations that have reliable (albeit periodic) natural recruitment and those that do not. The Shortnose sturgeon populations without reliable natural recruitment are at the greatest risk (Secor *et al.*, 2002). Alternatively, several authors have also demonstrated that sturgeon populations generally, and Shortnose sturgeon populations in particular, are much more sensitive to adult mortality than other species of fish (Boreman, 1997; Gross *et al.,* 2002; Secor *et al.,* 2002). These authors concluded that sturgeon populations cannot survive fishing related mortalities that exceed five percent of an adult spawning run and they are vulnerable to declines and local extinction if juveniles die from fishing related mortalities.

Threats

The construction of dams throughout the Shortnose sturgeon's range probably reduced their reproductive success by reducing the volume of suitable spawning habitat. Dredging activities have been known to take individual sturgeon and have the potential to alter the quality of their feeding, rearing, and overwintering habitat (http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm). More recently, larval and juvenile Shortnose sturgeon in the different populations along the Atlantic have been killed after being impinged on the intake screens or entrained in the intake structures of power plants on the Delaware, Hudson, Connecticut, Savannah and Santee rivers (Dadswell *et al.,* 1984). Sturgeon populations have also been reduced further by habitat fragmentation and loss, siltation, water pollution, decreased water quality (low D.O., salinity alterations), bridge construction, and incidental capture in coastal fisheries (Dadswell *et al.,* 1984; Collins *et al.,* 1996; NMFS, 1998a; Secor and Gunderson, 1998; Collins *et al.,* 2000; Newcomb and Fuller, 2001).

Construction of dams and pollution of many large northeastern river systems during the period of industrial growth in the late 1800's and early 1900's may have resulted in substantial loss of suitable habitat. In addition, habitat alterations from point source discharges, dredging or disposal of material into rivers, or related development activities involving estuarine/riverine mudflats and marshes, remain constant threats. Commercial exploitation of Shortnose sturgeon occurred throughout its range starting in colonial times and continued periodically into the 1950's.

Critical Habitat

No critical habitat rules have been published for the Shortnose sturgeon

Atlantic Sturgeon

The following sections were taken from the 2007 NMFS Status Review of Atlantic Sturgeon:

Life History and Distribution

Life History

Although specifics vary latitudinally, the general life history pattern of Atlantic sturgeon is that of a long lived, late maturing, estuarine dependent, anadromous species. The species' historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida (Murawski and Pacheco, 1977; Smith and Clugston, 1997).

Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco, 1977; Smith, 1985; Bain, 1997; Smith and Clugston, 1997; Caron *et al*., 2002). In some southern rivers, a fall spawning migration may also occur (Rogers and Weber, 1995; Weber and Jennings, 1996; Moser *et al*., 1998).

Atlantic sturgeon spawning is believed to occur in flowing water between the fresh/salt water interface and fall line of large rivers, where optimal flows are 46-76 cm/s and depths of 11-27 meters (Borodin, 1925; Leland, 1968; Scott and Crossman, 1973; Crance, 1987; Bain *et al*., 2000). Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble) (Gilbert, 1989; Smith and Clugston, 1997).

Upon reaching a size of approximately 76-92 cm, the subadults may move to coastal waters (Murawski and Pacheco, 1977; Smith, 1985), where populations may undertake long range migrations (Dovel and Berggren 1983, Bain 1997, T. King supplemental data 2006). Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers. Subadult Atlantic sturgeon wander among coastal and estuarine habitats, undergoing rapid growth (Dovel and Berggren, 1983; Stevenson, 1997). These migratory subadults, as well as adult sturgeon, are normally captured in shallow (10-50m) nearshore areas dominated by gravel and sand substrate (Stein *et al*., 2004). Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina, which presumably provide better foraging opportunities (Dovel and Berggren, 1983; Johnson *et al*., 1997; Rochard *et al*., 1997; Kynard *et al*., 2000; Eyler *et al*., 2004; Stein *et al*., 2004; Dadswell, 2006).

Species' Description, Distribution, and Population Structure

Assessment of the current distribution and abundance of Atlantic sturgeon is based on a comprehensive review of the literature and interviews with provincial, state, and Federal fishery management personnel regarding historic and ongoing sampling programs which targeted or incidentally captured Atlantic sturgeon. Water bodies where no information is available, either historic or current, were assessed as to whether Atlantic sturgeon could use the present habitat based on the geomorphology of the system and expert opinion. Riverine systems where gravid Atlantic sturgeon or young-of-year (YOY)(< age-1; ≤ 41 cm TL or 35 cm FL) have been documented within the past 15 years were considered to contain extant spawning populations, as this is the average period of time to achieve sexual maturity. The presence of juveniles greater than age-0 (YOY) does not provide evidence of spawning within a river because subadults are known to undertake extensive migrations into non-natal riverine systems.

Comprehensive information on current or historic abundance of Atlantic sturgeon is lacking for most river systems. Data are largely available from studies directed at other species and provide evidence primarily of presence or absence. Historic and current spawning populations of Atlantic sturgeon in East Coast estuarine systems of the United States are summarized in Table 7-10. Size and age data were used to indicate how a particular habitat (i.e., spawning, nursery, or migrating habitat) is utilized by sturgeon. The presence of multiple year classes demonstrates successful spawning in multiple years but not necessarily in that system. Available quantitative data on abundance and, where available, data that document changes in abundance of sturgeon populations are included in the 2007 status review.

Table 6-10. Historic and Current Spawning Populations of Atlantic sturgeon in East Coast Estuarine Systems of the United States

State	River	Historical Spawning Status	Current Spawning Status	Use of River by Atlantic Sturgeon
QE	Saint Lawrence	Yes	Yes	Spawning, Nursery
NB	Miramichi	Unknown	Unknown	Nursery
NS	Avon	Yes	No	Unknown
NS	Annapolis	Yes	Yes	Spawning, Nursery
NB	Saint John	Yes	Yes	Spawning, Nursery
NB/ME	Saint Croix	Yes	Possibly	Nursery
ME	Penobscot	Yes	Possibly	Nursery
ME	Kennebec	Yes	Yes	Spawning, Nursery
ME	Androscoggin	Yes	Possibly	Nursery
ME	Sheepscot	Yes	Possibly	Nursery
NH	Piscataqua	Unknown	No	Unknown
NH/MA	Merrimack River	Yes	No	Nursery
MA/RI	Taunton	Yes	No	Nursery
RI/CT	Pawcatuck	Unknown	No	Unknown
MA/RI/ CT	Thames	No	No	Unknown
CT	Connecticut	Yes	No	Nursery
CT	Housatonic	Unknown	No	Unknown
NY	Hudson	Yes	Yes	Spawning, Nursery
DE/NJ/ PA	Delaware	Yes	Yes	Spawning, Nursery
MD/PA	Susquehanna	Yes	No	Nursery
MD/VA	Potomac	Yes	No	Nursery
VA	James	Yes	Yes	Spawning, Nursery
VA	York	Yes	Possibly	Spawning, Nursery
VA	Rappahannock	Yes	No	Nursery
VA	Nottoway	Yes	Unknown	Unknown
NC	Roanoke	Yes	Yes	Spawning, Nursery
NC	Tar-Pamlico	Yes	Yes	Spawning, Nursery
NC	Neuse	Yes	Possibly	Spawning, Nursery
NC	New Brunswick	Yes	Yes	Spawning, Nursery
SC	Waccamaw	Yes	Yes	Spawning, Nursery
SC/NC	Great Pee Dee	Yes	Yes	Spawning, Nursery
SC	Black	Unknown	Unknown	Unknown
SC	Santee	Yes	Yes	Spawning, Nursery
SC	Cooper	Yes	Yes	Spawning, Nursery
SC	Ashley	Yes	Unknown	Nursery
SC	Ashepoo	Unknown	Unknown	Nursery
SC	Combahee	Yes	Yes	Spawning, Nursery
SC	Edisto	Yes	Yes	Spawning, Nursery
SC	Sampit	Yes	No	Nursery
SC	Broad-Coosawatchie	Yes	Unknown	Unknown
SC/GA	Savannah	Yes	Yes	Spawning, Nursery
GA	Ogeechee	Yes	Yes	Spawning, Nursery
GA	Altamaha	Yes	Yes	Spawning, Nursery
GA	Satilla	Yes	Yes	Spawning, Nursery
GA/FL	St. Mary's	Yes	No	Nursery
FL	St. John's	Unknown	No	Nursery

Population Dynamics and Status
In 1998, in response to a petition to list Atlantic sturgeon under the ESA, NMFS and the U.S. Fish and Wildlife Service (USFWS) published a determination that listing the species was not warranted at that time. In order to continue to monitor its status, the NMFS retained the Atlantic sturgeon on its candidate species list and later transferred it to its species of concern list. In 2003, a workshop sponsored by the NOAA Fisheries Service and U.S. Fish and Wildlife Service (USFWS) was held to review the status of Atlantic sturgeon. The workshop provided an opportunity to gain additional information to determine if a new review of the status of the species was warranted. The 2003 workshop attendees concluded that some populations seemed to be recovering while other populations continued to be depressed.

As a result, NOAA Fisheries Service initiated a second status review of Atlantic sturgeon in 2005 to reevaluate whether this species required protection under the Endangered Species Act (ESA). Following two separate workshops in 2005 which highlighted ongoing concerns regarding the current status of Atlantic sturgeon, NMFS initiated a third status review. A biological review team (BRT) was formed comprised of representatives from NMFS, USFWS, and the U.S. Geological Survey to compile information on the status of Atlantic sturgeon. In 2007 the Status Review Team (SRT) made its status review report available to the public. The SRT concluded that Atlantic sturgeon populations should be divided into five distinct population segments (DPS's): (1) Gulf of Maine, (2) New York, (3) Chesapeake Bay, (4) Carolina, and (5) South Atlantic (Figure 7-18). These Atlantic sturgeon populations are markedly separated based on physical, genetic, and physiological factors; are located in a unique ecological setting; have unique genetic characteristics; and would represent a significant gap in the range of the taxon if one of them were to become extinct.

Using an extinction risk analysis (ERA), the SRT concluded that three of the five DPSs (Carolina, Chesapeake, and New York Bight) were likely (> 50% chance) to become endangered in the foreseeable future (20 years). The SRT recommended that these three DPSs should be listed as threatened under the ESA. The remaining DPSs (South Atlantic and Gulf of Maine) were found to have a moderate risk (<50% chance) of becoming endangered in the next 20 years. However, the SRT did not provide a listing recommendation for these remaining DPS's as available science was insufficient to allow a full assessment of these populations.

In the fall of 2010, NOAA Fisheries proposed that populations of Atlantic sturgeon along the southeast Atlantic coast be listed as endangered under the federal Endangered Species Act. On February 6, 2012, NOAA Fisheries Service issued a final determination to list the South Atlantic and Carolina population sements of Atlantic sturgeon as endangered under the Endangered Species Act (effective date of April 6, 2012). NOAA also reached decisions about the other East Coast population segments, listing the New York Bight and Chesapeake Bay populations as endangered, and the Gulf of Maine population as threatened.

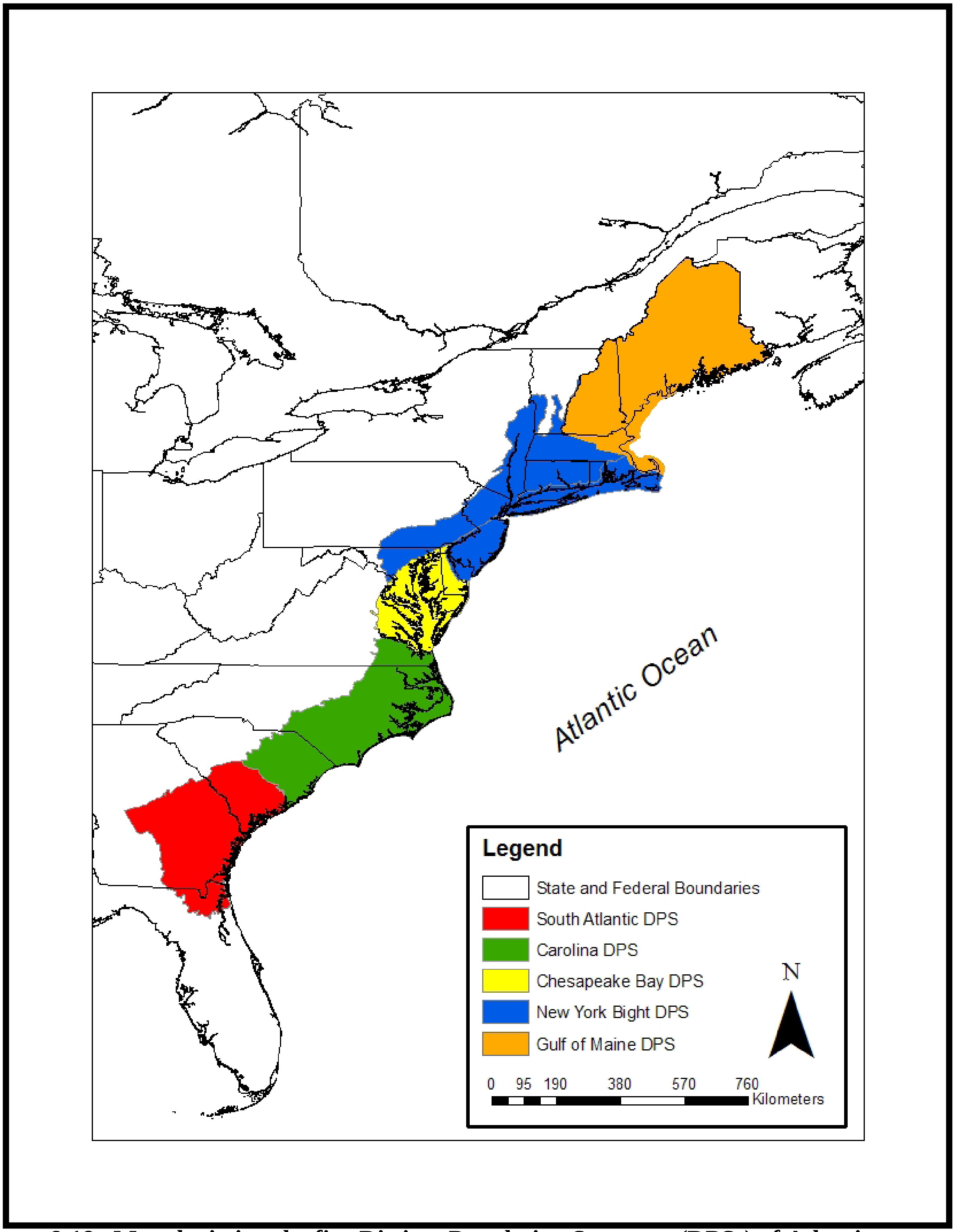

Figure 6-18. Map depicting the five Distinct Population Segments (DPSs) of Atlantic sturgeon: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic.

Threats

Of the stressors evaluated, bycatch mortality, water quality, and dredging activities were most often identified as significant threats to the viability of Atlantic sturgeon populations. Additionally, some populations were impacted by unique stressors, such as habitat impediments (e.g., Cape Fear and Santee-Cooper rivers) and apparent ship strikes (e.g., Delaware and James Rivers).

Critical Habitat

No critical habitat rules have been published for the Atlantic sturgeon.

Dredging Methods and Associated Impacts

According to the Shortnose sturgeon recovery plan (NMFS 1998a) and Atlantic sturgeon status review (Atlantic Sturgeon Status Review Team, 2007), projects that may adversely affect sturgeon include dredging, pollutant or thermal discharges, bridge construction/removal, dam construction, removal and relicensing, and power plant construction and operation. Potential direct and indirect impacts associated with dredging that may adversely impact sturgeon include entrainment and/or capture of adults, juveniles, larvae, and eggs by dredging and trawling activities, short-term impacts to foraging and refuge habitat, water quality, and sediment quality, and disruption of migratory pathways.

A. Hydraulic Hopper dredge

Hopper dredges can lethally harm sturgeon by entraining them in dredge dragarms and impeller pumps. Hopper dredging activities throughout the Atlantic and Gulf coasts of the US are known for incidentally taking sturgeon species. Documented incidental takes of Atlantic (n=9), Shortnose (n=5), and Gulf (n=2) sturgeon have occurred during hopper dredging activities since 1990 throughout the Atlantic (North and South) and Gulf coasts.

Hopper dredges may be used within known sturgeon habitat within the proposed project area. In SAD, only 9 incidental takes have occurred during hopper dredging operations, all of which were Atlantic sturgeon. Considering that Atlantic sturgeon primarily lead a marine existence, with the exception of their spawning migration, and hopper dredging operations are often utilized in ocean bar channels or offshore borrow areas, it is likely that the risk of entrainment by hopper dredges is higher for Atlantic sturgeon than Shortnose sturgeon. It is often less economical to use a hopper dredge in upstream environments where Shortnose sturgeon predominantly spend their time. The unit of effort with respect to hopper dredging in Shortnose sturgeon habitat is less than Atlantic sturgeon habitat and; thus, the risk of Shortnose sturgeon take with a hopper dredge is likely less than Atlantic sturgeon in the South Atlantic region.

As identified in Section 5.1.2, the use of the "turtle deflecting draghead" reduces the potential for take of benthic oriented species (i.e. sea turtles and sturgeon) by creating a sand wave in front of the draghead and pushing animals out of the way that were otherwise at risk of entrainment. Though the use of the "turtle deflecting draghead" likely reduces potential risk of sturgeon entrainment based on the understanding of its operating conditions, it is likely that takes can still occur due to dragtender operator error, uneven bottom contours, difficult dredging conditions (currents, slope, etc.), etc. Few studies exist that evaluate entrainment risk relative to sturgeon behavior, size class, life cycle, etc; though effects of entrainment on adult fish are presumed low (Dickerson *et al.,* 2004).

Hopper dredges have been known to impact Shortnose sturgeons. The current best estimate (Collins et al 2001 and Collins et al. 2002) within Savannah Harbor is that adult sturgeon can be expected throughout the year somewhere within River Mile 3.4 to 29.5 (river kilometers 5.5 to 47.5) and juvenile sturgeon from River Mile 19.3 to 29.5 (river kilometers 31.2 to 47.5). Impact analysis during the SHEP study indicate that impacts from hopper dredges may occur if hopper dredges were used upstream of River Mile 3 (roughly Station 16+000). There have been no documented takes of Shortnose sturgeon in Savannah Harbor by dredge operations. Shortnose sturgeon are not likely to be present near the river's mouth (downstream of Station 16+000) and in the entrance channel (from Station 0+000 to -98+600B), therefore, impacts from dredges working in that portion of the channel, would not be expected to occur. The AIWW cuts through the Savannah Harbor at river mile 28; therefore, adult Shortnose sturgeon may be expected in this part of the AIWW as they migrate through the Savannah River. However, hopper dredges are not authorized for use within the upper Savannah Harbor.

B. Hydraulic Cutterhead Dredge (Pipeline)

Adult and juvenile sturgeons are believed to be very mobile, even when occupying resting areas during the summer months (deep holes and other deep areas). Though five Shortnose sturgeon takes by a pipeline (hydraulic cutterhead) have been documented, the potential for significant numbers of adult and juvenile fish being hit by the cutterhead is fairly low. According to a shortnose sturgeon habitat suitability model review conducted by Applied Technology and Management, Inc. (ATM, 2003) for the SHEP Fisheries Interagency Coordination Team, it is generally agreed that Shortnose sturgeon larvae are not in the SHEP project impact area, which also includes part of the AIWW. No shortnose sturgeon larvae were found in a 2-year study in the Savannah River estuary. However, an Atlantic sturgeon larva was found at approximately RKM 41 during a recent ichthyoplankton study (Reinert et al. 1998). The maintained harbor extends up to RKM 34.3. Therefore, no impacts to sturgeon eggs or larvae are expected. In addition to existing information, an extensive monitoring study in the SE US is being funded by NOAA on the Atlantic and Shortnose sturgeon. This effort began in the spring of 2011 and is scheduled to last for 5 years. The work in the Savannah River is being conducted by SC DNR.

C. Mechanical Dredges – Clamshell (bucket) Dredge

Though rare, documented incidental take of Shortnose and Atlantic sturgeon by mechanical dredges have been reported. Clamshell dredges operate by dropping an open bucket into the water column which slowly descends to the bottom where the bucket closes, ascends, and discards the dredged material into a scow, barge, etc.

Since 1990, for all mechanical dredging operations throughout the North Atlantic, South Atlantic, and Gulf waters a total of three sturgeon (one Shortnose and two Atlantic) have been reported as captured by clamshell dredge operations. Of the three documented captures by a clamshell, one occurred in SAD on 12/03/00 while performing work for the Wilmington Harbor deepening project in the Cape Fear River, NC. Though this sturgeon was cited in various reports as a lethal incidental take, the endangered species incident report prepared by Coastwise Consulting indicated that the "bucket brought up an Atlantic Sturgeon, Acipenser oxyphyncus, entangled in a net. The specimen was decomposing." Assuming that the specimen was killed by entanglement in a net prior to being captured by the bucket, this documented "take" can be discounted. Detailed information is not available for the other two mechanical dredge takes. Given the mobility of sturgeon, the lack of a suction field from mechanical dredging, and the small area of active dredging by a bucket during each load, the likelihood of mechanical dredging to incidentally take sturgeon species is small. Furthermore, compared to other hydraulic dredging techniques, mechanical dredging is often recommended by NMFS as the preferred dredging technique for minimizing incidental take of sea turtles and sturgeon. Though clamshell dredge operations have reported capture of larger sturgeon (adult/juvenile), it is unlikely that clamshell dredging operation would impact small juvenile and larval sturgeon since there is no suction field generated by mechanical dredges.

Direct impacts

Few studies exist that specifically evaluate dredging impacts to sturgeon. However, based on known incidental take history from both Endangered Species Observer (ESO) and non-ESO reporting, maintenance dredging of federal navigation channels using hydraulic (cutterhead and hopper) and mechanical (clamshell) dredge types may adversely affect Shortnose and Atlantic sturgeon populations. From 1990-2007 a total of 24 sturgeon takes (11 Atlantic, 11 Shortnose, and 2 Gulf) have been documented for hopper (n=16), cutterhead (n=5), and clamshell (n=3) dredging activities along the Atlantic (North and South) and Gulf coasts. Of all documented incidental takes, 15 were lethal, 8 were non-lethal, and 1 was unknown. All 11 Shortnose sturgeon takes occurred in NAD (Delaware River – 5; Kennebec River – 6) during cutterhead (n=5 (all lethal)), hopper (n=5), and clamshell (n=1) dredging operations (Figure 7-19 and 7-20). Though incidental take of sturgeon have been documented for hydraulic and mechanical dredging, only hydraulic hopper dredge operations are capable of effectively screening for incidental take and have included ESOs to monitor and report incidental take since 1995. The proportion of hydraulic cutterhead and clamshell dredging operations being observed (using ESOs or other observing method) are unknown, but probably relatively small; thus, take data do not consider equal observer coverage for all dredging operations. Based on the current understanding of the different dredging operations relative to sturgeon behavior, clamshell and hydraulic cutterhead dredges are still considered by NMFS as alternative dredge types to reduce potential entrainment impacts to sturgeon (NMFS 1998a).

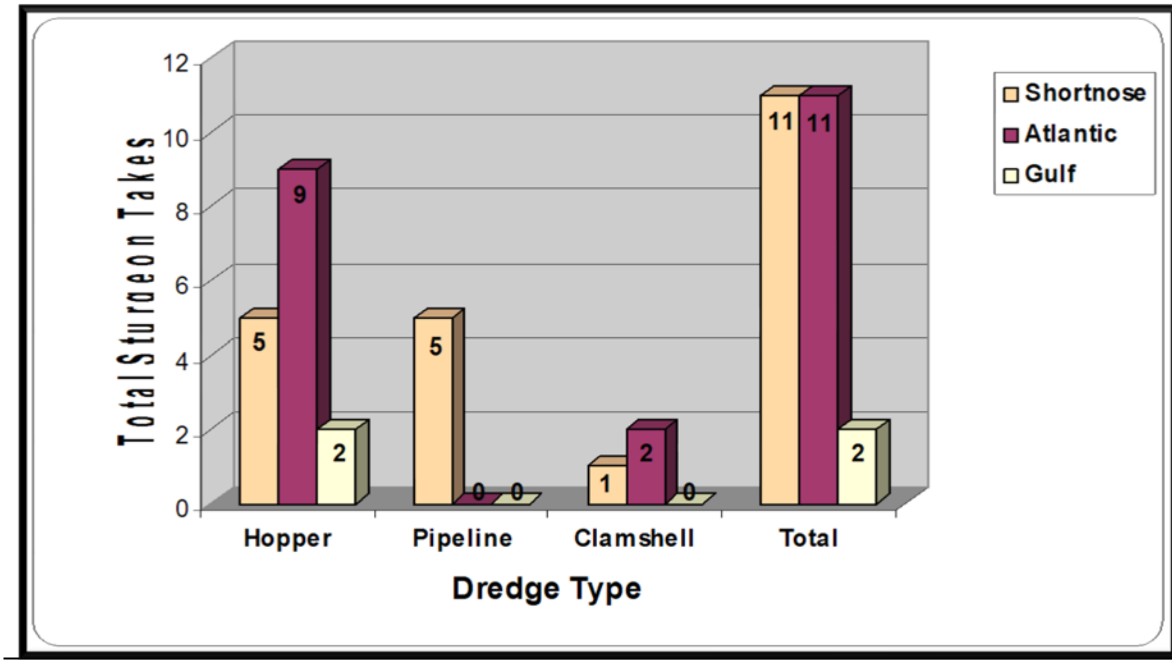

Figure 6-19. Total sturgeon (Shortnose, Atlantic, and Gulf) incidental takes documented from 1990-2007 for hopper, pipeline (hydraulic cutterhead), clamshell dredging techniques.

Throughout CESAD (including Savannah Harbor), only 10 sturgeon takes have been documented since 1990, all of which were Atlantic sturgeon and consisted of 1 take by a clamshell dredge and 9 by a hopper dredge. Though pipeline (hydraulic cutterhead) take of Shortnose sturgeon have been documented in CENAD (n=5) no incidental take of Shortnose or Atlantic sturgeon have been documented by pipeline (hydraulic cutterhead) dredging activities in CESAD (Figure 7-20).

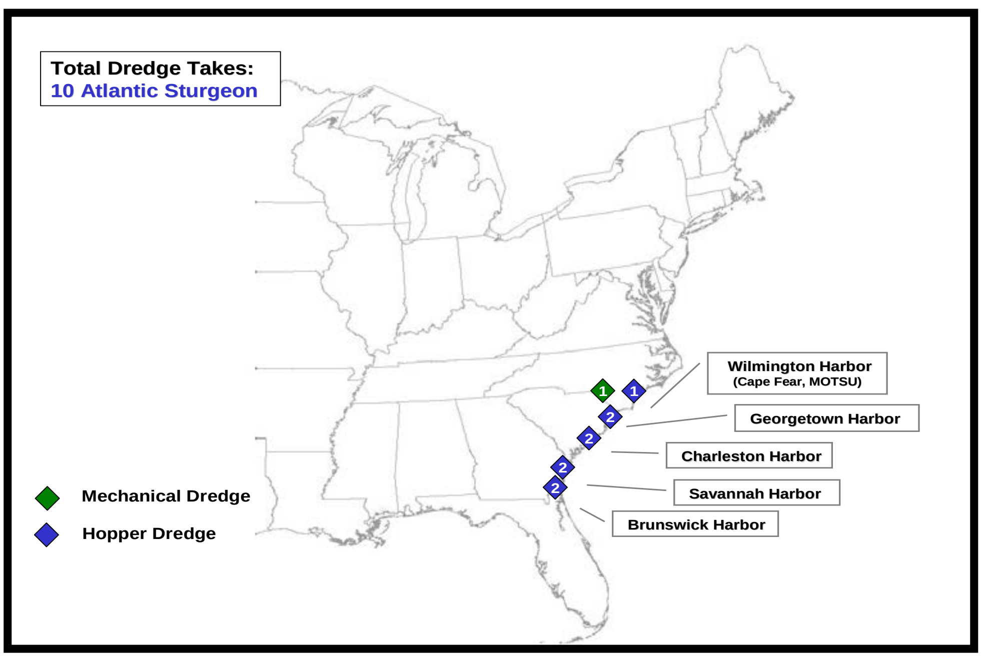

Figure 6-20. Distribution of sturgeon incidental take by dredge type and channel location since 1990 throughout the South Atlantic Division (SAD) (Only Atlantic sturgeon were documented with no reported pipeline (hydraulic cutterhead) take).

Hoover (2005) evaluated the risk of entrainment of paddlefish and lake and pallid sturgeon by comparing the suction velocities generated by dredges, or “flow fields” with swimming performance data (i.e. rheotaxis, endurance, and behavior). Intake water velocity data are known for simulations of flow fields created by hydraulic dredges. For any given point within a flow field, entrainment risks presented by a given water velocity were determined based on swimming performance data for tested fish species. Calculated risk estimates can be used to identify species and size classes of sturgeon potentially susceptible to entrainment by various types and sizes of dredges. Though this type of assessment does not consider cumulative risk associated with behavioral, physiological, and demographic data; it does provide some insight towards escape probabilities for individual species. Additional data for other sturgeon species could help develop support for low risk dredging alternatives for areas where high sturgeon abundance is known.

Atlantic and Shortnose sturgeon are both anadromous fish species; however, their habitat ranges, as a component of their migration cycle, are slightly different. Atlantic sturgeon spawn in freshwater but primarily lead a marine existence; whereas, Shortnose sturgeon spawn in freshwater but rarely occur in the marine environment aside from seasonal migrations to estuarine waters. When evaluating potential impacts, this difference in habitat range is most significant when considering the effects of hopper dredging activities to sturgeon species. As discussed in Section 5, hopper dredges are maneuverable sea going vessels that are capable of dredging in more dynamic environments, including open ocean and inlet systems. Furthermore, because of the increase in cost for transport of dredged material to offshore dredged material disposal sites (ODMDS) via hopper dredges from upstream riverine reaches, mechanical (clamshell) and/or pipeline (hydraulic cutterhead) dredging techniques are often the preferred dredging mechanism in upstream reaches. Considering that Atlantic sturgeon spend significantly more time in the nearshore marine environment than Shortnose sturgeon, the opportunity for hopper dredge interactions with Atlantic sturgeon are more significant. This could explain the predominance of Atlantic sturgeon taken by a hopper dredge identified in Figure 7-19.

Indirect impacts

Indirect impacts to sturgeon from either mechanical or hydraulic dredging include (1) short-term impacts to benthic foraging and refuge habitat, (2) short-term impacts to water and sediment quality from resuspension of sediments and subsequent increase in turbidity/siltation, (3) disruption of spawning migratory pathways, and (4) long term changes to water quality parameters that effect sturgeon habitat. These potential impacts will be discussed in the following paragraphs.

A. Benthic Foraging

At individual dredged channels and ports throughout the South Atlantic, it is not known how extensively the channels and turning basins are used by sturgeon as feeding areas. Specific aggregation areas for spawning, feeding, resting, etc. have not been identified for all dredging locations throughout the distribution range for Shortnose and Atlantic sturgeon. However, since channel maintenance activities remove the bottom sediments and any benthos that reside there, these actions likely decrease sturgeon foraging habitat for a period of time. Benthos will recruit to the newly exposed bottom surface from adjacent river bed. Channels maintained at frequent dredging intervals are not expected to be used extensively for feeding or other activities (EA, 2008). This would be essentially the same for existing and maintenance conditions after the harbor is deepened. As identified in the 2007 Status Review of Atlantic Sturgeon, "Hatin *et al.* (*in press*) tested whether dredging operations affected Atlantic sturgeon behavior by comparing Catch Per Unit Effort (CPUE) before and after dredging events in 1999 and 2000. The authors documented a three to seven-fold reduction in Atlantic sturgeon presence after dredging operations began, indicating that sturgeon avoid these areas during operations."

Though initial loss of benthic resources are likely, quick recovery between 6-months (McCauley *et al*., 1977; Van Dolah *et al*., 1979; Van Dolah *et al.*, 1984; and Clarke and Miller-Way, 1992) to two years (Bonsdorff, 1980; Ray, 1997) is expected; thus, the impacts to sturgeon foraging habitat are expected to be short-term. Recent benthic studies in Savannah Harbor, just prior to annual maintenance dredging, have shown primarily healthy benthic communities both inside and outside the navigation channel. For most sediment types, average abundance and biomass were found to be higher inside the channel compared to locations outside the channel with the exception of silt-sand substrates (USACE, 2008). Sturgeon foraging sites with soft mud bottoms and oligohaline or mesohaline salinities tend to recover quickly, likely due to the dominance of opportunistic species assemblages (e.g., *Streblospio benedicti, Capitella capitata, Polydora Ligni*) (Ray, 1997). Recovery in dredged sites occurs by four basic mechanisms: remnant (undredged) materials in the sites, slumping of materials with their resident fauna into the site, adult immigration, and larval settlement. Remnant materials, sediments missed during the dredging operation, act as sources of "seed" populations to colonize recently defaunated sediments. Adult immigration can occur as organisms burrow laterally throughout the sediments, drift with currents and tides, or actively seek out recently defaunated sediments (Ray, 1997). Likewise materials slumping or falling into the site from channel slopes provide organisms for colonization (Kaplan *et al.*, 1975).

For benthic assemblages in estuarine and riverine systems, the distribution of individual species is consistent with their known sediment and salinity preferences (polyhaline, mesohaline, and oligohaline). The distribution of each of these assemblages varies depending on the intensity of river flow, often correlated with season (Ray, 1997; Posey *et al*., 1996). Therefore, in addition to the anthropogenic dredging impacts to benthic assemblages, natural community shifts are correlated with river flow rates. Considering the ephemeral nature of this environment, benthic assemblages consist of opportunistic species which are capable of adapting to natural fluctuations in the environment (Ray, 1997). Assuming that natural benthic community shifts are an inherent component of sturgeon foraging behavior, it is possible that post-dredging movements to more productive foraging grounds are not far outside of the normal foraging behavior response to natural benthic community shifts.

B. Water Quality - Turbidity

Extensive studies have been conducted on the behavioral responses of fish to increased turbidity. These studies measured reactions such as cough reflexes, swimming activity, gill flaring, and territoriality that may lead to physiological stress and mortality; however, specific studies on sturgeon responses are limited. The effects of suspended sediment on fish should be viewed as a function of concentration and exposure duration (Wilber and Clarke, 2001). The behavioral responses of adult salmonids for suspended sediment dosages under dredging-related conditions include altered swimming behavior, with fish either attracted to or avoiding plumes of turbid water (Newcombe and Jensen, 1996).

Turbidity impacts to sturgeon as a result of proposed dredging activities are expected to be temporary, with suspended particles settling out within a short time frame. These sediment disturbance impacts are expected to be minimal in nature and are not expected to have a measurable effect on water quality beyond the frequent natural increases in sediment load. Refer to Section 5 of this appendix as well as Section 5 of the EIS for more information regarding the impacts of dredging.

Effect Determination.

Hydraulic (cutterhead and hopper) and mechanical dredge techniques have been documented to directly impact Shortnose and Atlantic sturgeon species through entrainment in the cutterhead or draghead or capture in the clamshell bucket. Hydraulic and mechanical dredging techniques may also indirectly impact sturgeon species through (1) short-term impacts to benthic foraging and refuge habitat, (2) short-term impacts to water and sediment quality from re-suspension of sediments and subsequent increase in turbidity/siltation, and (3) disruption of spawning migratory pathways.

There would not be long term changes to water quality parameters or sturgeon habitat expected to occur from AIWW channel maintenance. The only reach in the AIWW with suitable material for beach re-nourishment is reach 2 in South Carolina. Therefore, hopper dredging within the scope of this project would be limited to dredging/disposal options that involve near shore beach re-nourishment (Hilton Head south end & Daufuskie only), or disposal in the designated off shore disposal sites or ODMDS. With implementation of the conservation measures and Terms and Conditions (T&C's) set forth in the 1991, 1995, and 1997 NMFS South Atlantic Regional Biological Opinions and the CESAD Hopper Dredging Protocol, the proposed project may affect, but is not likely to adversely affect Shortnose or Atlantic sturgeon or their critical habitat.

7.0 Summary Effect Determination

Since the following nine species generally do not reside within the project impact areas, the proposed action will have no effect on them or their habitats: Red-cockaded woodpecker, American chaffseed, Pondberry, Canby's dropwort, Kirtland's warbler, Bachman's warbler, Eastern indigo snake, Altamaha spinymussel and Flatwoods salamander.

Continued use of upland DMCAs could be considered a minor enhancement of wood stork feeding habitat. There would be no measureable difference between with and without project to this species. Since no critical habitat has been designated for this species, the proposed plan would not destroy or modify any habitat determined critical for the wood stork species' survival. The proposed action may affect, but is not likely to adversely affect the wood stork.

The dredged material from maintenance of the AIWW would be deposited in a variety of different disposal areas (see section 1.7). One of the disposal options (though not the preferred alternative) is beach re-nourishment, which if implemented, could have temporary adverse impacts on foraging habitat for the Piping plover. However, since placement of material into these areas would be designed to reduce the erosion of the beach shoreline**,** there could be some long-term benefits to Piping plover foraging habitat. The USFWS would be consulted prior to any placement of any dredged material into these areas. The project may affect, but is not likely to adversely affect the Piping plover or its critical habitat.

Considering that the “Manatee Protection Conditions” will be included in the USACE dredging contracts and NMFS-approved observers will be on board all hopper dredge operations, Savannah District believes that the proposed project “may affect, but is not likely to adversely affect” the manatee or its critical habitat.

Potential hopper dredging activities for maintenance of the project will be accomplished under the Terms and Conditions (T&C’s) set forth in the 1991, 1995 and 1997 NMFS South Atlantic Regional Biological Opinions (SARBO), CESAD Hopper Dredging Protocol, which address North Atlantic right whale interactions, and the NMFS Biological Opinion for SHEP dated November 2011. In the event that this project is initiated prior to the resolution of the region-wide speed restriction issue, USACE agrees to implement a non-precedential, interim measure during maintenance of the AIWW as follows: hopper dredges will comply with a 10-knot speed limit during calving season in accordance with recent NMFS recommendations. The District would abide by the terms of new SARBOs when they are finalized. Based on the implementation of these terms and conditions, as well as the conservation measures outlined above, the proposed project may affect, but is not likely to adversely affect North Atlantic right, humpback or sperm whales; or the critical habitat of the North Atlantic right whale. If and when the new NMFS South Atlantic Regional Biological Opinion and CESAD Hopper Dredging Protocol are signed, the project would follow the conditions of those new documents.

With implementation of the conservation measures and construction windows mentioned above, the proposed project “may affect, but is not likely to adversely affect” the leatherback, loggerhead, Kemp’s ridley, hawksbill, and green sea turtle.

With implementation of the conservation measures and Terms and Conditions set forth in the 1991, 1995 and 1997 NMFS South Atlantic Regional Biological Opinions and the CESAD Hopper Dredging Protocol, the proposed project may affect, but is not likely to adversely affect Shortnose or Atlantic sturgeon or their critical habitat. If and when the new NMFS South Atlantic Regional Biological Opinion and CESAD Hopper Dredging Protocol are signed, the project would follow the conditions of those new documents.

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