NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Action Agencies: Army Corps of Engineers (USACE), Philadelphia District (lead)
Bureau of Ocean Energy Management

Activity Considered: **Use of sand borrow areas for beach nourishment and hurricane protection, offshore Delaware and New Jersey**
NER-2014-10904
GARFO-2014-00018

Conducted by: National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office

Date Issued: 26 JUNE 2014

Approved by: for JOHN BULLARD

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1.0 INTRODUCTION

This constitutes the Biological Opinion of NOAA's National Marine Fisheries Service (NMFS) issued pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, on the effects of use of offshore sand borrow areas with placement at the following locations: Manasquan Inlet to Barnegat Inlet; Barnegat Inlet to Great Egg Inlet (Long Beach Island); Brigantine Inlet to Great Egg Harbor Inlet (Brigantine Island and Absecon Island); Great Egg Harbor Inlet and Peck Beach (Ocean City); Great Egg Harbor Inlet to Townsends Inlet; Townsends Inlet to Cape May Inlet (Avalon and Stone Harbor); Cape May Inlet to Lower Township (Cape May City); Lower Cape May Meadows – Cape May Point; Rehobeth Beach – Dewey Beach, Sand Bypassing Plant – Indian River Inlet; Bethany-South Bethany; and, Fenwick Island. These activities are proposed to be authorized and carried out by the U.S. Army Corps of Engineers, Philadelphia District (USACE). Some of the projects also require authorization from the Bureau of Ocean Energy Management (BOEM).

This Opinion is based on information provided in the Biological Assessments (BA) dated March 28, 2014, past consultations with the USACE Philadelphia District and scientific papers and other sources of information as cited in this Opinion. We will keep a complete administrative record of this consultation at our Greater Atlantic Regional Fisheries Office. Consultation was initiated on March 28, 2014. Because the actions considered in this Opinion are similar, they take place in the same geographic area, and affect the same species in the same manner, we determined it would be most efficient to combine the analysis of effects of use of these borrow areas in one consultation. As such, while there are thirteen independent actions considered here, we are producing one Biological Opinion. This type of "multi-action" or "batched" consultation is contemplated in the NMFS-USFWS Section 7 Consultation Handbook (see page 5-5).

2.0 CONSULTATION HISTORY

In September 1995, USACE requested formal consultation with regard to potential impacts associated with dredging projects permitted, funded or conducted by the Philadelphia District. On November 26, 1996, we issued a Biological Opinion addressing the effects of all dredging authorized or carried out by the Philadelphia District including navigation projects, coastal engineering, and authorization of dredging activities carried out by individuals under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. We amended the Opinion with a revised Incidental Take Statement (ITS) on May 25, 1999. The species considered in that Opinion are: shortnose sturgeon; loggerhead, Kemp's ridley, green and leatherback sea turtles; and, humpback and right whales. The Description of the Action describes a general "coastal engineering" program but other than the Cape May Inlet to Lower Township, Great Egg Harbor/Peck Beach and Delaware Coast Protection Project, no specific projects are named. The Opinion does not identify the borrow areas to be used or the volume of or frequency of dredging.

We are working with USACE to replace the 1996 Opinion. USACE and NMFS have agreed that the 1996 Opinion will be replaced with several Opinions that each consider a smaller scope of activities than considered in the 1996 Opinion. In 2013, we completed the first of these consultations by issuing an Opinion considering effects of maintenance of the 40-foot Delaware

River, Philadelphia to the Sea Federal Navigation Project. This batched Opinion considering the use of offshore sand sources for beach nourishment in New Jersey and Delaware will be the second phase of our planned replacement of the 1996 Opinion. Remaining activities to be considered in a subsequent consultation include: maintenance of the Philadelphia to Trenton Federal Navigation Project, dredging in Federal navigation channels other than the Delaware River main channel, and use of sand resources in Delaware Bay for beach nourishment.

3.0 DESCRIPTION OF THE PROPOSED ACTION

The Philadelphia District conducts coastal storm damage reduction projects along the Atlantic coast from Manasquan Inlet to Cape May in New Jersey and along the Atlantic coast of Delaware. The projects that fall within the District's coastal program and the current construction phase of each project are shown below (Figure 1).

Figure 1. Status of USACE Coastal Projects within the Philadelphia District

Project Descriptions

Some borrow areas that are being proposed for use as part of the District's beach nourishment program are located within Federal waters and would require approval from BOEM prior to their use. BOEM has jurisdiction over mineral resources on the Federal Outer Continental Shelf (OCS) pursuant to section 8(k)(2)(d) of the OCS Lands Act (OCSLA). USACE is currently in negotiations with BOEM to finalize an MOA for the use of Borrow Area D2 for the Long Beach Island project and is starting coordination for the use of Borrow Area F2 for the Manasquan project. Information on each project and benthic resources in the borrow areas is presented below. All of the projects considered here are authorized for 50 years. Some projects have been ongoing for several years while others have not started. The longest timeframe considered here is for activities that will undergo initial construction in 2014 and then continue until 2064. All of the activities considered here are summarized in the table below (Table 1). For those projects that have already begun, tables 2 and 3 provide information on the dredging that has been completed to date. More information on each project, including information on benthic resources in the borrow areas is presented below the table.

Table 1. Summary of All Proposed Dredging

Project Name	**Borrow Area(s)**	**Type of Dredge**	**Estimated Volume of Sand**	**Frequency of Dredge Events**	**Time frame for action**	**Number of events Remaining**	**Total Volume of Sand to be Dredged**
Manasquan to Barnegat - Initial Construction	A, B, D, E, F2	H/C	9,865,000	one time	2014-2064	1	9,865,000
Manasquan to Barnegat - Periodic Renourishment	A, B, D, E, F2	H/C	1,364,000	every 4 years		12	16,368,000
Barnegat to Little Egg (Long Beach Island) - Initial Construction	D1, D2	H/C	7,800,000	one time	2014-2064	1	7,800,000
Barnegat to Little Egg (Long Beach Island) - Periodic Maintenance	D1, D2	H/C	2,000,000	every 7 years		7	14,000,000
Brigantine to Great Egg Harbor (Absecon) - Complete Initial Construction	Absecon Inlet, H	H/C	2,000,000	one time	2014-2064	1	2,000,000
Brigantine to Great Egg Harbor (Absecon) - Periodic Nourishment	Absecon Inlet, H, G1	H/C	1,666,000	every 3 years		16	26,656,000
Great Egg and Peck Beach (Ocean City) - Periodic Nourishment	Great Egg Harbor	C	1,100,000	every 3 years	initial construction began in 1991; remaining authorization 2014-2041	9	9,900,000
Great Egg to Townsends (Ocean City)- Initial Construction	L3	H/C	1,577,000	one time	2014-2064	1	1,577,000

Great Egg to Townsends (Ocean City)- Periodic Maintenance	L3, C1, M8, L1	H/C	302,000	every 3 years		16	4,832,000
Great Egg to Townsends (Ludlam Island) - Initial Construction	L3	H/C	2,590,000	one time	2014-2064	1	2,590,000
Great Egg to Townsends (Ludlam Island) - Periodic Nourishment	L3, C1, M8, L1	H/C	734,000	every 5 years		10	7,340,000
Townsend to Cape May (Avalon and Stone Harbor) - Periodic Nourishment	Townsend Inlet and Hereford Inlet	C	746,000	every 3 years	initial construction in 2003; remaining authorization 2014-2053	13	9,698,000
Cape May Inlet to Lower Township (Cape May City) - Periodic Nourishment	K	H/C	360,000	every 2 years	initial construction in 1991; remaining authorization 2014-2041. Next dredging scheduled for 2015	14	5,040,000
Lower Cape May Meadows/Cape May Point - Periodic Nourishment	K	H	650,000	every 4 years	initial construction in 2005; remaining authorization 2014-2055	10	6,500,000

Rehobeth and Dewey Beach - Periodic Nourishment	Fenwick Island, B	H	360,000	every 3 years	initial construction in 2005; remaining authorization 2014-2055. Next dredging scheduled for 2016-2017	13	4,680,000
Indian River Inlet Sand Bypass - Periodic Nourishment	Indian River Inlet South Fillet/Indian River Inlet Flood Shoal	PUMP/C	100,000	annually	Initial construction in 1990; remaining authorization 2014-2021	8	800,000
Bethany/South Bethany - Periodic Nourishment	E, Fenwick Island	H/C	480,000	every 3 years	initial construction in 2008; remaining authorization 2014-2058. Next dredging scheduled for 2016-2017	14	6,720,000
Fenwick Island - Periodic Nourishment	Fenwick Island	H/C	320,000	every 4 years	initial construction in 2005; remaining authorization 2014-2055. Next dredging scheduled for 2016-2017	10	3,200,000

Total:
139,566,000

Table 2. Summary of Work Completed to Date in New Jersey

Constructed New Jersey Coastal Storm Damage Reduction Projects				
Year	**Project Phase**	**Quantity of Sand (CY)**	**Borrow Area (s)**	**Dredge Type(s)**
Barnegat Inlet to Little Egg Inlet (Long Beach Island)				
2007	Surf City – Initial Construction	880,000	D1	Hopper
2010	Harvey Cedars – Initial Construction	2,700,000	D1	Hopper
2011	Surf City – FCCE Repair (2009 Nor'Ida)	300,000	D1	Hopper
2012	Brant Beach – Initial Construction	1,200,000	D1	Hydraulic cutterhead
2013	Harvey Cedars, Surf City, Brant Beach FCCE (Hurricane Sandy Repair/Restore)	2,400,000	D1	Hoppers
Brigantine Inlet to Great Egg Harbor Inlet - Brigantine Island				
2006	Brigantine Island - Initial Construction	700,000	Brigantine Inlet	Hydraulic cutterhead
2011	Brigantine Island – FCCE Repair (2009 Nor'Ida Storm)	125,000	Upland source	N/A (truck fill)
2012	Periodic Nourishment	350,000	Brigantine Inlet	Hydraulic cutterhead
2013	Brigantine Island – FCCE (2012 Hurricane Sandy Repair/Restore)	926,836	Brigantine Inlet	Hydraulic cutterhead
Brigantine Inlet to Great Egg Harbor Inlet - Absecon Island				
2004	Atlantic City and Ventnor – Initial Construction	4,200,000	Absecon Inlet	Hydraulic cutterhead
2011	Atlantic City and Ventnor – FCCE Repair (2009 Nor'Ida Storm)	1,178,000	Absecon Inlet	Hydraulic cutterhead
2012	Atlantic City and Ventnor – Periodic Nourishment	1,600,000	Absecon Inlet & Borrow Area H	Hydraulic cutterhead and hopper
2013	Atlantic City and Ventnor – FCCE Repair/Restore (2012 Hurricane Sandy)	1,500,000	Borrow Area H	Hydraulic cutterhead
Great Egg Harbor Inlet and Peck Beach (Ocean City)				
1992	Initial Construction-Phase I	2,618,000	Great Egg Harbor Inlet	Hydraulic cutterhead
1993	Initial Construction – Phase II	2,727,000	Great Egg Harbor Inlet	Hydraulic cutterhead

Constructed New Jersey Coastal Storm Damage Reduction Projects				
Year	**Project Phase**	**Quantity of Sand (CY)**	**Borrow Area (s)**	**Dredge Type(s)**
1993	Initial Construction – Phase III (storm rehab)	846,000	Great Egg Harbor Inlet	Hydraulic cutterhead
1995	Periodic Nourishment	2,017,000	Great Egg Harbor Inlet	Hydraulic cutterhead
1997	Periodic Nourishment	800,000	Great Egg Harbor Inlet	Hydraulic cutterhead
2000	Periodic Nourishment	1,351,000	Great Egg Harbor Inlet	Hydraulic cutterhead
2004	Periodic Nourishment	1,600,000	Great Egg Harbor Inlet	Hydraulic cutterhead
2010	Periodic Nourishment	1,850,000	Great Egg Harbor Inlet	Hydraulic cutterhead
2013	Periodic Nourishment	1,746,200	Great Egg Harbor Inlet	Hydraulic cutterhead
Townsends Inlet to Cape May Inlet				
2003	Avalon and Stone Harbor – Initial Construction	4,200,000	Townsend Inlet and Hereford Inlet	Hydraulic cutterhead
2008	Avalon and Stone Harbor – Supplemental Truckfill	175,000	Upland Source	N/A (truckfill)
2011	Avalon and Stone Harbor - FCCE Repair (2009 Nor'Ida Storm)	1,030,000	Townsend Inlet and Hereford Inlet	Hydraulic cutterhead
2013	Avalon and Stone Harbor - FCCE (2012 Hurricane Sandy Repair/Restore)	1,010,000	Townsend Inlet and Hereford Inlet	Hydraulic cutterhead
Cape May Inlet to Lower Township				
1991	Initial Construction	1,365,000	Borrow Area M1	Hopper
1993	Periodic Nourishment	415,000	Borrow Area M1	Hopper
1993	Storm Rehabilitation	300,000	Borrow Area M1	Hopper
1995	Periodic Nourishment	330,000	Borrow Area M1	Hopper
1997	Periodic Nourishment	366,000	Borrow Area M1	Hopper
1999	Periodic Nourishment	400,000	Borrow Area M1	Hopper
2003	Periodic Nourishment	267,000	Borrow Area 4/5/M1	Hopper
2004	Periodic Nourishment	290,145	Borrow Area 4/5	Hopper
2007	Periodic Nourishment	190,000	Borrow Area 4/5	Hopper
2009	Periodic Nourishment	233,650	Upland Source	N/A (truckfill)
2012	Periodic Nourishment	635,000	Borrow Area K	Hydraulic cutterhead

Constructed New Jersey Coastal Storm Damage Reduction Projects				
Year	**Project Phase**	**Quantity of Sand (CY)**	**Borrow Area (s)**	**Dredge Type(s)**
2012	Periodic Nourishment – Sand Backpass	66,000	Cape May Beach Accretion (Trenton Ave to Stockton Place)	N/A (truckfill)
2014	FCCE Repair/Restore (2012 Hurricane Sandy)	585,000	Borrow Area K	Hydraulic cutterhead
Lower Cape May Meadows				
2005	Initial Construction	1,406,000	Borrow Area 4/5	Hopper
2009	Periodic Nourishment (A)	70,000	Borrow Area K	Hopper
2011	Periodic Nourishment (B)	360,000	Borrow Area K	Hopper
2013	Periodic Nourishment (C)	345,000	Borrow Area K	Hopper

Table 3. Summary of Work Completed to Date in Delaware

Constructed Delaware Coastal Storm Damage Reduction Projects				
Year	**Project Phase**	**Quantity of Sand (CY)**	**Borrow Area (s)**	**Dredge Type(s)**
Rehoboth Beach and Dewey Beach				
2005	Initial Construction	1,690,000	Area G	Hopper
2009	Periodic nourishment (partial)	290,000	Fenwick Island	Hopper
2012	Periodic nourishment and FCCE Repairs (2009 No'Rida storm)	982,000	Fenwick Island	Hopper
2013	FCCE Repair/Restore (2012 Hurricane Sandy)	509,000	Fenwick Island	Hopper
Indian River Inlet (IRI) Sand Bypass Plant				
1990	Initial Construction	175,000	IRI Flood Shoal	Hydraulic cutterhead
1990 - 2013	Annual Sand Bypass (average)	84,419 (avg./year)	Southern Fillet	Bypass Plant
1992	Additional Nourishment/Storm Repair	40,000	IRI Flood Shoal	Cutterhead
2013	FCCE Repair/Restore (2012 Hurricane Sandy)	529,000	IRI Flood Shoal	Hydraulic cutterhead
Bethany Beach/South Bethany				
2008	Initial Construction	3,130,000	Area E	Hopper

Constructed Delaware Coastal Storm Damage Reduction Projects				
Year	**Project Phase**	**Quantity of Sand (CY)**	**Borrow Area (s)**	**Dredge Type(s)**
2009	Post storm maintenance	198,000	Area E	Hopper
2011	FCCE Repairs (2009 No’Rida storm)	296,000	Area E/Fenwick Island	Hydraulic cutterhead
2012	Periodic nourishment and FCCE Repairs (2009 No’Rida storm)	1,145,000	Fenwick Island	Hydraulic cutterhead
2013	FCCE Repair/Restore (2012 Hurricane Sandy)	536,000	Fenwick Island	Hopper
Fenwick Island				
2005	Initial Construction	833,000	Fenwick Island	Hopper
2011	Periodic nourishment and FCCE Repairs (2009 No’Rida storm)	332,000	Fenwick Island	Hydraulic cutterhead
2013	FCCE Repair/Restore (2012 Hurricane Sandy)	368,000	Fenwick Island	Hopper

3.1 Manasquan Inlet to Barnegat Inlet

In 2002, the Philadelphia District evaluated the environmental impacts associated with the proposed construction of the Manasquan Inlet to Barnegat Inlet Storm Damage Reduction Project, and prepared a final Feasibility Report and Integrated Environmental Impact Statement (FEIS). In 2013, the District prepared an Environmental Assessment (EA) to address changes to the project area since 2002 as a result of Hurricane Sandy. The Manasquan Inlet to Barnegat Inlet project plan calls for the construction of berm and dune restoration from Point Pleasant Beach to the border of Island Beach State Park, NJ for a distance of approximately 14 miles (Figure 2). The Manasquan Inlet to Barnegat Inlet project was authorized in the 2007 Water Resources Development Act with no funding appropriated thru FY 13 to initiate initial construction. This project was significantly damaged following Hurricane Sandy with a breach in Mantoloking and significant damage recorded in Seaside Heights, Mantoloking, Ortley Beach, Lavallette and Seaside Park. This project was determined to be eligible for P.L. 113-2 2013 Disaster Relief Appropriations Act (Hurricane Sandy) funds as an Authorized but Unconstructed project. Because of the significant damage that occurred within the project area during Hurricane Sandy, and the amount of time that had passed since the completion of the Feasibility Study and FEIS, an EA was completed in 2013 to update the project status and potential environmental impacts. Initial construction of this project is currently planned to start in the fall of 2014 with the placement of approximately 10 million CY of material.

The design template includes a +22 ft North American Vertical Datum (NAVD) dune, with a 25 ft crest width, slopes of 1V:5H from the crest to the berm which extends 75 ft seaward with an elevation of +8.5 ft NAVD for the municipalities of Bay Head, Mantoloking, Brick Township, Toms River Township, Lavallette, Seaside Park and Berkeley Township. The municipalities of

Point Pleasant Beach and Seaside Heights will have a dune with an elevation of +18 ft NAVD, and a berm width of 100 ft. Point Pleasant Beach will have a berm height of +11.5 ft NAVD, and Seaside Heights will have a berm elevation of +8.5 ft NAVD. The beachfill continues from MHW to MLW with slopes of 1:10H. The profile is expected to maintain the existing shape from MLW to the depth of closure, at approximately –26 ft NAVD. At the northern end, the project terminates at the Manasquan Inlet south jetty with no requirement for a taper. At the southern end, the project will taper to the existing beach within Berkeley Township and will avoid the need for any construction activity within Island Beach State Park. Initial sand quantity is estimated at 9,865,000 CY and includes design fill quantity, advanced fill, and overfill. To maintain the design template, this plan includes periodic nourishments of sand obtained from offshore borrow sources in the amount of 1,364,000 CY every 4 years over a 50 year period. This project is currently authorized but unconstructed.

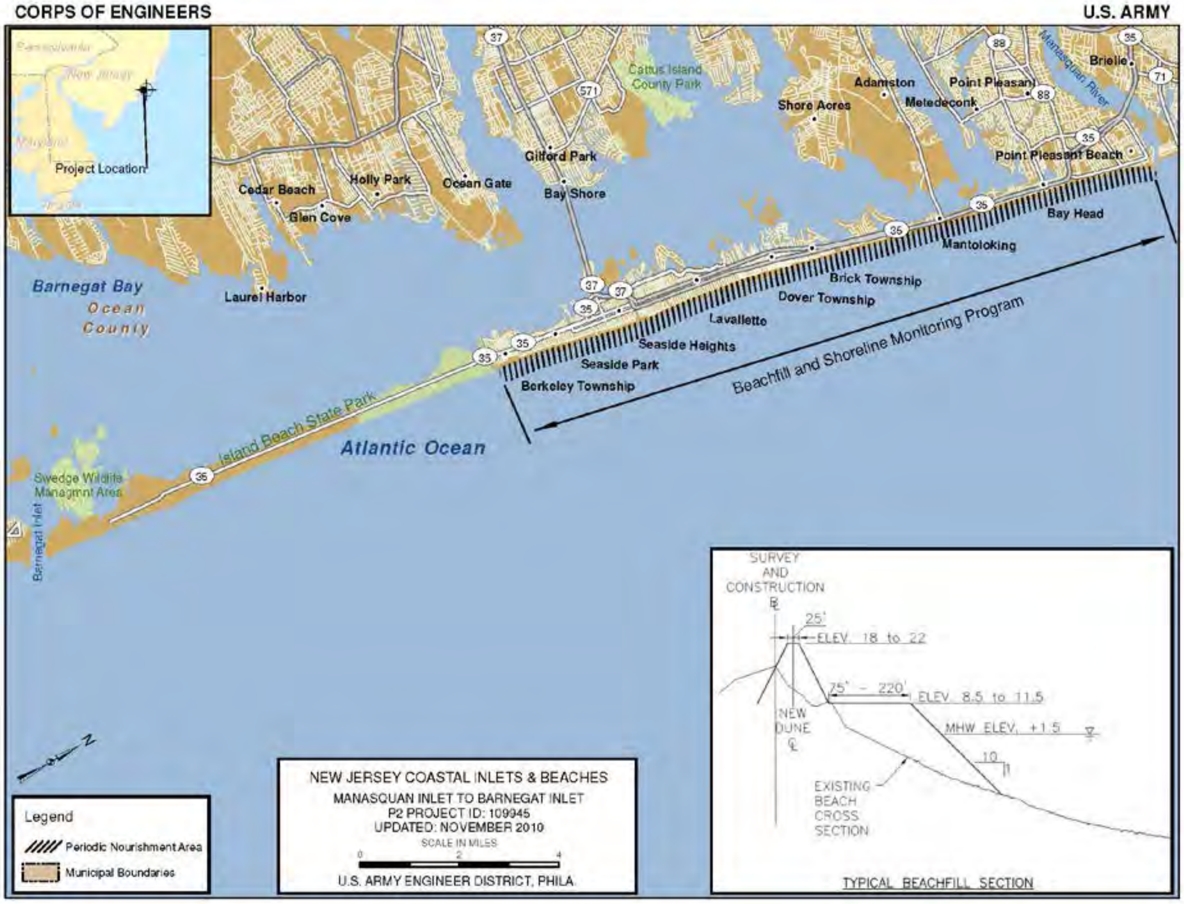


Figure 2. Manasquan Inlet to Barnegat Inlet New Jersey Project Area

Four borrow areas are currently approved for use for the Manasquan project area. Borrow Area A is located about 2.25 miles offshore of the northern end of Island Beach State Park (Figure 3). This area is approximately 457 acres in size and contains approximately 13.3 million CY (CY) of suitable beach fill material with a maximum disturbance depth of approximately -81 ft NAVD. Borrow Area B is located about 1.75 miles offshore of Mantoloking, NJ. This area is approximately 365 acres in size and contains approximately 7.5 million CY of suitable beach fill material with a maximum disturbance depth of approximately -81 feet NAVD. The current elevations of Borrow Area A and Borrow Area B are approximately -72 NAVD (-69 feet MLW) and -68 NAVD (-65 feet MLW), respectively. Dredging would increase the depth by a total of approximately 9 feet in Borrow Area A and a maximum of 13 feet in Borrow Area B over the life of the project. Through coordination with NJDEP, the Corps has developed a revised dredging plan for Borrow Area B that will allow the removal of approximately 5 million CY of sand while still maintaining some of the shoal structure found within the borrow area. Borrow Area D is located about 1.75 miles offshore of Seaside Park, NJ. This area is approximately 232 acres in size and contains approximately 4.5 million CY of suitable beach fill material with a maximum disturbance depth of approximately -81 feet NAVD. Borrow Area E is located about 2.5 miles offshore of the northern end of Island Beach State Park and is directly adjacent to Borrow area A. This area is approximately 322 acres in size and contains approximately 8.8 million CY of suitable beach fill material with a maximum disturbance depth of approximately -81 feet NAVD.

The benthic communities in these borrow areas contained marine species common to the stable mid-Atlantic coastline environments. In addition, the macrobenthic assemblages in the borrow areas were similar to each other with the most abundant taxa consisting of common polychaete species and oligochaetes with opportunistic life-history characteristics. Such taxa are capable of quickly recolonizing the borrow area after dredging operations (Versar, 1998a and 2007).

The Corps is also pursuing the use of Borrow Area F2 as another potential source of sand for future periodic nourishments for the project area. Borrow Area F2 is located about 4.6 miles offshore of Mantoloking and is approximately 1700 acres in size. It contains approximately 38.6 million CY of suitable beach fill material with a maximum disturbance depth of approximately -81 feet NAVD. Area F2 lies entirely within Federal waters (i.e. beyond 3 nautical miles from the New Jersey shoreline). Borrow Area F2 will not be used for initial construction. It is expected, however, that F2 will be available for use during periodic nourishment, in addition to Borrow Areas A, B, D, and E.

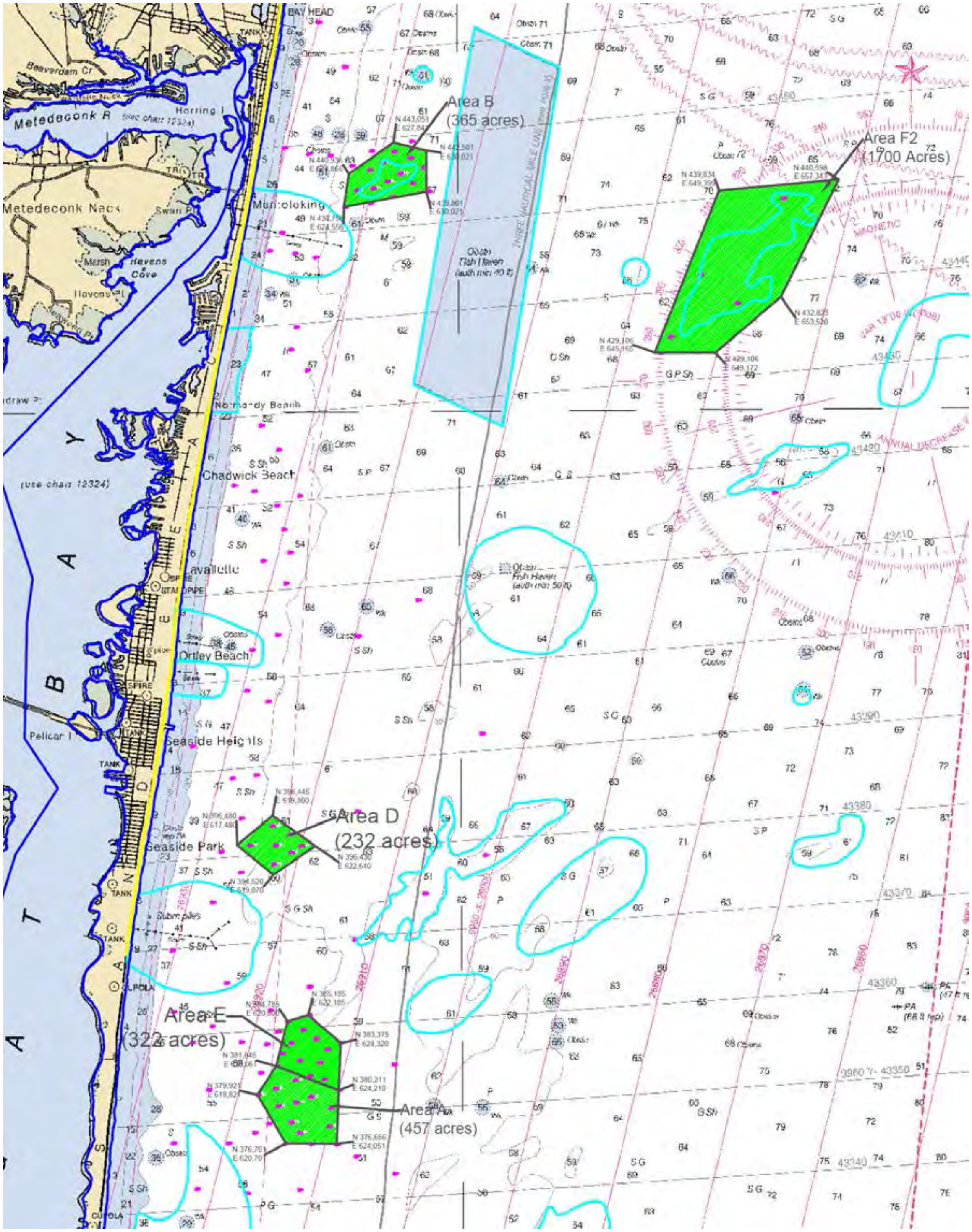


Figure 3. Manasquan Inlet to Barnegat Inlet Borrow Area Locations

3.2 Barnegat Inlet to Little Egg Inlet (Long Beach Island)

In 1999, the Philadelphia District evaluated the potential environmental impacts associated with the construction of the Barnegat Inlet to Little Egg Inlet Storm Damage Reduction Project, and prepared a Final EIS. In 2014, the District prepared an Environmental Assessment (EA) to add a new borrow area to the project (Borrow Area D2) and to address changes to the project area since 1999. The Barnegat Inlet to Little Egg Inlet project plan calls for the construction of berm and dune restoration along the ocean frontage of Long Beach Island for a distance of approximately 18 miles (Figure 4).

The proposed design template calls for a 125 foot wide berm with a top elevation of +8 ft NAVD and a dune with a top elevation of +22 ft NAVD, with a 30 foot top width and side slopes of 1V:5H. To maintain the design template, this plan also includes periodic nourishment of approximately 2 million CY of sand obtained from offshore borrow sources every 7 years over a 50 year time frame.

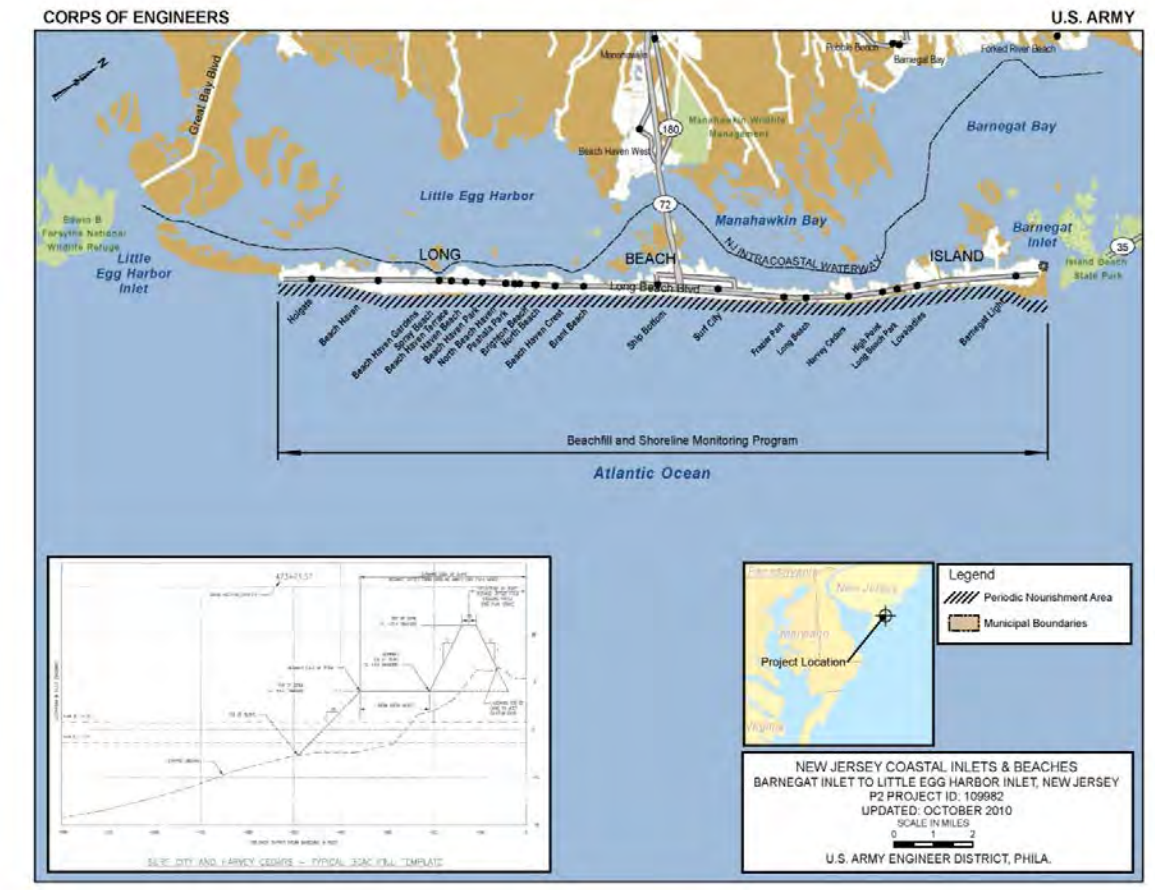


Figure 4. Barnegat Inlet to Little Egg Inlet, New Jersey Project Area

The Barnegat Inlet to Little Egg Inlet Coastal Storm Damage Reduction Project was authorized for construction by the Water Resources and Development Act of 2000. The project is considered an ongoing construction project for purposes of P.L.113-2 of the Disaster Relief Appropriations Act, 2013. Due to the large size of this project (approximately 18 miles in length) and availability of funding, this project is being constructed in phases. Initial construction began with the placement of 880,000 CY of sand from December of 2006 to January 2007 within the Borough of Surf City. The next phase of initial construction was completed in the Borough of Harvey Cedars from October 2009 to June 2010. During this phase, approximately 2,700,000 CY of sand was placed within Harvey Cedars. In addition, approximately 300,000 CY of material was placed in Surf City between April 2011 and June 2011 to replace material lost during a coastal storm in 2009. Another phase of the initial construction was completed in 2012 when approximately 1,200,000 CY of sand was placed in the Brant Beach section of Long Beach Township. Following Hurricane Sandy in October 2012, the three previously completed sections of Surf City, Harvey Cedars and Brant Beach were again found eligible for Flood Control and Coastal Emergencies (FCCE) Act, PL 84-99 (FCCE) funding to repair the project to pre-storm conditions. Additionally, in response to the Disaster Relief Appropriations Act of 2013, this project also became eligible for FCCE funding under P.L.113-2 to restore the project to design template as an on-going authorized but unconstructed project. Emergency repairs were conducted in 2013 with the placement of approximately 2,400,000 CY of material in Brant Beach, Surf City, and Harvey Cedars. The next phase of initial construction is scheduled to take place beginning in the fall of 2014 with the placement of approximately 7.8 million CY of material in Long Beach Township, the Borough of Ship Bottom, and the Borough of Beach Haven. All sand to date has been obtained from an offshore borrow area identified as Borrow Area D1. Future nourishment cycles will be conducted approximately every 7 years. A summary of construction activities that have taken place for this project can be found in Table 2.

For completion of initial construction of the project, approximately 2.9 million CY of material will be obtained from Borrow Area D1 and approximately 4.9 million CY of material will be dredged from Borrow Area D2 (Figure 5).

Borrow Area D1 is approximately 683 acres and is located almost 3 miles offshore of the Harvey Cedars portion of the project area with a depth ranging between -35 and -65 feet NAVD88. There is an insufficient volume of sand remaining in D1 for continued project maintenance and/or full project construction. Further investigations lead to the identification of Borrow Area D2. Borrow Area D2 is approximately 1,034 acres and is located immediately adjacent to Borrow Area D1. Current depths in Borrow Area D2 range between -40 and -60 feet NAVD88.

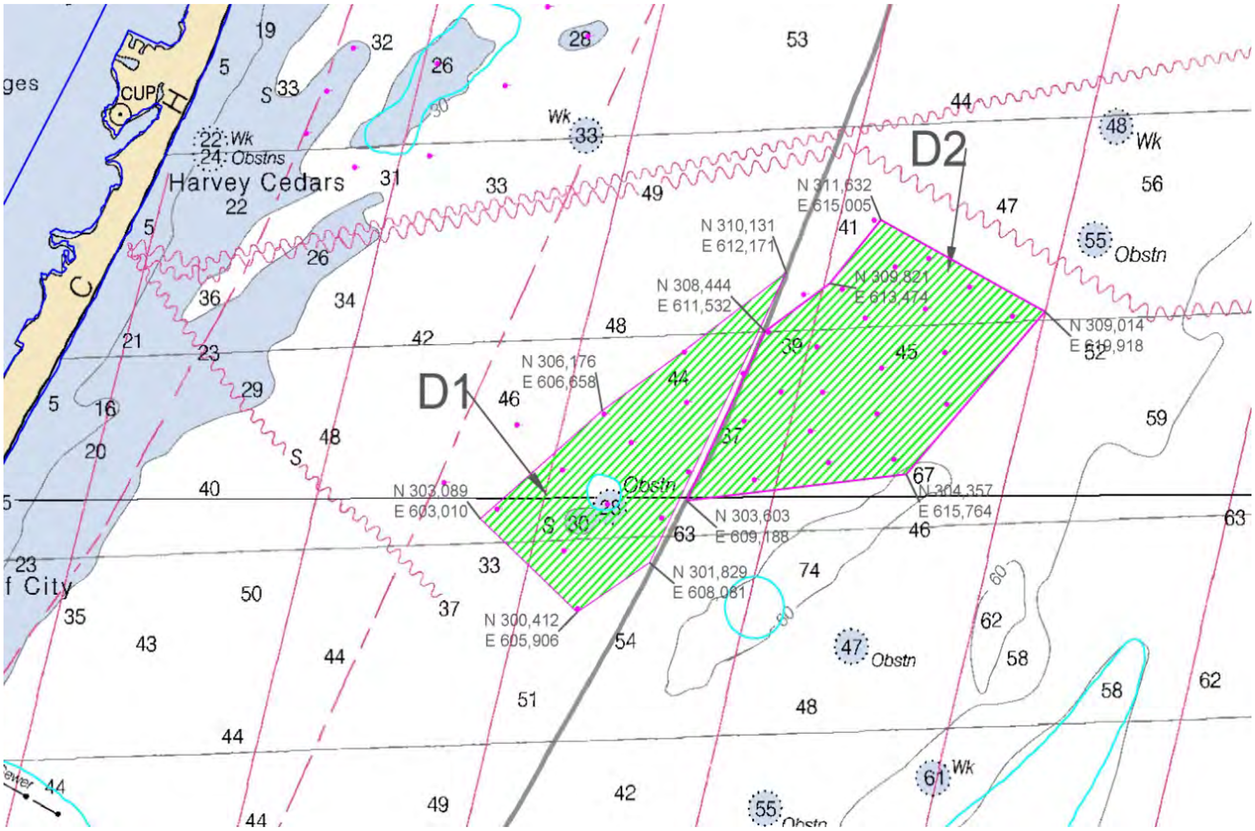


Figure 5. Long Beach Island Borrow Areas

Borrow Areas D1 and D2 were evaluated to assess dredging impacts on benthic macroinvertebrates (Scott, 2012) after D1 was used in 2008 and 2010 for beach renourishment. A comparison of surface sediment components at stations in Area D1 sampled both prior to and after dredging operations suggest that a slight shift in the surface sediment habitat occurred since the first sampling in 1997. Prior to dredging, the five stations contained mainly a mix of coarse sand to gravel type sediments. Subsequent to these dredging events, these sites were classified as having a fine-medium sand mix. Changes in the corresponding benthic community appear to be more highly associated with sampling year than to slight variances in sand percentages. Benthic data are inherently highly variable with many factors contributing to distribution patterns. Results of the benthic sampling also indicated that the benthic community within the borrow areas was not unique or uncommon to the Long Beach Island region. Most of the species collected were smaller species with adults reaching sizes less than 2 cm in length and having life history characteristics that will allow for quick recovery after a dredging disturbance. The dominant epifauna species were the small sessile, tunicate, Ascidiacea, and the small *Spirorbis corrugates*, all of which attach themselves to coarse sand particles. The dominant infauna taxa were also small, fast growing species including the polychaete worm *Polygordius* spp., the syllid worm *Parapionosyllis longicirrata*, oligochaete worms, and the small tanaid crustacean *Tannaissus psammophilus*.

Previous dredging associated with this project has been done by hydraulic cutterhead and hopper dredges. It is currently anticipated that a hopper dredge will be used for material removed from Borrow Area D2, due to the distance of the borrow area from the placement site. Borrow Area D2 is located entirely within Federal waters and would be used upon approval from BOEM.

3.3 Brigantine Inlet to Great Egg Harbor Inlet (Brigantine Island)

The Brigantine Inlet to Great Egg Harbor Inlet project, also known as Brigantine Island, provides flood and coastal storm damage reduction along 1.8 miles of coastline fronting the northern third of the City of Brigantine (Figure 6). The project consists of berm and dune restoration utilizing sand from an offshore borrow site. The environmental impacts of this project were reviewed and presented in the 1998 “Final Feasibility Report and Integrated EIS” prepared by the District.

The design template calls for a berm with a top elevation of 6 feet NAVD and a dune with a top elevation of 10 ft NAVD, with a 25 foot top width and side slopes of 1V:5H. The plan also includes periodic nourishment of approximately 312,000 CY of sand every 6 years over a 50 year time period. Initial construction for this project has been completed and periodic nourishment is currently scheduled to occur every 6 years over the 50 year project life.

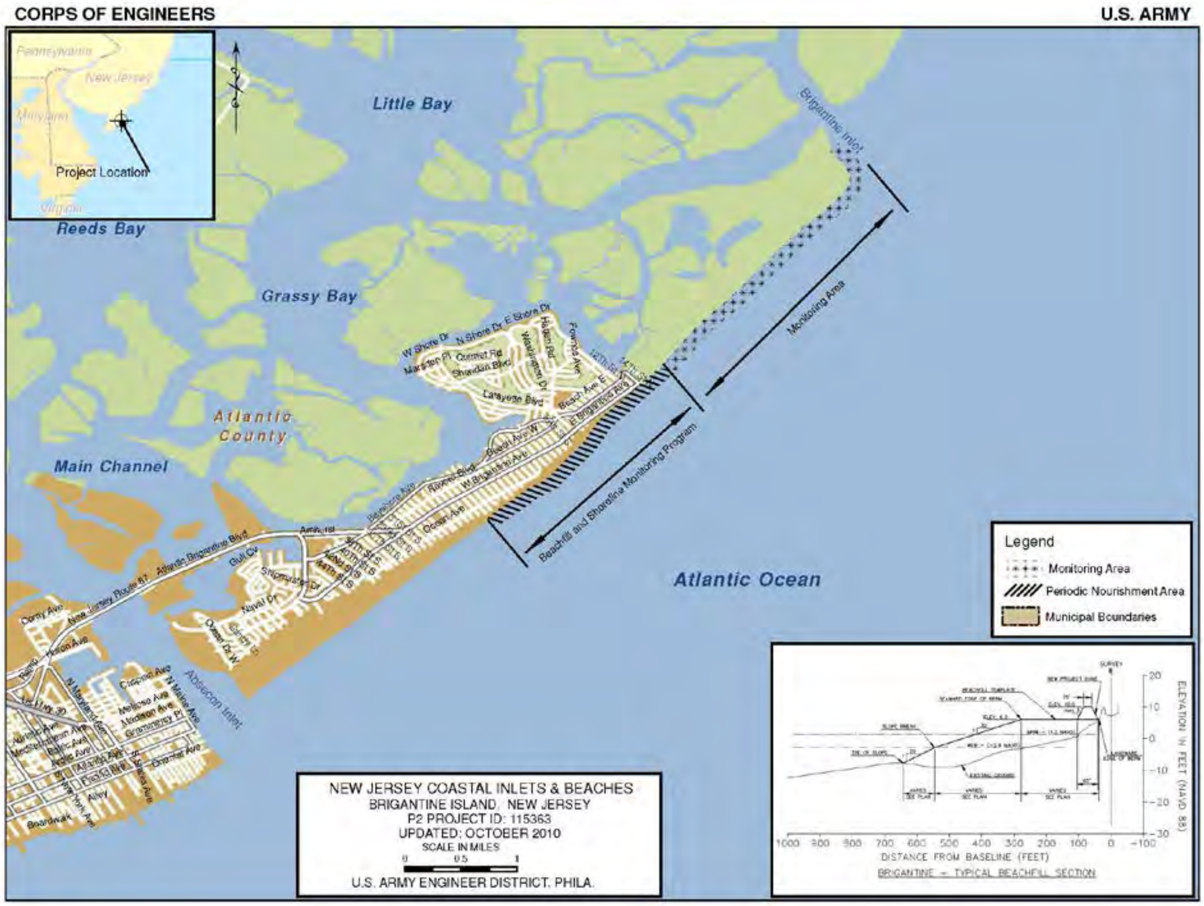
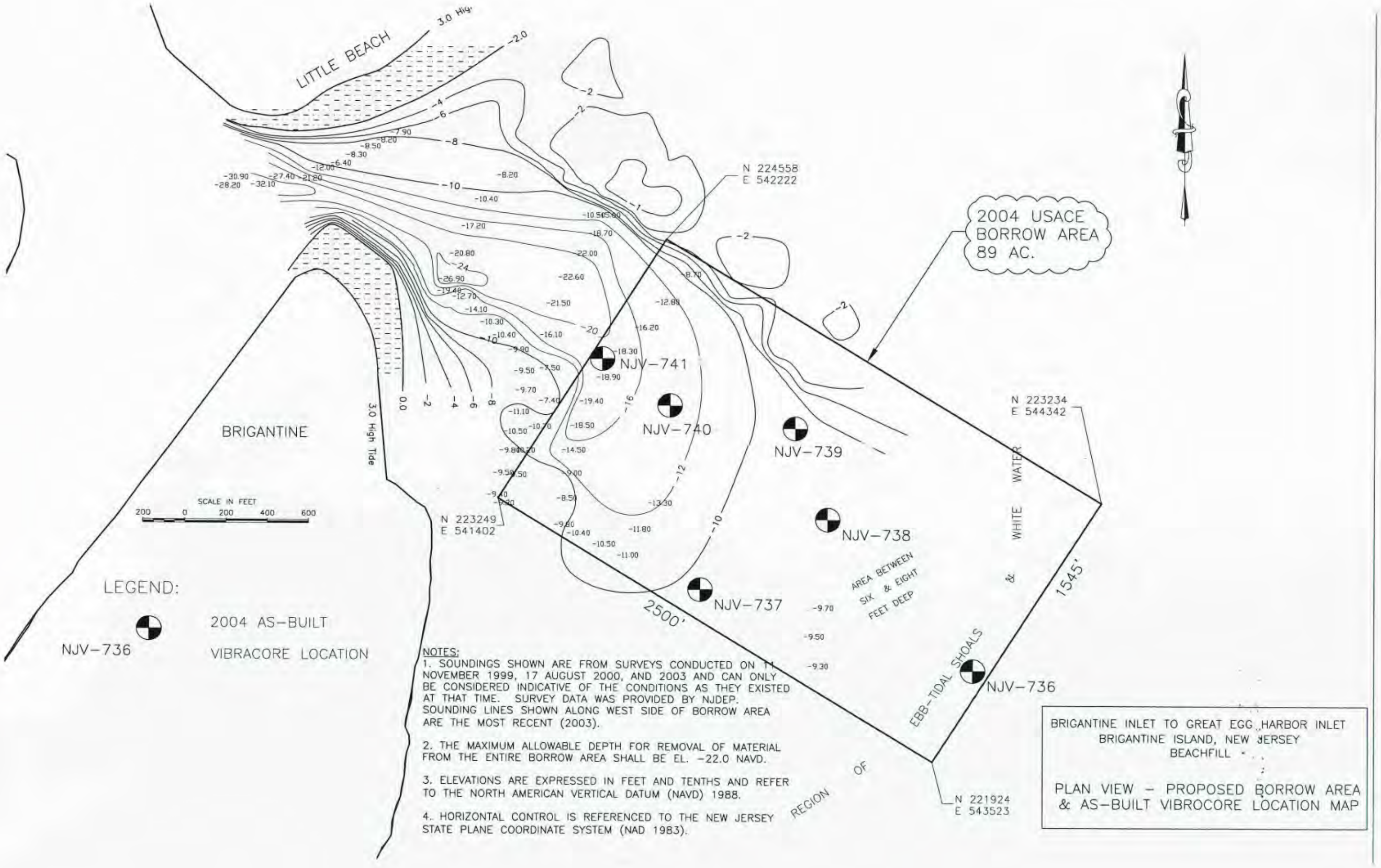


Figure 6. Brigantine Inlet to Great Egg Harbor Inlet (Brigantine Island), New Jersey Project Area

Initial construction of the Brigantine Island Project was completed in February 2006 with the placement of 700,000 CY of material. In November 2009 a Nor'easter caused significant damage to this project and was authorized for use of FCCE funds to restore the project to pre-storm conditions. Rehabilitation to pre-storm conditions began in September 2011 and was completed in December 2011 with placement of 125,000 CY of sand obtained from an approved upland quarry. The first round of periodic nourishment was completed in 2012 with the placement of 350,000 CY of material. The second nourishment cycle was completed in 2013 concurrently with the needed repairs resulting from Hurricane Sandy. The project became eligible for FCCE funding under P.L. 113-2 to restore the project to design template. Approximately 926,836 CY of material was placed to accomplish the repairs and nourishment. Future nourishment cycles are scheduled to occur approximately every 6 years. The Brigantine Inlet Borrow Area was utilized for all dredging events by means of a hydraulic cutterhead dredge. It is anticipated that material for all remaining nourishment cycles will come from this borrow area as well. A summary of all construction activities related to this project can be found in Table 2.

The Brigantine Inlet Borrow Area is approximately 89 acres and lies just offshore of Brigantine Inlet (Figure 7). The borrow area is located in a high energy, dynamic, inlet environment that quickly replenishes lost sand following dredging activities. Current depths in the borrow area range between -6 and -16 NAVD.

Results of a benthic community analysis conducted by Versar (1997) revealed that the borrow area had a relatively low mean abundance and diversity for a euhaline environment. It also had a significantly lower mean number of taxa and mean biomass than other nearby borrow areas and reference sites. Abundance in the borrow area was dominated by amphipods which quickly recover from dredging operations due to their high mobility.



NOTES:

1. SOUNDINGS SHOWN ARE FROM SURVEYS CONDUCTED ON 11 NOVEMBER 1999, 17 AUGUST 2000, AND 2003 AND CAN ONLY BE CONSIDERED INDICATIVE OF THE CONDITIONS AS THEY EXISTED AT THAT TIME. SURVEY DATA WAS PROVIDED BY NJDEP. SOUNDING LINES SHOWN ALONG WEST SIDE OF BORROW AREA ARE THE MOST RECENT (2003).

2. THE MAXIMUM ALLOWABLE DEPTH FOR REMOVAL OF MATERIAL FROM THE ENTIRE BORROW AREA SHALL BE EL. -22.0 NAVD.

3. ELEVATIONS ARE EXPRESSED IN FEET AND TENTHS AND REFER TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) 1988.

4. HORIZONTAL CONTROL IS REFERENCED TO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM (NAD 1983).

BRIGANTINE INLET TO GREAT EGG HARBOR INLET
BRIGANTINE ISLAND, NEW JERSEY
BEACHFILL

PLAN VIEW – PROPOSED BORROW AREA
& AS-BUILT VIBROCORE LOCATION MAP

Figure 7 – Brigantine Island Borrow Area

3.4 Brigantine Inlet to Great Egg Harbor Inlet (Absecon Island)

In 1996, the District evaluated the potential environmental impacts associated with the construction of the Absecon Island Storm Damage Reduction Project, and prepared a Final EIS. The selected plan involved the placement of sand obtained from a borrow area in Absecon Inlet to construct a berm and dune along the ocean frontage of Absecon Island for approximately 8.1 miles (Figure 8).

The proposed design template called for a 200 foot wide berm with a top elevation of +7.25 ft NAVD88 in Atlantic City, and a 100 foot wide berm with a top elevation of +7.25 ft NAVD88 in Ventnor, Margate, and Longport. The beachfill transitions from a 200 foot berm to a 100 foot berm between Atlantic City and Ventnor for a distance of 1000 feet. In Ventnor, Margate and Longport, the plan consists of dunes constructed to a top elevation of +12.75 ft NAVD88, with a 25 foot top width, and side slopes of 1V:5H. The Atlantic City dune has a top elevation of +14.75 ft NAVD88, top width of 25 feet, and side slopes of 1V:5H. To maintain the design template, this plan also included periodic nourishment every three years over a 50 year time period. Also included in the plan is the construction of 1700 feet of bulkhead fronted by a stone revetment along the Absecon Inlet frontage of Atlantic City. Initial construction of a portion of this project was completed in June 2004 with the placement of 4,200,000 CY of material in Atlantic City and Ventor City. Periodic nourishment is scheduled to take place every 3 years over the life of the project. Beachfill segments in Margate and Longport and the construction of a bulkhead along the Absecon Inlet frontage of Atlantic City are to be constructed as part of the SANDY relief act PL113-2.

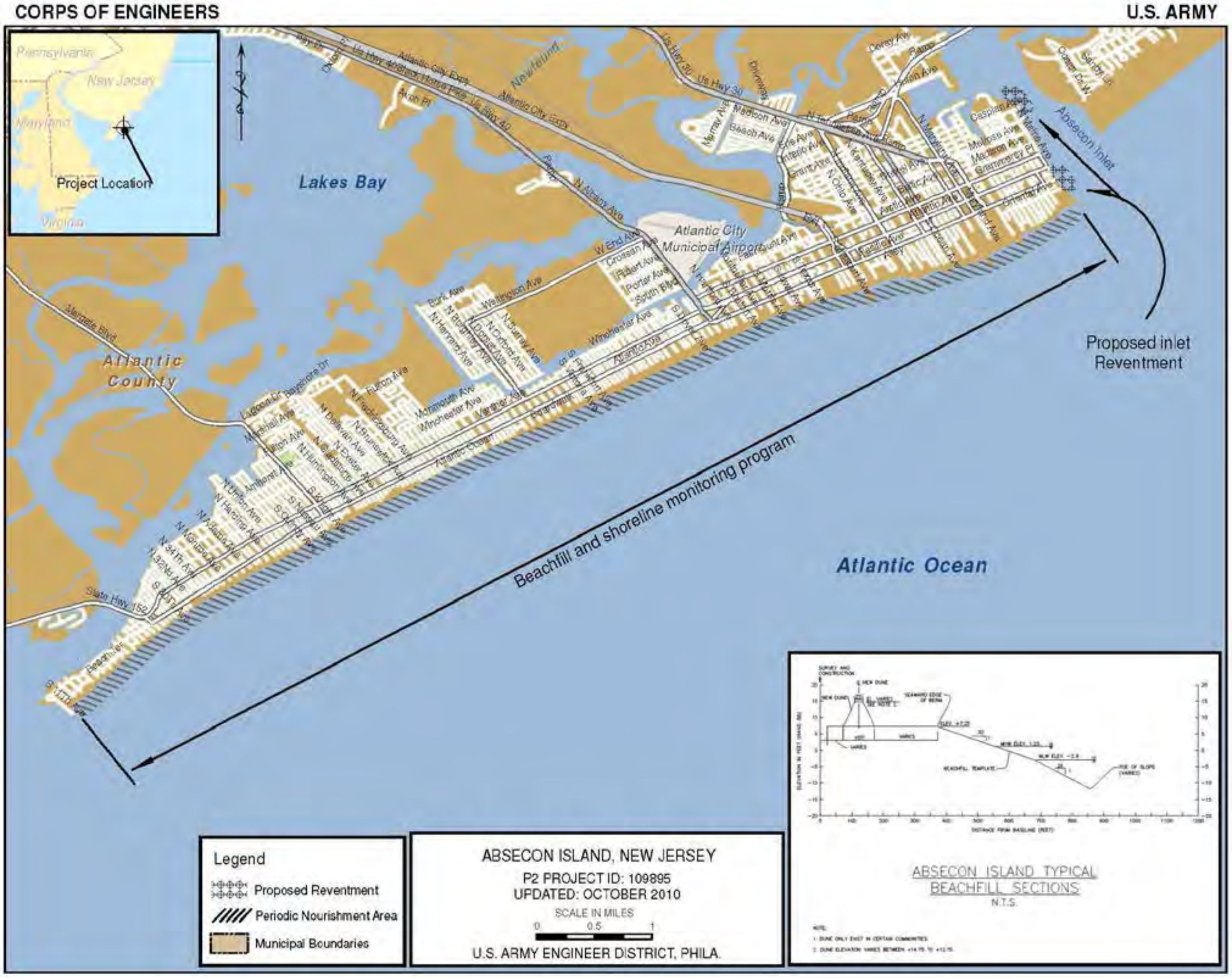


Figure 8. Brigantine Inlet to Great Egg Harbor Inlet (Absecon Island), New Jersey Project Area

In 2004, the District completed initial construction in the Atlantic City and Ventnor City portions of the Absecon Island project with the placement of 4,200,000 CY of sand. The first periodic nourishment was scheduled to be completed 3 years following completion of initial construction but was delayed due to lack of funding. In November 2009 a Nor'easter caused significant damage to this project, resulting in the placement of 1,178,000 CY of material in 2011 using FCCE funds to restore the completed portions of the project to pre-storm conditions. Subsequent periodic nourishment was completed in 2012 with the placement of 1,600,000 CY of material. Following Hurricane Sandy, this project was determined to be eligible for P.L. 113-2 2013 Disaster Relief Appropriations Act funds. As a result, an additional 1,500,000 CY of material was placed in 2013 using FCCE funds to repair and restore the project template following Hurricane Sandy. Initial construction for the Margate and Longport portions of the project area is scheduled to be initiated in the fall of 2014 with the placement of approximately 2 million CY of sand. Details of all construction activities to date are summarized in Table 2.

The Absecon Inlet Borrow Area is approximately 400 acres and is located in Absecon Inlet.

This borrow area was used for the initial construction and fills that were completed in 2011 and 2012. While suitable sand still exists in the Absecon Inlet Borrow Area, the District decided to reduce the use of this site in order to preserve the general structure of the Absecon Inlet ebb shoal and to ensure that the flow dynamics in and around the inlet were not significantly impacted as this could lead to heightened erosion problems in that area. Two borrow areas, identified as Borrow Area H and Borrow Area G1 were identified as potential sand sources (Figure 9). Borrow Area G1 is located outside of the state waters and is under BOEM jurisdiction. With approval from BOEM, the District may pursue the potential use of this site in the future. Borrow Area H underwent benthic, cultural and geotechnical evaluations in 2009. These investigations indicated that the borrow area would be acceptable for use for the Absecon Island project.

Borrow Area H is approximately 600 acres, and is located approximately 2.5 miles southeast of Absecon Inlet. It is estimated that approximately 7 million CY of beachfill material are available to an average dredge depth of 8 feet below the current bathymetric surface which varies between elevation -32 and -44 NAVD 88. The borrow area has been divided into 3 sections which will be dredged to different depths in order to maintain some of the bathymetry and overall shape of the existing finger shoal located within the borrow area.

Borrow area G1 is approximately 900 acres, and is located approximately 3 miles northeast of Absecon Inlet. The borrow area has the potential to provide up to approximately 10 million CY of beachfill material. Use of this borrow area would require further coordination with BOEM.

The benthic communities inhabiting the Absecon Inlet Borrow Area and Borrow Area H are similar to the benthic community collected from nearby areas (Scott 2004, Scott and Kelley 2000). The dominant taxa included taxa common to the east coast of New Jersey, including the epifaunal, small, ascidid tunicates, the small polychaete *Polygordius jouinae*, and four several crustacean species, *P. deichmannae*, *T. psammophilus*, *A. similis*, and *U. serrata*. All of these species are common to the New Jersey coastline benthic environment.

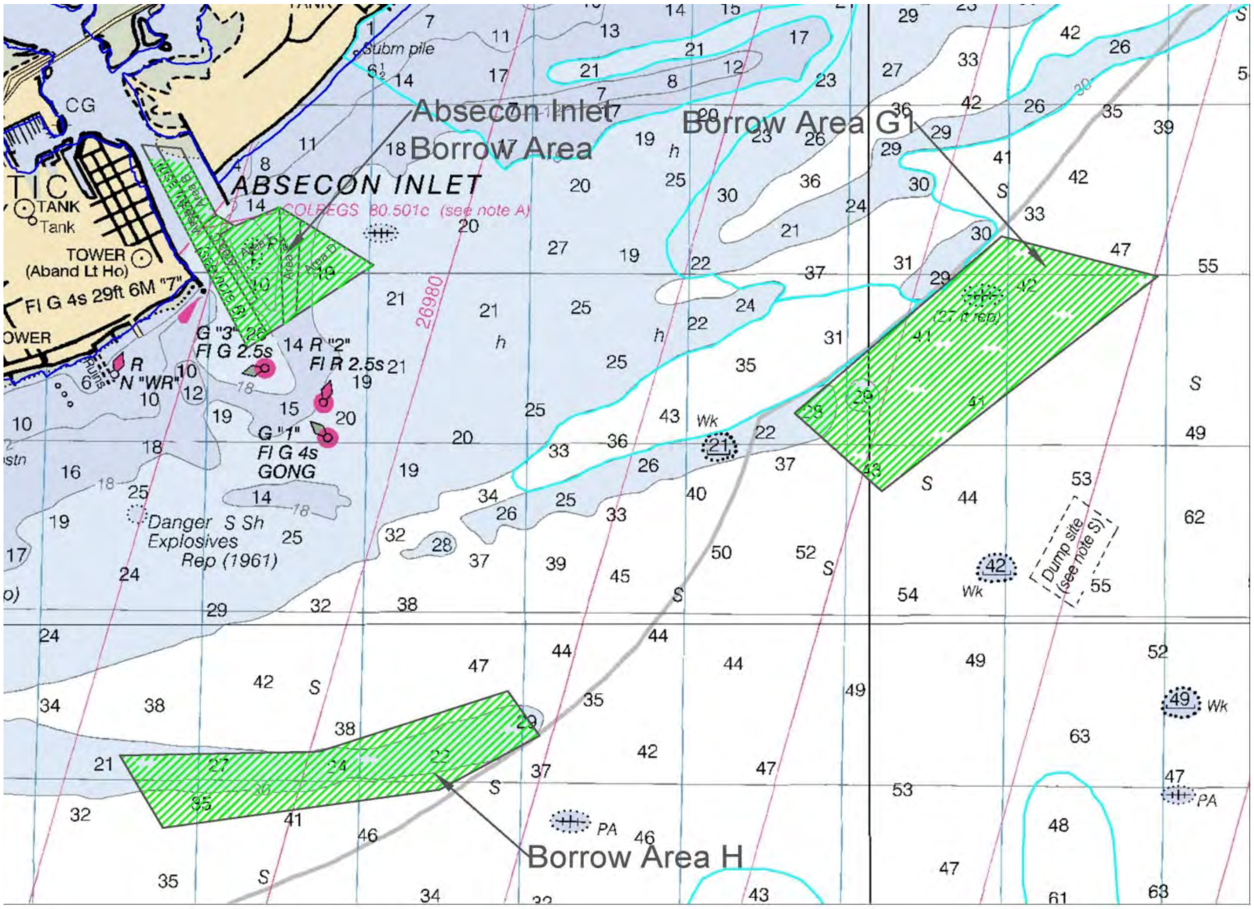


Figure 9. Absecon Inlet Borrow Areas

3.5 Great Egg Harbor Inlet & Peck Beach (Ocean City)

In 1989, the Philadelphia District evaluated the potential environmental impacts associated with the construction of the Great Egg Harbor Inlet & Peck Beach Storm Damage Reduction Project, and prepared a Final Supplement to the FEIS. In 2012, the District completed an EA to evaluate the potential impacts associated with expanding the project's borrow area. The selected plan involved the placement of sand obtained from an inlet borrow source to construct a berm with a minimum width of 100 feet at an elevation of +8.7 NAVD88 from Surf Road southwest to 34th Street with a 1,000-foot taper south of 34th Street (Figure 10) for the purpose of storm damage reduction.

Initial construction was completed in 2 phases, beginning in 1991 and ending in 1993. Periodic nourishment to maintain the design template currently occurs approximately every 3 years.

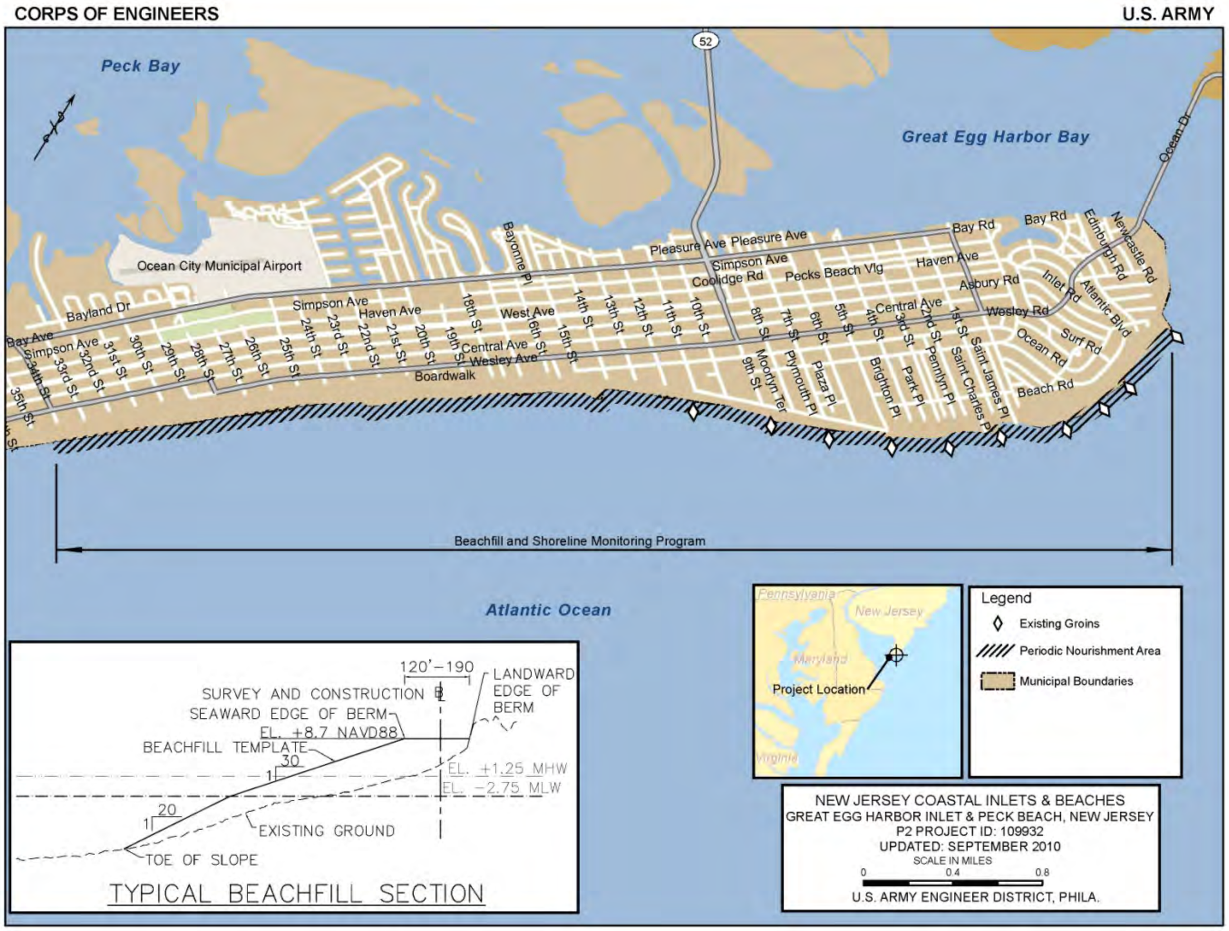


Figure 10. Great Egg Harbor Inlet & Peck Beach (Ocean City), New Jersey Project Area

The initial construction of the Ocean City project began in October 1991 and was completed in March 1993 in two major phases: placement of 2,618,000 CY (CY) of sand from Great Egg Harbor Inlet to 15th Street, followed by a separate contract placing 2,727,000 CY from 15th Street to 36th Street. Another 846,000 CY was placed between the Inlet and 15th Street in 1993 to replace sand lost due to storm activity. Following the initial construction, 6 periodic nourishment cycles were completed, with the most recent cycle being completed in 2013. Periodic nourishment for this project is scheduled to continue approximately every three years for the rest of the life of the project. A summary of all construction activities completed to date for this project can be found in Table 2.

Initial construction and several nourishment cycles were conducted utilizing a 580 acre borrow area within Great Egg Harbor Inlet. As part of the ongoing project, the District has been monitoring the hydraulic and sediment conditions within the inlet for the past fifteen years. The results of this monitoring have indicated that it would be beneficial to minimize dredging impacts to certain areas and geomorphic features within the borrow area. Because inlets are typically dynamic environments, the geomorphic features and recommended dredging patterns may change with each renourishment/dredging cycle. A larger authorized borrow area within the inlet system will allow for better optimization of dredging patterns within that system based on actual project performance and existing conditions, as well as provide the District the flexibility to make the best sediment management decisions. In order to allow for these improved sediment management practices, the District expanded the previously approved borrow area by approximately 1205 acres (Figure 11).

As part of the ongoing Ocean City project, the Corps has been conducting benthic resources investigations in the Great Egg Harbor Borrow Area since the early 1990's (Stone and Webster 1991, Kropp 1995, Chaillou and Scott 1997, Scott and Kelley 1998 and Scott 2004 and 2007). In 2005, benthic and surf clam communities were sampled in the newly expanded portion of the borrow area. The sampling and laboratory methods were equivalent to methods employed in previous studies since 1995. Results from the 2005 study indicated that previous dredging to remove sand from the borrow area had little to no adverse long-term impacts on the benthic community. The 2005 survey also reinforces past conclusions that the benthic community inhabiting the Great Egg Harbor Inlet Borrow Area (including the expanded area) is similar to other benthic communities in shallow, high energy, Mid-Atlantic coastline environments. The abundant taxa consisted of common amphipod, bivalve, and polychaete species with opportunistic life history characteristics. These characteristics include organisms with short life-cycles of one year or less, are fast growing, and have multiple broods per year. Such characteristics allow these organisms to rapidly recover and recruit into an area disturbed by dredging provided the sediment type is not changed (Scott 2007).

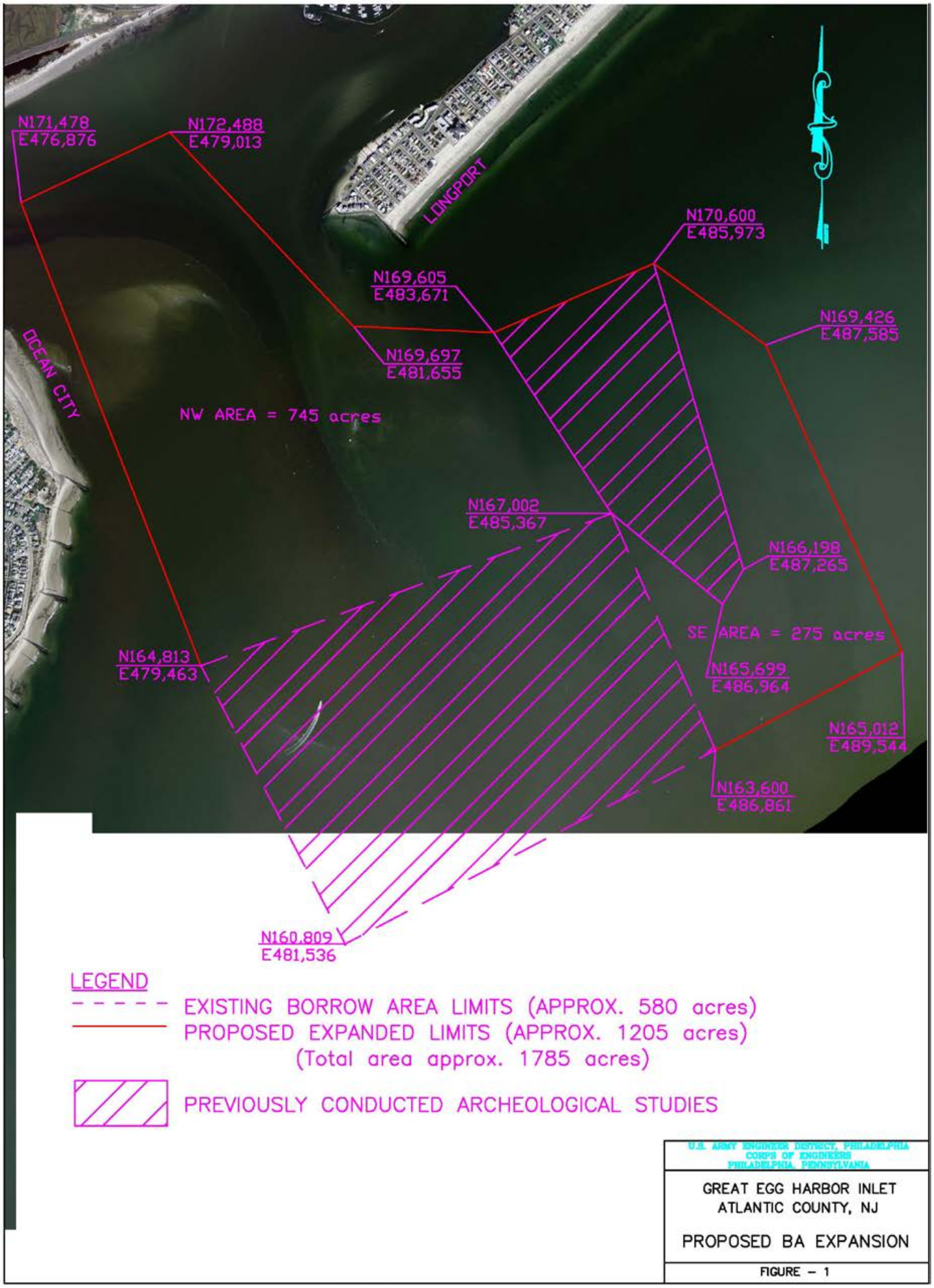


Figure 11 – Ocean City Borrow Area

3.6 Great Egg Harbor Inlet to Townsends Inlet

In 2001, the Philadelphia District evaluated the potential environmental impacts associated with the construction of the Great Egg Harbor Inlet to Townsends Inlet Storm Damage Reduction Project, and prepared a Final Supplement to the FEIS. An EA was completed in 2013 to address changes to the project area since 2001 and after Hurricane Sandy. The Great Egg Harbor Inlet to Townsends Inlet project (Figure 12) will provide flood and coastal storm damage reduction along approximately 16 miles of coastline from Great Egg Harbor Inlet to Townsends Inlet, and includes the municipalities of Ocean City, Upper Township, and Sea Isle City, once complete. The project will consist of berm and dune restoration utilizing sand from an offshore borrow site with periodic nourishment cycles over a 50 year time period.

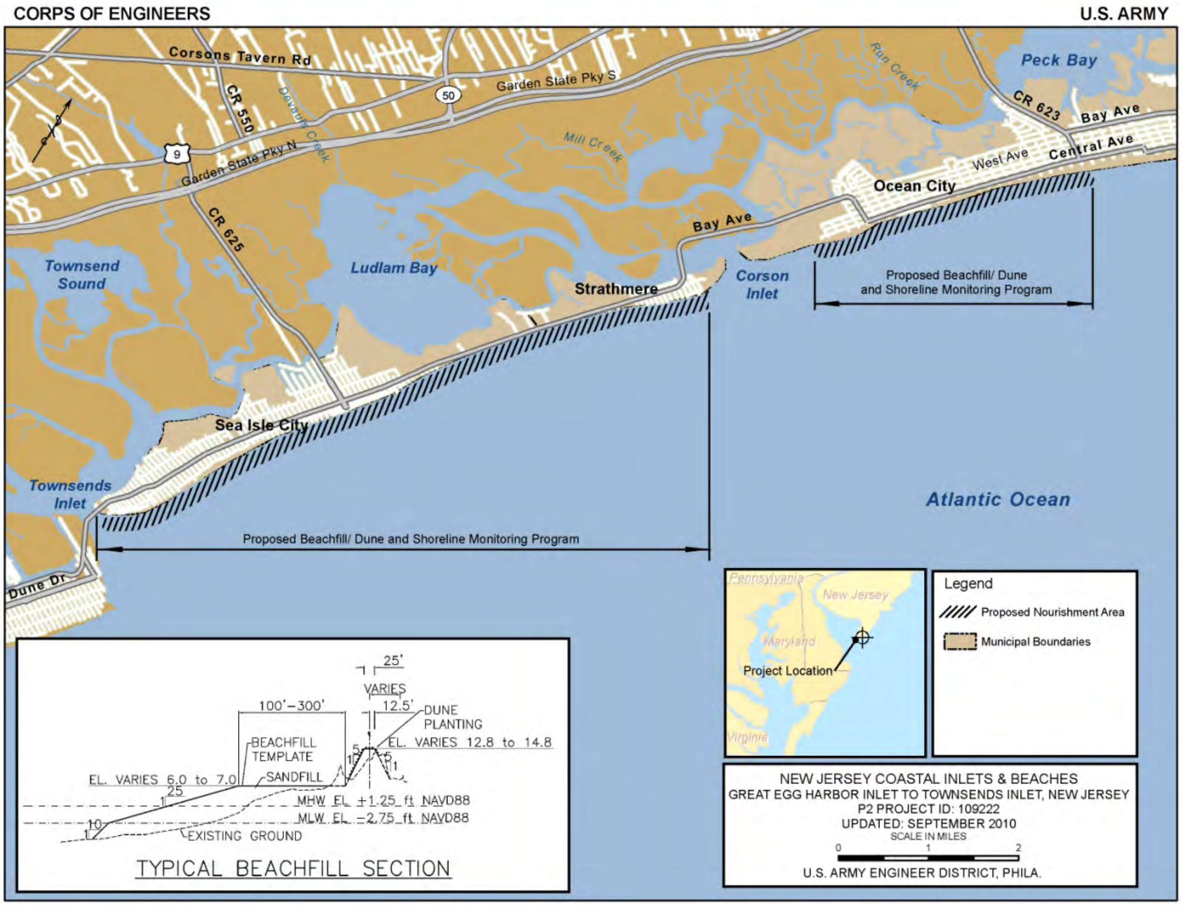


Figure 12. Great Egg Harbor Inlet to Townsends Inlet, New Jersey Coastal Project

The Ocean City portion of the project will consist of berm and dune restoration utilizing beachfill from an offshore sand source(s). The dune crest will have a top elevation of +12.8 ft NAVD88, a top width of 25 feet and side slopes of 1V:5H. The berm will extend from the seaward toe of the dune for a distance of 100 feet at an elevation of 7.0 ft NAVD88 before sloping down at 1V:25H to elevation -1.25ft NAVD88. The remainder of the design template parallels the existing profile slope to the depth of closure. The total width of the berm from the seaward toe of the dune to Mean High Water (MHW) is 218 feet. The plan extends from 34th Street to 59th Street for 2.6 miles. Initial sand quantity is 1,577,000 CY which includes design fill quantity of 1,275,000 CY of sand plus advanced nourishment of 302,000 CY of sand. Periodic nourishment of 302,000 CY of sand is scheduled to occur every 3 years synchronized with the existing Federal beachfill project at Ocean City (Great Egg Harbor Inlet to Peck Beach). This project is currently authorized but unconstructed.

On Ludlam Island, the dune crest will have a top elevation of +14.8 ft NAVD88, a top width of 25 feet and side slopes of 1V:5H. The berm width will extend from the seaward toe for a distance of 50 feet at an elevation of 6.0 ft NAVD88 before sloping down (varying from 1V:30H to 1V:50H) to elevation -1.25 ft NAVD88. The remainder of the design template parallels the existing profile slope to the depth of closure. The total width from the seaward toe of the dune to Mean High Water (MHW) varies depending upon location from 190 to 285 feet. The plan extends from 125 feet north of Seaview Avenue in Strathmere to Pleasure Ave (just beyond 93rd Street) in Sea Isle City for 6.5 miles. In addition, there is a taper of 734 feet into Corson's Inlet State Park and a taper of 66 feet into the terminal groin south of 93rd Street. Total length of beachfill, including tapers, is 6.7 miles. Initial sand quantity is 2,590,000 CY which includes design fill quantity of 1,856,000 CY plus advanced nourishments of 734,000 CY. Periodic nourishment of 734,000 CY is scheduled to occur every 5 years. The plan also includes the extension of two stormwater outfall pipes at both 82nd and 86th Street in Sea Isle City by 150 feet. This portion of the project is also authorized but unconstructed. The stormwater outfalls will be extended after sand is placed on the beach.

The Great Egg Harbor Inlet to Townsends Inlet project was authorized for construction in the Water Resources Development Act of 2007 with $899,000 appropriated thru FY 13 to initiate initial construction. Subsequent to USACE (2001), the project area has experienced several significant storm events most notably the Nor'easter Storm of 2009, Hurricane Irene in 2011, and the devastating Hurricane Sandy in October 2012, which have caused severe economic damages in the region. Based on the vulnerability of this area, a Federal storm damage reduction project is needed that will provide a long-term commitment to these communities. In response to Hurricane Sandy, the project schedule for implementation is being expedited in accordance with P.L. 113-2: Disaster Relief Appropriations Act (FY 2013) for authorized Federal projects in areas affected by Hurricane Sandy that have not been constructed. Initial construction is currently scheduled to begin in the fall of 2014 with the placement of 1.6 million CY of material in Ocean City and 2.6 million CY of material on Ludlum Island.

For initial construction of the project, all material would be taken from the offshore borrow area identified as "L3," limited to the portion of the site inside the 3-nautical mile limit of Federal jurisdiction. Sand for periodic nourishment would be obtained from borrow areas: L3, C1 (Corson Inlet), M8 and L1 (Figure 13). Borrow Area M8 and a portion of L3 are located entirely within Federal waters (beyond 3 nautical miles), and would be used for periodic nourishment after approvals are obtained from BOEM. The first renourishment cycles may require the use of L3, C1 and L1 until M8 and the offshore portion of L3 are available. These borrow areas contain sufficient sand to provide periodic nourishment over the life of the project, and would be used interchangeably.

Borrow Area L3 is approximately 1,825 acres and is located approximately 2.5 miles offshore from Strathmere. An additional 258 acres of L3 is located in Federal waters and will require BOEM approval for use. Current elevations in L3 are between -36 and -56 feet NAVD 88. Borrow Area L1 is approximately 1,518 acres and is located adjacent to Borrow Area L3. Current elevations in L1 are between -38 and -52 feet NAVD 88. Borrow Area C1 is approximately 243 acres and is located in Corson's Inlet. Current elevations in C1 are between -4 and -20 feet NAVD 88. Borrow Area M8 is approximately 853 acres and is located approximately 3 miles offshore from Corson's Inlet. Current elevations in M8 are between -36 and -60 feet NAVD 88. It is anticipated that through adaptive management, none of the proposed borrow areas would ever need to be dredged greater than 10 feet deeper than adjacent bathymetry, nor a depth greater than -55 feet NAVD 88 over the life of the project.

Benthic investigations were performed by Scott and Bruce (1999) and Scott and Wirth (2000) at the proposed offshore sand borrow sites (L1, L3, M8, and C1). The community composition of the offshore borrow areas and reference areas was very similar and are considered to be relatively diverse. The mean number of taxa per sample ranged from 20.2 (L3) to 28.85 (L1). The Corson Inlet Site had a mean number of 11.25 taxa per sample. The diversity indices, as measured by the Shannon Wiener Index and the Simpson's Dominance Index, indicated that the benthic community was relatively evenly distributed for all of the offshore sites. The diversity indices were low for the Corson Inlet Site, which is expected given that it is a high-energy environment. All of the offshore areas were dominated (over 60%) by polychaete worms. The Corson Inlet area was dominated by the bivalve, *Donax fossor*. Amphipod crustaceans also contributed substantially to the faunal composition, but to a lesser extent in the offshore areas and at the Corson Inlet area. Benthic communities can be variable seasonally or over the long-term. However, the benthic communities as described in USACE (2001) are not expected to be significantly different in the offshore sand sources. Dredging in C1 is not expected to have a significant effect on the benthic community since the predominant species inhabiting the borrow area are highly adapted to the dynamic conditions that prevail there.

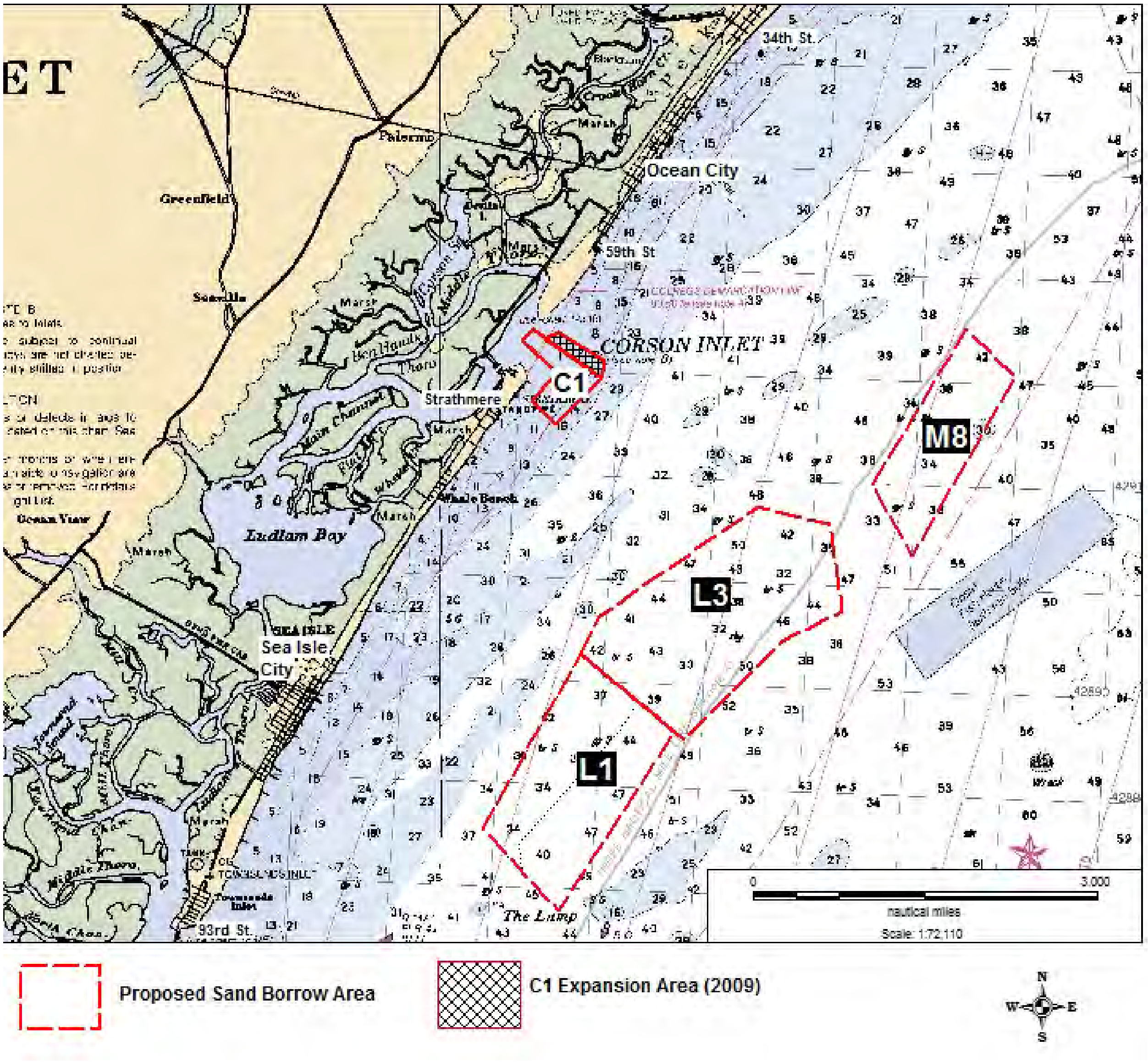


Figure 13 – Great Egg Inlet to Townsends Inlet Borrow Areas

3.7 Townsends Inlet to Cape May Inlet (Avalon & Stone Harbor)

In March 1997, the Philadelphia District evaluated the potential environmental impacts associated with the construction of the Townsends Inlet to Cape May Inlet project, and prepared a Final Feasibility Report and Final Environmental Impact Statement. The Townsends Inlet to Cape May Inlet project (Figure 14) provides flood and coastal storm damage reduction along 4.3 miles of coastline fronting Avalon and Stone Harbor consisting of berm and dune restoration. The project plan also calls for ecosystem restoration and the construction of 2.2 miles of seawall.

The selected design template calls for a 150 foot berm at elevation +7.25 ft NAVD88 with a dune at elevation +14.75 ft NAVD88 with a crest width of 25 feet for the oceanfront of Avalon and Stone Harbor, and stone seawall sections for the Avalon and North Wildwood inlet frontages with top elevations of +12.75 ft NAVD88 and +11.75 ft NAVD88 respectively. The selected oceanfront plans include dune grass, dune fencing and suitable advance beachfill and periodic nourishment to ensure the integrity of the design. Initial construction of the beachfill feature was completed in June 2003 with the placement of 4 million CY of material in Avalon and Stone Harbor. Periodic nourishment of approximately 746,000 CY of sand is scheduled to take place every 3 years over the life of the project. Initial construction of the two seawall features of the project were completed in 2010. Initial construction of the beachfill and seawalls has been completed with subsequent periodic nourishments scheduled every 3 years. The ecosystem restoration portion of the project is authorized but unconstructed.

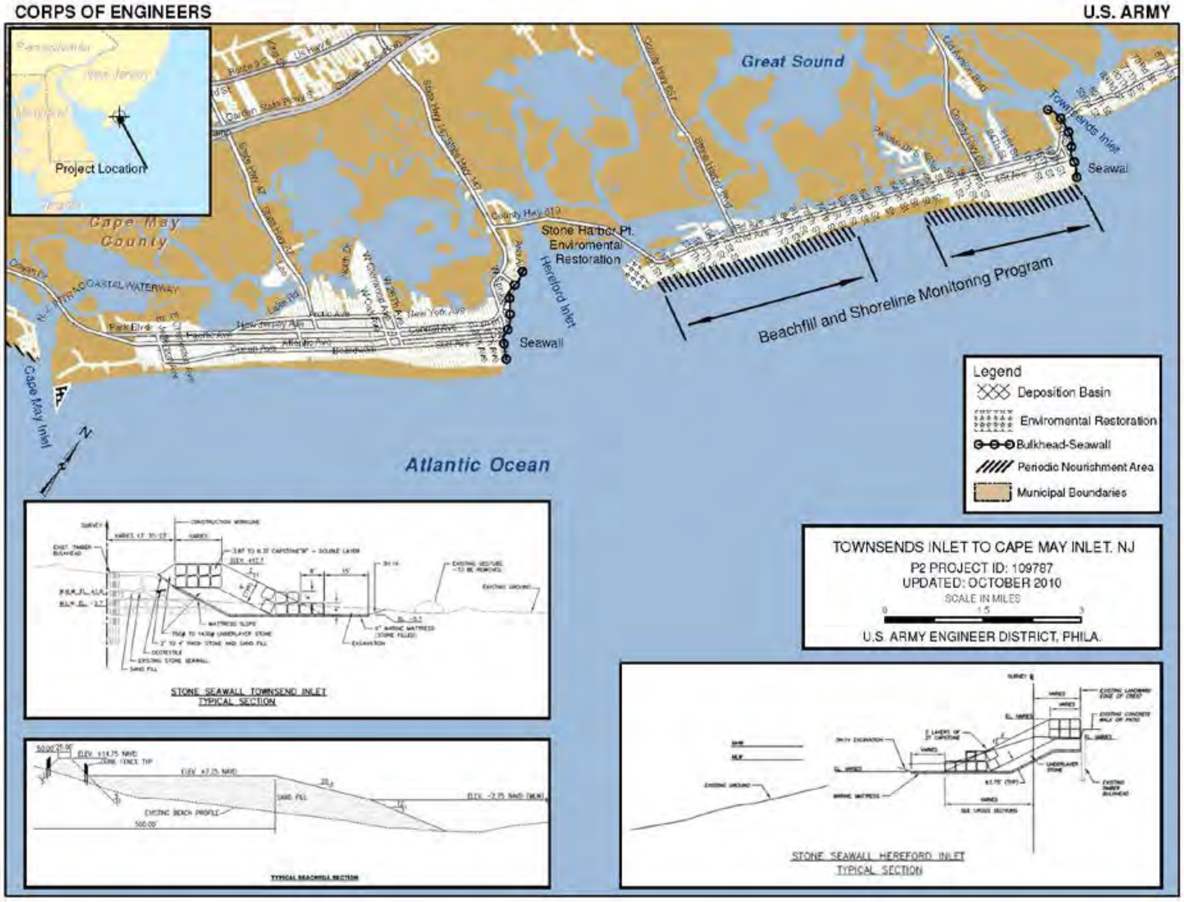


Figure 14. Townsends Inlet to Cape May Inlet, New Jersey Project Area

Initial construction for the Townsends Inlet to Cape May Inlet Project was completed in 2003 with the placement of approximately 4,200,000 CY of material on the beaches of Avalon and Stone Harbor. Periodic nourishment is scheduled to occur every 3 years but has been delayed in the past due to a lack of funding. FCCE funded beachfills occurred in 2011 and 2013 as a result of storm damages to the project area. A total of approximately 1,030,000 CY of material was placed in 2011 and 1,010,000 CY was placed in 2013. A summary of all beachfill activities done to date on this project can be found in Table 2.

Two inlet borrow areas have been identified for use on this project (Townsends Inlet Borrow Area and Hereford Inlet Borrow Area) (Figures 15a and 15b). Townsends Inlet Borrow Area is approximately 110 acres at depths between -10 and -24 feet NAVS88. The Hereford Inlet Borrow Area is approximately 190 acres at depths between -6 and -24 feet NAVD. In October 1995, Versar, Inc., conducted a benthic-sediment assessment on these borrow sites to establish a baseline for the benthic macroinvertebrate assemblages within the proposed borrow sites. The data obtained from each borrow area were compared to the other borrow areas, nearshore reference points, and the New York Bight Apex. The benthic investigations in and around the selected borrow sites revealed benthic communities that range between low and high infaunal abundance with low species diversity. The benthic populations at these borrow areas were dominated by the abundance of haustorid amphipod crustaceans which are a highly mobile, short lived amphipod, with highly opportunistic reproductive capacity and polychaete species (Versar, 1996).

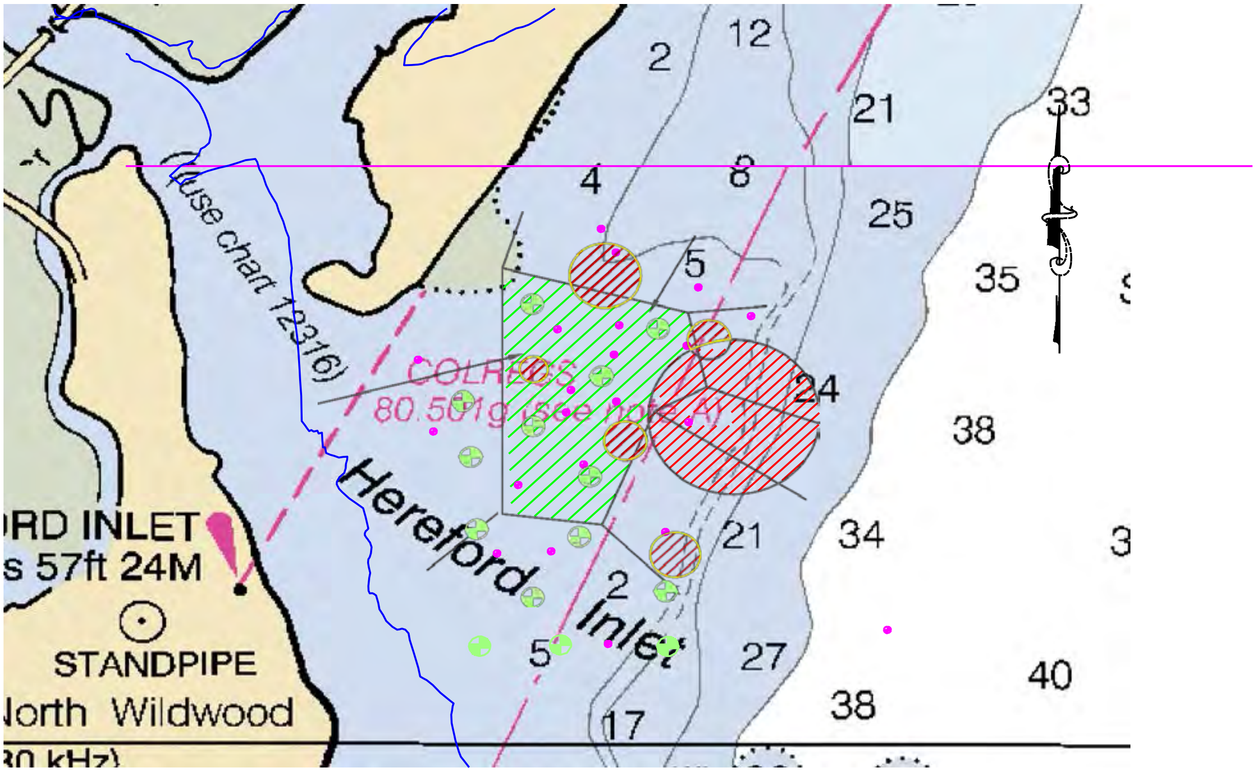


Figure 15a – Townsends Inlet Borrow Area

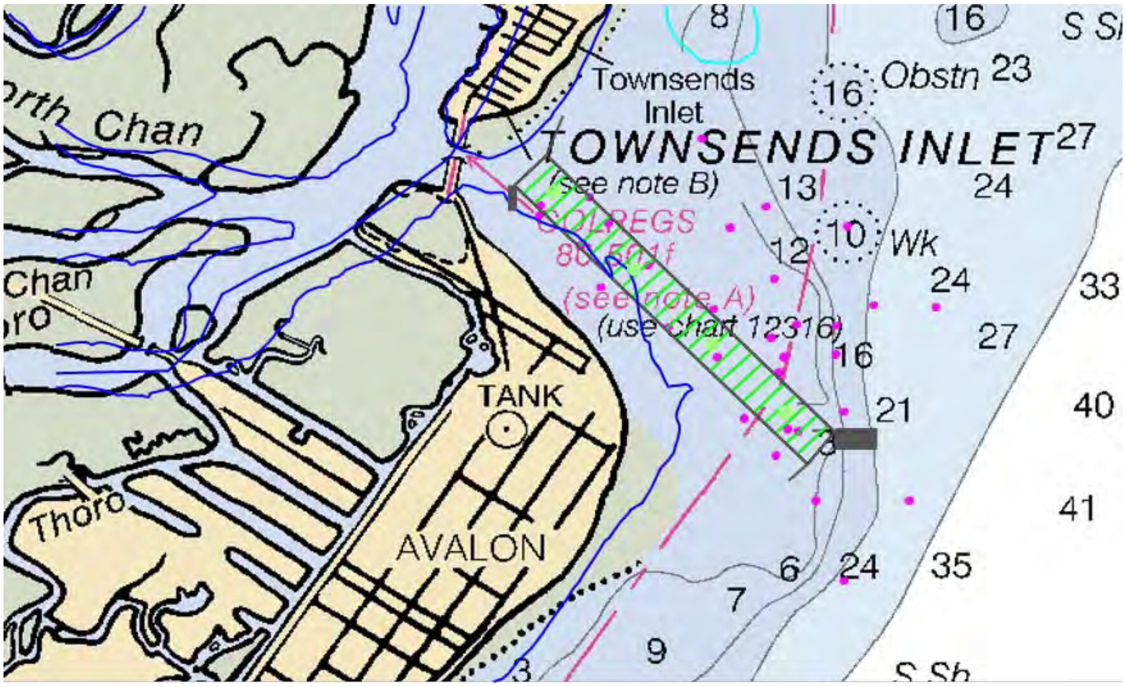


Figure 15b – Hereford Inlet Borrow Area

3.8 Cape May Inlet to Lower Township (Cape May City)

In 1980, the Philadelphia District evaluated the potential environmental impacts associated with the construction of the Cape May Inlet to Lower Township Storm Damage Reduction Project, and prepared a Final Supplement to the FEIS. In 2008, the District prepared an EA to evaluate potential environmental impacts associated with the selection of a new offshore borrow area. The Cape May Inlet to Lower Township project (Figure 16) consists of initial beachfill (25 to 180-foot wide berm at elevation +8.7 ft NAVD88), extension of 17 storm water outfalls, reconstruction of 7 groins and construction of two new groins, and a shoreline monitoring program for the project area. Initial construction was completed in 1991 and periodic nourishment currently takes place every 2 years to maintain the design template for the project. All groin work and extension of storm water outfalls has been completed.

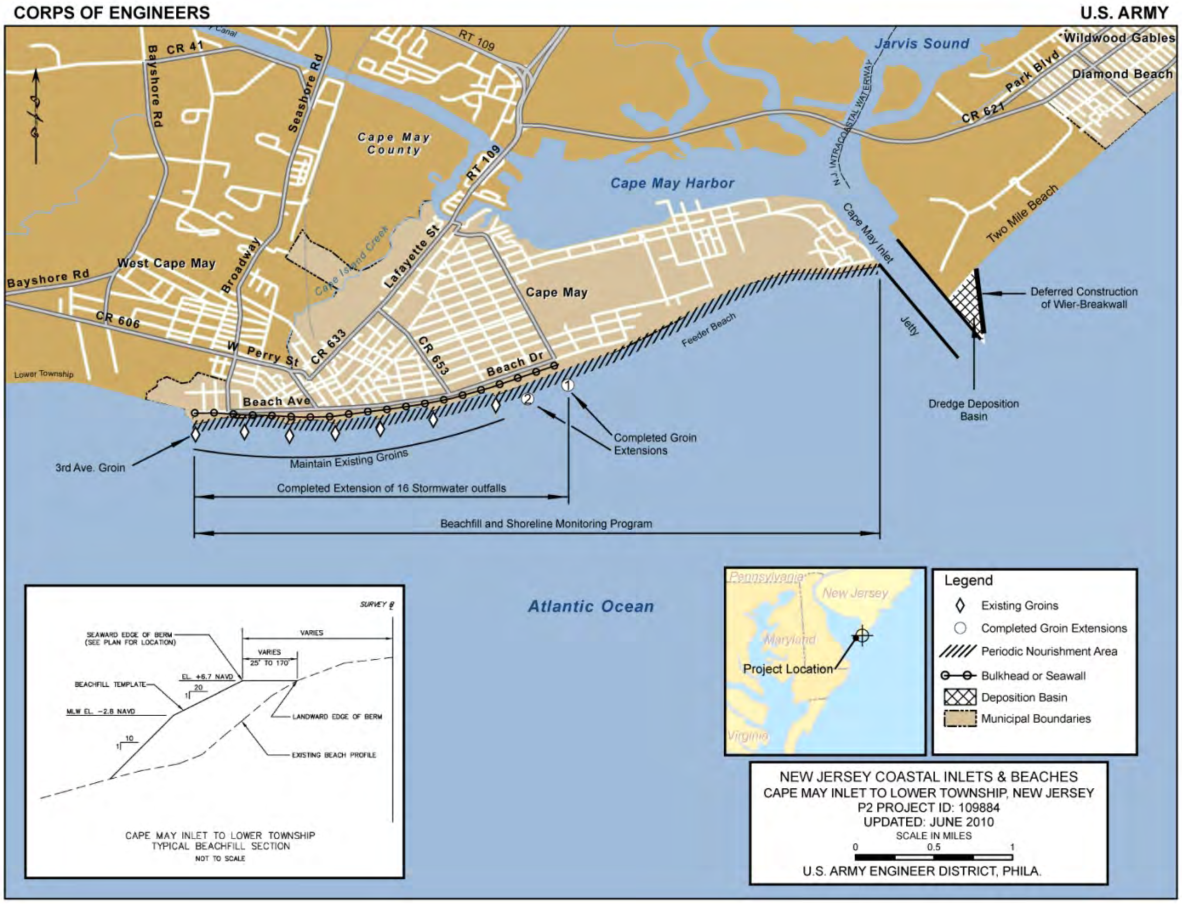


Figure 16. Cape May Inlet to Lower Township (Cape May City, New Jersey) Project Area

Initial construction for the Cape May City projects was completed in July 1991 in two major phases: placement of 465,000 CY (CY) of sand on the US Coast Guard Training Center beach completed in August 1989, followed by a separate contract placing 900,000 CY on the Cape May City beach completed in July 1991. Also as part of initial construction were the extension of existing groins at Baltimore and Trenton Avenues. Since the completion of the initial construction, 10 periodic nourishment cycles have been completed. This material has been obtained from a total of 4 offshore borrow areas (M1, K, 4 and 5). Periodic nourishment is scheduled to occur every two years in order to maintain the design template. The next nourishment cycle is scheduled for 2015. A summary of all sand placement activities can be found in Table 2.

During the time since the Cape May City project was initiated, the original approved borrow area (M1) has failed to replenish itself with sand as previously expected. This is mainly due to a weak sand transport mechanism and a lack of supply. Subsequently, Borrow Areas 4 and 5 were used for the initial construction of The Meadows in 2004-2005 and periodic nourishment of Cape May City in 2002 and 2006. During dredging activities in 2006, it was discovered that a significant amount of fine-grained material had been deposited in the borrow areas. The borrow areas also contained areas of larger "cobble" sized material. The combination of these features makes the overall grain size of this material incompatible with the existing beach sand, making it necessary to investigate additional sources of material. In 2008, an additional borrow area was identified as the primary sand source for these projects (Borrow Area K) (Figure 17). Borrow Area K is approximately 430 acres and lies approximately 14,000 to 19,000 feet offshore of Cape May Inlet. It is estimated that approximately 5 million CY of beachfill material is available to a dredge depth of 8 feet below the current bathymetric surface.

Benthic investigations were performed by Versar (2008) to establish the baseline conditions of the benthic community within the borrow area. The results of the investigations indicated that the borrow area did not contain unique or rare macroinvertebrate communities that would preclude their use as a sand borrow source for beach placement activities. The benthic community in Borrow Area K was also similar to other benthic communities found in and along the New Jersey Coast. In order to preserve historic surf clam habitat within the borrow area to the greatest extent possible, the Corps has divided the borrow area into three sections. Since the inshore portions of the borrow area had lesser abundances of surf clams in the historic survey data, dredging will begin in the borrow area subsection closest to shore, moving further seaward as needed. Borrow Area K was used for beachfill activities in Cape May City in 2012 and 2014.

3.9 Lower Cape May Meadows/Cape May Point

The Lower Cape May Meadows project, also known as “The Meadows”, is an ecosystem restoration project that provides flood and coastal storm damage reduction along approximately 2.5 miles of coastline fronting Lower Cape May Meadows and the Borough of Cape May Point (Figure 18). The project consists of berm and dune restoration from the 3rd Avenue terminal groin in Cape May City to the Central Avenue groin in Cape May Point utilizing sand from an offshore borrow site. The project also included wetland restoration, invasive species control and piping plover habitat creation following beach nourishment activities. The environmental impacts of this project were reviewed and presented in the 1998 Final Feasibility Report and Integrated EIS prepared by the District as well as a 2008 EA evaluating potential impacts associated with a new offshore borrow area.

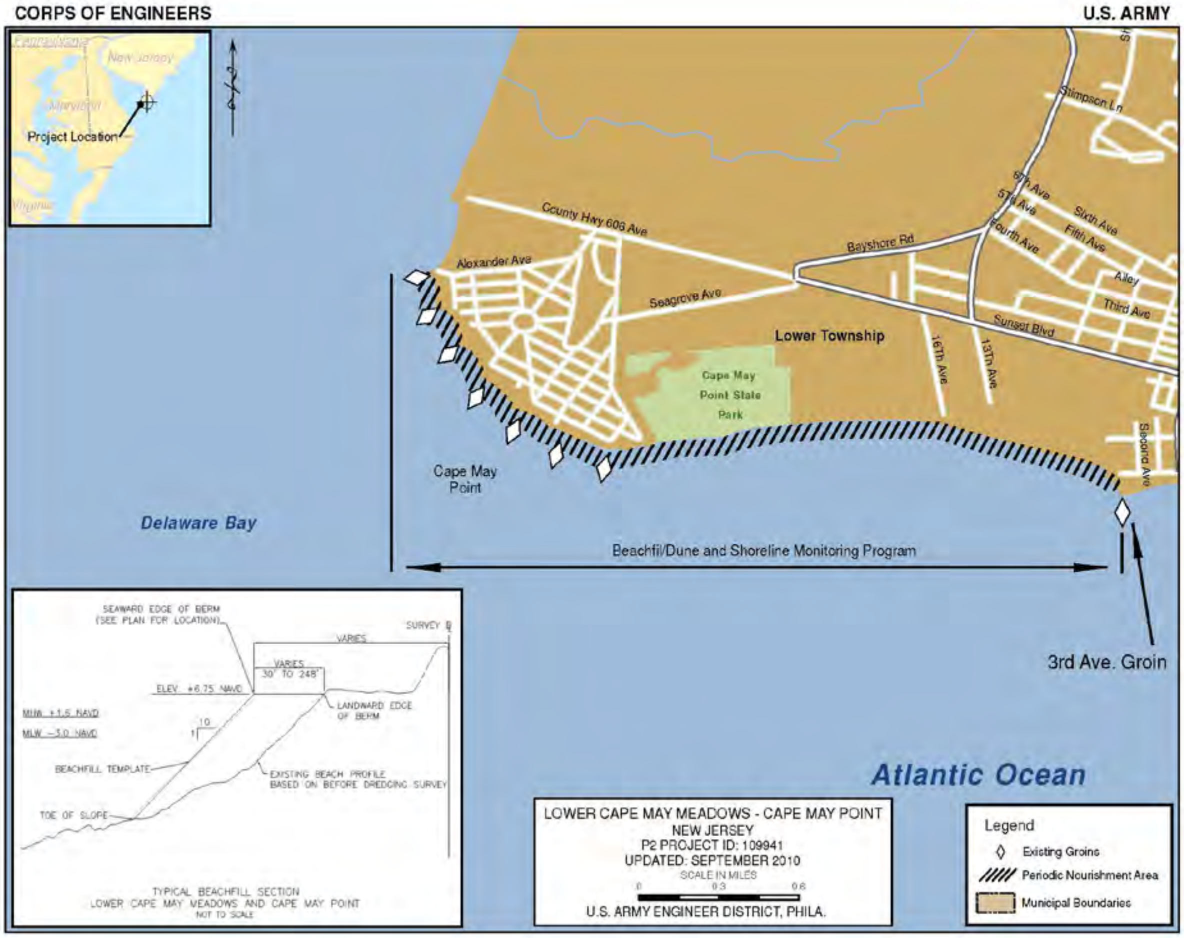


Figure 17. Lower Cape May Meadows – Cape May Point, New Jersey Project Area

The design template includes a 20 foot wide berm with a top elevation of +6.7 ft NAVD and a dune with a top elevation of +16.7 ft NAVD. The total length of fill is 10,050 linear feet (1.9 miles). To maintain the design template, this plan also includes periodic nourishments every 4 years with sand obtained from offshore borrow sources over a 50 year time period. Initial beachfill construction was completed in 2005 with the placement of 1,406,000 CY of sand. The plan also included planting 18 acres of dune vegetation. Environmental restoration of the wetlands behind the dune was also included in the project plan. These features consisted of the control of 95 acres of *Phragmites australis*, planting 105 acres of emergent wetland vegetation, excavation of existing drainage ditches to restore freshwater flow, linking the hydrological segments of the project area, installing four water control structures, and the creation of 3 "piping plover" ponds behind the dune.

Initial dune and beach construction for the Lower Cape May Meadows project was completed in 2005 with the placement of 1,406,000 CY of sand. Since the completion of initial construction, 3 periodic nourishment cycles have been completed. Periodic nourishment is generally scheduled to occur every 4 years. A summary of all sand placement activities completed to date can be found in Table 2.

As stated above, Borrow Areas 4 and 5 were used for the initial construction of the Lower Cape May Meadows project in 2004-2005 and periodic nourishment of Cape May City in 2002 and 2006. During dredging activities in 2006, it was discovered that a significant amount of fine-grained material had been deposited in the borrow areas. The borrow areas also contained areas of larger "cobble" sized material. The combination of these features makes the overall grain size of this material incompatible with the existing beach sand, making it necessary to investigate additional sources of material. In 2008, an additional borrow area was identified as the primary sand source for these projects (Borrow Area K) (Figure 19). Borrow Area K is approximately 430 acres and lies approximately 14,000 to 19,000 feet offshore of Cape May Inlet. It is estimated that approximately 5 million CY of beachfill material is available to a dredge depth of 8 feet below the current bathymetric surface.

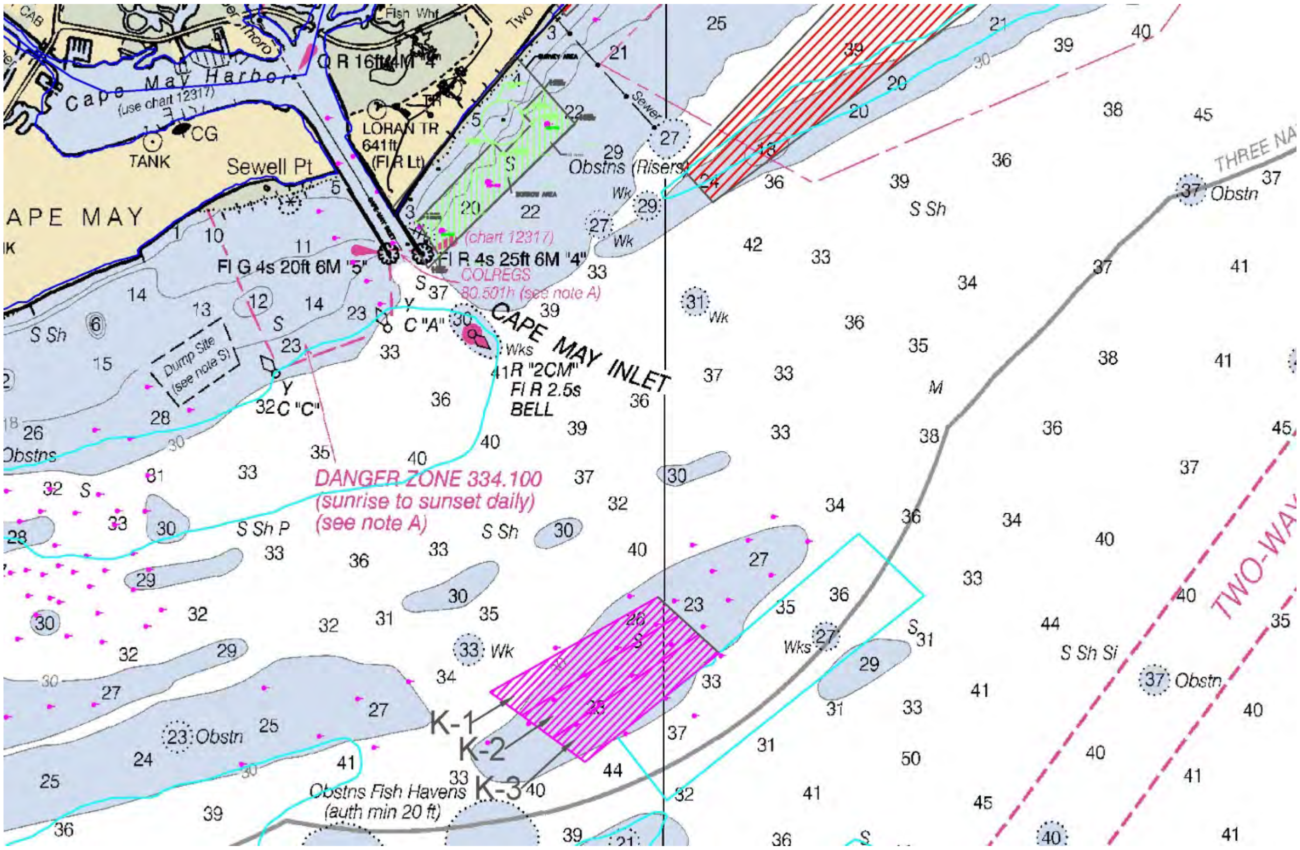


Figure 18. – Cape May City and Cape May Meadows Borrow Area

Benthic investigations were performed by Versar (2008) to establish the baseline conditions of the benthic community within the borrow area. The results of the investigations indicated that the borrow area did not contain unique or rare macroinvertebrate communities that would preclude their use as a sand borrow source for beach placement activities. The benthic community in Borrow Area K was also similar to other benthic communities found in and along the New Jersey Coast. In order to preserve historic surf clam habitat within the borrow area to the greatest extent possible, the Corps has divided the borrow area into three sections. Since the inshore portions of the borrow area had lesser abundances of surf clams in the historic survey data, dredging will begin in the borrow area subsection closest to shore, moving further seaward as needed. Borrow Area K was used for beachfill activities in Cape May Meadows in 2009, 2012 and 2013.

3.10 Rehoboth Beach & Dewey Beach

The Rehoboth Beach & Dewey Beach project (Figure 19) provides flood and coastal storm damage reduction along the Delaware Bay Coastline for approximately 2.6 miles extending from the northern end of Rehoboth Beach to the southern border of Dewey Beach. The project is located on the Atlantic coast of Delaware just north of the Delaware Seashore State Park. The project consists of berm and dune restoration utilizing sand from an offshore borrow site with periodic nourishment cycles over a 50 year time period. The selected plan includes dune grass, dune fencing and suitable beachfill with periodic nourishment every three years to ensure the integrity of the design. The environmental impacts associated with the construction of this project were reviewed and presented in the 1996 Final Feasibility Report and Final EIS prepared by the District.

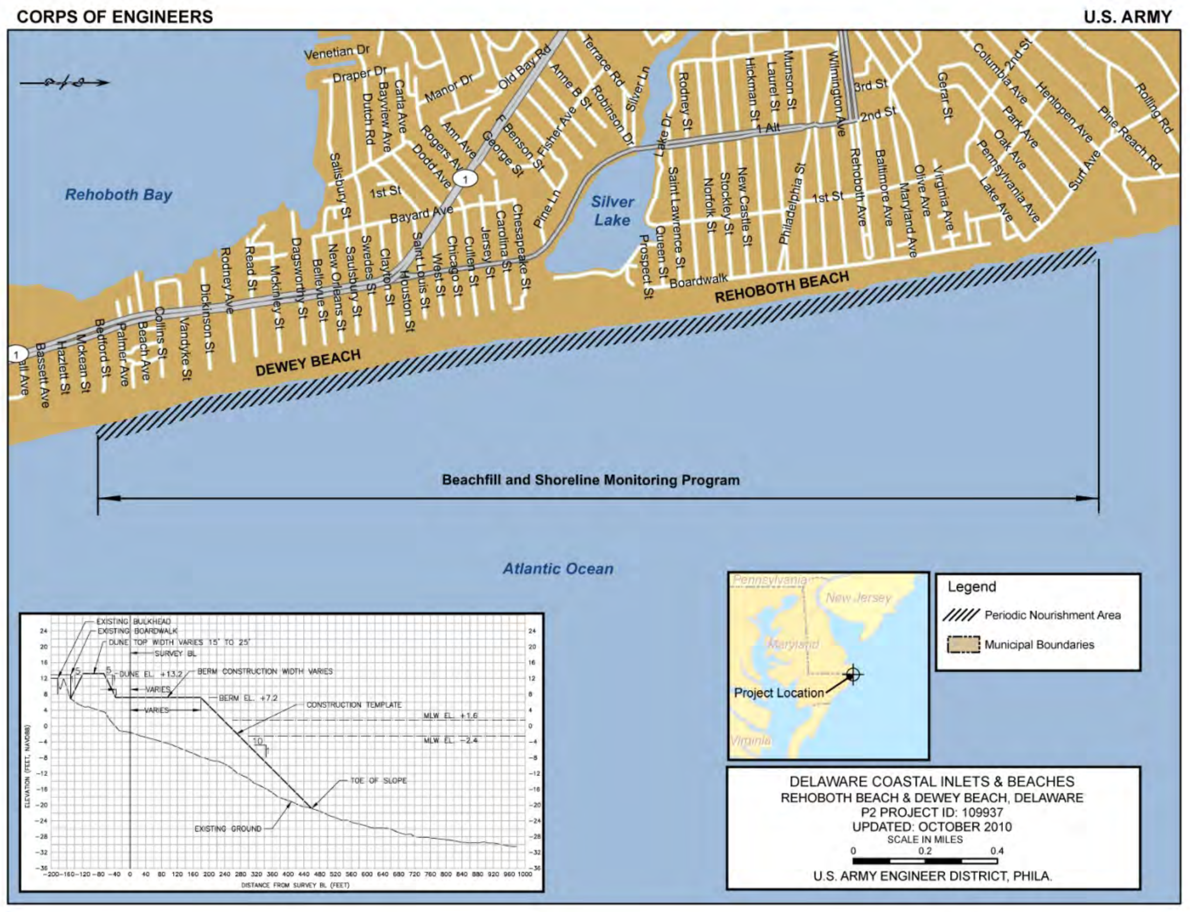


Figure 19. Rehoboth Beach & Dewey Beach, Delaware Project Area

The selected design template at Rehoboth Beach/Dewey Beach consists of one continuous project for a distance of 13,500 linear feet. Along Rehoboth Beach, the plan provides for a 125-foot wide berm at elevation +7.2 feet NAVD and a dune at elevation +13.2 ft NAVD. At Dewey Beach, the project would transition to a 150-foot wide berm at elevation +7.2 ft NAVD and a dune at elevation +13.2 feet NAVD. The berm and dune slopes will be 1V:15H and 1V:5H respectively at all locations. Initial construction of the project was completed in 2005 and periodic nourishment is ongoing every 3 years for the life of the project.

As was previously stated, the initial construction of the Rehoboth Beach and Dewey Beach Project was completed in July 2005. For initial construction, approximately 1,690,000 CY of sand were dredged from Area G and placed as beachfill on Dewey Beach and Rehoboth Beach. Area G was a sand source located about 2-3 nautical miles offshore of Indian River Inlet. Due to the high gravel content of the sand, Area G was discontinued after the initial construction phase. The Fenwick Island sand source is now being used in the interim until another suitable source is approved. In 2009, a second periodic nourishment cycle resulted in the placement of approximately 290,000 CY of sand, which was placed on Dewey Beach. In 2012, approximately 982,000 CY of sand was placed on both Dewey Beach and Rehoboth Beach combining the remaining second periodic nourishment cycle and FCCE repairs from the 2009 Nor'easter storm. In 2013, approximately 509,000 CY of sand was placed in these communities in order to repair the damages caused by the 2012 Hurricane Sandy, and to restore the project to full template. The third periodic nourishment cycle is scheduled for the 2016-2017 timeframe. A complete summary of all beachfill activities completed to date for this project can be found in Table 3.

The Fenwick Island Borrow Area is currently being used for nourishment activities related to this project. The Fenwick Island Borrow Area is approximately 2,686 acres in size, and is 0.76 to 2.9 nautical miles offshore of the Town of Fenwick Island. This site is over 15 nautical miles from Rehoboth Beach and Dewey Beach (Figure 20). Due to the long distance of sand transport, this work can only be accomplished with a hopper dredge. This site contains one prominent shoal that has been avoided, and is, otherwise, mostly flat in bathymetry. It was estimated that this site contains in excess of 40 million CY of fine to medium sands.

A benthic investigation of the Fenwick Island Borrow Area was performed by Versar (2005), which included surficial video images and infaunal samples. Three distinct sediment habitats were identified from the video sled analysis. The sediment types were either fine-medium sands (63%), coarse sands (26%), and gravel-pebble-cobble-rock (11%). The benthic infauna community composition at the three sediment habitats (fine sand, coarse sand, and gravel) was very similar in terms of percentage contribution of the major taxonomic groups. In all three sediment habitats, polychaete worms were the dominant group (53%) composed mostly of *Aricidea catherinae, Mediomastus ambiseta*, *Prionospio perkensi, Hemipodus roseus* and *Levinsenia gracilis*. Oligochaete worms (35%) made up the second highest taxonomic group, then ribbon worms (Nemertinea) (8%). Molluscs and arthropod crustaceans contributed little to the overall community composition in all sediment habitats. Versar (2005) determined that differences in the benthic community composition between the three habitats were minimal, however, differences in the dominant taxa within the taxonomic groups were apparent. A post dredge benthic monitoring investigation by Versar (2009) revealed slight differences in sand grain sizes and the benthic community between pre-dredge samples and post dredge samples, however, this may be attributed more to normal spatial variations in sediments and temporal variations in the benthic community. One exception was noted in a station that was in the deepest part of the borrow area (deepened by dredging) that contained mostly fine sands, and had more than half as fewer taxa, abundance, and biomass than all other stations sampled. However, this location was not sampled in the pre-dredge sampling (Versar, 2005), and could not be compared directly.

A new proposed offshore sand source (Borrow Area B) lies between Indian River Inlet and Dewey Beach. Borrow Area B is about 1.8 to 3.0 nautical miles offshore of Delaware Seashore State Park (north side of Indian River Inlet) in the Atlantic Ocean (Figure 20). It is approximately 2,132 acres in size, and is about 2.9 nautical miles (17,700 ft.) long (north to south). This area was described by USACE (1995a) as a linear shoal field containing fine to medium sands with sand strata thickness ranging between 5 feet near the edges of the area to 20 feet near the center. Area B spans three geomorphic regions that contain sandy deposits: the attached shoal field and shoreface, the inner platform, and the outer platform (McKenna and Ramsey, 2002). Borrow Area B does not possess any prominent shoal features, but there are hard bottom features (pebble/cobble bottoms) in portions of the area, which may be Essential Fish Habitat (EFH) for species such as black seabass (*Centropristus striata*). This was identified in a benthic sled camera investigation of this area in 2000 (Diaz et al. 2001) and Versar (2012) where pockets of surficial gravel/cobble deposits, which in several locations, supported blue mussel beds. This investigation also identified the presence of relic coral within some of these pockets. These areas would be avoided based on the benthic surveys performed. A benthic survey performed by Versar (2012) indicated that the borrow area was dominated by oligochaete worms, the polychaete worms: *Mediomastus ambiseta*, *Polygordius* spp. and *Parapionosyllis longicirrata*; and the small tunicate Ascidiacea. These taxa possess opportunistic life history characteristics such as small size, fast growing species, and prolific fecundity that would allow for rapid recruitment after a dredging disturbance.

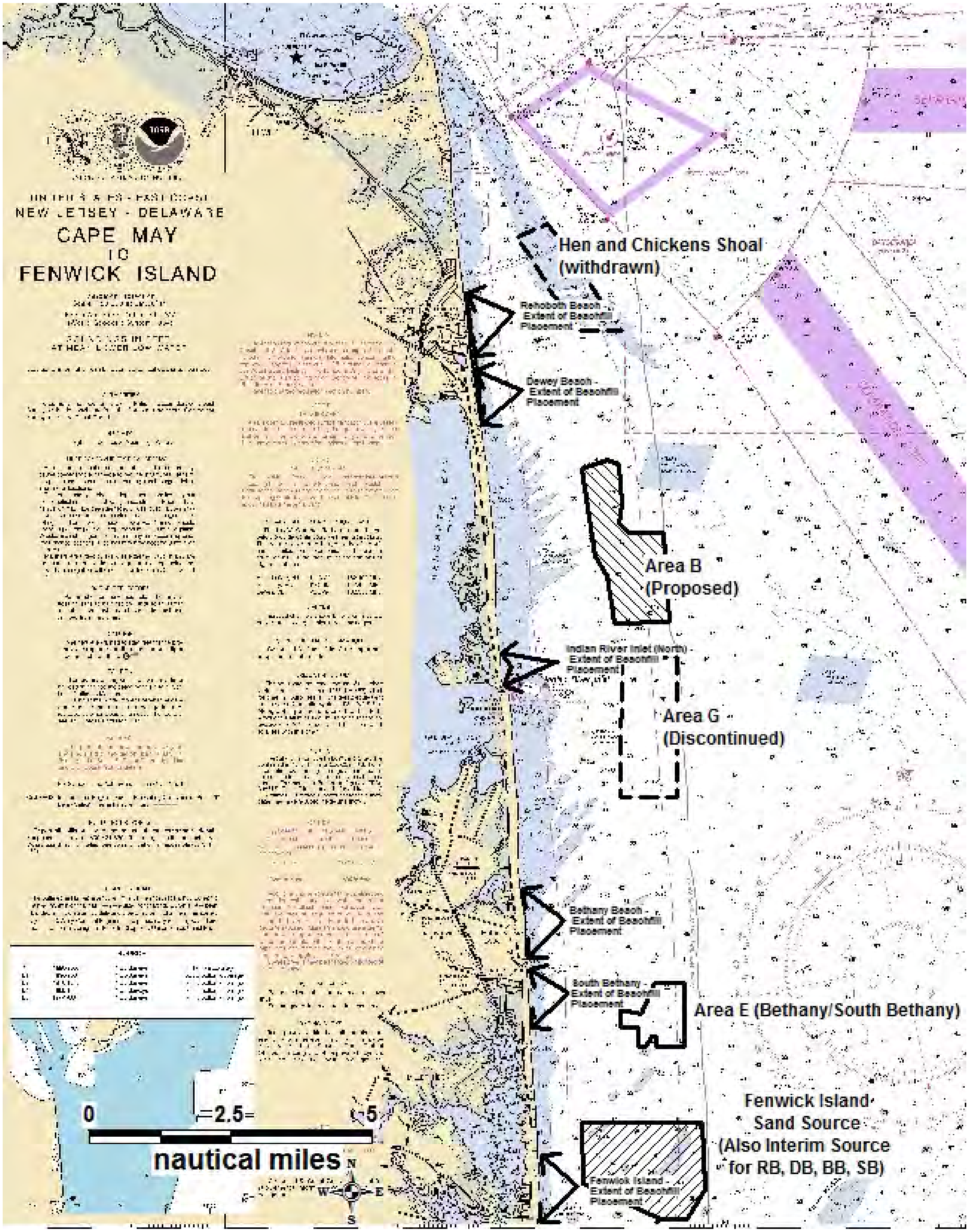


Figure 20 – Delaware Coast Borrow Areas

3.11 Indian River Inlet Sand Bypass Plant

In 1984, the Philadelphia District evaluated the environmental impacts associated with the construction of the Indian River Inlet Sand Bypass Plant, and prepared a Final EA. The project consists of a onetime initial placement of fill to build the existing beach to a minimum profile which is required to protect the highway, followed by nourishment of the beach over the life of the project using a mechanical sand by-passing system. The project is located in Sussex County, Delaware, on the Atlantic Ocean at Indian River Inlet.

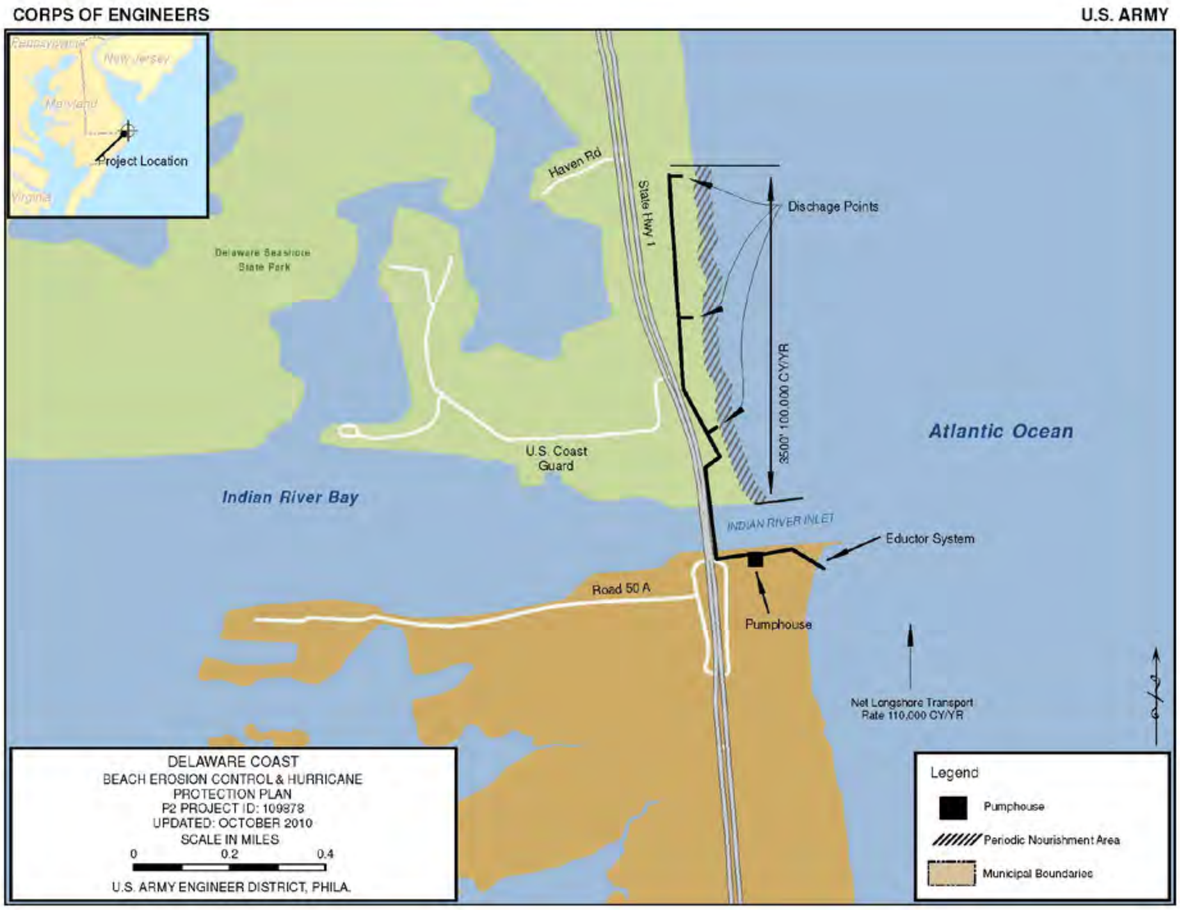


Figure 21. Indian River Inlet Sand Bypass Plant, Delaware Project Area

The initial design template consists of 80,000 CY of sand placed along the north beach between station 0+00 and station 15+00. The selected design template adequate to protect Rt.1, calls for a berm 180 feet east of the east edge of the highway (including shoulder) at an elevation of +10 NGVD. The volume of sand required for nourishment of the north beach is 100,000 CY annually. This project will utilize sand obtained by dredging the required quantity from the interior of the Indian River Inlet. Initial construction of this project has been completed with annual nourishment taking place. The project is currently authorized until September 2021.

The Indian River Inlet (IRI) Sand Bypass Plant was constructed in 1990, which required the initial placement of approximately 175,000 CY of sand on the North Shore of IRI (Figure 21). This placement was conducted by the Delaware Department of Natural Resources and Environmental Control (DNREC) utilizing a hydraulic cutterhead dredge. The sand source for the initial placement was the IRI flood shoal. Sand bypass operations are performed by the DNREC on an annual basis (since 1990) where an average of 84,419 CY of sand are pumped annually from the south shore IRI fillet to the north shore (Figure 22). Repairs due to storm damages were required in 1992 and 2013 for the north shore beach. In 2013, approximately 529,000 CY were dredged from the IRI flood shoal with a hydraulic cutterhead dredge, and placed to repair and restore the north shore beach. The IRI flood shoal sand source was approximately 50 acres in size with depths ranging from -10 ft. NAVD to -26 ft. NAVD. A maximum dredging depth was permitted for -30 ft. NAVD.

Annual sand bypass operations are expected to continue, however, future repairs may be required using either the IRI flood shoal or the offshore sand sources.

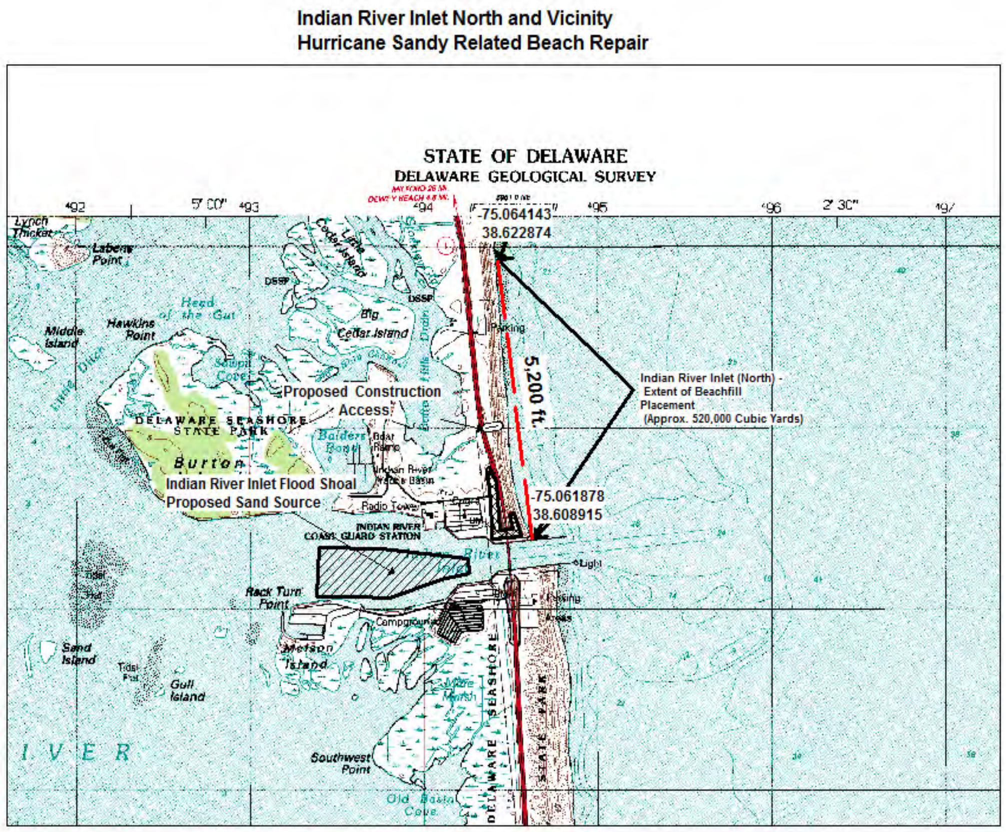


Figure 22 – Indian River Inlet Borrow Area

3.12 Bethany/South Bethany

The Bethany/South Bethany project provides flood and coastal storm damage reduction along approximately 2 miles of the Atlantic Ocean coastline fronting the towns of Bethany Beach and South Bethany, in Sussex County Delaware. The project consists of berm and dune restoration utilizing sand from an offshore borrow site with periodic nourishment cycles over a 50 year time period. The selected plan includes dune grass, dune fencing, and suitable advance beach fill and periodic nourishment every 3 years to ensure the integrity of the design.

This plan consists of two independent discontinuous segments, one in Bethany Beach and another in South Bethany. The environmental impacts associated with the construction of this project were reviewed and presented in the June 1998 Final Feasibility Report and EIS prepared by the District. An addendum was later added on February 9, 1999 to address minor discrepancies mainly pertaining to the estimated costs associated with terminating the project segments with tapers versus groins.

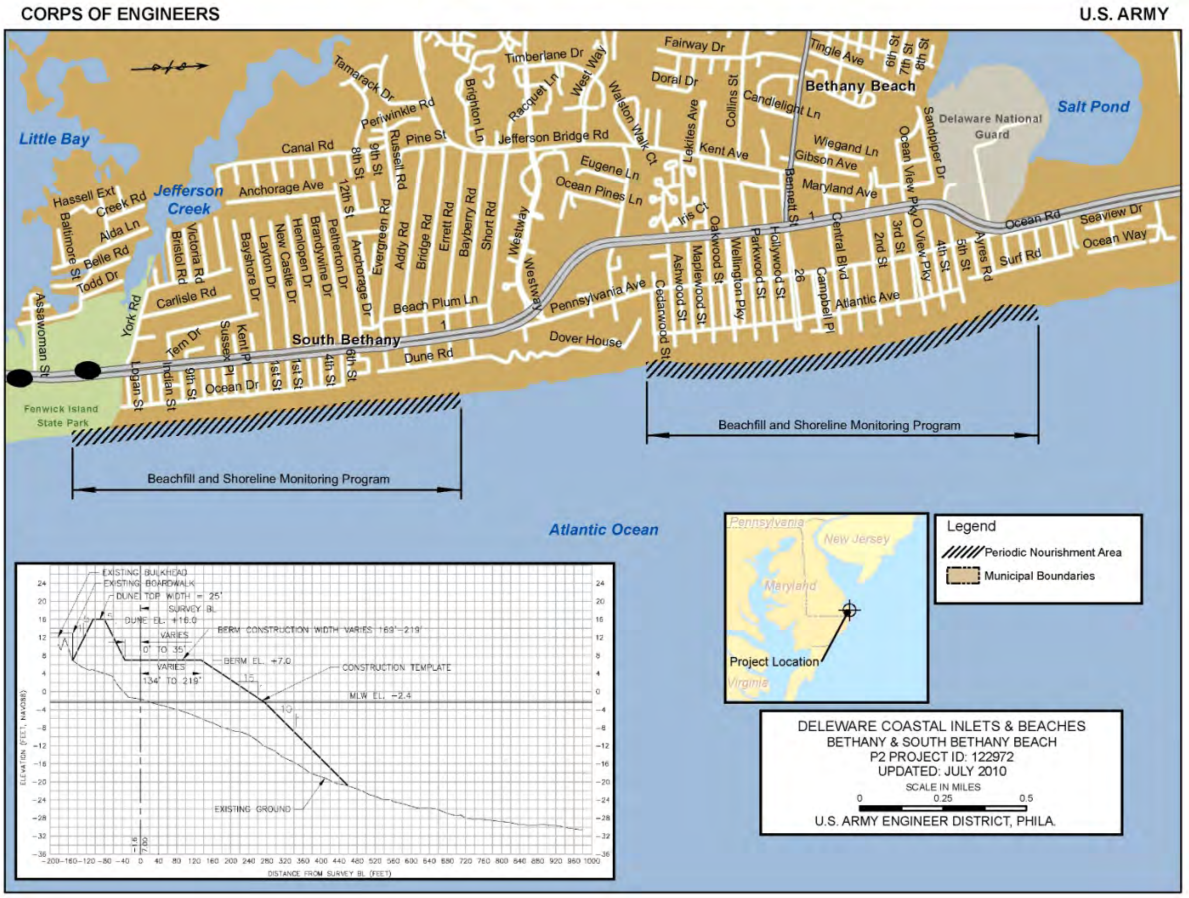


Figure 23. Bethany & South Bethany Beach, Delaware Coastal Project

The selected design template consists of a sand fill dune and beach project, in two independent discontinuous segments, at the towns of Bethany Beach and South Bethany. The selected plan at each location consist of a 150 foot wide berm at an elevation of +7.0 ft NAVD, and a dune with a top elevation of +16.0 ft NAVD and crest width of 25 feet. The dune and beachfill extend along the entire corporate limits of both communities. The length of the dune and beachfill for the project at Bethany Beach is about 7,770 feet. This length includes about 5,250 feet of the full design section within the corporate limits of Bethany Beach and 1,260 foot long sand fill tapers at each end of the full design section. The project length at South Bethany is about 7,180 feet. This length includes about 4,100 feet of the full design section within the corporate limits of South Bethany and 1,540 foot long sand fill tapers at each end of the full design section. The total length for both segments is 14,950 feet. Initial construction of the project was completed in 2008 with ongoing periodic nourishment occurring every 3 years.

The initial construction for the Bethany – South Bethany project was completed in June 2008 with the placement of approximately 3,130,000 CY of sand. An additional 198,000 CY of sand was placed in 2009 as maintenance of the initial construction following the Mother's Day storm in 2008. In 2011, approximately 296,000 CY of sand was placed on Bethany Beach and South Bethany to repair the project following the 2009 Nor'easter storm as part of FCCE funding. FCCE repairs from the 2009 Nor'easter storm combined with the second periodic nourishment cycle were completed in 2012 resulting in the placement of 1,145,000 CY of sand. In 2013, approximately 536,000 CY of sand was placed in these communities in order to repair the damages caused by the 2012 Hurricane Sandy, and to restore the project to full template. The third periodic nourishment cycle is scheduled for the 2016-2017 timeframe. A summary of all beachfill activities completed to date for this project can be found in Table 3.

Borrow Area E was used for initial construction in 2008 and for repairs in 2009 and 2011. Borrow Area E lies approximately 9,600 to 16,000 feet offshore of Bethany Beach and South Bethany, and extends south to offshore of Fenwick Island State Park (Figure 20). The total area encompasses approximately 3,500 acres, however, only a 775-acre portion of the site was used. Borrow Area E contains a relatively flat, homogenous, marine bottom with depths ranging from -33 ft. to -48 ft. mllw. Benthic sampling performed by Versar (1998b) identified a total of 89 infauna and 8 epifauna species within Borrow Area E. The benthic community was dominated by the polychaete worms: *Polygordius* sp. and *Spiophanes bombyx*, and oligochaete worms, however, these three taxa accounted for only 40% of the combined abundance of all of the taxa. Other abundant taxa included Nemertinea (ribbon worm), *Tellina agilis* (bivalve), *Tannaissus psammophilus* (an isopod-like arthropod), *Protohaustorius wigleyi* (amphipod), *Acanthohaustorius* sp. (amphipod), and Echinoidea (sea urchins and sand dollars). Larger benthic species collected from commercial surfclam (*Spisula solidissima*) survey tows yielded moderate numbers of knobbed whelk (*Busycon carica*), horseshoe crabs (*Limulus polyphemus*), lady crab (*Ovalipes ocellatus*), starfish (Asteridae) and cancer crab (*Cancer irroratus*). Versar (1998) concluded that Borrow Area E does not support a unique or rare macroinvertebrate community that would preclude its use as a sand source.

Versar (2005) conducted an evaluation of the benthic community within a 43-acre portion of Area E dredged in 1998 (by a previous State of Delaware beach nourishment project), and in an undisturbed portion of Area E. The benthic community within the 10-12 ft deeper dredge pit showed a markedly different benthic community, which was dominated by the bivalve, *Nucula proxima* and the Gastropod, *Acteocina canaliculata*, which were not identified outside of the pit. In Versar (2005), the benthic community outside of the pit in Area E was dominated by the Polychaetes: *Streptosyllis pettiboneae*, *Aricidea cahterinae, Aricidea cerrutti, Polygordius* spp., and *Hesionura coineaui*; Oligochaeta, *Tanaissus psammophillus*, Nemertinea, and *Tellina agillis*. A video sled track was deployed along the bottom of Area E by the Virginia Institute of Marine Sciences (VIMS) and Versar, Inc (Versar, 2005) to provide a description of the physical and biological benthic habitats on the surface. This sled deployment was performed (utilizing 269 data points) to provide more thorough coverage and detail regarding the area's physical habitats and surficial biological features. Over 57% of the Area E video sled track contained physical habitats composed of fine-medium sands with variable bedform sizes and shapes, and forms. Of this type of grain size, the dominant bedform type was small (< 30 cm wavelength) bedforms with sharp-peaked crests. The second most dominant surficial sediment type encountered was pebble-cobble-rock bottoms, which encompassed 33% of the video images. The third most common surficial sediment type was coarse sand-granules representing nearly 10% of the bottom video images. Of all of these habitats, only 5.4% contained biogenic features associated with mounds or pits created by burrowing benthic organisms.

3.13 Fenwick Island

The Fenwick Island Project (Figure 24) provides flood and coastal storm damage reduction along the Atlantic shoreline for approximately 1.2 miles. The project is located on Fenwick Island, Sussex County a coastal community on the Atlantic coast of Delaware. The project consists of berm and dune restoration utilizing sand from an offshore borrow site with periodic nourishment cycle every four years over a 50 year time period. The environmental impacts associated with the construction of this project were reviewed and presented in the 2000 Final Feasibility Report and Final EIS prepared by the District.

The selected design template at Fenwick Island consists of a berm at an elevation of +7.7 ft NAVD with a foreshore slope of 1V:10H from the crest of the berm to mean low water (MLW). The design also calls for a dune with a top elevation of +17.7 ft NAVD at a 25 foot crest, side slopes of 1V:5H, and base width of 125 feet. The berm extends 75 feet from the seaward toe of the dune. The beachfill extends along the entire community of Fenwick Island for a distance of approximately 6,000 feet. A taper of 500 feet extends from the northern end of the project, bringing the total project length to approximately 6,500 feet. Initial construction of the project has been completed and ongoing periodic nourishment occurs every four years.

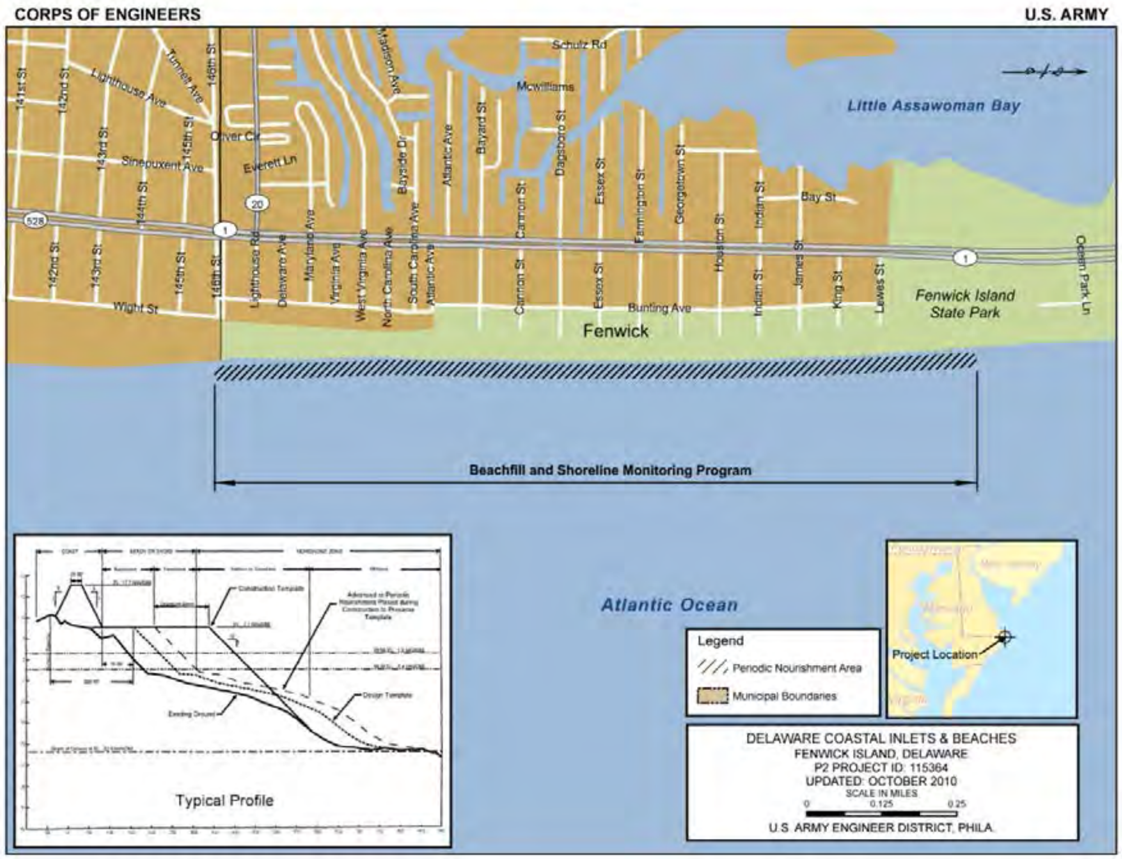


Figure 24. Fenwick Island, Delaware Project Area

The initial construction for the Fenwick Island project was completed in November 2005. For the initial construction, approximately 833,000 CY of sand were dredged with a hopper dredge from the Fenwick Island sand borrow area, and placed as beachfill on the Town of Fenwick Island beach. In 2011, approximately 332,000 CY of sand was placed on the Fenwick Island beach for the second periodic nourishment, which was combined with a repair of the project following the 2009 Nor'easter storm as part of FCCE funding. In 2013, approximately 368,000 CY of sand were placed in order to repair the damages caused by the 2012 Hurricane Sandy, and to restore the project to full template. The third periodic nourishment cycle is scheduled for the 2016-2017 timeframe. A summary of all beach nourishment activities completed to date for this project can be found in Table 3.

The Fenwick Island Borrow Area was utilized for all periodic nourishment cycles and FCCE repairs subsequent to the initial construction. The Fenwick Island Borrow Area is approximately 2,686 acres in size, and is 0.76 to 2.9 nautical miles offshore of the Town of Fenwick Island (Figure 20). This site contains one prominent shoal that has been avoided, and is, otherwise, mostly flat in bathymetry. It was estimated that this site contains in excess of 40 million CY of fine to medium sands.

3.14 USE OF MEC or UXO SCREENING

Due to the possibility of encountering munitions and explosives of concern (MEC, or unexploded ordinance (UXO)) within offshore and inlet borrow areas, it is required that MEC screening be utilized for all beach nourishment projects within the Philadelphia District. The purpose of the screening is to prevent an ordnance from being placed on the beach. This is accomplished through the use of: 1) a screening device placed on the dredge intake or in a pipeline section prior to reaching the dredge pump, and 2) a screen at the discharge end of the pipeline on the beach. The screening device on the dredge intake prevents the passage of any material greater than 1.25 inches in diameter. The openings on the screening device may have one dimension greater than the other. The maximum allowable opening size is 1.25 inches by 6 inches. The screening device on the discharge end (on the beach) is designed to retain all items 0.75 inches in diameter and larger. The openings on the screening device are of uniform dimension, slotted openings are not permitted. The screening devices are used for 100% of the dredging activities considered in this Opinion. Visual inspection of the screens and sand placement are performed at all times. Intake or pipeline screening is inspected at a minimum of once every 8 hours.

3.15 Information on Dredges that may be used

All dredging considered in this Opinion will be carried out with a hydraulic hopper dredge or cutterhead dredge. The dredge used will depend on the distance between the borrow area and the beach where sand is being placed as well as contractor and dredge availability. The use of mechanical dredges is not anticipated.

3.15.1 Self-Propelled Hopper Dredges

Hopper dredges are typically self-propelled seagoing vessels. They are equipped with propulsion machinery, sediment containers (i.e., hoppers), dredge pumps, and other specialized equipment required to excavate sediments from the channel bottom. Hopper dredges have propulsion power adequate for required free-running speed and dredging against strong currents.

A hopper dredge removes material from the bottom of the channel in thin layers, usually 2-12 inches, depending on the density and cohesiveness of the dredged material (Taylor, 1990). Pumps within the hull, but sometimes mounted on the dragarm, create a region of low pressure around the dragheads; this forces water and sediment up the dragarm and into the hopper. The more closely the draghead is maintained in contact with the sediment, the more efficient the dredging (i.e., the greater the concentration of sediment pumped into the hopper). Draghead types may consist of IHC and California type dragheads. In the hopper, the slurry mixture of sediment and water is managed to settle out the dredged material solids and overflow the supernatant water. When a full load is achieved, the vessel suspends dredging, the dragarms are heaved aboard, and the dredge travels to the placement site where dredged material is disposed of.

California type dragheads sit flatter in the sediment than the IHC configuration which is more upright. Individual draghead designs (i.e. dimensions, structural reinforcing/configuration) vary between dredging contractors and hopper vessels. Port openings on the bottom of dragheads also vary between contractors and draghead design. Generally speaking the port geometry is typically rectangular or square with minimum openings of ten inch by ten inch or twelve inch by twelve inch or some rectangular variation.

Industry and government hopper dredges are equipped with various power and pump configurations and may differ in hopper capacity with different dredging capabilities. An engineering analysis of the known hydraulic characteristics of the pump and pipeline system on the USACE hopper dredge "Essayons" (i.e. a 6,423 CY hopper dredge) indicates an operational flow rate of forty cubic feet per second with a flow velocity of eleven feet per second at the draghead port openings. The estimated force exerted on a one-foot diameter turtle (i.e. one foot diameter disc shaped object) at the pump operational point in this system was estimated to be twenty-eight pounds of suction or drag force on the object at the port opening of the draghead.

Dredging is typically parallel to the centerline or axis of the channel. Under certain conditions, a waffle or crisscross pattern may be utilized to minimize trenching or during clean-up dredging operations to remove ridges and produce a more level channel bottom. This movement up and down the channel while dredging is called trailing and may be accomplished at speeds of 1-3 knots, depending on the shoaling, sediment characteristics, sea conditions, and numerous other factors. In the hopper, the slurry mixture of the sediment and water is managed by a weir system to settle out the dredged material solids and overflow the supernatant water. When an economic load is achieved, the vessel suspends dredging, the drag arms are raised, and the dredge travels to the designated placement site. Because dredging stops during the trip to the placement site, the overall efficiency of the hopper dredge is dependent on the distance between the dredging location and placement sites; the more distant to the placement site, the less efficient the dredging operation resulting in longer contract periods to accomplish the work.

3.15.2 Hydraulic Cutterhead Pipeline Dredges

The cutterhead dredge is essentially a barge hull with a moveable rotating cutter apparatus surrounding the intake of a suction pipe (Taylor, 1990). By combining the mechanical cutting action with the hydraulic suction, the hydraulic cutterhead has the capability of efficiently dredging a wide range of material, including clay, silt, sand, and gravel.

The largest hydraulic cutterhead dredges have 30 to 42 inch diameter pumps with 15,000 to 20,000 horsepower. The dredge used for this project is expected to have a pump and pipeline with approximately 30" diameter. These dredges are capable of pumping certain types of material through as much as 5-6 miles of pipeline, though up to 3 miles is more typical. The cutterhead pipeline plant employs spuds and anchors in a manner similar to floating mechanical dredges.

3.16 Interrelated or Interdependent Actions

Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR § 402.02; see also 1998 FWS-NMFS Joint Consultation Handbook, pp. 4-26 to 4-28). We have not identified any interrelated or interdependent actions.

3.17 Action Area

The action area is defined in 50 CFR § 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation includes the areas affected by dredging and disposal activities as well as the areas transited by dredges and dredged material disposal vessels. The action area, therefore, includes the entirety of the borrow areas and disposal areas noted above. The action area will also encompass the underwater area where dredging will result in increased suspended sediment. The size of the sediment plume will vary depending on the type of dredge used and is detailed below. The proposed action also includes work on the shoreline (e.g., recontouring the beach, extension of outfalls, construction of a bulkhead); the area affected by these activities is also included in the action area. Physical features of the borrow areas and the beaches were described above.

4.0 SPECIES THAT ARE NOT LIKELY TO BE ADVERSELY AFFECTED BY THE PROPOSED ACTION

4.1 North Atlantic right, humpback and fin whales

Individual North Atlantic right whales (*Eubalaena glacialis*) occur along the U.S. Atlantic coast. The species population size was estimated to be at least 444 individuals in 2009 based on a census of individual whales identified using photo-identification techniques (Waring *et al.* 2013). The population trend for right whales is increasing; the mean growth rate for the population from 1990-2009 was 2.6% (Waring *et al.* 2013). Six major habitats or congregation areas for western North Atlantic right whales exist: the coastal waters of the southeastern United States; the Great South Channel; Georges Bank/Gulf of Maine; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Scotian Shelf (Waring et al. 2013). Right whales demonstrate extensive movements between these habitats. New England waters are important feeding habitats for right whales. Right whales forage on extremely dense patches of zooplankton, primarily copepods *Calanus finmarchus* but also *Pseudocalanus* spp. and *Centropages* spp.; (Pace and Merrick 2008). Calving occurs in nearshore waters off the coast of Georgia and Florida between December and March.

The majority of 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. Right whales are present in the action area while migrating between these areas. A review of available sightings data indicates sightings of right whales in the action area year round (sightings records in all months except July). Due to the lack of concentrations of copepods in the action area, feeding by right whales is likely to be rare in the action area.

Certain U.S. waters were designated as critical habitat for Northern right whales[1] in 1994 (59 FR 28793). The Great South Channel critical habitat is the area bounded by 41º40′ N/69º45′ W; 41º00′ N/69º05′ W; 41º38′ W; and 42º10′ N/68º31′ W. The Cape Cod Bay critical habitat is the area bounded by 42º02.8′ N/70º10′ W; 42º12′ N/70º15′ W; 42º12′ N/70º30′ W; 41º46.8′ N/70º30′ W and on the south and east by the interior shore line of Cape Cod, Massachusetts.

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[1] In 2008, NMFS listed the endangered northern right whale (*Eubalaena spp.*) as two separate, endangered species: the North Pacific right whale (*E. japonica*) and North Atlantic right whale (*E. glacialis*) (*73 FR 12024*). We received a petition to revise the 1994 critical habitat designation in October 2009. In an October 2010 Federal Register notice, we announced that we intend to revise existing critical habitat by continuing our ongoing rulemaking process to designate critical habitat for North Atlantic right whales. To date, we have not published a proposed rule so the 1994 critical habitat designation is the only critical habitat for right whales in the Atlantic.

The Southeastern US critical habitat is the area 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 5 nautical miles. The action area does not overlap with any of the critical habitat areas.

Humpback whales (*Megaptera novaeangliae*) feed on herring, sand lance and other small fish, during the spring, summer, and fall over a range that encompasses the eastern coast of the United States. During the winter months, humpback whales mate and calve in the West Indies. Humpback whales in this area belong to the Gulf of Maine stock. The humpback whale population is thought to be steadily increasing and numbers over 11,000 individuals (Waring *et al.* 2013). Humpback whales are expected in the action area between April and November.

Fin whales (*Balaenoptera physalus*) occur in the action area. Fin whales feed on krill and other small schooling fish. The best abundance estimate available for the western North Atlantic fin whale stock is 3,985 (CV=0.24) (Waring *et al.* 2010). Fin whales are common in waters of the U. S., principally from Cape Hatteras northward, with New England waters representing a major feeding ground. Some calving is thought to take place between October and January in latitudes of the U.S. mid-Atlantic region (Hain et al. 1992); however, it is unknown where calving, mating, and wintering occurs for most of the population. Fin whales are migratory, moving seasonally into and out of high-latitude feeding areas, but the overall migration pattern is complex, and specific routes have not been documented. However, acoustic recordings from passive-listening hydrophone arrays indicate that a southward "flow pattern" occurs in the fall from the Labrador-Newfoundland region, past Bermuda, and into the West Indies (Clark 1995). Fin whales are thought to undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions (Waring et al. 2013). Fin wales are expected in the action area

Whales in the action area will be exposed to effects of the proposed actions including vessel traffic, increased turbidity/suspended sediment (which may affect prey), and potential removal of prey during dredging. All sand will be placed on beaches or in nearshore shallow areas adjacent to beaches. Whales do not occur in these areas; therefore, no whales will be exposed to effects of sand placement. We have determined that all effects of the proposed actions on right, humpback and fin whales will be insignificant and discountable[2]. Our supporting analysis is presented below. We do not anticipate any incidental take of right, fin or humpback whales from any of the activities considered in this Opinion.

Vessel Traffic

There have not been any reports of dredge vessels colliding with listed species but contact injuries resulting from dredge movements could occur at or near the water surface and could

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[2] The NMFS Consultation Handbook states that a “not likely to adversely affect” determination is “the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial….Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects 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” (page xv-xvi).

therefore involve any of the listed species present in the area. Because the dredge is unlikely to be moving at speeds greater than three knots during dredging operations, blunt trauma injuries resulting from contact with the hull are unlikely during dredging. It is more likely that contact injuries during actual dredging would involve the propeller of the vessel. Contact injuries with the dredge are more likely to occur when the dredge is moving from the dredging area to port, or between dredge locations. While the distance between these areas is relatively short (12 – 16 miles), the dredge in transit would be moving at faster speeds (9.8 – 10.8 mph) than during dredging operations (2 – 3 mph), particularly when empty while returning to the borrow area.

Large whales, particularly right whales, are vulnerable to injury and mortality from ship strikes. Ship strike injuries to whales take two forms: (1) propeller wounds characterized by external gashes or severed tail stocks; and (2) blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression (Laist *et al*. 2001). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. Laist *et al*. (2001) reports that of 41 ship strike accounts that reported vessel speed, no lethal or severe injuries occurred at speeds below ten knots, and no collisions have been reported for vessels traveling less than six knots. A majority of whale ship strikes seem to occur over or near the continental shelf, probably reflecting the concentration of vessel traffic and whales in these areas (Laist *et al*. 2001).

Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist *et al*. 2001). An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%. As noted above, the speed of the dredge is not expected to exceed 2.6 knots while dredging and 10 knots while transiting to and from the disposal sites. In addition, all vessels will have lookouts on board and operators will receive training on prudent vessel operating procedures to avoid vessel strikes with all protected species. All project related vessels will slow down or alter course if whales are sighted and no vessel will approach within 500 meters of a whale. With these measures in place, interactions between the dredge vessels and any listed whales are extremely unlikely. Therefore, the effects of vessel strike are discountable.

Exposure to Increased Turbidity

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the water, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

Resuspension of fine-grained dredged material during hopper dredging operations is caused by the dragheads as they are pulled through the sediment, turbulence generated by the vessel and its prop wash, and overflow of turbid water during hopper filling operations. During the filling operation, dredged material slurry is often pumped into the hoppers after they have been filled with slurry in order to maximize the amount of solid material in the hopper. The lower density turbid water at the surface of the filled hoppers overflows and is usually discharged through ports located near the waterline of the dredge. In the vicinity of hopper dredge operations, a near-bottom turbidity plume of resuspended bottom material may extend 2,300 to 2,400 ft down current from the dredge (USACE 1983). In the immediate vicinity of the dredge, a well-defined upper plume is generated by the overflow process. Approximately 1,000 ft behind the dredge, the two plumes merge into a single plume (USACE 1983). Suspended solid concentrations may be as high as several tens of parts per thousand (ppt; grams per liter) near the discharge port and as high as a few parts per thousand near the draghead. In a study done by Anchor Environmental (2003), nearfield concentrations ranged from 80.0-475.0 mg/l. Turbidity levels in the near-surface plume appear to decrease exponentially with increasing distance from the dredge due to settling and dispersion, quickly reaching concentrations less than 1 ppt. By a distance of 4,000 feet from the dredge, plume concentrations are expected to return to background levels (USACE 1983). Studies also indicate that in almost all cases, the vast majority of resuspended sediments resettle close to the dredge within one hour, and only a small fraction takes longer to resettle (Anchor Environmental 2003).

Total suspended sediment (TSS) is most likely to affect whales if a plume causes a barrier to normal behaviors or if elevated levels of suspended sediment affects prey. As whales are highly mobile, individuals are likely to be able to avoid any sediment plume that is present and any effect on their movements or behavior is likely to be insignificant. In addition, the total suspended sediment levels expected (80 – 475 mg/L) are below those shown to have an adverse effect on fish (580.0 mg/L for the most sensitive species, with 1,000.0 mg/L more typical (Breitburg 1988 in Burton 1993; Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993)). The whales that may be present in the action area feed on krill and small schooling fish. No impacts to these forage fish are likely to result from exposure to increased suspended sediment during dredging operations. Given this information, effects to whales from increased turbidity is extremely unlikely; effects to listed whales will be discountable.

Based on the analysis presented above, all effects to right, humpback and fin whales will be insignificant or discountable. Therefore, the proposed actions are not likely to adversely affect these species. No incidental take of right, humpback or fin whales is anticipated.

4.2 Leatherback sea turtles

Leatherback sea turtles are widely distributed throughout the oceans of the world, including the Atlantic, Pacific, and Indian Oceans, and the Mediterranean Sea (Ernst and Barbour 1972). The species is listed as endangered throughout its range. In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982). By 1995, this global population of adult females was estimated to have declined to 34,500 (Spotila *et al.* 1996). The most recent population size estimate for the North Atlantic alone is a range of 34,000-94,000 adult leatherbacks (TEWG 2007).

Three critical habitat areas have been designated for leatherbacks including areas along the U.S. West Coast (77 FR 4170, January 2012) and St. Croix, U.S. Virgin Islands (44 FR 17710, March 1979). There is no leatherback critical habitat in the action area.

Adult leatherback sea turtles engage in routine migrations between northern temperate and tropical waters (NMFS and USFWS 1992). Leatherbacks are frequently thought of as a pelagic species that feed on jellyfish (*e.g.*, *Stomolophus, Chryaora*, and *Aurelia* species) and tunicates (*e.g.*, salps, pyrosomas) (Rebel 1974; Davenport and Balazs 1991). However, leatherbacks are also known to use coastal waters of the U.S. continental shelf (James *et al.* 2005a; Eckert *et al.* 2006; Murphy *et al.* 2006), as well as the European continental shelf on a seasonal basis (Witt *et al.* 2007). The CETAP aerial survey of the outer Continental Shelf from Cape Hatteras, North Carolina to Cape Sable, Nova Scotia conducted between 1978 and 1982 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 water depths ranging from 1 to 4,151 m, but 84.4% of sightings were in waters less than 180 m (Shoop and Kenney 1992). Leatherbacks were sighted in waters within a sea surface temperature range similar to that observed for loggerheads; from 7°-27.2°C (Shoop and Kenney 1992). However, leatherbacks appear to have a greater tolerance for colder waters in comparison to loggerhead sea turtles since more leatherbacks were found at the lower temperatures (Shoop and Kenney 1992). Studies of satellite tagged leatherbacks suggest that they spend 10%-41% of their time at the surface, depending on the phase of their migratory cycle (James *et al.* 2005b). The greatest amount of surface time (up to 41%) was recorded when leatherbacks occurred in continental shelf and slope waters north of 38°N (James *et al.* 2005b).

Leatherbacks are present in the action area between April and November as they migrate to and from southern tropical waters. If suitable forage is present, foraging is expected to occur. Nesting occurs outside of the action area and the presence of leatherbacks in the action area is limited to large juveniles and adults.

Leatherback sea turtles in the action area will be exposed to effects of the proposed actions including vessel traffic, increased turbidity/suspended sediment (which may affect prey), and potential removal of prey during dredging. Leatherbacks in the action area are too large to be vulnerable to impingement or entrainment in a dredge. There are no reports of any impingement or entrainment of leatherback sea turtles in any dredging projects along the U.S. Atlantic coast. All sand will be placed on beaches or in nearshore shallow areas adjacent to beaches. Leatherbacks do not occur in these areas; therefore, no leatherbacks will be exposed to effects of sand placement. We have determined that all effects of the proposed actions on leatherback sea turtles will be insignificant and discountable. Our supporting analysis is presented below. We do not anticipate any incidental take of any leatherback sea turtles from any of the activities considered in this Opinion.

Vessel Traffic

Sea turtles have been documented with injuries consistent with vessel interactions. It is reasonable to believe that the dredge vessels considered in this Opinion could inflict such injuries on sea turtles, should they collide. As mentioned, sea turtles are found distributed throughout the action area in the warmer months, generally from May through mid-November.

Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9% of living and dead stranded sea turtles had propeller or other boat strike injuries (Lutcavage et al. 1997). According to 2001 STSSN stranding data, at least 33 sea turtles (loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the northeast (Maine through North Carolina) were struck by a boat. This number underestimates the actual number of boat strikes that occur since not every boat struck turtle will strand, every stranded turtle will not be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem (NMFS SEFSC 2001).

Information is lacking on the type or speed of vessels involved in turtle vessel strikes. However, there does appear to be a correlation between the number of vessel struck turtles and the level of recreational boat traffic (NRC 1990). Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. The speed of the dredge is not expected to exceed 3 knots while dredging or while transiting to the pump out site with a full load and it is expected to operate at a maximum speed of 10 knots while empty. In addition, the risk of ship strike will be influenced by the amount of time the animal remains near the surface of the water. For the proposed action, the greatest risk of vessel collision will occur during transit between shore and the areas to be dredged. The presence of a lookout who can advise the vessel operator to slow the vessel or maneuver safely when sea turtles are spotted will further reduce the potential risk for interaction with vessels. The slow moving vessels in the action area will have an insignificant effect on the risk of interactions between sea turtles and vessels in the action area.

Exposure to Increased Turbidity

Total suspended sediment (TSS) is most likely to affect sea turtles if a plume causes a barrier to normal behaviors or if elevated levels of suspended sediment affects prey. As sea turtles are highly mobile, individuals are likely to be able to avoid any sediment plume that is present and any effect on their movements or behavior is likely to be insignificant. Leatherbacks feed on jellyfish. We are not aware of any studies examining the impacts of turbidity or suspended sediment on jellyfish. However, given that the total suspended sediment levels expected (80 – 475 mg/L) are below those shown to have an adverse effect on fish (580.0 mg/L for the most sensitive species, with 1,000.0 mg/L more typical (Breitburg 1988 in Burton 1993; Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993) we expect any effects to jellyfish to be insignificant. Based on this, effects to leatherbacks from increased turbidity is extremely unlikely; effects to listed whales will be discountable.

Based on the analysis presented above, all effects to leatherback sea turtles will be insignificant or discountable. Therefore, the proposed actions are not likely to adversely affect this species. No incidental take of leatherback sea turtles is anticipated.

5.0 STATUS OF LISTED SPECIES IN THE ACTION AREA THAT MAY BE AFFECTED BY THE PROPOSED ACTIONS

Several species listed under NMFS' jurisdiction occur in the action area for this consultation. NMFS has determined that the action being considered in this biological opinion may affect the following endangered or threatened species under NMFS' jurisdiction:

Sea Turtles

Northwest Atlantic DPS of Loggerhead sea turtle (*Caretta caretta*)	Threatened
Kemp's ridley sea turtle (*Lepidochelys kempi*)	Endangered
Green sea turtle (*Chelonia mydas*)	Endangered/Threatened[3]

Fish

Gulf of Maine DPS of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)	Threatened
New York Bight DPS of Atlantic sturgeon	Endangered
Chesapeake Bay DPS of Atlantic sturgeon	Endangered
South Atlantic DPS of Atlantic sturgeon	Endangered
Carolina DPS of Atlantic sturgeon	Endangered

This section will focus on the status of the various species within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action.

5.1 Overview of Status of Sea Turtles

With the exception of loggerheads, sea turtles are listed under the ESA at the species level rather than as subspecies or distinct population segments (DPS). Therefore, information on the range-wide status of Kemp's ridley and green sea turtles is included to provide the status of each species overall. Information on the status of loggerheads will only be presented for the DPS affected by this action. Additional background information on the range-wide status of these species can be found in a number of published documents, including sea turtle status reviews and biological reports (NMFS and USFWS 1995; Hirth 1997; Marine Turtle Expert Working Group [TEWG] 1998, 2000, 2007, 2009; NMFS and USFWS 2007a, 2007b, 2007c, 2007d; Conant *et al.* 2009), and recovery plans for the loggerhead sea turtle (NMFS and USFWS 2008), Kemp's ridley sea turtle (NMFS *et al.* 2011), Kemp's ridley sea turtle (NMFS *et al.* 2011) and green sea turtle (NMFS and USFWS 1991, 1998b).

2010 BP Deepwater Horizon Oil Spill

The April 20, 2010, explosion of the Deepwater Horizon oil rig affected sea turtles in the Gulf of Mexico. There is an on-going assessment of the long-term effects of the spill on Gulf of Mexico marine life, including sea turtle populations. Following the spill, juvenile Kemp's ridley, green, and loggerhead sea turtles were found in *Sargassum* algae mats in the convergence zones, where currents meet and oil collected. Sea turtles found in these areas were often coated in oil and/or had ingested oil. Approximately 536 live adult and juvenile sea turtles were recovered from the Gulf and brought into rehabilitation centers; of these, 456 were visibly oiled (these and the

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[3] Pursuant to NMFS regulations at 50 CFR § 223.205, the prohibitions of Section 9 of the Endangered Species Act apply to all green turtles, whether endangered or threatened.

following numbers were obtained from http://www.nmfs.noaa.gov/pr/health/oilspill/). To date, 469 of the live recovered sea turtles have been successfully returned to the wild, 25 died during rehabilitation, and 42 are still in care but will hopefully be returned to the wild eventually. During the clean-up period, 613 dead sea turtles were recovered in coastal waters or on beaches in Mississippi, Alabama, Louisiana, and the Florida Panhandle. As of February 2011, 478 of these dead turtles had been examined. Many of the examined sea turtles showed indications that they had died as a result of interactions with trawl gear, most likely used in the shrimp fishery, and not as a result of exposure to or ingestion of oil.

During the spring and summer of 2010, nearly 300 sea turtle nests were relocated from the northern Gulf to the east coast of Florida with the goal of preventing hatchlings from entering the oiled waters of the northern Gulf. From these relocated nests, 14,676 sea turtles, including 14,235 loggerheads, 125 Kemp's ridleys, and 316 greens, were ultimately released from Florida beaches.

A thorough assessment of the long-term effects of the spill on sea turtles has not yet been completed. However, the spill resulted in the direct mortality of many sea turtles and may have had sublethal effects or caused environmental damage that will impact other sea turtles into the future. The population level effects of the spill and associated response activity are likely to remain unknown for some period into the future.

5.2 Northwest Atlantic DPS of loggerhead sea turtle

The loggerhead is the most abundant species of sea turtle in U.S. waters. Loggerhead sea turtles are found in temperate and subtropical waters and occupy a range of habitats including offshore waters, continental shelves, bays, estuaries, and lagoons. They are also exposed to a variety of natural and anthropogenic threats in the terrestrial and marine environment.

Listing History

Loggerhead sea turtles were listed as threatened throughout their global range on July 28, 1978. Since that time, several status reviews have been conducted to review the status of the species and make recommendations regarding its ESA listing status. Based on a 2007, 5-year status review of the species, which discussed a variety of threats to loggerheads including climate change, NMFS and FWS determined that loggerhead sea turtles should not be delisted or reclassified as endangered. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified for the loggerhead (NMFS and USFWS 2007a). Genetic differences exist between loggerhead sea turtles that nest and forage in the different ocean basins (Bowen 2003; Bowen and Karl 2007). Differences in the maternally inherited mitochondrial DNA also exist between loggerhead nesting groups that occur within the same ocean basin (TEWG 2000; Pearce 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007; TEWG 2009; NMFS and USFWS 2008). Site fidelity of females to one or more nesting beaches in an area is believed to account for these genetic differences (TEWG 2000; Bowen 2003).

In part to evaluate those genetic differences, in 2008, NMFS and FWS established a Loggerhead Biological Review Team (BRT) to assess the global loggerhead population structure to determine whether DPSs exist and, if so, the status of each DPS. The BRT evaluated genetic data, tagging and telemetry data, demographic information, oceanographic features, and geographic barriers to determine whether population segments exist. The BRT report was completed in August 2009 (Conant *et al.* 2009). In this report, the BRT identified the following nine DPSs as being discrete from other conspecific population segments and significant to the species: (1) North Pacific Ocean, (2) South Pacific Ocean, (3) North Indian Ocean, (4) Southeast Indo-Pacific Ocean, (5) Southwest Indian Ocean, (6) Northwest Atlantic Ocean, (7) Northeast Atlantic Ocean, (8) Mediterranean Sea, and (9) South Atlantic Ocean.

The BRT concluded that although some DPSs are indicating increasing trends at nesting beaches (Southwest Indian Ocean and South Atlantic Ocean), available information about anthropogenic threats to juveniles and adults in neritic and oceanic environments indicate possible unsustainable additional mortalities. According to an analysis using expert opinion in a matrix model framework, the BRT report stated that all loggerhead DPSs have the potential to decline in the foreseeable future. Based on the threat matrix analysis, the potential for future decline was reported as greatest for the North Indian Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, Mediterranean Sea, and South Atlantic Ocean DPSs (Conant *et al.* 2009). The BRT concluded that the North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Southeast Indo-Pacific Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, and Mediterranean Sea DPSs were at risk of extinction. The BRT concluded that although the Southwest Indian Ocean and South Atlantic Ocean DPSs were likely not currently at immediate risk of extinction, the extinction risk was likely to increase in the foreseeable future.

On March 16, 2010, NMFS and USFWS published a proposed rule (75 FR 12598) to divide the worldwide population of loggerhead sea turtles into nine DPSs, as described in the 2009 Status Review. Two of the DPSs were proposed to be listed as threatened and seven of the DPSs, including the Northwest Atlantic Ocean DPS, were proposed to be listed as endangered. NMFS and the USFWS accepted comments on the proposed rule through September 13, 2010 (75 FR 30769, June 2, 2010). On March 22, 2011 (76 FR 15932), NMFS and USFWS extended the date by which a final determination would be made and solicited new information and analysis. This action was taken to address the interpretation of the existing data on status and trends and its relevance to the assessment of risk of extinction for the Northwest Atlantic Ocean DPS, as well as the magnitude and immediacy of the fisheries bycatch threat and measures to reduce this threat.

On September 22, 2011, NMFS and USFWS issued a final rule (76 FR 58868), determining that the loggerhead sea turtle is composed of nine DPSs (as defined in Conant *et al*., 2009) that constitute species that may be listed as threatened or endangered under the ESA. Five DPSs were listed as endangered (North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Northeast Atlantic Ocean, and Mediterranean Sea), and four DPSs were listed as threatened (Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean). Note that the Northwest Atlantic Ocean (NWA) DPS and the Southeast Indo-Pacific Ocean DPS were originally proposed as endangered. The NWA DPS was determined to be threatened based on review of nesting data available after the proposed rule was published, information provided in public comments on the proposed rule, and further discussions within the agencies. The two primary factors considered were population abundance and population trend. NMFS and USFWS found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats. This final listing rule became effective on October 24, 2011.

The September 2011 final rule also noted that critical habitat for the two DPSs occurring within the U.S. (NWA DPS and North Pacific DPS) will be designated in a future rulemaking. Information from the public related to the identification of critical habitat, essential physical or biological features for this species, and other relevant impacts of a critical habitat designation was solicited. Currently, no critical habitat is designated for any DPS of loggerhead sea turtles, and therefore, no critical habitat for any DPS occurs in the action area.

Presence of Loggerhead Sea Turtles in the Action Areas

The effects of these proposed actions are only experienced within the Atlantic Ocean. NMFS has considered the available information on the distribution of the 9 DPSs to determine the origin of any loggerhead sea turtles that may occur in the action areas. As noted in Conant *et al.* (2009), the range of the four DPSs occurring in the Atlantic Ocean are as follows: NWA DPS – north of the equator, south of 60° N latitude, and west of 40° W longitude; Northeast Atlantic Ocean (NEA) DPS – north of the equator, south of 60° N latitude, east of 40° W longitude, and west of 5° 36' W longitude; South Atlantic DPS – south of the equator, north of 60° S latitude, west of 20° E longitude, and east of 60° W longitude; Mediterranean DPS – the Mediterranean Sea east of 5° 36' W longitude. These boundaries were determined based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. While adults are highly structured with no overlap, there may be some degree of overlap by juveniles of the NWA, NEA, and Mediterranean DPSs on oceanic foraging grounds (Laurent *et al.* 1993, 1998; Bolten *et al.* 1998; LaCasella *et al.* 2005; Carreras *et al.* 2006, Monzón-Argüello *et al.* 2006; Revelles *et al.* 2007). Previous literature (Bowen *et al.* 2004) has suggested that there is the potential, albeit small, for some juveniles from the Mediterranean DPS to be present in U.S. Atlantic coastal foraging grounds. These conclusions must be interpreted with caution however, as they may be representing a shared common haplotype and lack of representative sampling at Eastern Atlantic rookeries rather than an actual presence of Mediterranean DPS turtles in US Atlantic coastal waters. A re-analysis of the data by the Atlantic loggerhead Turtle Expert Working Group has found that it is unlikely that U.S. fishing fleets are interacting with either the Northeast Atlantic loggerhead DPS or the Mediterranean loggerhead DPS (Peter Dutton, NMFS, Marine Turtle Genetics Program, Program Leader, personal communication, September 10, 2011). Given that the action area is a subset of the area fished by US fleets, it is reasonable to assume that based on this new analysis, no individuals from the Mediterranean DPS or Northeast Atlantic DPS would be present in the action area. Sea turtles of the South Atlantic DPS do not inhabit the action area of this consultation (Conant *et al.* 2009). As such, the remainder of this consultation will only focus on the NWA DPS, listed as threatened.

Distribution and Life History

Ehrhart *et al.* (2003) provided a summary of the literature identifying known nesting habitats and foraging areas for loggerheads within the Atlantic Ocean. Detailed information is also provided in the 5-year status review for loggerheads (NMFS and USFWS 2007a), the TEWG report (2009), and the final revised recovery plan for loggerheads in the Northwest Atlantic Ocean

(NMFS and USFWS 2008).

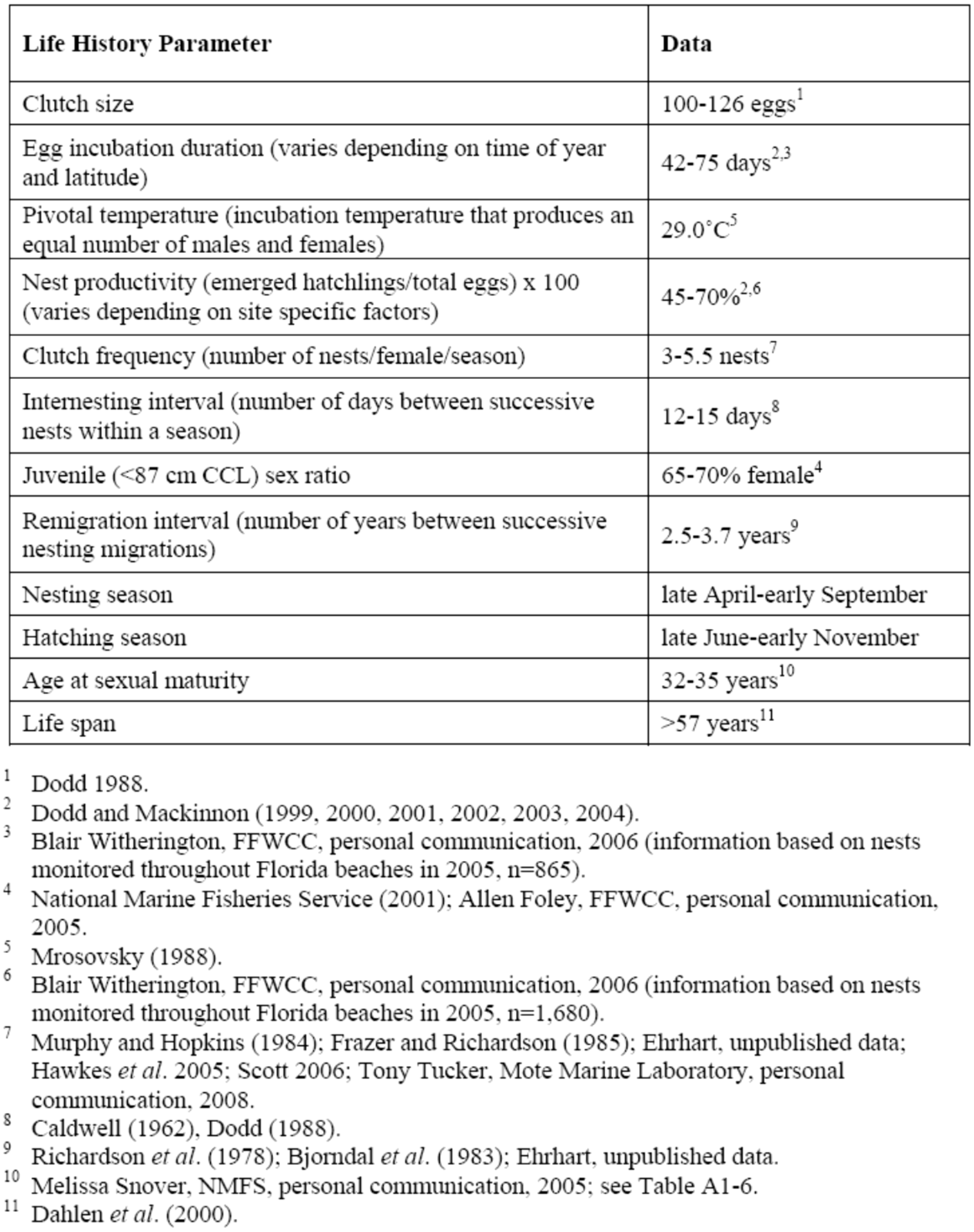
In the western Atlantic, waters as far north as 41° N to 42° N latitude are used for foraging by juveniles, as well as adults (Shoop 1987; Shoop and Kenney 1992; Ehrhart *et al.* 2003; Mitchell *et al.* 2003). In U.S. Atlantic waters, loggerheads commonly occur throughout the inner continental shelf from Florida to Cape Cod, Massachusetts and in the Gulf of Mexico from Florida to Texas, although their presence varies with the seasons due to changes in water temperature (Shoop and Kenney 1992; Epperly *et al.* 1995a, 1995b; Braun and Epperly 1996; Braun-McNeill *et al.* 2008; Mitchell *et al.* 2003). Loggerheads have been observed in waters with surface temperatures of 7°C to 30°C, but water temperatures ≥11°C are most favorable (Shoop and Kenney 1992; Epperly *et al.* 1995b). The presence of loggerhead sea turtles in U.S. Atlantic waters is also influenced by water depth. Aerial surveys of continental shelf waters north of Cape Hatteras, North Carolina indicated that loggerhead sea turtles were most commonly sighted in waters with bottom depths ranging from 22 m to 49 m deep (Shoop and Kenney 1992). However, more recent survey and satellite tracking data support that they occur in waters from the beach to beyond the continental shelf (Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; Mansfield 2006; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007; Mansfield et al. 2009).

Loggerhead sea turtles occur year round in ocean waters off North Carolina, South Carolina, Georgia, and Florida. In these areas of the South Atlantic Bight, water temperature is influenced by the proximity of the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to migrate to inshore waters of the Southeast United States (*e.g.*, Pamlico and Core Sounds) and also move up the U.S. Atlantic coast (Epperly *et al.* 1995a, 1995b, 1995c; Braun-McNeill and Epperly 2004), occurring in Virginia foraging areas as early as April/May and on the most northern foraging grounds in the Gulf of Maine in June (Shoop and Kenney 1992). The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some turtles may remain in Mid-Atlantic and Northeast areas until late fall. By December, loggerheads have migrated from inshore and more northern coastal waters to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Shoop and Kenney 1992; Epperly *et al.* 1995b).

Recent studies have established that the loggerhead's life history is more complex than previously believed. Rather than making discrete developmental shifts from oceanic to neritic environments, research is showing that both adults and (presumed) neritic stage juveniles continue to use the oceanic environment and will move back and forth between the two habitats (Witzell 2002; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007; Mansfield *et al.* 2009). One of the studies tracked the movements of adult post-nesting females and found that differences in habitat use were related to body size with larger adults staying in coastal waters and smaller adults traveling to oceanic waters (Hawkes *et al.* 2006). A tracking study of large juveniles found that the habitat preferences of this life stage were also diverse with some remaining in neritic waters and others moving off into oceanic waters (McClellan and Read 2007). However, unlike the Hawkes *et al.* (2006) study, there was no significant difference in the body size of turtles that remained in neritic waters versus oceanic waters (McClellan and Read 2007).

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988; NMFS and USFWS 2008). 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 (NMFS and USFWS 2008).

As presented below, Table 3 from the 2008 loggerhead recovery plan (Table 4 in this Opinion) highlights the key life history parameters for loggerheads nesting in the United States.



Life History Parameter	**Data**
Clutch size	100-126 eggs[1]
Egg incubation duration (varies depending on time of year and latitude)	42-75 days[2,3]
Pivotal temperature (incubation temperature that produces an equal number of males and females)	29.0°C[5]
Nest productivity (emerged hatchlings/total eggs) x 100 (varies depending on site specific factors)	45-70%[2,6]
Clutch frequency (number of nests/female/season)	3-5.5 nests[7]
Internesting interval (number of days between successive nests within a season)	12-15 days[8]
Juvenile (<87 cm CCL) sex ratio	65-70% female[4]
Remigration interval (number of years between successive nesting migrations)	2.5-3.7 years[9]
Nesting season	late April-early September
Hatching season	late June-early November
Age at sexual maturity	32-35 years[10]
Life span	>57 years[11]

[1] Dodd 1988.

[2] Dodd and Mackinnon (1999, 2000, 2001, 2002, 2003, 2004).

[3] Blair Witherington, FFWCC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=865).

[4] National Marine Fisheries Service (2001); Allen Foley, FFWCC, personal communication, 2005.

[5] Mrosovsky (1988).

[6] Blair Witherington, FFWCC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=1,680).

[7] Murphy and Hopkins (1984); Frazer and Richardson (1985); Ehrhart, unpublished data; Hawkes *et al*. 2005; Scott 2006; Tony Tucker, Mote Marine Laboratory, personal communication, 2008.

[8] Caldwell (1962), Dodd (1988).

[9] Richardson *et al*. (1978); Bjorndal *et al*. (1983); Ehrhart, unpublished data.

[10] Melissa Snover, NMFS, personal communication, 2005; see Table A1-6.

[11] Dahlen *et al*. (2000).

Table 4. Life History Characteristics of Loggerhead Sea Turtles (Reprinted from NMFS

and USFWS 2008)

Population Dynamics and Status

By far, the majority of Atlantic nesting occurs on beaches of the southeastern United States (NMFS and USFWS 2007a). For the past decade or so, the scientific literature has recognized five distinct nesting groups, or subpopulations, of loggerhead sea turtles in the Northwest Atlantic, divided geographically as follows: (1) a northern group of nesting females that nest from North Carolina to northeast Florida at about 29° N latitude; (2) a south Florida group of nesting females that nest from 29° N latitude on the east coast to Sarasota on the west coast; (3) a Florida Panhandle group of nesting females that nest around Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán group of nesting females that nest on beaches of the eastern Yucatán Peninsula, Mexico; and (5) a Dry Tortugas group that nests on beaches of the islands of the Dry Tortugas, near Key West, Florida and on Cal Sal Bank (TEWG 2009). Genetic analyses of mitochondrial DNA, which a sea turtle inherits from its mother, indicate that there are genetic differences between loggerheads that nest at and originate from the beaches used by each of the five identified nesting groups of females (TEWG 2009). However, analyses of microsatellite loci from nuclear DNA, which represents the genetic contribution from both parents, indicates little to no genetic differences between loggerheads originating from nesting beaches of the five Northwest Atlantic nesting groups (Pearce and Bowen 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007). These results suggest that female loggerheads have site fidelity to nesting beaches within a particular area, while males provide an avenue of gene flow between nesting groups by mating with females that originate from different nesting groups (Bowen 2003; Bowen *et al.* 2005). The extent of such gene flow, however, is unclear (Shamblin 2007).

The lack of genetic structure makes it difficult to designate specific boundaries for the nesting subpopulations based on genetic differences alone. Therefore, the Loggerhead Recovery Team recently used a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to reassess the designation of these subpopulations to identify recovery units in the 2008 recovery plan.

In the 2008 recovery plan, the Loggerhead Recovery Team designated five recovery units for the Northwest Atlantic population of loggerhead sea turtles based on the aforementioned nesting groups and inclusive of a few other nesting areas not mentioned above. The first four of these recovery units represent nesting assemblages located in the Southeast United States. The fifth recovery unit is composed of all other nesting assemblages of loggerheads within the Greater Caribbean, outside the United States, but which occur within U.S. waters during some portion of their lives. The five recovery units representing nesting assemblages are: (1) the Northern Recovery Unit (NRU: Florida/Georgia border through southern Virginia), (2) the Peninsular Florida Recovery Unit (PFRU: Florida/Georgia border through Pinellas County, Florida), (3) the Dry Tortugas Recovery Unit (DTRU: islands located west of Key West, Florida), (4) the Northern Gulf of Mexico Recovery Unit (NGMRU: Franklin County, Florida through Texas), and (5) the Greater Caribbean Recovery Unit (GCRU: Mexico through French Guiana, Bahamas, Lesser Antilles, and Greater Antilles).

The Recovery Team evaluated the status and trends of the Northwest Atlantic loggerhead population for each of the five recovery units, using nesting data available as of October 2008 (NMFS and USFWS 2008). The level and consistency of nesting coverage varies among recovery units, with coverage in Florida generally being the most consistent and thorough over time. Since 1989, nest count surveys in Florida have occurred in the form of statewide surveys (a near complete census of entire Florida nesting) and index beach surveys (Witherington *et al.* 2009). Index beaches were established to standardize data collection methods and maintain a constant level of effort on key nesting beaches over time.

NMFS and USFWS (2008), Witherington *et al*. (2009), and TEWG (2009) analyzed the status of the nesting assemblages within the NWA DPS using standardized data collected over periods ranging from 10-23 years. These analyses used different analytical approaches, but found the same finding that there had been a significant, overall nesting decline within the NWA DPS. However, with the addition of nesting data from 2008-2010, the trend line changes showing a very slight negative trend, but the rate of decline is not statistically different from zero (76 FR 58868, September 22, 2011). The nesting data presented in the Recovery Plan (through 2008) is described below, with updated trend information through 2010 for two recovery units.

From the beginning of standardized index surveys in 1989 until 1998, the PFRU, the largest nesting assemblage in the Northwest Atlantic by an order of magnitude, had a significant increase in the number of nests. However, from 1998 through 2008, there was a 41% decrease in annual nest counts from index beaches, which represent an average of 70% of the statewide nesting activity (NMFS and USFWS 2008). From 1989-2008, the PFRU had an overall declining nesting trend of 26% (95% CI: -42% to -5%; NMFS and USFWS 2008). With the addition of nesting data through 2010, the nesting trend for the PFRU does not show a nesting decline statistically different from zero (76 FR 58868, September 22, 2011).

The NRU, the second largest nesting assemblage of loggerheads in the United States, has been declining at a rate of 1.3% annually since 1983 (NMFS and USFWS 2008). The NRU dataset included 11 beaches with an uninterrupted time series of coverage of at least 20 years; these beaches represent approximately 27% of NRU nesting (in 2008). Through 2008, there was strong statistical data to suggest the NRU has experienced a long-term decline, but with the inclusion of nesting data through 2010, nesting for the NRU is showing possible signs of stabilizing (76 FR 58868, September 22, 2011).

Evaluation of long-term nesting trends for the NGMRU is difficult because of changed and expanded beach coverage. However, the NGMRU has shown a significant declining trend of 4.7% annually since index nesting beach surveys were initiated in 1997 (NMFS and USFWS 2008). The trend was analyzed using nesting data available as of October 2008.

No statistical trends in nesting abundance can be determined for the DTRU because of the lack of long-term data. Similarly, statistically valid analyses of long-term nesting trends for the entire GCRU are not available because there are few long-term standardized nesting surveys representative of the region. Additionally, changing survey effort at monitored beaches and scattered and low-level nesting by loggerheads at many locations currently precludes comprehensive analyses (NMFS and USFWS 2008).

Sea turtle census nesting surveys are important in that they provide information on the relative abundance of nesting each year, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The 2008 recovery plan compiled information on mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (*i.e.*, nesting groups). They are: (1) for the NRU, a mean of 5,215 loggerhead nests per year (from 1989-2008) with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year (from 1989-2007) with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year (from 1995-2004, excluding 2002) with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year (from 1995-2007) with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit. Note that the above values for average nesting females per year were based upon 4.1 nests per female per Murphy and Hopkins (1984).

Genetic studies of juvenile and a few adult loggerhead sea turtles collected from Northwest Atlantic foraging areas (beach strandings, a power plant in Florida, and North Carolina fisheries) show that the loggerheads that occupy East Coast U.S. waters originate from these Northwest Atlantic nesting groups; primarily from the nearby nesting beaches of southern Florida, as well as the northern Florida to North Carolina beaches, and finally from the beaches of the Yucatán Peninsula, Mexico (Rankin-Baransky *et al.* 2001; Witzell *et al.* 2002; Bass *et al.* 2004; Bowen *et al.* 2004). The contribution of these three nesting assemblages varies somewhat among the foraging habitats and age classes surveyed along the east coast. The distribution is not random and bears a significant relationship to the proximity and size of adjacent nesting colonies (Bowen *et al.* 2004). Bass *et al.* (2004) attribute the variety in the proportions of sea turtles from loggerhead turtle nesting assemblages documented in different east coast foraging habitats to a complex interplay of currents and the relative size and proximity of nesting beaches.

Unlike nesting surveys, in-water studies of sea turtles typically sample both sexes and multiple age classes. In-water studies have been conducted in some areas of the Northwest Atlantic and provide data by which to assess the relative abundance of loggerhead sea turtles and changes in abundance over time (Maier *et al.* 2004; Morreale *et al.* 2005; Mansfield 2006; Ehrhart *et al.* 2007; Epperly *et al.* 2007). The TEWG (2009) used raw data from six in-water study sites to conduct trend analyses. They identified an increasing trend in the abundance of loggerheads from three of the four sites located in the Southeast United States, one site showed no discernible trend, and the two sites located in the northeast United States showed a decreasing trend in abundance of loggerheads. The 2008 loggerhead recovery plan also includes a full discussion of in-water population studies for which trend data have been reported, and a brief summary will be provided here.

Maier *et al.* (2004) used fishery-independent trawl data to establish a regional index of loggerhead abundance for the southeast coast of the United States. (Winyah Bay, South Carolina to St. Augustine, Florida) during the period 2000-2003. A comparison of loggerhead catch data from this study with historical values suggested that in-water populations of loggerhead sea turtles along the southeast U.S. coast appear to be larger, possibly an order of magnitude higher than they were 25 years ago, but the authors caution a direct comparison between the two studies given differences in sampling methodology (Maier *et al.* 2004). A comparison of catch rates for sea turtles in pound net gear fished in the Pamlico-Albemarle Estuarine Complex of North Carolina between the years 1995-1997 and 2001-2003 found a significant increase in catch rates for loggerhead sea turtles for the latter period (Epperly *et al.* 2007). A long-term, on-going study of loggerhead abundance in the Indian River Lagoon System of Florida found a significant increase in the relative abundance of loggerheads over the last 4 years of the study (Ehrhart *et al.* 2007). However, there was no discernible trend in loggerhead abundance during the 24-year time period of the study (1982-2006) (Ehrhart *et al.* 2007). At St. Lucie Power Plant, data collected from 1977-2004 show an increasing trend of loggerheads at the power plant intake structures (FPL and Quantum Resources 2005).

In contrast to these studies, Morreale *et al.* (2005) observed a decline in the percentage and relative numbers of loggerhead sea turtles incidentally captured in pound net gear fished around Long Island, New York during the period 2002-2004 in comparison to the period 1987-1992, with only two loggerheads (of a total 54 turtles) observed captured in pound net gear during the period 2002-2004. This is in contrast to the previous decade's study where numbers of individual loggerheads ranged from 11 to 28 per year (Morreale *et al.* 2005). No additional loggerheads were reported captured in pound net gear in New York through 2007, although two were found cold-stunned on Long Island bay beaches in the fall of 2007 (Memo to the File, L. Lankshear, December 2007). Potential explanations for this decline include major shifts in loggerhead foraging areas and/or increased mortality in pelagic or early benthic stage/age classes (Morreale *et al.* 2005). Using aerial surveys, Mansfield (2006) also found a decline in the densities of loggerhead sea turtles in Chesapeake Bay over the period 2001-2004 compared to aerial survey data collected in the 1980s. Significantly fewer loggerheads ($p<0.05$) were observed in both the spring (May-June) and the summer (July-August) of 2001-2004 compared to those observed during aerial surveys in the 1980s (Mansfield 2006). A comparison of median densities from the 1980s to the 2000s suggested that there had been a 63.2% reduction in densities during the spring residency period and a 74.9% reduction in densities during the summer residency period (Mansfield 2006). The decline in observed loggerhead populations in Chesapeake Bay may be related to a significant decline in prey, namely horseshoe crabs and blue crabs, with loggerheads redistributing outside of Bay waters (NMFS and USFWS 2008).

As with other turtle species, population estimates for loggerhead sea turtles are difficult to determine. This is largely because of loggerheads' life history characteristics. However, a recent loggerhead assessment using a demographic matrix model estimated that the loggerhead adult female population in the western North Atlantic ranges from 16,847 to 89,649, with a median size of 30,050 (NMFS SEFSC 2009). The model results for population trajectory suggest that the population is most likely declining, but this result was very sensitive to the choice of the position of the parameters within their range and hypothesized distributions. The pelagic stage survival parameter had the largest effect on the model results. As a result of the large uncertainty in our knowledge of loggerhead life history, at this point predicting the future populations or population trajectories of loggerhead sea turtles with precision is very uncertain.

It should also be noted that additional analyses are underway which will incorporate any newly available information.

As part of the Atlantic Marine Assessment Program for Protected Species (AMAPPS), line transect aerial abundance surveys and turtle telemetry studies were conducted along the Atlantic coast in the summer of 2010. AMAPPS is a multi-agency initiative to assess marine mammal, sea turtle, and seabird abundance and distribution in the Atlantic. Aerial surveys were conducted from Cape Canaveral, Florida to the Gulf of St. Lawrence, Canada. Satellite tags on juvenile loggerheads were deployed in two locations – off the coasts of northern Florida to South Carolina (n=30) and off the New Jersey and Delaware coasts (n=14). As presented in NMFS NEFSC (2011), the 2010 survey found a preliminary total surface abundance estimate within the entire study area of about 60,000 loggerheads (CV=0.13) or 85,000 if a portion of unidentified hard-shelled sea turtles were included (CV=0.10). Surfacing times were generated from the satellite tag data collected during the aerial survey period, resulting in a 7% (5%-11% inter-quartile range) median surface time in the South Atlantic area and a 67% (57%-77% inter-quartile range) median surface time to the north. The calculated preliminary regional abundance estimate is about 588,000 loggerheads along the U.S. Atlantic coast, with an inter-quartile range of 382,000-817,000 (NMFS NEFSC 2011). The estimate increases to approximately 801,000 (inter-quartile range of 521,000-1,111,000) when based on known loggerheads and a portion of unidentified turtle sightings. The density of loggerheads was generally lower in the north than the south; based on number of turtle groups detected, 64% were seen south of Cape Hatteras, North Carolina, 30% in the southern Mid-Atlantic Bight, and 6% in the northern Mid-Atlantic Bight. Although they have been seen farther north in previous studies (*e.g.*, Shoop and Kenney 1992), no loggerheads were observed during the aerial surveys conducted in the summer of 2010 in the more northern zone encompassing Georges Bank, Cape Cod Bay, and the Gulf of Maine. These estimates of loggerhead abundance over the U.S. Atlantic continental shelf are considered very preliminary. A more thorough analysis will be completed pending the results of further studies related to improving estimates of regional and seasonal variation in loggerhead surface time (by increasing the sample size and geographical area of tagging) and other information needed to improve the biases inherent in aerial surveys of sea turtles (*e.g.*, research on depth of detection and species misidentification rate). This survey effort represents the most comprehensive assessment of sea turtle abundance and distribution in many years. Additional aerial surveys and research to improve the abundance estimates are anticipated in 2011-2014, depending on available funds.

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 neritic environment, and in the oceanic environment. The 5-year status review and 2008 recovery plan provide a summary of natural as well as anthropogenic threats to loggerhead sea turtles (NMFS and USFWS 2007a, 2008). Amongst those of natural origin, hurricanes are known to be destructive to sea turtle nests. Sand accretion, rainfall, and wave action that result from these storms can appreciably reduce hatchling success. Other sources of natural mortality include cold-stunning, biotoxin exposure, and native species predation.

Anthropogenic factors that impact hatchlings and adult females on land, or the success of nesting and hatching include: beach erosion, beach armoring, and nourishment; artificial lighting; beach cleaning; beach pollution; increased human presence; recreational beach equipment; vehicular and pedestrian traffic; coastal development/construction; exotic dune and beach vegetation; removal of native vegetation; and poaching. An increased 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 nests and feed on turtle eggs (NMFS and USFWS 2007a, 2008). Although sea turtle nesting beaches are protected along large expanses of the Northwest Atlantic coast (in areas like 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.

Loggerheads 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.

A 1990 National Research Council (NRC) report concluded that for juveniles, subadults, and breeding adults in coastal waters, the most important source of human caused mortality in U.S. Atlantic waters was fishery interactions. The sizes and reproductive values of sea turtles taken by fisheries vary significantly, depending on the location and season of the fishery, and size-selectivity resulting from gear characteristics. Therefore, it is possible for fisheries that interact with fewer, more reproductively valuable turtles to have a greater detrimental effect on the population than one that takes greater numbers of less reproductively valuable turtles (Wallace *et al*. 2008). The Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant *et al*. 2009). Attaining a more thorough understanding of the characteristics, as well as the quantity of sea turtle bycatch across all fisheries is of great importance.

Finkbeiner *et al*. (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Biological Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations.

Of the many fisheries known to adversely affect loggerheads, the U.S. South Atlantic and Gulf of Mexico shrimp fisheries were considered to pose the greatest threat of mortality to neritic juvenile and adult age classes of loggerheads (NRC 1990, Finkbeiner *et al*. 2011). Significant changes to the South Atlantic and Gulf of Mexico shrimp fisheries have occurred since 1990, and the effects of these shrimp fisheries on ESA-listed species, including loggerhead sea turtles, have been assessed several times through section 7 consultation. There is also a lengthy regulatory history with regard to the use of Turtle Excluder Devices (TEDs) in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (Epperly and Teas 2002; NMFS 2002a; Lewison *et al.* 2003). A 2002 section 7 consultation on the U.S. South Atlantic and Gulf of Mexico shrimp fisheries estimated the total annual level of take for loggerhead sea turtles to be 163,160 interactions (the total number of turtles that enter a shrimp trawl, which may then escape through the TED or fail to escape and be captured) with 3,948 of those takes being lethal (NMFS 2002a).

In addition to improvements in TED designs and TED enforcement, interactions between loggerheads and the shrimp fishery have also been declining because of reductions in fishing effort unrelated to fisheries management actions. The 2002 South Atlantic and GOM Shrimp Opinion (NMFS 2002a) take estimates are based in part on fishery effort levels. In recent years, low shrimp prices, rising fuel costs, competition with imported products, and the impacts of recent hurricanes in the Gulf of Mexico have all impacted the shrimp fleets; in some cases reducing fishing effort by as much as 50% for offshore waters of the Gulf of Mexico (GMFMC 2007). As a result, loggerhead interactions and mortalities in the Gulf of Mexico have been substantially less than projected in the 2002 Opinion. Currently, the estimated annual number of interactions between loggerheads and shrimp trawls in the Gulf of Mexico shrimp fishery is 23,336, with 647 (2.8%) of those interactions resulting in mortality (Memo from Dr. B. Ponwith, Southeast Fisheries Science Center to Dr. R. Crabtree, Southeast Region, PRD, December 2008). In August 2010, NMFS reinitiated section 7 consultation on southeastern state and federal shrimp fisheries based on a high level of strandings, elevated nearshore sea turtle abundance as measured by trawl catch per unit of effort, and lack of compliance with TED requirements. The 2012 section 7 consultation on the shrimp fishery was unable to estimate the current total annual level of take for loggerheads. Instead, it qualitatively estimated that the shrimp fishery, as currently operating, would result in at least thousands and possibly tens of thousands of interactions annually, of which at least hundreds and possibly thousands are expected to be lethal (NMFS 2012a).

Loggerhead sea turtles are also known to interact with non-shrimp trawl, gillnet, longline, dredge, pound net, pot/trap, and hook and line fisheries. The reduction of sea turtle captures in fishing operations is identified in recovery plans and 5-year status reviews as a priority for the recovery of all sea turtle species. In the threats analysis of the loggerhead recovery plan, trawl bycatch is identified as the greatest source of mortality. While loggerhead bycatch in U.S. Mid-Atlantic bottom otter trawl gear was previously estimated for the period 1996-2004 (Murray 2006, 2008), a recent bycatch analysis estimated the number of loggerhead sea turtle interactions with U.S. Mid-Atlantic bottom trawl gear from 2005-2008 (Warden 2011a). Northeast Fisheries Observer Program data from 1994-2008 were used to develop a model of interaction rates and those predicted rates were applied to 2005-2008 commercial fishing data to estimate the number of interactions for the trawl fleet. The number of predicted average annual loggerhead interactions for 2005-2008 was 292 (CV=0.13, 95% CI=221-369), with an additional 61 loggerheads (CV=0.17, 95% CI=41-83) interacting with trawls but being released through a TED. Of the 292 average annual observable loggerhead interactions, approximately 44 of those were adult equivalents. Warden (2011b) found that latitude, depth and SST were associated with the interaction rate, with the rates being highest south of 37°N latitude in waters < 50 m deep and SST > 15°C. This estimate is a decrease from the average annual loggerhead bycatch in bottom otter trawls during 1996-2004, estimated to be 616 sea turtles (CV=0.23, 95% CI over the 9-year period: 367-890) (Murray 2006, 2008).

There have been several published estimates of the number of loggerheads taken annually as a result of the dredge fishery for Atlantic sea scallops, ranging from a low of zero in 2005 (Murray 2007) to a high of 749 in 2003 (Murray 2004). Murray (2011) recently re-evaluated loggerhead sea turtle interactions in scallop dredge gear from 2001-2008. In that paper, the average number of annual observable interactions of hard-shelled sea turtles in the Mid-Atlantic scallop dredge fishery prior to the implementation of chain mats (January 1, 2001 through September 25, 2006) was estimated to be 288 turtles (CV = 0.14, 95% CI: 209-363) [equivalent to 49 adults], 218 of which were loggerheads [equivalent to 37 adults]. After the implementation of chain mats, the average annual number of observable interactions was estimated to be 20 hard-shelled sea turtles (CV = 0.48, 95% CI: 3-42), 19 of which were loggerheads. If the rate of observable interactions from dredges without chain mats had been applied to trips with chain mats, the estimated number of observable and inferred interactions of hard-shelled sea turtles after chain mats were implemented would have been 125 turtles per year (CV = 0.15, 95% CI: 88-163) [equivalent to 22 adults], 95 of which were loggerheads [equivalent to 16 adults]. Interaction rates of hard-shelled turtles were correlated with sea surface temperature, depth, and use of a chain mat. Results from this recent analysis suggest that chain mats and fishing effort reductions have contributed to the decline in estimated loggerhead sea turtle interactions with scallop dredge gear after 2006 (Murray 2011).

An estimate of the number of loggerheads taken annually in U.S. Mid-Atlantic gillnet fisheries has also recently been published (Murray 2009a, b). From 1995-2006, the annual bycatch of loggerheads in U.S. Mid-Atlantic gillnet gear was estimated to average 350 turtles (CV=0.20, 95% CI over the 12-year period: 234 to 504). Bycatch rates were correlated with latitude, sea surface temperature, and mesh size. The highest predicted bycatch rates occurred in warm waters of the southern Mid-Atlantic in large-mesh (>7 inch/17.8 cm) gillnets (Murray 2009a).

The U.S. tuna and swordfish longline fisheries that are managed under the Highly Migratory Species (HMS) FMP are estimated to capture 1,905 loggerheads (no more than 339 mortalities) for each 3-year period starting in 2007 (NMFS 2004a). NMFS has mandated gear changes for the HMS fishery to reduce sea turtle bycatch and the likelihood of death from those incidental takes that would still occur (Garrison and Stokes 2010). In 2010, there were 40 observed interactions between loggerhead sea turtles and longline gear used in the HMS fishery (Garrison and Stokes 2011a, 2011b). All of the loggerheads were released alive, with the vast majority released with all gear removed. While 2010 total estimates are not yet available, in 2009, 242.9 (95% CI: 167.9-351.2) loggerhead sea turtles are estimated to have been taken in the longline fisheries managed under the HMS FMP based on the observed takes (Garrison and Stokes 2010). The 2009 estimate is considerably lower than those in 2006 and 2007 and is consistent with historical averages since 2001 (Garrison and Stokes 2010). This fishery represents just one of several longline fisheries operating in the Atlantic Ocean. Lewison *et al.* (2004) estimated that 150,000-200,000 loggerheads were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries as well as others).

Documented takes also occur in other fishery gear types and by non-fishery mortality sources (*e.g.*, hopper dredges, power plants, vessel collisions), although quantitative/qualitative estimates are only available for activities on which NMFS has consulted (See sections 5 below). Past and future impacts of global climate change are considered in Section 6.0 below.

Summary of Status for Loggerhead Sea Turtles

Loggerheads continue to be affected by many factors occurring on nesting beaches and in the water. These include poaching, habitat loss, and nesting predation that affects eggs, hatchlings, and nesting females on land, as well as fishery interactions, vessel interactions, marine pollution, and non-fishery (*e.g*., dredging) operations affecting all sexes and age classes in the water (NRC 1990; NMFS and USFWS 2007a, 2008). As a result, loggerheads still face many of the original threats that were the cause of their listing under the ESA. Of the nine DPSs defined in the NMFS and USFWS final rule (75 FR 12598), only the NWA DPS is considered in this Opinion.

NMFS convened a new Loggerhead Turtle Expert Working Group (TEWG) to review all available information on Atlantic loggerheads in order to evaluate the status of this species in the Atlantic. A final report from the Loggerhead TEWG was published in July 2009. In this report, the TEWG indicated that it could not determine whether the decreasing annual numbers of nests among the Northwest Atlantic loggerhead subpopulations were due to stochastic processes resulting in fewer nests, a decreasing average reproductive output of adult females, decreasing numbers of adult females, or a combination of these factors. Many factors are responsible for past or present loggerhead mortality that could impact current nest numbers; however, no single mortality factor stands out as a likely primary factor. It is likely that several factors compound to create the current decline, including incidental capture (in fisheries, power plant intakes, and dredging operations), lower adult female survival rates, increases in the proportion of first-time nesters, continued directed harvest, and increases in mortality due to disease. Regardless, the TEWG stated that "it is clear that the current levels of hatchling output will result in depressed recruitment to subsequent life stages over the coming decades" (TEWG 2009). However, the report does not provide information on the rate or amount of expected decrease in recruitment but goes on to state that the ability to assess the current status of loggerhead subpopulations is limited due to a lack of fundamental life history information and specific census and mortality data.

While several documents reported the decline in nesting numbers in the NWA DPS (NMFS and USFWS 2008, TEWG 2009), when nest counts through 2012 are analyzed, researchers found no demonstrable trend, indicating a reversal of the post-1998 decline (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/). Loggerhead nesting has been on the rise since 2008, and Van Houton and Halley (2011) suggest that nesting in Florida, which contains by far the largest loggerhead rookery in the DPS, could substantially increase over the next few decades.

5.3 Status of Kemp's Ridley Sea Turtles

Distribution and Life History

The Kemp's ridley is one of the least abundant of the world's sea turtle species. In contrast to loggerhead and green sea turtles, which are found in multiple oceans of the world, Kemp's ridleys typically occur only in the Gulf of Mexico and the northwestern Atlantic Ocean (NMFS *et al.* 2011).

Kemp's ridleys mature at 10-17 years (Caillouet *et al.* 1995; Schmid and Witzell 1997; Snover *et al.* 2007; NMFS and USFWS 2007c). Nesting occurs from April through July each year with hatchlings emerging after 45-58 days (NMFS *et al.* 2011). Females lay an average of 2.5 clutches within a season (TEWG 1998, 2000) and the mean remigration interval for adult females is 2 years (Marquez *et al.* 1982; TEWG 1998, 2000).

Once they leave the nesting beach, hatchlings presumably enter the Gulf of Mexico where they feed on available S*argassum* and associated infauna or other epipelagic species (NMFS *et al.* 2011). The presence of juvenile turtles along both the U.S. Atlantic and Gulf of Mexico coasts, where they are recruited to the coastal benthic environment, indicates that post-hatchlings are distributed in both the Gulf of Mexico and Atlantic Ocean (TEWG 2000).

The location and size classes of dead turtles recovered by the STSSN suggests that benthic immature developmental areas occur along the U.S. coast and that these areas may change given resource quality and quantity (TEWG 2000). Developmental habitats are defined by several characteristics, including coastal areas sheltered from high winds and waves such as embayments and estuaries, and nearshore temperate waters shallower than 50 m (NMFS and USFWS 2007c). The suitability of these habitats depends on resource availability, with optimal environments providing rich sources of crabs and other invertebrates. Kemp's ridleys consume a variety of crab species, including *Callinectes*, *Ovalipes*, *Libinia*, and *Cancer* species. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). A wide variety of substrates have been documented to provide good foraging habitat, including seagrass beds, oyster reefs, sandy and mud bottoms, and rock outcroppings (NMFS and USFWS 2007c).

Foraging areas documented along the U.S. Atlantic coast include Charleston Harbor, Pamlico Sound (Epperly *et al.* 1995c), Chesapeake Bay (Musick and Limpus 1997), Delaware Bay (Stetzar 2002), and Long Island Sound (Morreale and Standora 1993; Morreale *et al.* 2005). For instance, in the Chesapeake Bay, Kemp's ridleys frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Upon leaving Chesapeake Bay in autumn, juvenile Kemp's ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined by juveniles of the same size from North Carolina sounds and 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 (Epperly *et al.* 1995a, 1995b; Musick and Limpus 1997).

Adult Kemp's ridleys are found in the coastal regions of the Gulf of Mexico and southeastern United States, but are typically rare in the northeastern U.S. waters of the Atlantic (TEWG 2000). Adults are primarily found in nearshore waters of 37 m or less that are rich in crabs and have a sandy or muddy bottom (NMFS and USFWS 2007c).

Population Dynamics and Status

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; NMFS and USFWS 2007c; NMFS *et al.* 2011). There is a limited amount of scattered nesting to the north and south of the primary nesting beach (NMFS and USFWS 2007c). Nesting often occurs in synchronized emergences termed *arribadas*. The number of recorded nests reached an estimated low of 702 nests in 1985, corresponding to fewer than 300 adult females nesting in that season (TEWG 2000; NMFS and USFWS 2007c; NMFS *et al.* 2011). Conservation efforts by Mexican and U.S. agencies have aided this species by eliminating egg harvest, protecting eggs and hatchlings, and reducing at-sea mortality through fishing regulations (TEWG 2000). Since the mid-1980s, the number of nests observed at Rancho Nuevo and nearby beaches has increased 14-16% per year (Heppell *et al.* 2005), allowing cautious optimism that the population is on its way to recovery. An estimated 5,500 females nested in the State of Tamaulipas over a 3-day period in May 2007 and over 4,000 of those nested at Rancho Nuevo (NMFS and USFWS 2007c). In 2008, 17,882 nests were documented on Mexican nesting beaches (NMFS 2011). There is limited nesting in the United States, most of which is located in South Texas. While six nests were documented in 1996, a record 195 nests were found in 2008 (NMFS 2011).

Threats

Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, predators, and oceanographic-related 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. In the last five years (2006-2010), the number of cold-stunned turtles on Cape Cod beaches averaged 115 Kemp's ridleys, 7 loggerheads, and 7 greens (NMFS unpublished data). The numbers ranged from a low in 2007 of 27 Kemp's ridleys, 5 loggerheads, and 5 greens to a high in 2010 of 213 Kemp's ridleys, 4 loggerheads, and 14 greens. Annual cold stun events vary in magnitude; the extent of episodic major cold stun events may be associated with numbers of turtles utilizing Northeast U.S. waters in a given year, oceanographic conditions, and/or the occurrence of storm events in the late fall. Although many cold-stunned turtles can survive if they are found early enough, these events represent a significant source of natural mortality for Kemp's ridleys.

Like other sea turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940s through the early 1960s, nests from Ranch Nuevo were heavily exploited, but beach protection in 1967 helped to curtail this activity (NMFS *et al.* 2011). Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where adult Kemp's ridley sea turtles occur. Information from fisheries observers helped to demonstrate the high number of turtles taken in these shrimp trawls (USFWS and NMFS 1992). Subsequently, NMFS has worked with the industry to reduce sea turtle takes in shrimp trawls and other trawl fisheries, including the development and use of turtle excluder devices (TEDs). As described above, there is lengthy regulatory history with regard to the use of TEDs in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (NMFS 2002a; Epperly 2003; Lewison *et al.* 2003). The 2002 Biological Opinion on shrimp trawling in the southeastern United States concluded that 155,503 Kemp's ridley sea turtles would be taken annually in the fishery with 4,208 of the takes resulting in mortality (NMFS 2002a).

Although modifications to shrimp trawls have helped to reduce mortality of Kemp's ridleys, a recent assessment found that the Southeast/Gulf of Mexico shrimp trawl fishery remained responsible for the vast majority of U.S. fishery interactions (up to 98%) and mortalities (more than 80%). Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Biological Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400) and greens (300). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations.

This species is also affected by other sources of anthropogenic impact (fishery and non-fishery related), similar to those discussed above. Three Kemp's ridley captures in Mid-Atlantic trawl fisheries were documented by NMFS observers between 1994 and 2008 (Warden and Bisack 2010), and eight Kemp's ridleys were documented by NMFS observers in mid-Atlantic sink gillnet fisheries between 1995 and 2006 (Murray 2009a). Additionally, in the spring of 2000, a total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. The cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected by NMFS to have been from a large-mesh gillnet fishery for monkfish and dogfish operating offshore in the preceding weeks (67 FR 71895, December 3, 2002). The five Kemp's 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, since it is unlikely that all of the carcasses washed ashore. The NMFS Northeast Fisheries Science Center also documented 14 Kemp's ridleys entangled in or impinged on Virginia pound net leaders from 2002-2005. Note that bycatch estimates for Kemp's ridleys in various fishing gear types (*e.g.*, trawl, gillnet, dredge) are not available at this time, largely due to the low number of observed interactions precluding a robust estimate. Kemp's ridley interactions in non-fisheries have also been observed; for example, the Oyster Creek Nuclear Generating Station in Barnegat Bay, New Jersey, recorded a total of 27 Kemp's ridleys (15 of which were found alive) impinged or captured on their intake screens from 1992-2006 (NMFS 2006).

Summary of Status for Kemp's Ridley Sea Turtles

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; NMFS and USFWS 2007c; NMFS *et al.* 2011). The number of nesting females in the Kemp's ridley population declined dramatically from the late 1940s through the mid-1980s, with an estimated 40,000 nesting females in a single *arribada* in 1947 and fewer than 300 nesting females in the entire 1985 nesting season (TEWG 2000; NMFS *et al.* 2011). However, the total annual number of nests at Rancho Nuevo gradually began to increase in the 1990s (NMFS and USFWS 2007c). Based on the number of nests laid in 2006 and the remigration interval for Kemp's ridley sea turtles (1.8-2 years), there were an estimated 7,000-8,000 adult female Kemp's ridley sea turtles in 2006 (NMFS and USFWS 2007c). The number of adult males in the population is unknown, but sex ratios of hatchlings and immature Kemp's ridleys suggest that the population is female-biased, suggesting that the number of adult males is less than the number of adult females (NMFS and USFWS 2007c). While there is cautious optimism for recovery, events such as the Deepwater Horizon oil release, and stranding events associated increased skimmer trawl use and poor TED compliance in the northern Gulf of Mexico may dampen recent population growth.

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality. Based on their 5-year status review of the species, NMFS and USFWS (2007c) determined that Kemp's ridley sea turtles should not be reclassified as threatened under the ESA. A revised bi-national recovery plan was published for public comment in 2010, and in September 2011, NMFS, USFWS, and the Services and the Secretary of Environment and Natural Resources, Mexico (SEMARNAT) released the second revision to the Kemp's ridley recovery plan.

5.4 Status of Green Sea Turtles

Green sea turtles are distributed circumglobally, and can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea (NMFS and USFWS 1991, 2007d; Seminoff 2004). In 1978, the Atlantic population of the green sea turtle was listed as threatened under the ESA, except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered. As it is difficult to differentiate between breeding populations away from the nesting beaches, all green sea turtles in the water are considered endangered.

Pacific Ocean

Green sea turtles occur in the western, central, and eastern Pacific. Foraging areas are also found throughout the Pacific and along the southwestern U.S. coast (NMFS and USFWS 1998b). In the western Pacific, major nesting rookeries at four sites including Heron Island (Australia), Raine Island (Australia), Guam, and Japan were evaluated and determined to be increasing in abundance, with the exception of Guam which appears stable (NMFS and USFWS 2007d). In the central Pacific, nesting occurs on French Frigate Shoals, Hawaii, which has also been reported as increasing with a mean of 400 nesting females annually from 2002-2006 (NMFS and USFWS 2007d). The main nesting sites for the green sea turtle in the eastern Pacific are located in Michoacan, Mexico and in the Galapagos Islands, Ecuador (NMFS and USFWS 2007d). The number of nesting females per year exceeds 1,000 females at each site (NMFS and USFWS 2007d). However, historically, greater than 20,000 females per year are believed to have nested in Michoacan alone (Cliffton *et al.* 1982; NMFS and USFWS 2007d). The Pacific Mexico green turtle nesting population (also called the black turtle) is considered endangered.

Historically, green sea turtles were used in many areas of the Pacific for food. They were also commercially exploited, which, coupled with habitat degradation, led to their decline in the Pacific (NMFS and USFWS 1998b). Green sea turtles in the Pacific continue to be affected by poaching, habitat loss or degradation, fishing gear interactions, and fibropapillomatosis, which is a viral disease that causes tumors in affected turtles (NMFS and USFWS 1998b; NMFS 2004b).

Indian Ocean
There are numerous nesting sites for green sea turtles in the Indian Ocean. One of the largest nesting sites for green sea turtles worldwide occurs on the beaches of Oman where an estimated 20,000 green sea turtles nest annually (Hirth 1997; Ferreira *et al.* 2003). Based on a review of the 32 Index Sites used to monitor green sea turtle nesting worldwide, Seminoff (2004) concluded that declines in green sea turtle nesting were evident for many of the Indian Ocean Index Sites. While several of these had not demonstrated further declines in the more recent past, only the Comoros Island Index Site in the western Indian Ocean showed evidence of increased nesting (Seminoff 2004).

Mediterranean Sea
There are four nesting concentrations of green sea turtles in the Mediterranean from which data are available – Turkey, Cyprus, Israel, and Syria. Currently, approximately 300-400 females nest each year, about two-thirds of which nest in Turkey and one-third in Cyprus. Although green sea turtles are depleted from historic levels in the Mediterranean Sea (Kasparek *et al.* 2001), nesting data gathered since the early 1990s in Turkey, Cyprus, and Israel show no apparent trend in any direction. However, a declining trend is apparent along the coast of Palestine/Israel, where 300-350 nests were deposited each year in the 1950s (Sella 1982) compared to a mean of 6 nests per year from 1993-2004 (Kuller 1999; Y. Levy, Israeli Sea Turtle Rescue Center, unpublished data). A recent discovery of green sea turtle nesting in Syria adds roughly 100 nests per year to green sea turtle nesting activity in the Mediterranean (Rees *et al.* 2005). That such a major nesting concentration could have gone unnoticed until recently (the Syria coast was surveyed in 1991, but nesting activity was attributed to loggerheads) bodes well for the ongoing speculation that the unsurveyed coast of Libya may also host substantial nesting.

Atlantic Ocean
Distribution and Life History
As has occurred in other oceans of its range, green sea turtles were once the target of directed fisheries in the United States and throughout the Caribbean. In 1890, over one million pounds of green sea turtles were taken in a directed fishery in the Gulf of Mexico (Doughty 1984). However, declines in the turtle fishery throughout the Gulf of Mexico were evident by 1902 (Doughty 1984).

In the western Atlantic, large juvenile and adult green sea turtles are largely herbivorous, occurring in habitats containing benthic algae and seagrasses from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999). Green sea turtles occur seasonally in Mid-Atlantic and Northeast waters such as Chesapeake Bay and Long Island Sound (Musick and Limpus 1997; Morreale and Standora 1998; Morreale *et al.* 2005), which serve as foraging and developmental habitats.

Some of the principal feeding areas in the western Atlantic Ocean include the upper west coast of Florida, the Florida Keys, 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 1971). The waters surrounding the island of Culebra, Puerto Rico, and its outlying keys are designated critical habitat for the green sea turtle.

Age at maturity for green sea turtles is estimated to be 20-50 years (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004). As is the case with the other sea turtle species described above, adult females may nest multiple times in a season (average 3 nests/season with approximately 100 eggs/nest) and typically do not nest in successive years (NMFS and USFWS 1991; Hirth 1997).

Population Dynamics and Status

Like other sea turtle species, nest count information for green sea turtles provides information on the relative abundance of nesting, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The 5-year status review for the species identified eight geographic areas considered to be primary sites for threatened green sea turtle nesting in the Atlantic/Caribbean, and reviewed the trend in nest count data for each (NMFS and USFWS 2007d). These include: (1) Yucatán Peninsula, Mexico, (2) Tortuguero, Costa Rica, (3) Aves Island, Venezuela, (4) Galibi Reserve, Suriname, (5) Isla Trindade, Brazil, (6) Ascension Island, United Kingdom, (7) Bioko Island, Equatorial Guinea, and (8) Bijagos Achipelago, Guinea-Bissau (NMFS and USFWS 2007d). Nesting at all of these sites is considered to be stable or increasing with the exception of Bioko Island, which may be declining. However, the lack of sufficient data precludes a meaningful trend assessment for this site (NMFS and USFWS 2007d).

Seminoff (2004) reviewed green sea turtle nesting data for eight sites in the western, eastern, and central Atlantic, including all of the above threatened nesting sites with the exception that nesting in Florida was reviewed in place of Isla Trindade, Brazil. He concluded that all sites in the central and western Atlantic showed increased nesting with the exception of nesting at Aves Island, Venezuela, while both sites in the eastern Atlantic demonstrated decreased nesting. These sites are not inclusive of all green sea turtle nesting in the Atlantic Ocean. However, other sites are not believed to support nesting levels high enough that would change the overall status of the species in the Atlantic (NMFS and USFWS 2007d).

By far, the most important nesting concentration for green sea turtles in the western Atlantic is in Tortuguero, Costa Rica (NMFS and USFWS 2007d). Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007d). The number of females nesting per year on beaches in the Yucatán, at Aves Island, Galibi Reserve, and Isla Trindade number in the hundreds to low thousands, depending on the site (NMFS and USFWS 2007d).

The status of the endangered Florida breeding population was also evaluated in the 5-year review (NMFS and USFWS 2007d). The pattern of green sea turtle nesting shows biennial peaks in abundance, with a generally positive trend since establishment of the Florida index beach surveys in 1989. This trend is perhaps due to increased protective legislation throughout the

Caribbean (Meylan *et al.* 1995), as well as protections in Florida and throughout the United States (NMFS and USFWS 2007d).

The statewide Florida surveys (2000-2006) have shown that a mean of approximately 5,600 nests are laid annually in Florida, with a low of 581 in 2001 to a high of 9,644 in 2005 (NMFS and USFWS 2007d). Most nesting occurs along the east coast of Florida, but occasional nesting has been documented along the Gulf coast of Florida, at Southwest Florida beaches, as well as the beaches in the Florida Panhandle (Meylan *et al.* 1995). More recently, green sea turtle nesting occurred on Bald Head Island, North Carolina (just east of the mouth of the Cape Fear River), Onslow Island, and Cape Hatteras National Seashore. One green sea turtle nested on a beach in Delaware in 2011, although its occurrence was considered very rare.

Threats

Green sea turtles face many of the same natural threats as loggerhead and Kemp's ridley sea turtles. In addition, green sea turtles appear to be particularly susceptible to fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body. Juveniles appear to be most affected in that they have the highest incidence of disease and the most extensive lesions, whereas lesions in nesting adults are rare. Also, green sea turtles frequenting nearshore waters, areas adjacent to large human populations, and areas with low water turnover, such as lagoons, have a higher incidence of the disease than individuals in deeper, more remote waters. The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability, leading potentially to death (George 1997).

As with the other sea turtle species, incidental fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches. Witherington *et al.* (2009) observes that because green sea turtles spend a shorter time in oceanic waters and as older juveniles occur on shallow seagrass pastures (where benthic trawling is unlikely), they avoid high mortalities in pelagic longline and benthic trawl fisheries. Although the relatively low number of observed green sea turtle captures makes it difficult to estimate bycatch rates and annual take levels, green sea turtles have been observed captured in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and mid-Atlantic trawl and gillnet fisheries. Murray (2009a) also lists five observed captures of green turtle in Mid-Atlantic sink gillnet gear between 1995 and 2006.

Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Biological Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400) and greens (300). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations.

Other activities like channel dredging, marine debris, pollution, vessel strikes, power plant impingement, and habitat destruction account for an unquantifiable level of other mortality. Stranding reports indicate that between 200-400 green sea turtles strand annually along the eastern U.S. coast from a variety of causes most of which are unknown (STSSN database).

Summary of Status of Green Sea Turtles

A review of 32 Index Sites[4] distributed globally revealed a 48-67% decline in the number of mature females nesting annually over the last three generations[5] (Seminoff 2004). An evaluation of green sea turtle nesting sites was also conducted as part of the 5-year status review of the species (NMFS and USFWS 2007d). Of the 23 threatened nesting groups assessed in that report for which nesting abundance trends could be determined, ten were considered to be increasing, nine were considered stable, and four were considered to be decreasing (NMFS and USFWS 2007d). Nesting groups were considered to be doing relatively well (the number of sites with increasing nesting were greater than the number of sites with decreasing nesting) in the Pacific, western Atlantic, and central Atlantic (NMFS and USFWS 2007d). However, nesting populations were determined to be doing relatively poorly in Southeast Asia, eastern Indian Ocean, and perhaps the Mediterranean. Overall, based on mean annual reproductive effort, the report estimated that 108,761 to 150,521 females nest each year among the 46 threatened and endangered nesting sites included in the evaluation (NMFS and USFWS 2007d). However, given the late age to maturity for green sea turtles, caution is urged regarding the status for any of the nesting groups since no area has a dataset spanning a full green sea turtle generation (NMFS and USFWS 2007d).

Seminoff (2004) and NMFS and USFWS (2007d) made comparable conclusions with regard to nesting for four nesting sites in the western Atlantic that indicate sea turtle abundance is increasing in the Atlantic Ocean. Each also concluded that nesting at Tortuguero, Costa Rica represented the most important nesting area for green sea turtles in the western Atlantic and that nesting had increased markedly since the 1970s (Seminoff 2004; NMFS and USFWS 2007d).

However, the 5-year review also noted that the Tortuguero nesting stock continued to be affected by ongoing directed take at their primary foraging area in Nicaragua (NMFS and USFWS 2007d). The endangered breeding population in Florida appears to be increasing based upon index nesting data from 1989-2010 (NMFS 2011).

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like hopper dredging, pollution, and habitat destruction account for an unknown level of other mortality. Based on its 5-year status review of the species, NMFS and USFWS (2007d) determined that the listing classification for green sea turtles should not be changed. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified (NMFS and USFWS 2007d).

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[4] The 32 Index Sites include all of the major known nesting areas as well as many of the lesser nesting areas for which quantitative data are available.

[5] Generation times ranged from 35.5 years to 49.5 years for the assessment depending on the Index Beach site

Based on this and the current best available information, we believe that the green sea turtle population is currently stable; as protective measures for sea turtles are currently in place and continue to be implemented, we expect this trend to continue or over the next 2 years. This stable trend is based solely on information we have on nesting trends. The number of sea turtles comprising the neritic and oceanic life stages of the population is currently unknown. As a result, the status and future trend of the population as a whole remains unclear. Therefore, until information and data become available on the numbers of individuals comprising the neritic and oceanic life stages, nesting trends represent the best available information and serve as the best representative of the population's trend.

5.5 Status of Atlantic sturgeon

The section below describes the Atlantic sturgeon listing, provides life history information that is relevant to all DPSs of Atlantic sturgeon, and provides information specific to the status of each DPS of Atlantic sturgeon. The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a subspecies of sturgeon distributed along the eastern coast of North America from Hamilton Inlet, Labrador, Canada to Cape Canaveral, FL (Scott and Scott 1988; ASSRT 2007;). NMFS has divided U.S. populations of Atlantic sturgeon into five DPSs[6] (77 FR 5880 and 77 FR 5914). These are: the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs (see Figure 25.).

The results of genetic studies suggest that natal origin influences the distribution of Atlantic sturgeon in the marine environment (Wirgin and King 2011). However, genetic data, as well as tracking and tagging data, demonstrate that sturgeon from each DPS and Canada occur throughout the full range of the subspecies. Therefore, sturgeon originating from any of the five DPSs can be affected by threats in the marine, estuarine, and riverine environment that occur far from natal spawning rivers.

On February 6, 2012, we published notice in the *Federal Register* that we were listing the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs as "endangered," and the Gulf of Maine DPS as "threatened" (77 FR 5880 and 77 FR 5914). The effective date of the listings was April 6, 2012. The DPSs do not include Atlantic sturgeon spawned in Canadian rivers. Therefore, fish that originated in Canada are not included in the listings.

Atlantic Sturgeon Life History

Atlantic sturgeon are long-lived (approximately 60 years), late maturing, estuarine dependent, anadromous[7] fish (Bigelow and Schroeder 1953; Vladykov and Greeley 1963; Mangin 1964; Pikitch *et al.* 2005; Dadswell 2006; ASSRT 2007).

The life history of Atlantic sturgeon can be divided up into five general categories as described in the table below (adapted from ASSRT 2007).

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[6] To be considered for listing under the ESA, a group of organisms must constitute a "species." A "species" is defined in section 3 of the ESA to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature."

[7] Anadromous refers to a fish that is born in freshwater, spends most of its life in the sea, and returns to freshwater to spawn (NEFSC FAQs, available at http://www.nefsc.noaa.gov/faq/fishfaq1a.html, modified June 16, 2011)

Age Class	Size	Description
Egg		Fertilized or unfertilized
Larvae		Negative photo-taxic, nourished by yolk sac
Young of Year (YOY)	**0.3 grams <41 cm TL**	Fish that are > 3 months and < one year; capable of capturing and consuming live food
Non-migrant subadults or juveniles	**>41 cm and <76 cm TL**	Fish that are at least age 1 and are not sexually mature and do not make coastal migrations.
Subadults	**>76cm and <150cm TL**	Fish that are not sexually mature but make coastal migrations
Adults	**>150 cm TL**	Sexually mature fish

Table 5. Descriptions of Atlantic sturgeon life history stages.

Atlantic sturgeon can grow to over 14 feet weighing 800 pounds(Pikitch *et al.* 2005). Atlantic sturgeon are bottom feeders that suck food into a ventral protruding mouth (Bigelow and Schroeder 1953). Four barbels in front of the mouth assist the sturgeon in locating prey (Bigelow and Schroeder 1953). Diets of adult and migrant subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007; Savoy 2007). Juvenile Atlantic sturgeon feed on aquatic insects, insect larvae, and other invertebrates (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007).

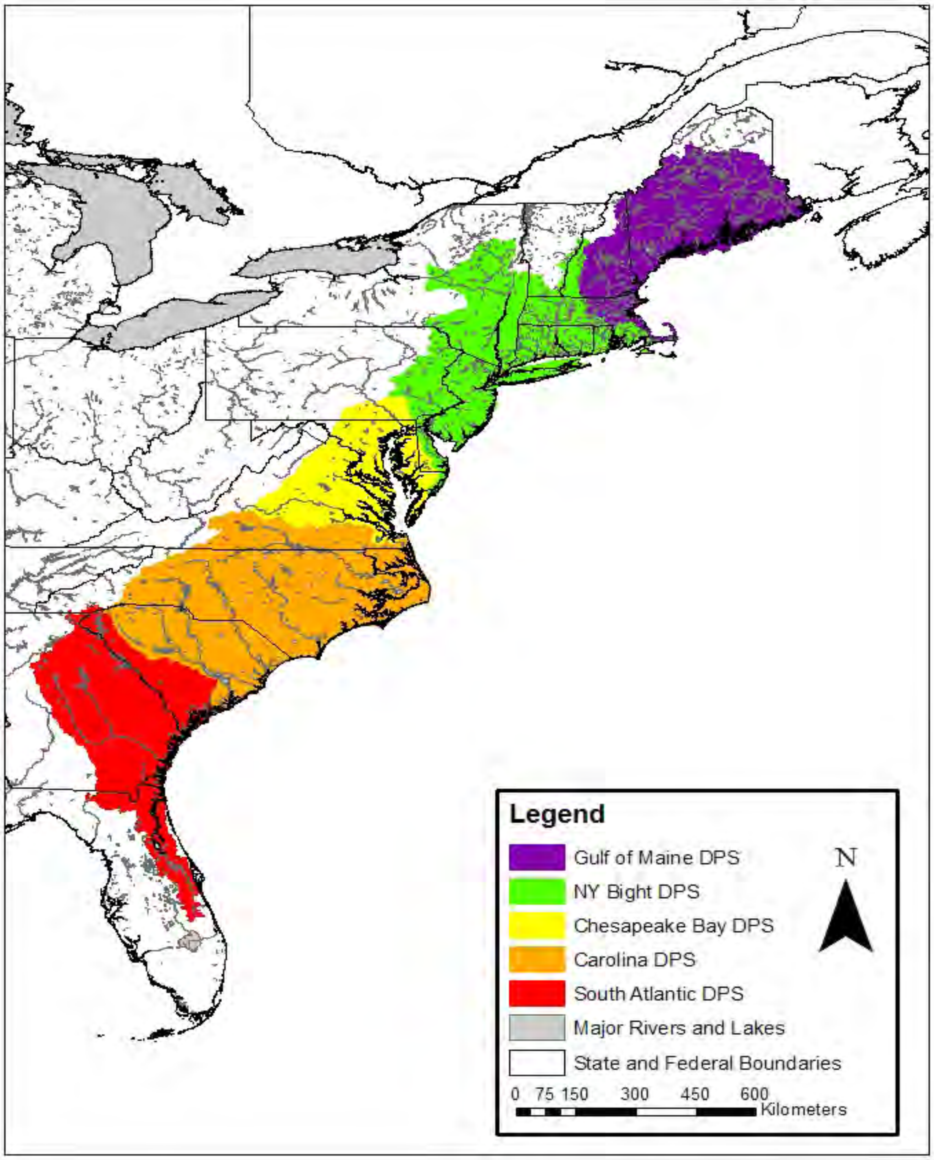


Figure 25. Map Depicting the Boundaries of the five Atlantic sturgeon DPSs

Rate of maturation is affected by water temperature and gender. In general: (1) Atlantic sturgeon that originate from southern systems grow faster and mature sooner than Atlantic sturgeon that originate from more northern systems; (2) males grow faster than females; (3) fully mature females attain a larger size (i.e. length) than fully mature males. The largest recorded Atlantic sturgeon was a female captured in 1924 that measured approximately 4.26 meters (Vladykov and Greeley 1963). Dadswell (2006) reported seeing seven fish of comparable size in the St. John River estuary from 1973 to 1995. Observations of large-sized sturgeon are particularly important given that egg production is correlated with age and body size (Smith *et al.* 1982; Van Eenennaam *et al.* 1996; Van Eenennaam and Doroshov 1998; Dadswell 2006). The lengths of Atlantic sturgeon caught since the mid-late 20th century have typically been less than three meters (Smith *et al.* 1982; Smith and Dingley 1984; Smith 1985; Scott and Scott 1988; Young *et al.* 1998; Collins *et al.* 2000; Caron *et al.* 2002; Dadswell 2006; ASSRT 2007; Kahnle *et al.* 2007; DFO, 2011). While females are prolific, with egg production ranging from 400,000 to 4 million eggs per spawning year, females spawn at intervals of two to five years (Vladykov and Greeley 1963; Smith *et al.*, 1982; Van Eenennaam *et al.* 1996; Van Eenennaam and Doroshov 1998; Stevenson and Secor 1999; Dadswell 2006). Given spawning periodicity and a female's relatively late age to maturity, the age at which 50% of the maximum lifetime egg production is achieved is estimated to be 29 years (Boreman 1997). Males exhibit spawning periodicity of one to five years (Smith 1985; Collins *et al.* 2000; Caron *et al.* 2002). While long-lived, Atlantic sturgeon are exposed to a multitude of threats prior to achieving maturation and have a limited number of spawning opportunities once mature.

Water temperature plays a primary role in triggering the timing of spawning migrations (ASMFC, 2009). Spawning migrations generally occur during 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). Male sturgeon begin upstream spawning migrations when waters reach approximately 6°C (43° F) (Smith *et al.* 1982; Dovel and Berggren 1983; Smith 1985; ASMFC 2009), and remain on the spawning grounds throughout the spawning season (Bain 1997). Females begin spawning migrations when temperatures are closer to 12°to 13°C (54° to 55°F) (Dovel and Berggren 1983; Smith 1985; Collins *et al.* 2000), make rapid spawning migrations upstream, and quickly depart following spawning (Bain 1997).

The spawning areas in most U.S. rivers have not been well defined. However, the habitat characteristics of spawning areas have been identified based on historical accounts of where fisheries occurred, tracking and tagging studies of spawning sturgeon, and physiological needs of early life stages. Spawning is believed to occur in flowing water between the salt front of estuaries and the fall line of large rivers, when and where optimal flows are 46-76 centimeters per second and depths are 3-27 meters (Borodin 1925; Dees 1961; Leland 1968; Scott and Crossman 1973; Crance 1987; Shirey *et al.* 1999; Bain *et al.* 2000; Collins *et al.* 2000; Caron *et al.* 2002; Hatin *et al.* 2002; ASMFC 2009). Sturgeon eggs are deposited on hard bottom substrate such as cobble, coarse sand, and bedrock (Dees 1961; Scott and Crossman 1973; Gilbert 1989; Smith and Clugston 1997; Bain *et al.* 2000; Collins *et al.* 2000; Caron *et al.* 2002; Hatin *et al.* 2002; Mohler 2003; ASMFC 2009), and become adhesive shortly after fertilization (Murawski and Pacheco 1977; Van den Avyle 1984; Mohler 2003). Incubation time for the eggs increases as water temperature decreases (Mohler 2003). At temperatures of 20° and 18° C, hatching occurs approximately 94 and 140 hours, respectively, after egg deposition (ASSRT 2007).

Larval Atlantic sturgeon (i.e. less than four weeks old, with total lengths (TL) less than 30 millimeters; Van Eenennaam *et al.* 1996) are assumed to mostly live on or near the bottom and inhabit the same riverine or estuarine areas where they were spawned (Smith *et al.* 1980; Bain *et al.* 2000; Kynard and Horgan 2002; ASMFC 2009). Studies suggest that age-0 (i.e., young-of-year), age-1, and age-2 juvenile Atlantic sturgeon occur in low salinity waters of the natal estuary (Haley 1999; Hatin *et al.* 2007; McCord *et al.* 2007; Munro *et al.* 2007) while older fish are more salt-tolerant and occur in both high salinity and low salinity waters (Collins *et al.* 2000). Atlantic sturgeon remain in the natal estuary for months to years before emigrating to open ocean as subadults (Holland and Yelverton 1973; Dovel and Berggen 1983; Waldman *et al.* 1996; Dadswell 2006; ASSRT 2007).

After emigration from the natal estuary, subadults and adults travel within the marine environment, typically in waters less than 50 meters in depth, using coastal bays, sounds, and ocean waters (Vladykov and Greeley 1963; Murawski and Pacheco 1977; Dovel and Berggren 1983; Smith 1985; Collins and Smith 1997; Welsh *et al.* 2002; Savoy and Pacileo 2003; Stein *et al.* 2004a; Laney *et al.* 2007; Dunton *et al.* 2010; Erickson *et al.* 2011; Wirgin and King 2011). Tracking and tagging studies reveal seasonal movements of Atlantic sturgeon along the coast. Satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight at depths greater than 20 meters during winter and spring, and in the northern portion of the Mid-Atlantic Bight at depths less than 20 meters in summer and fall (Erickson *et al.* 2011). Shirey (Delaware Department of Fish and Wildlife, unpublished data reviewed in ASMFC 2009) found a similar movement pattern for juvenile Atlantic sturgeon based on recaptures of fish originally tagged in the Delaware River. After leaving the Delaware River estuary during the fall, juvenile Atlantic sturgeon were recaptured by commercial fishermen in nearshore waters along the Atlantic coast as far south as Cape Hatteras, NC from November through early March. In the spring, a portion of the tagged fish re-entered the Delaware River estuary. However, many fish continued a northerly coastal migration through the Mid-Atlantic as well as into southern New England waters, where they were recovered throughout the summer months. Movements as far north as Maine were documented. A southerly coastal migration was apparent from tag returns reported in the fall, with the majority of these tag returns from relatively shallow nearshore fisheries, with few fish reported from waters in excess of 25 meters (C. Shirey, Delaware Department of Fish and Wildlife, unpublished data reviewed in ASMFC 2009). Areas where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy (e.g., Minas and Cumberland Basins), Massachusetts Bay, Connecticut River estuary, Long Island Sound, New York Bight, Delaware Bay, Chesapeake Bay, and waters off of North Carolina from the Virginia/North Carolina border to Cape Hatteras at depths up to 24 meters (Dovel and Berggren 1983; Dadswell *et al.* 1984; Johnson *et al.* 1997; Rochard *et al.* 1997; Kynard *et al.* 2000; Eyler *et al.* 2004; Stein *et al.* 2004a; Wehrell 2005; Dadswell 2006; ASSRT 2007; Laney *et al.* 2007). These sites may be used as foraging sites and/or thermal refuge.

Distribution and Abundance

Atlantic sturgeon underwent significant range-wide declines from historical abundance levels due to overfishing in the mid to late 19th century when a caviar market was established (Scott and Crossman 1973; Taub 1990; Kennebec River Resource Management Plan 1993; Smith and Clugston 1997; Dadswell 2006; ASSRT 2007). Abundance of spawning-aged females prior to this period of exploitation was predicted to be greater than 100,000 for the Delaware River, and at least 10,000 females for other spawning stocks (Secor and Waldman 1999; Secor 2002). Historical records suggest that Atlantic sturgeon spawned in at least 35 rivers prior to this period. Currently, only 17 U.S. rivers are known to support spawning (i.e., presence of young-of-year or gravid Atlantic sturgeon documented within the past 15 years) (ASSRT 2007). While there may be other rivers supporting spawning for which definitive evidence has not been obtained (e.g., in the Penobscot and York Rivers), the number of rivers supporting spawning of Atlantic sturgeon is approximately half of what it was historically. In addition, only five rivers (Kennebec, Androscoggin, Hudson, Delaware, James) are known to currently support spawning from Maine through Virginia, where historical records show that there used to be 15 spawning rivers (ASSRT 2007). Thus, there are substantial gaps between Atlantic sturgeon spawning rivers among northern and Mid-Atlantic states which could make recolonization of extirpated populations more difficult.

At the time of the listing, there were no current, published population abundance estimates for any of the currently known spawning stocks or for any of the five DPSs of Atlantic sturgeon. An estimate of 863 mature adults per year (596 males and 267 females) was calculated for the Hudson River based on fishery-dependent data collected from 1985 to 1995 (Kahnle *et al.*, 2007). An estimate of 343 spawning adults per year is available for the Altamaha River, GA, based on fishery-independent data collected in 2004 and 2005 (Schueller and Peterson 2006). Using the data collected from the Hudson and Altamaha Rivers to estimate the total number of Atlantic sturgeon in either subpopulation is not possible, since mature Atlantic sturgeon may not spawn every year (Vladykov and Greeley 1963; Smith 1985; Van Eenennaam *et al.* 1996; Stevenson and Secor 1999; Collins *et al.* 2000; Caron *et al.* 2002), the age structure of these populations is not well understood, and stage-to-stage survival is unknown. In other words, the information that would allow us to take an estimate of annual spawning adults and expand that estimate to an estimate of the total number of individuals (*e.g.*, yearlings, subadults, and adults) in a population is lacking. The ASSRT presumed that the Hudson and Altamaha rivers had the most robust of the remaining U.S. Atlantic sturgeon spawning populations and concluded that the other U.S. spawning populations were likely less than 300 spawning adults per year (ASSRT 2007).

Lacking complete estimates of population abundance across the distribution of Atlantic sturgeon, the NEFSC developed a virtual population analysis model with the goal of estimating bounds of Atlantic sturgeon ocean abundance (see Kocik et al. 2013). The NEFSC suggested that cumulative annual estimates of surviving fishery discards could provide a minimum estimate of abundance. The objectives of producing the Atlantic Sturgeon Production Index (ASPI) were to characterize uncertainty in abundance estimates arising from multiple sources of observation and process error and to complement future efforts to conduct a more comprehensive stock assessment (Table 6). The ASPI provides a general abundance metric to assess risk for actions that may affect Atlantic sturgeon in the ocean. In general, the model uses empirical estimates of post-capture survivors and natural survival, as well as probability estimates of recapture using tagging data from the United States Fish and Wildlife Service (USFWS) sturgeon tagging database, and federal fishery discard estimates from 2006 to 2010 to produce a virtual population. The USFWS sturgeon tagging database is a repository for sturgeon tagging information on the Atlantic coast. The database contains tag, release, and recapture information from state and federal researchers. The database records recaptures by the fishing fleet, researchers, and researchers on fishery vessels.

In additional to the ASPI, a population estimate was derived from the Northeast Area Monitoring and Assessment Program (NEAMAP) (**Table** 7). NEAMAP trawl surveys are conducted from Cape Cod, Massachusetts to Cape Hatteras, North Carolina in nearshore waters at depths up to

18.3 meters (60 feet) during the fall since 2007 and spring since 2008. Each survey employs a spatially stratified random design with a total of 35 strata and 150 stations. The ASMFC has initiated a new stock assessment with the goal of completing it by the end of 2014. NOAA Fisheries will be partnering with them to conduct the stock assessment, and the ocean population abundance estimates produced by the NEFSC will be shared with the stock assessment committee for consideration in the stock assessment.

Table 6. Description of the ASPI model and NEAMAP survey based area estimate method.

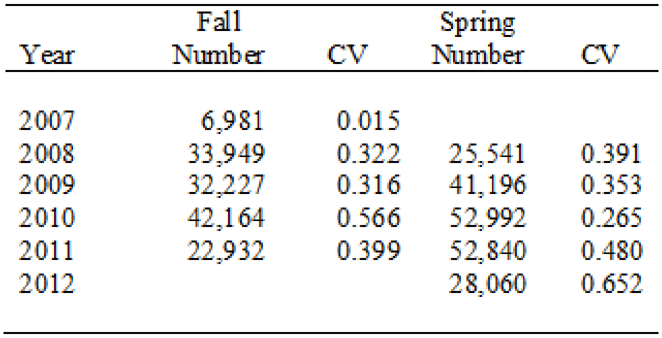
Model Name	Model Description
A. ASPI	Uses tag-based estimates of recapture probabilities from 1999 to 2009. Natural mortality based on Kahnle *et al.* (2007) rather than estimates derived from tagging model. Tag recaptures from commercial fisheries are adjusted for non reporting based on recaptures from observers and researchers. Tag loss assumed to be zero.
B. NEAMAP Swept Area	Uses NEAMAP survey-based swept area estimates of abundance and assumed estimates of gear efficiency. Estimates based on average of ten surveys from fall 2007 to spring 2012.

Table 7. Modeled Results

Model Run	Model Years	95% low	Mean	95% high
A. ASPI	1999-2009	165,381	417,934	744,597
B.1 NEAMAP Survey, swept area assuming 100% efficiency	2007-2012	8,921	33,888	58,856
B.2 NEAMAP Survey, swept area assuming 50% efficiency	2007-2012	13,962	67,776	105,984
B.3 NEAMAP Survey, swept area assuming 10% efficiency	2007-2012	89,206	338,882	588,558

The information from the NEAMAP survey can be used to calculate minimum swept area population estimates within the strata swept by the survey. The estimate from fall surveys ranges from 6,980 to 42,160 with coefficients of variation between 0.02 and 0.57, and the estimates from spring surveys ranges from 25,540 to 52,990 with coefficients of variation between 0.27 and 0.65 (Table 7). These are considered minimum estimates because the calculation makes the assumption that the gear will capture (i.e. net efficiency) 100% of the sturgeon in the water column along the tow path and that all sturgeon are with the sampling domain of the survey. We define catchability as: 1) the product of the probability of capture given encounter (i.e. net efficiency), and 2) the fraction of the population within the sampling domain. Catchabilities less than 100% will result in estimates greater than the minimum. The true catchability depends on many factors including the availability of the species to the survey and the behavior of the species with respect to the gear. True catchabilities much less than 100% are common for most species. The ratio of total sturgeon habitat to area sampled by the NEAMAP survey is unknown, but is certainly greater than one (i.e. the NEAMAP survey does not survey 100% of the Atlantic sturgeon habitat).

Table 8. Annual minimum swept area estimates for Atlantic sturgeon during the spring and fall from the Northeast Area Monitoring and Assessment Program survey. Estimates assume 100% net efficiencies. Estimates provided by Dr. Chris Bonzek, Virginia Institute of Marine Science (VIMS).



Year	Fall Number	CV	Spring Number	CV
2007	6,981	0.015		
2008	33,949	0.322	25,541	0.391
2009	32,227	0.316	41,196	0.353
2010	42,164	0.566	52,992	0.265
2011	22,932	0.399	52,840	0.480
2012			28,060	0.652

Available data do not support estimation of true catchabilty (i.e., net efficiency X availability) of the NEAMAP trawl survey for Atlantic sturgeon. Thus, the NEAMAP swept area biomass estimates were produced and presented in Kocik et al. (2013) for catchabilities from 5 to 100%. In estimating the efficiency of the sampling net, we consider the likelihood that an Atlantic sturgeon in the survey area is likely to be captured by the trawl. True efficiencies less than 100% are common for most species. Assuming the NEAMAP surveys have been 100% efficient would require the unlikely assumption that the survey gear captures all Atlantic sturgeon within the path of the trawl and all sturgeon are within the sampling area of the NEAMAP survey. In estimating the fraction of the Atlantic sturgeon population within the sampling area of the NEAMAP, we consider that the NEAMAP-based estimates do not include young of the year fish and juveniles in the rivers where the NEAMAP survey does not sample. Additionally, although the NEAMAP surveys are not conducted in the Gulf of Maine or south of Cape Hatteras, NC, the NEAMAP surveys are conducted from Cape Cod to Cape Hatteras at depths up to 18.3 meters (60 feet), which is within the preferred depth ranges of subadult and adult Atlantic sturgeon. NEAMAP surveys take place during seasons that coincide with known Atlantic sturgeon coastal migration patterns in the ocean. Therefore, the NEAMAP estimates are minimum estimates of the ocean population of Atlantic sturgeon but are based on sampling in a large portion of the marine range of the five DPSs, in known sturgeon coastal migration areas during times that sturgeon are expected to be migrating north and south.

Based on the above, we consider that the NEAMAP samples an area utilized by Atlantic sturgeon, but does not sample all the locations and times where Atlantic sturgeon are present and the trawl net captures some, but likely not all, of the Atlantic sturgeon present in the sampling area. Therefore, we assumed that net efficiency and the fraction of the population exposed to the NEAMAP survey in combination result in a 50% catchability. The 50% catchability assumption seems to reasonably account for the robust, yet not complete sampling of the Atlantic sturgeon oceanic temporal and spatial ranges and the documented high rates of encounter with NEAMAP survey gear and Atlantic sturgeon.

The ASPI model projects a mean population size of 417,934 Atlantic sturgeon and the NEAMAP Survey projects mean population sizes ranging from 33,888 to 338,882 depending on the assumption made regarding efficiency of that survey (see Table 8). The ASPI model uses estimates of post-capture survivors and natural survival, as well as probability estimates of recapture using tagging data from the United States Fish and Wildlife Service (USFWS) sturgeon tagging database, and federal fishery discard estimates from 2006 to 2010 to produce a virtual population. The NEAMAP estimate, in contrast, does not depend on as many assumptions. For the purposes of this Opinion, we consider the NEAMAP estimate resulting from the 50% catchability rate is the best available information on the number of subadult and adult Atlantic sturgeon in the ocean. .

The ocean population abundance of 67,776 fish estimated from the NEAMAP survey assuming 50% efficiency (based on net efficiency and the fraction of the total population exposed to the survey) was subsequently partitioned by DPS based on genetic frequencies of occurrence (Table 9) in the sampled area. Given the proportion of adults to subadults in the observer database (approximate ratio of 1:3), we have also estimated a number of subadults originating from each DPS. However, this cannot be considered an estimate of the total number of subadults because it only considers those subadults that are of a size vulnerable to capture in commercial sink gillnet and otter trawl gear in the marine environment and are present in the marine environment, which is only a fraction of the total number of subadults.

Table 9. Summary of calculated population estimates based upon the NEAMAP Survey swept area assuming 50% efficiency (based on net efficiency and area sampled) derived from applying the Mixed Stock Analysis to the total estimate of Atlantic sturgeon in the Ocean and the 1:3 ratio of adults to subadults

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Subadults (of size vulnerable to capture in fisheries)
GOM	7,455	1,864	5,591
NYB	34,566	8,642	25,925
CB	8,811	2,203	6,608
Carolina	1,356	339	1,017
SA	14,911	3,728	11,183
Canada	678	170	509

Threats Faced by Atlantic Sturgeon Throughout Their Range

Atlantic sturgeon are susceptible to over-exploitation given their life history characteristics (e.g., late maturity and dependence on a wide variety of habitats). Similar to other sturgeon species

(Vladykov and Greeley 1963; Pikitch *et al.* 2005), Atlantic sturgeon experienced range-wide declines from historical abundance levels due to overfishing (for caviar and meat) and impacts to habitat in the 19th and 20th centuries (Taub 1990; Smith and Clugston 1997; Secor and Waldman 1999).

Because a DPS is a group of populations, the stability, viability, and persistence of individual populations that make up the DPS affects the persistence and viability of the larger DPS. The loss of any population within a DPS could result in: (1) a long-term gap in the range of the DPS that is unlikely to be recolonized; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) loss of unique haplotypes; (5) loss of adaptive traits; and (6) reduction in total number. The loss of a population will negatively impact the persistence and viability of the DPS as a whole, as fewer than two individuals per generation spawn outside their natal rivers (Secor and Waldman 1999). The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, emigration to marine habitats to grow, and return of adults to natal rivers to spawn.

Based on the best available information, NMFS has concluded that bycatch in fisheries, vessel strikes, poor water quality, fresh water availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon (77 FR 5880 and 77 FR 5914; February 6, 2012). While all the threats are not necessarily present in the same area at the same time, given that Atlantic sturgeon subadults and adults use ocean waters from Labrador, Canada to Cape Canaveral, FL, as well as estuaries of large rivers along the U.S. East Coast, activities affecting these water bodies are likely to impact more than one Atlantic sturgeon DPS. In addition, because Atlantic sturgeon depend on a variety of habitats, every life stage is likely affected by one or more of the identified threats.

Atlantic sturgeon are particularly sensitive to bycatch mortality because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Based on these life history traits, Boreman (1997) calculated that Atlantic sturgeon can only withstand the annual loss of up to 5% of their population to bycatch mortality without suffering population declines. Mortality rates of Atlantic sturgeon taken as bycatch in various types of fishing gear range are variable with the greatest mortality occurring in sturgeon caught by sink gillnets. Atlantic sturgeon are particularly vulnerable to being caught in sink gillnets; therefore, fisheries using this type of gear account for a high percentage of Atlantic sturgeon bycatch. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or may result in delayed post-capture mortality.

As a wide-ranging anadromous species, Atlantic sturgeon are subject to numerous federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms, including the prohibition on possession, have addressed impacts to Atlantic sturgeon through directed fisheries, the listing determination concluded that the mechanisms in place to address the risk posed to Atlantic sturgeon from commercial bycatch were insufficient.

An ASMFC interstate fishery management plan for sturgeon (Sturgeon FMP) was developed and implemented in 1990 (Taub 1990). In 1998, the remaining Atlantic sturgeon fisheries in U.S. state waters were closed per Amendment 1 to the Sturgeon FMP. Complementary regulations were implemented by NMFS in 1999 that prohibit fishing for, harvesting, possessing, or retaining Atlantic sturgeon or their parts in or from the EEZ in the course of a commercial fishing activity.

Commercial fisheries for Atlantic sturgeon still exist in Canadian waters (DFO 2011). Sturgeon belonging to one or more of the DPSs may be harvested in the Canadian fisheries. In particular, the Bay of Fundy fishery in the Saint John estuary may capture sturgeon of U.S. origin given that sturgeon from the Gulf of Maine and the New York Bight DPSs have been incidentally captured in other Bay of Fundy fisheries (DFO, 2010; Wirgin and King 2011). Because Atlantic sturgeon are listed under Appendix II of the Convention on International Trade in Endangered Species (CITES), the U.S. and Canada are currently working on a conservation strategy to address the potential for captures of U.S. fish in Canadian-directed Atlantic sturgeon fisheries and of Canadian fish incidentally captured in U.S. commercial fisheries. At this time, there are no estimates of the number of individuals from any of the DPSs that are captured or killed in Canadian fisheries each year.

Based on geographic distribution, most U.S. Atlantic sturgeon that are intercepted in Canadian fisheries are likely to originate from the Gulf of Maine DPS, with a smaller percentage from the New York Bight DPS.

Bycatch in U.S. waters is one of the threats faced by all five DPSs. At this time, we have an estimate of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by federal FMPs (NMFS NEFSC 2011b) in the Northeast Region but do not have a similar estimate for southeast fisheries. We also do not have an estimate of the number of Atlantic sturgeon captured or killed in state fisheries. At this time, we are not able to quantify the effects of other significant threats (e.g., vessel strikes, poor water quality, water availability, dams, and dredging) in terms of habitat impacts or loss of individuals. While we have some information on the number of mortalities that have occurred in the past in association with certain activities (e.g., mortalities in the Delaware and James Rivers that are thought to be due to vessel strikes), we are not able to use those numbers to extrapolate effects throughout one or more DPSs. This is because of (1) the small number of data points and, (2) the lack of information on the percent of incidents that the observed mortalities represent.

As noted above, the NEFSC prepared an estimate of the number of encounters of Atlantic sturgeon in fisheries authorized by Northeast FMPs (NMFS NEFSC 2011b). The analysis estimates that from 2006 through 2010, there were averages of 1,548 and 1,569 encounters per year in observed gillnet and trawl fisheries, respectively, with an average of 3,118 encounters combined annually. Mortality rates in gillnet gear were approximately 20%. Mortality rates in otter trawl gear are generally lower, at approximately 5%.

Determination of DPS Composition in the Action Area
As explained above, the range of all five DPSs overlaps and extends from Canada through Cape Canaveral, Florida. Subadult and adult Atlantic sturgeon can be found throughout the range of the species; therefore, subadult and adult Atlantic sturgeon in the action area would not be limited to just individuals originating from the NYB DPS. Based on mixed-stock analysis, we have determined that subadult and adult Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: Gulf of Maine 7%; NYB 58%; Chesapeake Bay 18%; South Atlantic 17%; and Carolina 0.5%. These percentages are based on genetic sampling of individuals (n=105) sampled in directed research targeting Atlantic sturgeon along the Delaware Coast, just south of Delaware Bay. This is the closest sampling effort (geographically) to the action area for which mixed stock analysis results are available. Because the genetic composition of the mixed stock changes with distance from the rivers of origin, it is appropriate to use mixed stock analysis results from the nearest sampling location. Therefore, this represents the best available information on the likely genetic makeup of individuals occurring in the action area. The genetic assignments have a plus/minus 5% confidence interval; however, for purposes of section 7 consultation we have selected the reported values above, which approximate the mid-point of the range, as a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area. These assignments and the data from which they are derived are described in detail in Damon-Randall *et al.* (2012a).

5.5.1 Gulf of Maine DPS of Atlantic sturgeon

The Gulf of Maine DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, MA. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT, 2007). Spawning still occurs in the Kennebec River, and it is possible that it still occurs in the Penobscot River as well. Recent evidence indicates that spawning may also be occurring in the Androscoggin River. During the 2011 spawning season, the Maine Department of Marine Resources captured a larval Atlantic sturgeon below the Brunswick Dam. There is no evidence of recent spawning in the remaining rivers. In the 1800s, construction of the Essex Dam on the Merrimack River at river kilometer (rkm) 49 blocked access to 58 percent of Atlantic sturgeon habitat in the river (Oakley, 2003; ASSRT, 2007). However, the accessible portions of the Merrimack seem to be suitable habitat for Atlantic sturgeon spawning and rearing (i.e., nursery habitat) (Keiffer and Kynard, 1993). Therefore, the availability of spawning habitat does not appear to be the reason for the lack of observed spawning in the Merrimack River. Studies are on-going to determine whether Atlantic sturgeon are spawning in these rivers. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT, 2007). The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS as well as likely throughout the entire range (ASSRT, 2007; Fernandes, *et al.*, 2010).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the

Kennebec River suggest that spawning more likely occurs in June-July (Squiers *et al.*, 1981; ASMFC, 1998; NMFS and USFWS, 1998). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (i.e., expressing milt) in July 1994 below the (former) Edwards Dam; (2) capture of 31 adult Atlantic sturgeon from June 15,1980, through July 26,1980, in a small commercial fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least 4 ripe males and 1 ripe female captured on July 26,1980; and, (3) capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, ME (NMFS and USFWS, 1998; ASMFC 2007). The low salinity values for waters above Merrymeeting Bay are consistent with values found in other rivers where successful Atlantic sturgeon spawning is known to occur.

Several threats play a role in shaping the current status of Gulf of Maine DPS Atlantic sturgeon. Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17th century (Squiers *et al.*, 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers *et al.*, 1979). Following the 1880s, the sturgeon fishery was almost non-existent due to a collapse of the sturgeon stocks. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon by-catch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries occurring in state and federal waters still occur. In the marine range, Gulf of Maine DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast FMPs. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the Gulf of Maine DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the Gulf of Maine DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region; however, as noted above, not all projects are monitored for interactions with fish. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We are also not able to quantify any effects to habitat.

Connectivity is disrupted by the presence of dams on several rivers in the Gulf of Maine region, including the Penobscot and Merrimack Rivers. While there are also dams on the Kennebec, Androscoggin and Saco Rivers, these dams are near the site of natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon are known to occur upstream of any hydroelectric projects in the Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. While not expected to be killed or injured during passage at a dam, the extent that Atlantic sturgeon are affected by the existence of dams and their operations in the Gulf of Maine region is currently unknown. The documentation of an Atlantic sturgeon larvae downstream of the Brunswick Dam in the Androscoggin River suggests however, that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. Until it was breached in July 2013, the range of Atlantic sturgeon in the Penobscot River was limited by the presence of the Veazie Dam. Since the removal of the Veazie Dam, sturgeon can now travel as far upstream as the Great Works Dam. The Great Works Dam prevents Atlantic sturgeon from accessing the presumed historical spawning habitat located downstream of Milford Falls, the site of the Milford Dam. While removal of the Great Works Dams is anticipated to occur in the near future, the presence of this dam is currently preventing access to significant habitats within the Penobscot River. While Atlantic sturgeon are known to occur in the Penobscot River, it is unknown if spawning is currently occurring or whether the presence of the Great Works Dam affects the likelihood of spawning occurring in this river. The Essex Dam on the Merrimack River blocks access to approximately 58% of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. Like the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning occurring in this river.

Gulf of Maine DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Gulf of Maine over the past decades (Lichter *et al.* 2006; EPA, 2008). Many rivers in Maine, including the Androscoggin River, were heavily polluted in the past from industrial discharges from pulp and paper mills. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

There are no empirical abundance estimates for the Gulf of Maine DPS. The Atlantic sturgeon SRT (2007) presumed that the Gulf of Maine DPS was comprised of less than 300 spawning adults per year, based on abundance estimates for the Hudson and Altamaha River riverine populations of Atlantic sturgeon. Surveys of the Kennebec River over two time periods, 1977-1981 and 1998-2000, resulted in the capture of nine adult Atlantic sturgeon (Squiers, 2004). However, since the surveys were primarily directed at capture of shortnose sturgeon, the capture gear used may not have been selective for the larger-sized, adult Atlantic sturgeon; several hundred subadult Atlantic sturgeon were caught in the Kennebec River during these studies.

Summary of the Gulf of Maine DPS

Spawning for the Gulf of Maine DPS is known to occur in two rivers (Kennebec and Androscoggin) and possibly in a third. Spawning may be occurring in other rivers, such as the Sheepscot or Penobscot, but has not been confirmed. There are indications of increasing abundance of Atlantic sturgeon belonging to the Gulf of Maine DPS. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River, and are observed in rivers where they were unknown to occur or had not been observed to occur for many years (e.g., the Saco, Presumpscot, and Charles rivers). These observations suggest that abundance of the Gulf of Maine DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. However, despite some positive signs, there is not enough information to establish a trend for this DPS.

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC, 2007). Atlantic sturgeon from the GOM DPS are not commonly taken as bycatch in areas south of Chatham, MA, with only 8 percent (e.g., 7 of the 84 fish) of interactions observed in the Mid Atlantic/Carolina region being assigned to the Gulf of Maine DPS (Wirgin and King, 2011). Tagging results also indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south. However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy.(Canada) indicate that approximately 35 percent originated from the Gulf of Maine DPS (Wirgin *et al.*, in draft).

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). NMFS has determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

5.5.2 New York Bight DPS of Atlantic sturgeon

The New York Bight DPS includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters from Chatham, MA to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco, 1977; Secor, 2002; ASSRT, 2007). Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence (within the last 15 years) of spawning in the Connecticut and Taunton Rivers (ASSRT, 2007). Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT, 2007; Savoy, 2007; Wirgin and King, 2011).

The abundance of the Hudson River Atlantic sturgeon riverine population prior to the onset of expanded exploitation in the 1800s is unknown but, has been conservatively estimated at 10,000 adult females (Secor, 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (Secor, 2002; ASSRT, 2007; Kahnle *et al.*, 2007). As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). Kahnle *et al.* (1998; 2007) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. All available data on abundance of juvenile Atlantic sturgeon in the Hudson River Estuary indicate a substantial drop in production of young since the mid 1970s (Kahnle *et al.*, 1998). A decline appeared to occur in the mid to late 1970s followed by a secondary drop in the late 1980s (Kahnle *et al.*, 1998; Sweka *et al.*, 2007; ASMFC, 2010). Catch-per-unit-effort data suggests that recruitment has remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980s (Sweka *et al.*, 2007; ASMFC, 2010). In examining the CPUE data from 1985-2007, there are significant fluctuations during this time. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s although the CPUE is generally higher in the 2000s as compared to the 1990s. Given the significant annual fluctuation, it is difficult to discern any trend. Despite the CPUEs from 2000-2007 being generally higher than those from 1990-1999, they are low compared to the late 1980s. In addition to bycatch mortality in Federal waters, bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (shad), has now been closed and there is no indication that it will reopen soon. In the Hudson River sources of potential mortality include vessel strikes and entrainment in dredges. Individuals are also exposed to effects of bridge construction (including the ongoing replacement of the Tappan Zee bridge). Impingement at water intakes, including the Danskammer, Roseton and Indian Point power plants also occurs. There is currently not enough information regarding any life stage to establish a trend for the Hudson River population.

There is no abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman, 1999; Secor, 2002). Sampling in 2009 to target young-of- the year (YOY) Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 mm TL (Fisher, 2009) and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron in Calvo *et al.*, 2010). Genetics information collected from 33 of the 2009 year class YOY indicates that at least 3 females successfully contributed to the 2009 year class (Fisher, 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning is still occurring in the Delaware River, the relatively low numbers suggest the existing riverine population is limited in size.

Several threats play a role in shaping the current status and trends observed in the Delaware River and Estuary. In-river threats include habitat disturbance from dredging, and impacts from historical pollution and impaired water quality. A dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron, 2009), and the river receives significant shipping traffic. Vessel strikes have been identified as a threat in the Delaware River; however, at this time we do not have information to quantify this threat or its impact to the population or the New York Bight DPS. Similar to the Hudson River, there is currently not enough information to determine a trend for the Delaware River population.

Summary of the New York Bight DPS

Atlantic sturgeon originating from the New York Bight DPS spawn in the Hudson and Delaware rivers. While genetic testing can differentiate between individuals originating from the Hudson or Delaware river the available information suggests that the straying rate is high between these rivers. There are no indications of increasing abundance for the New York Bight DPS (ASSRT, 2009; 2010). Some of the impact from the threats that contributed to the decline of the New York Bight DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally-managed fisheries, and vessel strikes remain significant threats to the New York Bight DPS.

In the marine range, New York Bight DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, currently available estimates indicate that at least 4% of adults may be killed as a result of bycatch in fisheries authorized under Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent of the Atlantic sturgeon bycatch interactions in the Mid Atlantic Bight region were sturgeon from the New York Bight DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1-2% were from the New York Bight DPS. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects operate with observers present to document fish mortalities many do not. We have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We are also not able to quantify any effects to habitat.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke Dam on the Connecticut River blocks further upstream passage; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. Connectivity may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. The extent that Atlantic sturgeon are affected by operations of dams in the New York Bight region is currently unknown.

New York Bight DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Hudson and Delaware over the past decades (Lichter *et al.* 2006; EPA, 2008). Both the Hudson and Delaware rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sanitary sewer discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes occur in the Delaware River. Twenty-nine mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2004 to 2008, and at least 13 of these fish were large adults. Given the time of year in which the fish were observed (predominantly May through July, with two in August), it is likely that many of the adults were migrating through the river to the spawning grounds. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the New York Bight DPS.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. NMFS has determined that the New York Bight DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

5.5.3 Chesapeake Bay DPS of Atlantic sturgeon

The Chesapeake Bay DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, VA. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT, 2007). Based on the review by Oakley (2003), 100 percent of Atlantic sturgeon habitat is currently accessible in these rivers since most of the barriers to passage (i.e. dams) are located upriver of where spawning is expected to have historically occurred (ASSRT, 2007). Spawning still occurs in the James River, and the presence of juvenile and adult sturgeon in the York River suggests that spawning may occur there as well (Musick *et al.*, 1994; ASSRT, 2007; Greene, 2009). However, conclusive evidence of current spawning is only available for the James River. Atlantic sturgeon that are spawned elsewhere are known to use the Chesapeake Bay for other life functions, such as foraging and as juvenile nursery habitat prior to entering the marine system as subadults (Vladykov and Greeley, 1963; ASSRT, 2007; Wirgin *et al.*, 2007; Grunwald *et al.*, 2008).

Age to maturity for Chesapeake Bay DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). Age at maturity is 5 to 19 years for Atlantic sturgeon originating from South Carolina rivers (Smith *et al.*, 1982) and 11 to 21 years for Atlantic sturgeon originating from the Hudson River (Young *et al.*, 1998). Therefore, age at maturity for Atlantic sturgeon of the Chesapeake Bay DPS likely falls within these values.

Several threats play a role in shaping the current status of Chesapeake Bay DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of Atlantic sturgeon from the James River and Chesapeake Bay in the 19th century (Hildebrand and Schroeder, 1928; Vladykov and Greeley, 1963; ASMFC, 1998; Secor, 2002; Bushnoe *et al.*, 2005; ASSRT, 2007) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (Secor, 2002; Bushnoe *et al.*, 2005; ASSRT, 2007; Balazik *et al.*, 2010). Habitat disturbance caused by in-river work such as dredging for navigational purposes is thought to have reduced available spawning habitat in the James River (Holton and Walsh, 1995; Bushnoe *et al.*, 2005; ASSRT, 2007). At this time, we do not have information to quantify this loss of spawning habitat.

Decreased water quality also threatens Atlantic sturgeon of the Chesapeake Bay DPS, especially since the Chesapeake Bay system is vulnerable to the effects of nutrient enrichment due to a relatively low tidal exchange and flushing rate, large surface to volume ratio, and strong stratification during the spring and summer months (Pyzik *et al.*, 2004; ASMFC, 1998; ASSRT, 2007; EPA, 2008). These conditions contribute to reductions in dissolved oxygen levels throughout the Bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low dissolved oxygen) conditions within the Bay (Niklitschek and Secor, 2005; 2010). At this time we do not have sufficient information to quantify the extent that degraded water quality effects habitat or individuals in the James River or throughout the Chesapeake Bay.

Vessel strikes have been observed in the James River (ASSRT, 2007). Eleven Atlantic sturgeon were reported to have been struck by vessels from 2005 through 2007. Several of these were mature individuals. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the New York Bight DPS.

In the marine and coastal range of the Chesapeake Bay DPS from Canada to Florida, fisheries bycatch in federally and state managed fisheries pose a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population (Stein *et al.*, 2004; ASMFC, 2007; ASSRT, 2007).

Summary of the Chesapeake Bay DPS

Spawning for the Chesapeake Bay DPS is known to occur in only the James River. Spawning may be occurring in other rivers, such as the York, but has not been confirmed. There are anecdotal reports of increased sightings and captures of Atlantic sturgeon in the James River. However, this information has not been comprehensive enough to develop a population estimate for the James River or to provide sufficient evidence to confirm increased abundance. Some of the impact from the threats that facilitated the decline of the Chesapeake Bay DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). We do not currently have enough information about any life stage to establish a trend for this DPS.

Areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in U.S. state and federally-managed fisheries, Canadian fisheries and vessel strikes remain significant threats to the Chesapeake Bay DPS of Atlantic sturgeon. Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007). The Chesapeake Bay DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for population recovery.

5.5.4 Carolina DPS of Atlantic sturgeon

The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) from Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. Sturgeon are commonly captured 40 miles offshore (D. Fox, DSU, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters deep (Stein et al. 2004, ASMFC 2007), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms.

Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers. We determined spawning was occurring if young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system (Table 10). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. There may also be spawning populations in the Neuse, Santee and Cooper Rivers, though it is uncertain. Historically, both the Sampit and Ashley Rivers were documented to have spawning populations at one time. However, the spawning population in the Sampit River is believed to be extirpated and the current status of the spawning population in the Ashley River is unknown. Both rivers may be used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. This represents our current knowledge of the river systems utilized by the Carolina DPS for specific life functions, such as spawning, nursery habitat, and foraging. However, fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

River/Estuary	**Spawning Population**	**Data**
Roanoke River, VA/NC; Albemarle Sound, NC	Yes	collection of 15 YOY (1997-1998); single YOY (2005)
Tar-Pamlico River, NC; Pamlico Sound	Yes	one YOY (2005)
Neuse River, NC; Pamlico Sound	Unknown	
Cape Fear River, NC	Yes	upstream migration of adults in the fall, carcass of a ripe female

		upstream in mid-September (2006)
Waccamaw River, SC; Winyah Bay	Yes	age-1, potentially YOY (1980s)
Pee Dee River, SC; Winyah Bay	Yes	running ripe male in Great Pee Dee River (2003)
Sampit, SC; Winyah Bay	Extirpated	
Santee River, SC	Unknown	
Cooper River, SC	Unknown	
Ashley River, SC	Unknown	

Table 10. Major rivers, tributaries, and sounds within the range of the Carolina DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

The riverine spawning habitat of the Carolina DPS occurs within the Mid-Atlantic Coastal Plain ecoregion (TNC 2002a), which includes bottomland hardwood forests, swamps, and some of the world's most active coastal dunes, sounds, and estuaries. Natural fires, floods, and storms are so dominant in this region that the landscape changes very quickly. Rivers routinely change their courses and emerge from their banks. The primary threats to biological diversity in the Mid-Atlantic Coastal Plain, as listed by TNC are: global climate change and rising sea level; altered surface hydrology and landform alteration (e.g., flood-control and hydroelectric dams, inter-basin transfers of water, drainage ditches, breached levees, artificial levees, dredged inlets and river channels, beach renourishment, and spoil deposition banks and piles); a regionally receding water table, probably resulting from both over-use and inadequate recharge; fire suppression; land fragmentation, mainly by highway development; land-use conversion (e.g., from forests to timber plantations, farms, golf courses, housing developments, and resorts); the invasion of exotic plants and animals; air and water pollution, mainly from agricultural activities including concentrated animal feed operations; and over-harvesting and poaching of species. Many of the Carolina DPS' spawning rivers, located in the Mid-Coastal Plain, originate in areas of marl. Waters draining calcareous, impervious surface materials such as marl are: (1) likely to be alkaline; (2) dominated by surface run-off; (3) have little groundwater connection; and, (4) are seasonally ephemeral.

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002, Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same time-frame. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the Carolina DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the Carolina DPS has been extirpated, with a potential extirpation in an additional system. The ASSRT estimated the remaining river populations within the DPS to have fewer than 300 spawning adults; this is thought to be a small fraction of historic population sizes (ASSRT 2007).

Threats

The Carolina DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e, being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dams, dredging, and degraded water quality is contributing to the status of the Carolina DPS. Dams have curtailed Atlantic sturgeon spawning and juvenile developmental habitat by blocking over 60 percent of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and dissolved oxygen (DO)) downstream of these dams, as well as on the Roanoke River, has been reduced, which modifies and curtails the extent of spawning and nursery habitat for the Carolina DPS. Dredging in spawning and nursery grounds modifies the quality of the habitat and is further curtailing the extent of available habitat in the Cape Fear and Cooper Rivers, where Atlantic sturgeon habitat has already been modified and curtailed by the presence of dams. Reductions in water quality from terrestrial activities have modified habitat utilized by the Carolina DPS. In the Pamlico and Neuse systems, nutrient-loading and seasonal anoxia are occurring, associated in part with concentrated animal feeding operations (CAFOs). Heavy industrial development and CAFOs have degraded water quality in the Cape Fear River. Water quality in the Waccamaw and Pee Dee rivers have been affected by industrialization and riverine sediment samples contain high levels of various toxins, including dioxins. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the Carolina DPS. Twenty interbasin water transfers in existence prior to 1993, averaging 66.5 million gallons per day (mgd), were authorized at their maximum levels without being subjected to an evaluation for certification by North Carolina Department of Environmental and Natural Resources or other resource agencies. Since the 1993 legislation requiring certificates for transfers, almost 170 mgd of interbasin water withdrawals have been authorized, with an additional 60 mgd pending certification. The removal of large amounts of water from the system will alter flows, temperature, and DO. Existing water allocation issues will likely be compounded by population growth and potentially , by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the Carolina DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the Carolina DPS. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Further, a total population abundance for the DPS is not available, and it is therefore not possible to calculate the percentage of the DPS subject to bycatch mortality based on the available bycatch mortality rates for individual fisheries. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Carolina DPS Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution, etc.)

The recovery of Atlantic sturgeon along the Atlantic Coast, especially in areas where habitat is limited and water quality is severely degraded, will require improvements in the following areas: (1) elimination of barriers to spawning habitat either through dam removal, breaching, or installation of successful fish passage facilities; (2) operation of water control structures to provide appropriate flows, especially during spawning season; (3) imposition of dredging restrictions including seasonal moratoriums and avoidance of spawning/nursery habitat; and, (4) mitigation of water quality parameters that are restricting sturgeon use of a river (i.e., DO). Additional data regarding sturgeon use of riverine and estuarine environments is needed.

The concept of a viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the Carolina DPS put them in danger of extinction throughout their range; none of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. Although the largest impact that caused the precipitous decline of the species has been curtailed (directed fishing), the population sizes within the Carolina DPS are at greatly reduced levels compared to historical population sizes. Small numbers of individuals resulting from drastic reductions in populations, such as occurred with Atlantic sturgeon due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry, 1971; Shaffer, 1981; Soulé, 1980). Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. While a long life-span also allows multiple opportunities to contribute to future generations, it also increases the timeframe over which exposure to the multitude of threats facing the Carolina DPS can occur.

The viability of the Carolina DPS depends on having multiple self-sustaining riverine spawning populations and maintaining suitable habitat to support the various life functions (spawning, feeding, growth) of Atlantic sturgeon populations. Because a DPS is a group of populations, the stability, viability, and persistence of individual populations affects the persistence and viability of the larger DPS. The loss of any population within a DPS will result in: (1) a long-term gap in the range of the DPS that is unlikely to be recolonized; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) potential loss of unique haplotypes; (5) potential loss of adaptive traits; and (6) reduction in total number. The loss of a population will negatively impact the persistence and viability of the DPS as a whole, as fewer than two individuals per generation spawn outside their natal rivers (Secor and Waldman 1999). The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, the immigration into marine habitats to grow, and then the return of adults to natal rivers to spawn.

Summary of the Status of the Carolina DPS of Atlantic Sturgeon

In summary, the Carolina DPS is a small fraction of its historic population size. The ASSRT estimated there to be less than 300 spawning adults per year (total of both sexes) in each of the major river systems occupied by the DPS in which spawning still occurs. Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. While a long life-span allows multiple opportunities to contribute to future generations, this is hampered within the Carolina DPS by habitat alteration and bycatch. This DPS was severely depleted by past directed commercial fishing, and faces ongoing impacts and threats from habitat alteration or inaccessibility, bycatch, and the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch that have prevented river populations from rebounding and will prevent their recovery.

The presence of dams has resulted in the loss of over 60 percent of the historical sturgeon habitat on the Cape Fear River and in the Santee-Cooper system. Dams are contributing to the endangered status of the Carolina DPS by curtailing the extent of available spawning habitat and further modifying the remaining habitat downstream by affecting water quality parameters (such as depth, temperature, velocity, and DO) that are important to sturgeon. Dredging is also contributing to the status of the Carolina DPS by modifying Atlantic sturgeon spawning and nursery habitat. Habitat modifications through reductions in water quality are contributing to the status of the Carolina DPS due to nutrient-loading, seasonal anoxia, and contaminated sediments. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current threat to the Carolina DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may utilize multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning,. While many of the threats to the Carolina DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch is currently not being addressed through existing mechanisms. Further, access to habitat and water quality continues to be a problem even with NMFS' authority under the Federal Power Act to recommend fish passsage and existing controls on some pollution sources. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the Carolina DPS.

5.5.5 South Atlantic DPS of Atlantic sturgeon

The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers (ACE) Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. The marine range of Atlantic sturgeon from the South Atlantic DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida.

Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. We determined spawning was occurring if young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system (Table 11). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. Historically, both the Broad-Coosawatchie and St. Marys Rivers were documented to have spawning populations at one time; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. However, the spawning population in the St. Marys River, as well as any historical spawning population present in the St. Johns, is believed to be extirpated, and the status of the spawning population in the Broad-Coosawatchie is unknown. Both the St. Marys and St. Johns Rivers are used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. The use of the Broad-Coosawatchie by sturgeon from other spawning populations is unknown at this time. The presence of historical and current spawning populations in the Ashepoo River has not been documented; however, this river may currently be used for nursery habitat by young Atlantic sturgeon originating from other spawning populations. This represents our current knowledge of the river systems utilized by the South Atlantic DPS for specific life functions, such as spawning, nursery habitat, and foraging. However, fish from the South Atlantic DPS likely use other river systems than those listed here for their specific life functions.

River/Estuary	**Spawning Population**	**Data**
ACE (Ashepoo, Combahee, and Edisto Rivers) Basin, SC; St. Helena Sound	Yes	1,331 YOY (1994-2001); gravid female and running ripe male in the Edisto (1997); 39 spawning adults (1998)
Broad-Coosawhatchie Rivers, SC; Port Royal Sound	Unknown	
Savannah River, SC/GA	Yes	22 YOY (1999-2006); running ripe male (1997)
Ogeechee River, GA	Yes	age-1 captures, but high inter-annual variability (1991-1998); 17 YOY (2003); 9 YOY (2004)
Altamaha River, GA	Yes	74 captured/308 estimated spawning adults (2004); 139 captured/378 estimated spawning adults (2005)

Satilla River, GA	Yes	4 YOY and spawning adults (1995-1996)
St. Marys River, GA/FL	Extirpated	
St. Johns River, FL	Extirpated	

Table 11. Major rivers, tributaries, and sounds within the range of the South Atlantic DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

The riverine spawning habitat of the South Atlantic DPS occurs within the South Atlantic Coastal Plain ecoregion (TNC 2002b), which includes fall-line sandhills, rolling longleaf pine uplands, wet pine flatwoods, isolated depression wetlands, small streams, large river systems, and estuaries. Other ecological systems in the ecoregion include maritime forests on barrier islands, pitcher plant seepage bogs and Altamaha grit (sandstone) outcrops. Other ecological systems in the ecoregion include maritime forests on barrier islands, pitcher plant seepage bogs and Altamaha grit (sandstone) outcrops. The primary threats to biological diversity in the South Atlantic Coastal Plain listed by TNC are intensive silvicultural practices, including conversion of natural forests to highly managed pine monocultures and the clear-cutting of bottomland hardwood forests. Changes in water quality and quantity, caused by hydrologic alterations (impoundments, groundwater withdrawal, and ditching), and point and nonpoint pollution, are threatening the aquatic systems. Development is a growing threat, especially in coastal areas. Agricultural conversion, fire regime alteration, and the introduction of nonnative species are additional threats to the ecoregion's diversity. The South Atlantic DPS' spawning rivers, located in the South Atlantic Coastal Plain, are primarily of two types: brownwater (with headwaters north of the Fall Line, silt-laden) and blackwater (with headwaters in the coastal plain, stained by tannic acids).

Secor (2002) estimates that 8,000 adult females were present in South Carolina prior to 1890. Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in the state prior to 1890. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. Currently, the Atlantic sturgeon spawning population in at least two river systems within the South Atlantic DPS has been extirpated. The Altamaha River population of Atlantic sturgeon, with an estimated 343 adults spawning annually, is believed to be the largest population in the Southeast, yet is estimated to be only 6 percent of its historical population size. The ASSRT estimated the abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, to be less than 1 percent of what they were historically (ASSRT 2007).

Threats

The South Atlantic DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e, being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dredging and degraded water quality is contributing to the status of the South Atlantic DPS. Dredging is a present threat to the South Atlantic DPS and is contributing to their status by modifying the quality and availability of Atlantic sturgeon habitat. Maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River and modeling indicates that the proposed deepening of the navigation channel will result in reduced DO and upriver movement of the salt wedge, curtailing spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns River. Reductions in water quality from terrestrial activities have modified habitat utilized by the South Atlantic DPS. Low DO is modifying sturgeon habitat in the Savannah due to dredging, and non-point source inputs are causing low DO in the Ogeechee River and in the St. Marys River, which completely eliminates juvenile nursery habitat in summer. Low DO has also been observed in the St. Johns River in the summer. Sturgeon are more sensitive to low DO and the negative (metabolic, growth, and feeding) effects caused by low DO increase when water temperatures are concurrently high, as they are within the range of the South Atlantic DPS. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the South Atlantic DPS. Large withdrawals of over 240 million gallons per day mgd of water occur in the Savannah River for power generation and municipal uses. However, users withdrawing less than 100,000 gallons per day (gpd) are not required to get permits, so actual water withdrawals from the Savannah and other rivers within the range of the South Atlantic DPS are likely much higher. The removal of large amounts of water from the system will alter flows, temperature, and DO. Water shortages and “water wars” are already occurring in the rivers occupied by the South Atlantic DPS and will likely be compounded in the future by population growth and potentially by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the South Atlantic DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the South Atlantic DPS. The loss of large subadults and adults as a result of bycatch impacts Atlantic sturgeon populations because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Further, a total population abundance for the DPS is not available, and it is therefore not possible to calculate the percentage of the DPS subject to bycatch mortality based on the available bycatch mortality rates for individual fisheries. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the South Atlantic DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no permit requirements for water withdrawals under 100,000 gpd in Georgia, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution.)

The recovery of Atlantic sturgeon along the Atlantic Coast, especially in areas where habitat is limited and water quality is severely degraded, will require improvements in the following areas: (1) elimination of barriers to spawning habitat either through dam removal, breaching, or installation of successful fish passage facilities; (2) operation of water control structures to provide appropriate flows, especially during spawning season; (3) imposition of dredging restrictions including seasonal moratoriums and avoidance of spawning/nursery habitat; and, (4) mitigation of water quality parameters that are restricting sturgeon use of a river (i.e., DO). Additional data regarding sturgeon use of riverine and estuarine environments is needed.

A viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the South Atlantic DPS put them in danger of extinction throughout their range. None of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. Although the largest impact that caused the precipitous decline of the species has been curtailed (directed fishing), the population sizes within the South Atlantic DPS have remained relatively constant at greatly reduced levels for 100 years. Small numbers of individuals resulting from drastic reductions in populations, such as occurred with Atlantic sturgeon due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry, 1971; Shaffer, 1981; Soulé, 1980). Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. While a long life-span also allows multiple opportunities to contribute to future generations, it also increases the timeframe over which exposure to the multitude of threats facing the South Atlantic DPS can occur.

Summary of the Status of the South Atlantic DPS of Atlantic Sturgeon

The South Atlantic DPS is estimated to number a fraction of its historical abundance. . There are an estimated 343 spawning adults per year in the Altamaha and less than 300 spawning adults per year (total of both sexes) in each of the other major river systems occupied by the DPS in which spawning still occurs, whose freshwater range occurs in the watersheds (including all rivers and tributaries) of the ACE Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the South Atlantic DPS by habitat alteration, bycatch, and from the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch.

Dredging is contributing to the status of the South Atlantic DPS by modifying spawning, nursery, and foraging habitat. Habitat modifications through reductions in water quality are also contributing to the status of the South Atlantic DPS through reductions in DO, particularly during times of high water temperatures, which increase the detrimental effects on Atlantic sturgeon habitat. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current impact to the South Atlantic DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may utilize multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning. While many of the threats to the South Atlantic DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch is currently not being addressed through existing mechanisms. Further, access to habitat and water quality continues to be a problem even with NMFS' authority under the Federal Power Act to recommend fish passsage and existing controls on some pollution sources. There is a lack of regulation for some large water withdrawals, which threatens sturgeon habitat. Current regulatory regimes do not require a permit for water withdrawals under 100,000 gpd in Georgia and there are no restrictions on interbasin water transfers in South Carolina. Existing water allocation issues will likely be compounded by population growth, drought, and potentially climate change. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the South Atlantic DPS.

5.12.1 Summary of Sea turtles in the Action Area

Sea turtles are seasonally present in the action area from April to early November each year, with the highest number of individuals present from June to October. One of the main factors influencing sea turtle presence in northern waters is seasonal temperature patterns (Ruben and Morreale 1999). Temperature is correlated with the time of year, with the warmer waters in the late spring, summer, and early fall being the most suitable for cold-blooded sea turtles. Sea turtles are most likely to occur in the action area when water temperatures are above 11°C and depending on seasonal weather patterns, could be present from early April through November. The majority of sea turtle observations have been of loggerhead sea turtles, although green and kemp's ridleys have been recorded in the area.

To some extent, water depth also dictates the number of sea turtles occurring in a particular area. Satellite tracking studies of sea turtles in the Northeast found that foraging turtles mainly occurred in areas where the water depth was between approximately 16 and 49 ft (Ruben and Morreale 1999). This depth was interpreted not to be as much an upper physiological depth limit for turtles, as a natural limiting depth where light and food are most suitable for foraging turtles (Morreale and Standora 1990). Some of the areas to be dredged and the depths preferred by sea turtles do overlap, suggesting that if suitable forage was present, loggerheads and Kemp's ridleys may be foraging in the areas where dredging will occur.

5.12.2 Summary of Atlantic sturgeon in the Action Area

Subadult (less than 150cm in total length, not sexually mature, but have left their natal rivers) and adult Atlantic sturgeon undertake seasonal, nearshore (i.e., typically depths less than 50 meters), coastal marine migrations along the United States eastern coastline (Erickson *et al*. 2011; Dunton *et al*. 2010). Based on tagging data, it is believed that beginning in the fall, Atlantic sturgeon undergo large scale migrations to more southerly waters (e.g., off the coast North Carolina, the mouth of the Chesapeake Bay) and primarily remain in these waters throughout the winter (i.e., approximately December through March), while in the spring, it appears that migrations begin to shift to more northerly waters (e.g., waters off New Jersey and New York) (Dovel and Berggren 1983; Dunton *et al*. 2010; Erikson *et al*. 2011). Atlantic sturgeon aggregate in several distinct areas along the Mid-Atlantic coastline; Atlantic sturgeon are most likely to occur in areas adjacent to estuaries and/or coastal features formed by bay mouths and inlets (Stein *et al.* 2004a; Laney *et. al* 2007; Erickson et al. 2011; Dunton *et al.* 2010). These aggregation areas are located within the coastal waters off North Carolina; waters between the Chesapeake Bay and Delaware Bay; the New Jersey Coast; and the southwest shores of Long Island (Laney *et. al* 2007; Erickson et al. 2011; Dunton *et al*. 2010). Based on five fishery-independent surveys, Dunton *et al*. (2010) identified several "hotspots" for Atlantic sturgeon captures, including an area off Sandy Hook, New Jersey, and off Rockaway, New York. These "hotspots" are aggregation areas that are most often used during the spring, summer, and fall months (Erickson *et al*. 2011; Dunton *et al*. 2010). Areas between these sites serve as migration corridors to and from these areas, as well as to spawning grounds found within natal rivers.

Subadult and adult Atlantic sturgeon occur in the action area. We expect that in areas where suitable forage is present, Atlantic sturgeon will be foraging in the action area. The action area is also used by Atlantic sturgeon as they migrate along the coast to their natal rivers for spawning and to overwintering aggregations.

6.0 ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR § 402.02). The environmental baseline for this Opinion includes the effects of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, discharge of pollutants that may affect water quality, scientific research, shipping and other vessel traffic and fisheries, and recovery activities associated with reducing those impacts.

6.1 Federal Actions that have Undergone Formal or Early Section 7 Consultation

NMFS has undertaken several ESA section 7 consultations to address the effects of actions authorized, funded or carried out by Federal agencies. Each of those consultations sought to develop ways of reducing the probability of adverse impacts of the action on listed species. Consultations are detailed below.

6.1.1 Use of Sand Borrow Areas

As explained in Section 2.0 above, USACE and NMFS have consulted previously on dredging activities in the action area. Between May and November, all hopper dredges operating in the action area from 1993-2007 carried endangered species observers. Observers inspected inflow baskets for sea turtle parts between each dredge load. Observers worked a 12-hour shift, providing 50% coverage of all material captured in the inflow baskets. Only one sea turtle was recoded during the course of these observations (dead loggerhead, Cape May Inlet, 1993). In 2007, the State of New Jersey required the use of munitions screening on all dredges operating to provide sand to beaches. Observers have not been used on hopper dredges operating in the New Jersey portion of the action area since 2007. Similarly, munitions screening has been used in the Delaware portion of the action area since 2007; however, the use of observers at these projects has continued. No sea turtles or sea turtle parts have been observed in the inflow screens to date. Observers have not been in place for any cutterhead dredging projects; however baskets have been placed at discharge pipes since 2007; these baskets are designed to capture any material with a diameter larger than 0.75” to prevent the placement of small munitions or UXO on the beaches. The baskets are cleaned out every few hours. No sea turtle or sturgeon parts have been identified to date.

6.1.2 Scientific Studies

We have completed ESA section 7 consultation on research projects that will occur in the action area. Copies of all Opinions referenced here are available on our website: http://www.nero.noaa.gov/protected/section7/bo/actbo.html.

The U.S. Fish and Wildlife Service funds an ocean trawl survey carried out by the State of New Jersey; the project is currently funded through 2019. This federal action was one of several activities considered in a consultation completed in January 2013. In the Opinion, we concluded that the action may adversely affect, but was not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon. The ITS exempts the take of Atlantic sturgeon through capture in the trawl survey. All captured Atlantic sturgeon are expected to be released alive and no lethal take is anticipated.

We provide funding to the Virginia Institute of Marine Science (VIMS) to carry out the Northeast Area Monitoring and Assessment Program (NEAMAP) Near Shore Trawl Program. Effects of this activity were most recently assessesed in an Opinion issued on May 28, 2013. In that Opinion, we concluded that the surveys may adversely affect, but were not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon or any species of listed sea turtle. No lethal interactions are anticipated.

NMFS Northeast Fisheries Science Center (NEFSC) carries out several studies in the action area. The effects of these studies were most recently considered in an Opinion issued in November

2012. In that Opinion, we concluded that the surveys may adversely affect, but were not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon or any species of listed sea turtle.

6.1.3 Vessel Operations

Potential adverse effects from federal vessel operations in the action area of this consultation include operations of the US Navy (USN) and the US Coast Guard (USCG), which maintain the largest federal vessel fleets, the EPA, the National Oceanic and Atmospheric Administration (NOAA), and the USACE. NMFS has conducted formal consultations with the USCG, the USN, EPA and NOAA on their vessel operations. In addition to operation of USACE vessels, NMFS has consulted with the USACE to recommend permit restrictions for operations of contract or private vessels around whales. Through the section 7 process, where applicable, NMFS has and will continue to, establish conservation measures for all these agency vessel operations to avoid adverse effects to listed species. Refer to the biological opinions for the USCG (September 15, 1995; July 22, 1996; and June 8, 1998) and the USN (May 15, 1997) for detail on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures.

6.1.4 Authorization of Fisheries through Fishery Management Plans

NMFS authorizes the operation of several fisheries in the action area under the authority of the Magnuson-Stevens Fishery Conservation and Management Act and through Fishery Management Plans (FMPs) and their implementing regulations. The action area includes portions of NOAA Statistical Areas 612, 614 and 621 (see map at: http://www.nero.noaa.gov/nero/fishermen/charts/stat1.html). Fisheries that operate in the action area that may affect ESA-listed species include: American lobster, Atlantic bluefish, Atlantic herring, Atlantic mackerel/squid/ butterfish, Atlantic sea scallop, monkfish, Northeast multispecies, spiny dogfish, surf clam/ocean quahog and summer flounder/scup/black sea bass. Section 7 consultations have been completed on these fisheries to consider effects to listed whales, sea turtles and sturgeon. Of the fisheries noted above, we expect that interactions with listed species may occur in all except Atlantic herring and surf clam/ocean quahog.

Batched Fisheries Opinion

On December 16, 2013, we issued an Opinion on the continued implementation of management measures for the Northeast multispecies, monkfish, spiny dogfish, Atlantic bluefish, Northeast skate complex, mackerel/squid/butterfish, and summer flounder/scup/black sea bass fisheries. We concluded that the proposed actions may adversely affect, but would not likely jeopardize the continued existence of listed whales, sea turtles and Atlantic sturgeon. The Opinion included an ITS which exempted the following take, via injury or mortality:

- Loggerhead sea turtles: 269 over a five-year average in gillnet gear, 213 loggerheads over a four-year average in bottom trawl gear, and one loggerhead in trap/pot gear
- Kemp's ridley sea turtles: the annual take of 4 in gillnet gear and 3 in bottom trawl gear.
- Green sea turtles: annual take of 4 in gillnet gear, and 3 in bottom trawl
- Atlantic sturgeon from the GOM DPS, annual take of up to 137 individuals over a five-year average in gillnet gear, the annual take of up to 148 individuals over a five-year average in bottom trawl gear

- Atlantic sturgeon from the NYB DPS, annual take of up to 632 individuals over a five-year average in gillnet gear, the annual take of up to 685 individuals over a five-year average in bottom trawl gear
- Atlantic sturgeon from the CB DPS, annual take of up to 162 individuals over a five-year average in gillnet gear, the annual take of up to 175 individuals over a five-year average in bottom trawl gear
- Atlantic sturgeon from the Carolina DPS, annual take of up to 162 individuals over a five-year average in gillnet gear, the annual take of up to 175 individuals over a five-year average in bottom trawl gear
- Atlantic sturgeon from the SA DPS, annual take of up to 273 individuals over a five-year average in gillnet gear, the annual take of up to 296 individuals over a five-year average in bottom trawl gear
- GOM DPS Atlantic Salmon, 5 over a five-year average in gillnet gear and 5 over a five-year average in trawl gear.

American Lobster Fishery

The American lobster fishery has been identified as causing injuries to and mortality of loggerhead sea turtles as a result of entanglement in buoy lines of the pot/trap gear. Pot/trap gear has also been identified as a gear type causing injuries and mortality of right, Humpback, and fin whales. The most recent Opinion for this fishery, completed on August 3, 2012, concluded that operation of the federally regulated portion of the lobster trap fishery may adversely affect loggerhead sea turtles as a result of entanglement in the groundlines and/or buoy lines associated with this type of gear. An ITS was issued with the 2012 Opinion that exempted the take of 1 loggerhead sea turtle.

Atlantic Sea Scallop Fishery

Loggerhead, Kemp's ridley, and green sea turtles have been reported by NMFS observers as being captured in scallop dredge and or trawl gear. Between January 1, 2001 and September 25, 2006 the average number of annual observable interactions of hard-shelled sea turtles in the Mid-Atlantic dredge fishery was estimated to be 288 turtles, of which 218 could be confirmed as loggerheads (Murray 2011). Between September 26, 2006 and December 31, 2008, after the implementation of chain mats the average annual number of observable plus unobservable, quantifiable interactions in the Mid-Atlantic dredge fishery was estimated to be 125 turtles, of which 95 could be confirmed as loggerheads (Murray 2011). An estimate of loggerhead bycatch in Mid-Atlantic scallop trawl gear from 2005-2008 averaged 95 turtles annually (Warden 2011a).

Formal section 7 consultation on the continued authorization of the scallop fishery was last reinitiated on February 28, 2012, with an Opinion issued by NMFS on July 12, 2012. In this Opinion, NMFS determined that the continued authorization of the Scallop FMP (including the seasonal use of turtle deflector dredges [TDDs] in Mid-Atlantic waters starting in 2013) may adversely affect but was not likely to jeopardize the continued existence of loggerhead, leatherback, Kemp's ridley, and green sea turtles, or the five DPSs of Atlantic sturgeon, and issued an ITS. In the ITS, the scallop fishery is estimated to interact annually with up to 301 loggerhead, two leatherback, three Kemp's ridley, and two green sea turtles, as well as one Atlantic sturgeon from any of the five DPSs. Of the loggerhead interactions, up to 112 per year are anticipated to be lethal from 2013 going forward.

NMFS' Southeast Regional Office has carried out formal ESA section 7 consultations for several FMPs with action areas that at least partially overlap with the action area. These include a Biological Opinion on the continued authorization of the Atlantic shark fishery, December 2012, (including a newly authorized Federal smoothhound fishery) and a Biological Opinion on the continued authorization of fishing under the FMP for Coastal Migratory Pelagic Resources in the Atlantic and Gulf of Mexico. In both of these consultations NMFS concluded that the proposed action was not likely to jeopardize the continued existence of any of the species being considered here.

NMFS has conducted a formal consultation on the pelagic longline component of the Atlantic highly migratory species FMP. Portions of this fishery occur within the action area. In a June 1, 2004 Opinion, NMFS concluded that the ongoing action was likely to adversely affect but was not likely to jeopardize the continued existence of loggerhead, Kemp's ridley or green sea turtles but was likely to jeopardize the continued existence of leatherback sea turtles. This Opinion included a Reasonable and Prudent Alternative that when implemented would modify operations of the fishery in a way that would remove jeopardy. This fishery is currently operated in a manner that is consistent with the RPA. The RPA included an ITS which is reflected in the table below. Unless specifically noted, all numbers denote an annual number of captures that may be lethal or non-lethal.

Table 12. Information on Fisheries Opinions conducted by NMFS SERO for federally managed fisheries that operate in the action area

FMP	**Date of Most Recent Opinion**	**Loggerhead**	**Kemp's ridley**	**Green**	**Atlantic sturgeon (all 5 DPSs)**
Shark fisheries as managed under the Consolidated HMS FMP	December 12, 2012	126 (78 lethal) every 3 years	36 (15 lethal) every 3 years	57 (24 lethal) every 3 years	321 (66 lethal) every 3 years
Coastal migratory pelagic	August 13, 2007	33 every 3 years	4 every 3 years	14 every 3 years	NA
Pelagic longline under the HMS FMP (per the RPA)	June 1, 2004	1,905 (339 lethal) every 3 years	*105 (18 lethal) every 3 years	*105 (18 lethal) every 3 years	NA

**combination of 105 (18 lethal) Kemp's ridley, green, hawksbill, or Olive ridley*

6.2 State or Private Actions in the Action Area

6.2.1 State Authorized Fisheries

Atlantic sturgeon and sea turtles may be vulnerable to capture, injury and mortality in fisheries occurring in state waters. The action area includes portions of New Jeresy and Delaware state waters. Information on the number of sturgeon captured or killed in state fisheries is extremely limited and as such, efforts are currently underway to obtain more information on the numbers of sturgeon captured and killed in state water fisheries. We are currently working with the Atlantic States Marine Fisheries Commission (ASMFC) and the coastal states to assess the impacts of state authorized fisheries on sturgeon. We anticipate that some states are likely to apply for ESA section 10(a)(1)(B) Incidental Take Permits to cover their fisheries; however, to date, applications have not been submitted by New Jersey or Delaware. Below, we discuss the different fisheries authorized by the states and any available information on interactions between these fisheries and sturgeon.

Atlantic croaker

Atlantic croaker (*Micropogonias undulates*) occur in coastal waters from the Gulf of Maine to Argentina, and are one of the most abundant inshore bottom-dwelling fish along the U.S. Atlantic coast. Atlantic croaker are managed under an ASMFC ISFMP (including Amendment 1 in 2005 and Addendum 1 in 2010), but no specific management measures are required.

Recreational fisheries for Atlantic croaker are likely to use hook and line; commercial fisheries targeting croaker primarily use otter trawls. The average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the Atlantic croaker fishery was estimated to be 70 loggerhead sea turtles (Warden 2011). Additional information on sea turtle interactions with gillnet gear, including gillnet gear used in the Atlantic croaker fishery, has been published by Murray (2009a, 2009b). The average annual bycatch of loggerhead sea turtles in gillnet gear used in the Atlantic croaker fishery, based on VTR data from 2002-2006, was estimated to be 11 per year with a 95% CI of 3-20 (Murray 2009b). A quantitative assessment of the number of Atlantic sturgeon captured in the croaker fishery is not available. Mortality rates of Atlantic sturgeon in commercial trawls has been estimated at 5%. A review of the NEFOP database indicates that from 2006-2010, 60 Atlantic sturgeon (out of a total of 726 observed interactions) were captured during observed trips where the trip target was identified as croaker. This represents a minimum number of Atlantic sturgeon captured in the croaker fishery during this time period as it only considers observed trips for boats with federal permits only. We do not have an estimate of the number of interactions between sturgeon or sea turtles with the croaker fishery in the action area.

Horseshoe crabs

ASMFC manages horseshoe crabs through an Interstate Fisheries Management Plan that sets state quotas, and allows states to set closed seasons. Horseshoe crabs are present in Chesapeake Bay. Stein *et al.* (2004) examined bycatch of Atlantic sturgeon using the NMFS sea-sampling/observer database (1989-2000) and found that the bycatch rate for horseshoe crabs was very low, at 0.05%. Few Atlantic sturgeon are expected to be caught in the horeshoe crab fishery in the action area. Sea turtles are not known to be captured during horseshoe crab fishing.

Striped bass

Striped bass are managed by ASMFC through Amendment 6 to the Interstate FMP, which requires minimum sizes for the commercial and recreational fisheries, possession limits for the recreational fishery, and state quotas for the commercial fishery (ASMFC 2003). Under Addendum 2, the coastwide striped bass quota remains the same, at 70% of historical levels. Data from the Atlantic Coast Sturgeon Tagging Database (2000-2004) shows that the striped bass fishery accounted for 43% of Atlantic sturgeon recaptures; however, no information on the total number of Atlantic sturgeon caught by fishermen targeting striped bass or the mortality rate is available. No information on interactions between sea turtles and the striped bass fishery is available.

Weakfish

The weakfish fishery occurs in both state and federal waters but the majority of commercially and recreationally caught weakfish are caught in state waters (ASMFC 2002). The dominant commercial gears include gill nets, pound nets, haul seines, and trawls, with the majority of landings occurring in the fall and winter months (ASMFC 2002). Fishing for weakfish occurs in Chesapeake Bay.

The average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the weakfish fishery was estimated to be 1 loggerhead sea turtle (Warden 2011). Additional information on sea turtle interactions with gillnet gear, including gillnet gear used in the weakfish fishery, has been published by Murray (2009a, 2009b). The average annual bycatch of loggerhead sea turtles in gillnet gear used in the weakfish fishery, based on VTR data from 2002-2006, was estimated to be one (1) per year with a 95% CI of 0-1 (Murray 2009b).

A quantitative assessment of the number of Atlantic sturgeon captured in the weakfish fishery is not available. A review of the NEFOP database indicates that from 2006-2010, 36 Atlantic sturgeon (out of a total of 726 observed interactions) were captured during observed trips where the trip target was identified as weakfish. This represents a minimum number of Atlantic sturgeon captured in the weakfish fishery during this time period as it only considers observed trips, and most inshore fisheries are not observed. An earlier review of bycatch rates and landings for the weakfish fishery reported that the weakfish-striped bass fishery had an Atlantic sturgeon bycatch rate of 16% from 1989-2000; the weakfish-Atlantic croaker fishery had an Atlantic sturgeon bycatch rate of 0.02%, and the weakfish fishery had an Atlantic sturgeon bycatch rate of 1.0% (ASSRT 2007).

American lobster trap fishery

An American lobster trap fishery also occurs in the action area. This fishery is managed under the ASMFC's ISFMP. This fishery has also been identified as a source of gear causing injuries to, and mortality of, loggerhead sea turtles as a result of entanglement in vertical buoy lines of the pot/trap gear. Between 2002 and 2008, the lobster trap fishery in state waters was verified as the fishery involved in at least 27 leatherback entanglements in the Northeast Region. All entanglements involved the vertical line of the gear. These verified/confirmed entanglements occurred in Maine, Massachusetts, and Rhode Island state waters from June through October (Northeast Region STDN database). While no entanglements in lobster gear have been reported for the action area, the potential for future entanglement exists. Atlantic sturgeon are not known to interact with lobster trap gear.

Whelk and blue crab fisheries

A whelk fishery using pot/trap gear is known to occur in offshore New Jersey and Delaware. This fishery operates when sea turtles may be in the area. Sea turtles (loggerheads and Kemp's ridleys in particular) are believed to become entangled in the top bridle line of the whelk pot, given a few documented entanglements of loggerheads in whelk pots, the configuration of the gear, and the turtles' preference for the pot contents. Research is underway to determine the magnitude of these interactions and to develop gear modifications to reduce these potential entanglements. The blue crab fishery using pot/trap gear also occurs in the action area. The magnitude of interactions with these pots and sea turtles is unknown, but loggerheads and leatherbacks have been found entangled in this gear. For instance, in May and June 2002, three leatherbacks were documented entangled in crab pot gear in various areas of the Chesapeake Bay. It is possible that these interactions are more frequent than what has been documented. No interactions between Atlantic sturgeon and crab pot gear has been reported to NMFS.

6.3 Other Impacts of Human Activities in the Action Area

6.3.1 Contaminants and Water Quality

Point source discharges (i.e., municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) and compounds associated with discharges (i.e., metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon populations. The compounds associated with discharges can alter the pH of receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival. Agriculture and forestry occur within the Chesapeake Bay watershed, which potentially results in an increase in the amount of suspended sediment present in the river. Concentrated amounts of suspended solids discharged into a river system may lead to smothering of fish eggs and larvae and may result in a reduction in the amount of available dissolved oxygen.

Within the action area, listed species and their habitat most likely have been impacted by pollution. Marine debris (e.g., discarded fishing line or lines from boats) can entangle turtles in the water and drown them.

Chemical contaminants may also have an effect on sea turtle and Atlantic sturgeon reproduction and survival. While the effects of contaminants on turtles is relatively unclear, pollution may be linked to the fibropapilloma virus that kills many turtles each year (NMFS 1997). If pollution is not the causal agent, it may make sea turtles more susceptible to disease by weakening their immune systems. Several characteristics of Atlantic sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to long term, repeated exposure to environmental contaminants and bioaccumulation of toxicants (Dadswell 1979). Toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms (Varanasi 1992) like sturgeon. Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long term effects are not yet known (Ruelle and Henry 1992; Ruelle and Keenlyne 1993). Available data suggest that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976). Although there have not been any studies to assess the impact of contaminants on Atlantic sturgeon, elevated levels of environmental contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Cameron et al. 1992; Longwell et al. 1992), reduced egg viability (Von Westernhagen et al. 1981; Hansen 1985; Mac and Edsall 1991), and reduced survival of larval fish (Berlin et al. 1981; Giesy et al. 1986). Some researchers have speculated that PCBs may reduce the shortnose sturgeon's resistance to fin rot (Dovel et al.

1992); similar impacts may be seen in Atlantic sturgeon.

Although there is scant information available on levels of contaminants in Atlantic sturgeon tissues, some research on other, related species indicates that concern about effects of contaminants on the health of sturgeon populations is warranted. Detectable levels of chlordane, DDE, DDT, and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (US Fish and Wildlife Service 1993). These compounds may affect physiological processes and impede a fish's ability to withstand stress. PCBs are believed to adversely affect reproduction in pallid sturgeon (Ruelle and Keenlyne 1993). Ruelle and Henry (1992) found a strong correlation between fish weight $r = 0.91$, $p < 0.01$), fish fork length $r = 0.91$, $p < 0.01$), and DDE concentration in pallid sturgeon livers, indicating that DDE concentration increases proportionally with fish size.

Excessive turbidity due to coastal development and/or construction sites could influence sea turtle foraging ability. Turtles are not very easily affected by changes in water quality or increased suspended sediments, but if these alterations make habitat less suitable for turtles and hinder their capability to forage, eventually they would tend to leave or avoid these less desirable areas (Ruben and Morreale 1999). Turbidity is most likely to affect Atlantic sturgeon if it results in reductions in benthic forage. This is not known to be a concern in the action area.

6.4 Reducing Threats to ESA-listed Sea Turtles

Numerous efforts are ongoing to reduce threats to listed sea turtles. Below, we detail efforts that are ongoing within the action area. The majority of these activities are related to regulations that have been implemented to reduce the potential for incidental mortality of sea turtles from commercial fisheries. These include sea turtle release gear requirements for Atlantic HMS; TED requirements for Southeast shrimp trawl fishery and the southern part of the summer flounder trawl fishery; mesh size restrictions in the North Carolina gillnet fishery and Virginia's gillnet and pound net fisheries; modified leader requirements in the Virginia Chesapeake Bay pound net fishery; area closures in the North Carolina gillnet fishery; and gear modifications in the Atlantic sea scallop dredge fishery. In addition to regulations, outreach programs have been established and data on sea turtle interactions and strandings are collected. The summaries below discuss all of these measures in more detail.

6.4.1 Use of a Chain-Mat Modified Scallop Dredge in the Mid-Atlantic

In response to the observed capture of sea turtles in scallop dredge gear, including serious injuries and sea turtle mortality as a result of capture, NMFS proposed a modification to scallop dredge gear (70 FR 30660, May 27, 2005). The rule was finalized as proposed (71 FR 50361, August 25, 2006) and required federally permitted scallop vessels fishing with dredge gear to modify their gear by adding an arrangement of horizontal and vertical chains (hereafter referred to as a "chain mat") between the sweep and the cutting bar when fishing in Mid-Atlantic waters south of 41°9'N from the shoreline to the outer boundary of the EEZ during the period of May 1-November 30 each year. The requirement was subsequently modified by emergency rule on November 15, 2006 (71 FR 66466), and by a final rule published on April 8, 2008 (73 FR 18984). On May 5, 2009, NMFS proposed additional minor modifications to the regulations on how chain mats are configured (74 FR 20667). In general, the chain mat gear modification is expected to reduce the severity of some sea turtle interactions with scallop dredge gear.

However, this modification is not expected to reduce the overall number of sea turtle interactions with scallop dredge gear.

6.4.2 Sea Turtle Handling and Resuscitation Techniques

NMFS published as a final rule in the *Federal Register* (66 FR 67495, December 31, 2001) sea turtle handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear.

6.4.3 Sea Turtle Entanglements and Rehabilitation

A final rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS, the USFWS, the U.S. Coast Guard, or any other Federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA (50 CFR § 223.206(b)).

6.4.4 Education and Outreach Activities

Education and outreach activities do not directly reduce the threats to ESA-listed sea turtles. However, education and outreach are a means of better informing the public of steps that can be taken to reduce impacts to sea turtles (*i.e.*, reducing light pollution in the vicinity of nesting beaches) and increasing communication between affected user groups (*e.g.*, the fishing community). For the HMS fishery, NMFS has been active in public outreach to educate fishermen regarding sea turtle handling and resuscitation techniques. For example, NMFS has conducted workshops with longline fishermen to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts in an attempt to increase the survival of protected species through education on proper release techniques.

6.4.5 Sea Turtle Stranding and Salvage Network (STSSN)

As is the case with education and outreach, the STSSN does not directly reduce the threats to sea turtles. However, the extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded turtles. Data collected by the STSSN are used to monitor stranding levels and identify areas where unusual or elevated mortality is occurring. These data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN tag live turtles when encountered (either via the stranding network through incidental takes or in-water studies). Tagging studies help provide an understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for the species.

6.5 Reducing Threats to Atlantic sturgeon

Several conservation actions aimed at reducing threats to Atlantic sturgeon are currently ongoing. In the near future, NMFS will be convening a recovery team and will be drafting a recovery plan which will outline recovery goals and criteria and steps necessary to recover all Atlantic sturgeon DPSs. Numerous research activities are underway, involving NMFS and other Federal, State and academic partners, to obtain more information on the distribution and abundance of Atlantic sturgeon throughout their range, including in the action area. Efforts are also underway to better understand threats faced by the DPSs and ways to minimize these threats, including bycatch and water quality, and to develop population estimates for each DPS. Fishing gear research is underway to design fishing gear that minimizes interactions with Atlantic sturgeon while maximizing retention of targeted fish species. Several states are in the process of preparing ESA Section 10 Habitat Conservation Plans aimed at minimizing the effects of state fisheries on Atlantic sturgeon.

7.0 CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change in the action area (i.e., the U.S. Mid-Atlantic coast) and how listed sea turtles and sturgeon may be affected by those predicted environmental changes over the life of the proposed action (i.e., between now and 2062). Climate change is relevant to the Status of the Species, Environmental Baseline and Cumulative Effects sections of this Opinion; rather than include partial discussion in several sections of this Opinion, we are synthesizing this information into one discussion. Consideration of effects of the proposed action in light of predicted changes in environmental conditions due to anticipated climate change are included in the Effects of the Action section below (section 8.0 below).

7.1 Background Information on Global climate change

The global mean temperature has risen 0.76ºC (1.36°F) over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (Intergovernmental Panel on Climate Change (IPCC) 2007a) and precipitation has increased nationally by 5%-10%, mostly due to an increase in heavy downpours (NAST 2000). There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and other pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007b); these trends are most apparent over the past few decades. Information on future impacts of climate change in the action area is discussed below.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next century. Both of the principal climate models used by the National Assessment Synthesis Team (NAST) project warming in the southeast by the 2090s, but at different rates (NAST 2000): the Canadian model scenario shows the southeast U.S. experiencing a high degree of warming, which translates into lower soil moisture as higher temperatures increase evaporation; the Hadley model scenario projects less warming and a significant increase in precipitation (about 20%). The scenarios examined, which assume no major interventions to reduce continued growth of world greenhouse gases (GHG), indicate that temperatures in the U.S. will rise by about 3°-5°C (5°-9°F) on average in the next 100 years which is more than the projected global increase (NAST 2000). A warming of about 0.2°C (0.4°F) per decade is projected for the next two decades over a range of emission scenarios (IPCC 2007). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has resulted in increased precipitation, river discharge, and glacial and sea-ice melting (Greene *et al.* 2008).

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (Greene *et al.* 2008, IPCC 2006). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the earth's atmosphere caused by anthropogenic forces (IPCC 2006). The NAO impacts climate variability throughout the northern hemisphere (IPCC 2006). Data from the 1960s through the present show that the NAO index has increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2006). This warming extends over 1000m (0.62 miles) deep and is deeper than anywhere in the world oceans and is particularly evident under the Gulf Stream/ North Atlantic Current system (IPCC 2006). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (Greene *et al.* 2008, IPCC 2006). There is evidence that the NADW has already freshened significantly (IPCC 2006). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the whole earth system (Greene *et al.* 2008).

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the action area, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the U.S. Warming is very likely to continue in the U.S. over the next 25 to 50 years regardless of reduction in GHGs, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 25 to 50 years, and it is possible that the rate of change will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

A warmer and drier climate is expected to result in reductions in stream flows and increases in water temperatures. Expected consequences could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch *et al.* 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants other than heat currently degrade water quality (Murdoch *et al.* 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources in the southeast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer *et al.* 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development may experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer *et al.* 2008).

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2^{o}C (0.4°F) per decade; and 3) a rise in sea level (NAST 2000). A warmer and drier climate will reduce stream flows and increase water temperature resulting in a decrease of DO and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing. Sea level is expected to continue rising: during the 20th century global sea level has increased 15 to 20 cm (6-8 inches).

7.2 Species Specific Information on Climate Change Effects

7.2.1 Loggerhead Sea Turtles

The most recent Recovery Plan for loggerhead sea turtles as well as the 2009 Status Review Report identifies global climate change as a threat to loggerhead sea turtles. However, trying to assess the likely effects of climate change on loggerhead sea turtles is extremely difficult given the uncertainty in all climate change models and the difficulty in determining the likely rate of temperature increases and the scope and scale of any accompanying habitat effects. Additionally, no significant climate change-related impacts to loggerhead sea turtle populations have been observed to date. Over the long-term, climate change related impacts are expected to influence biological trajectories on a century scale (Parmesan and Yohe 2003). As noted in the 2009 Status Review (Conant *et al.* 2009), impacts from global climate change induced by human activities are likely to become more apparent in future years (IPCC 2007). Climate change related increasing temperatures, sea level rise, changes in ocean productivity, and increased frequency of storm events may affect loggerhead sea turtles.

Increasing temperatures are expected to result in increased polar melting and changes in precipitation which may lead to rising sea levels (Titus and Narayanan 1995 in Conant *et al.* 2009), which could result in increased erosion rates along nesting beaches. Sea level rise could result in the inundation of nesting sites and decrease available nesting habitat (Daniels *et al.* 1993; Fish *et al.* 2005; Baker *et al.* 2006). The BRT noted that the loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis *et al.* 2006; Baker *et al.* 2006; both in Conant *et al.* 2009). Along developed coastlines, and especially in areas where erosion control structures have been constructed to limit shoreline movement, rising sea levels may cause severe effects on nesting females and their eggs as nesting females may deposit eggs seaward of the erosion control structures potentially subjecting them to repeated tidal inundation. However, if global temperatures increase and there is a range shift northwards, beaches not currently used for nesting may become available for loggerhead sea turtles, which may offset some loss of accessibility to beaches in the southern portions of the range.

Climate change has the potential to result in changes at nesting beaches that may affect loggerhead sex ratios. Loggerhead sea turtles exhibit temperature-dependent sex determination. Rapidly increasing global temperatures may result in warmer incubation temperatures and highly female-biased sex ratios (*e.g.*, Glen and Mrosovsky 2004; Hawkes *et al.* 2009); however, to the extent that nesting can occur at beaches further north where sand temperatures are not as warm, these effects may be partially offset. The BRT specifically identified climate change as a threat to loggerhead sea turtles in the neritic/oceanic zone where climate change may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution. In the threats matrix analysis, climate change was considered for oceanic juveniles and adults and eggs/hatchlings. The report states that for oceanic juveniles and adults, "although the effect of trophic level change from…climate change…is unknown it is believed to be very low." For eggs/hatchlings the report states that total mortality from anthropogenic causes, including sea level rise resulting from climate change, is believed to be low relative to the entire life stage. However, only limited data are available on past trends related to climate effects on loggerhead sea turtles; current scientific methods are not able to reliably predict the future magnitude of climate change, associated impacts, whether and to what extent some impacts will offset others, or the adaptive capacity of this species.

However, Van Houtan and Halley (2011) recently developed climate based models to investigate loggerhead nesting (considering juvenile recruitment and breeding remigration) in the North Pacific and Northwest Atlantic. These models found that climate conditions/oceanographic influences explain loggerhead nesting variability, with climate models alone explaining an average 60% (range 18%-88%) of the observed nesting changes over the past several decades. In terms of future nesting projections, modeled climate data show a future positive trend for Florida nesting, with increases through 2040 as a result of the Atlantic Multidecadal Oscillation signal.

7.2.2 Kemp's Ridley Sea Turtles

The recovery plan for Kemp's ridley sea turtles (NMFS *et al.* 2011) identifies climate change as a threat; however, as with the other species discussed above, no significant climate change-related impacts to Kemp's ridley sea turtles have been observed to date. Atmospheric warming could cause habitat alteration which may change food resources such as crabs and other invertebrates. It may increase hurricane activity, leading to an increase in debris in nearshore and offshore waters, which may result in an increase in entanglement, ingestion, or drowning. In addition, increased hurricane activity may cause damage to nesting beaches or inundate nests with sea water. Atmospheric warming may change convergence zones, currents and other oceanographic features that are relevant to Kemp's ridleys, as well as change rain regimes and levels of nearshore runoff.

Considering that the Kemp's ridley has temperature-dependent sex determination (Wibbels 2003) and the vast majority of the nesting range is restricted to the State of Tamaulipas, Mexico, global warming could potentially shift population sex ratios towards females and thus change the reproductive ecology of this species. A female bias is presumed to increase egg production (assuming that the availability of males does not become a limiting factor) (Coyne and Landry 2007) and increase the rate of recovery; however, it is unknown at what point the percentage of males may become insufficient to facilitate maximum fertilization rates in a population. If males become a limiting factor in the reproductive ecology of the Kemp's ridley, then reproductive output in the population could decrease (Coyne 2000). Low numbers of males could also result in the loss of genetic diversity within a population; however, there is currently no evidence that this is a problem in the Kemp's ridley population (NMFS *et al.* 2011). Models (Davenport 1997, Hulin and Guillon 2007, Hawkes *et al.* 2007, all referenced in NMFS *et al.* 2011) predict very long-term reductions in fertility in sea turtles due to climate change, but due to the relatively long life cycle of sea turtles, reductions may not be seen until 30 to 50 years in the future.

Another potential impact from global climate change is sea level rise, which may result in increased beach erosion at nesting sites. Beach erosion may be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents. In the case of the Kemp's ridley where most of the critical nesting beaches are undeveloped, beaches may shift landward and still be available for nesting. The Padre Island National Seashore (PAIS) shoreline is accreting, unlike much of the Texas coast, and with nesting increasing and the sand temperatures slightly cooler than at Rancho Nuevo, PAIS could become an increasingly important source of males for the population.

7.2.3 Green Sea Turtles

The five year status review for green sea turtles (NMFS and USFWS 2007d) notes that global climate change is affecting green sea turtles and is likely to continue to be a threat. There is an increasing female bias in the sex ratio of green turtle hatchlings. While this is partly attributable to imperfect egg hatchery practices, global climate change is also implicated as a likely cause. This is because warmer sand temperatures at nesting beaches are likely to result in the production of more female embryos. At least one nesting site, Ascension Island, has had an increase in mean sand temperature in recent years (Hays *et al.* 2003 in NMFS and USFWS 2007d). Climate change may also affect nesting beaches through sea level rise, which may reduce the availability of nesting habitat and increase the risk of nest inundation. Loss of appropriate nesting habitat may also be accelerated by a combination of other environmental and oceanographic changes, such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion. Oceanic changes related to rising water temperatures could result in changes in the abundance and distribution of the primary food sources of green sea turtles, which in turn could result in changes in behavior and distribution of this species. Seagrass habitats may suffer from decreased productivity and/or increased stress due to sea level rise, as well as salinity and temperature changes (Short and Neckles 1999; Duarte 2002).

As noted above, the increasing female bias in green sea turtle hatchlings is thought to be at least partially linked to increases in temperatures at nesting beaches. However, at this time, we do not know how much of this bias is due to hatchery practice and how much is due to increased sand temperature. Because we do not have information to predict the extent and rate to which sand temperatures at the nesting beaches used by green sea turtles may increase in the short-term future, we cannot predict the extent of any future bias. Also, we do not know to what extent to which green sea turtles may be able to cope with this change by selecting cooler areas of the beach or shifting their nesting distribution to other beaches at which increases in sand temperature may not be experienced.

7.2.5 Atlantic sturgeon

Global climate change may affect all DPSs of Atlantic sturgeon in the future; however, effects of increased water temperature and decreased water availability are most likely to effect the South Atlantic and Carolina DPSs. Rising sea level may result in the salt wedge moving upstream in affected rivers. Atlantic sturgeon spawning occurs in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. Similarly, juvenile Atlantic sturgeon have limited tolerance to salinity and remain in waters with little to no salinity. If the salt wedge moves further upstream, Atlantic sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the saltwedge would be limited. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any shifts that may occur; thus, it is not possible to predict any future loss in spawning or rearing habitat. However, in all river systems, spawning occurs miles upstream of the saltwedge. It is unlikely that shifts in the location of the saltwedge would eliminate freshwater spawning or rearing habitat. If habitat was severely restricted, productivity or survivability may decrease.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with DO and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers. Atlantic sturgeon prefer water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats.

Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all Atlantic sturgeon life stages, including adults, may become susceptible to strandings or habitat restriction. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat.

7.3 Effects of Climate Change in the Action Area

Information on how climate change will impact the action area is limited. According to the New York State Energy Research and Development Authority's 2011 ClimAid Synthesis Report, temperatures across New York State are expected to rise by 1.5 to 3°F by the 2020s, 3 to 5.5°F by the 2050s, and 4 to 9°F by the 2080s (ClimAid 2011). In addition, data from the Office of the New Jersey State Climatologist has shown a statistically significant rise in average statewide temperature (approximately 2 degrees Fahrenheit) over the last 113 years. It is predicted that in the Northeastern US, precipitation, particularly in the form of rainfall, and runoff are expected to increase in future years (NECIA 2007). NOAA tide gauge data reported by the State indicates that the sea level within the Battery of New York Harbor has risen at a rate of approximately 2.77 mm/yr since recordings began in 1856, while at the New Jersey coast site of Sandy Hook, sea level has risen at a rate of approximately 3.9 mm/y since recording began in the early- to mid-1900s.

Sea surface temperatures have fluctuated around a mean for much of the past century, as measured by continuous 100+ year records at Woods Hole (Mass.), and Boothbay Harbor (Maine) and shorter records from Boston Harbor and other bays. Periods of higher than average temperatures (in the 1950s) and cooler periods (1960s) have been associated with changes in the North Atlantic Oscillation (NAO), which affects current patterns. Over the past 30 years however, records indicate that ocean temperatures in the Northeast have been increasing; for example, Boothbay Harbor's temperature has increased by about 1°C since 1970. While we are not able to find predictive models for New Jersey, given the geographic proximity of these waters to the Northeast, we assume that predictions would be similar. The model projections are for an increase of somewhere between 3-4°C by 2100 and a pH drop of 0.3-0.4 units by 2100 (Frumhoff *et al.* 2007). Assuming that these predictions also apply to the action area, one could anticipate similar conditions in the action area over that same time period.

Assuming that there is a linear trend in increasing water temperatures, and that a predicted 3-4°C increase in water temperature by 2100 for the waters to the Northeast would also be experienced in the action area, one could anticipate a 0.03 - 0.05°C increase each year. Because the action considered here will be complete in 50 years, we expect an increase in temperature of no more than 2.5°C in the action area over the duration of the proposed action.

7.3.1 Effects to Atlantic sturgeon

As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on Atlantic sturgeon.

In the action area, it is possible that changing seasonal temperature regimes could result in changes in the timing of seasonal migrations through the area as sturgeon move to spawning and overwintering grounds. There could be shifts in the timing of spawning; presumably, if water temperatures warm earlier in the spring, and water temperature is a primary spawning cue, spawning migrations and spawning events could occur earlier in the year. However, because spawning is not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change), it is not possible to predict how any change in water temperature or river flow alone will affect the seasonal movements of sturgeon through the action area to rivers where they spawn.

Any forage species that are temperature dependent may also shift in distribution as water temperatures warm. However, because we do not know the adaptive capacity of these individuals or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict how these changes may affect foraging sturgeon. If sturgeon distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food. Similarly, if sturgeon shifted to areas where different forage was available and sturgeon were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sturgeon shifted to an area or time where insufficient forage was available; however, the likelihood of this happening seems low because sturgeon feed on a wide variety of species and in a wide variety of habitats.

Limited information on the thermal tolerances of Atlantic sturgeon is available. Atlantic sturgeon have been observed in water temperatures above 30°C in the south (see Damon-Randall *et al.* 2010); in the wild, shortnose sturgeon are typically found in waters less than 28°C. In the laboratory, juvenile Atlantic sturgeon showed negative behavioral and bioenergetics responses (related to food consumption and metabolism) after prolonged exposure to temperatures greater than 28°C (82.4°F) (Niklitschek 2001). Tolerance to temperatures is thought to increase with age and body size (Ziegweid *et al.* 2008 and Jenkins *et al.* 1993), however, no information on the lethal thermal maximum or stressful temperatures for subadult or adult Atlantic sturgeon is available. Shortnose sturgeon, have been documented in the lab to experience mortality at temperatures of 33.7°C (92.66°F) or greater and are thought to experience stress at temperatures above 28°C. For purposes of considering thermal tolerances, we consider Atlantic sturgeon to be a reasonable surrogate for shortnose sturgeon given similar geographic distribution and known biological similarities.

Normal sea surface temperatures in the action area have an annual average high of about 23°C. A predicted increase in water temperature of 3-4°C within 100 years is expected to result in temperatures approaching the preferred temperature of Atlantic sturgeon (28°C) on more days and/or in larger areas. However, it is not likely that over the 50 year time period considered here waters in the action area would become so warm that they would change the use of the action area by Atlantic sturgeon.

As described above, over the long term, global climate change may affect Atlantic sturgeon by affecting the location of the salt wedge in rivers, distribution of prey, water temperature and water quality. However, there is significant uncertainty, due to a lack of scientific data, on the degree to which these effects may be experienced and the degree to which Atlantic sturgeon will be able to successfully adapt to any such changes. Any activities occurring within and outside the action area that contribute to global climate change are also expected to affect Atlantic sturgeon in the action area. While we can make some predictions on the likely effects of climate change on these species, without modeling and additional scientific data these predictions remain speculative. Additionally, these predictions do not take into account the adaptive capacity of these species which may allow them to deal with change better than predicted.

7.3.2 Effects of Climate Change in the Action Area on Sea Turtles

As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on sea turtles; however, we have considered the available information to consider likely impacts to these species in the action area.

Sea turtles are most likely to be affected by climate change due to increasing sand temperatures at nesting beaches which in turn would result in increased female: male sex ratio among hatchlings, sea level rise which could result in a reduction in available nesting beach habitat, increased risk of nest inundation, changes in the abundance and distribution of forage species which could result in changes in the foraging behavior and distribution of sea turtle species, and changes in water temperature which could possibly lead to a northward shift in their range.

Over the time period considered in this Opinion (through 2064), an increase in sea surface temperatures attributable to global climate change is expected to be 1.5-2°C. It is unlikely to be enough of a change to contribute to shifts in the range or distribution of sea turtles. Theoretically, we expect that as waters in the action area warm, more sea turtles could be present or sea turtles could be present for longer periods of time. However, if temperature affected the distribution of sea turtle forage in a way that decreased forage in the action area, sea turtles may be less likely to occur in the action area. The nesting range of some sea turtle species may shift northward. Nesting in Virginia and further northward is relatively rare, and nests along New Jersey and Delaware beaches are not considered viable without human intervention due to cold winter sand and water temperatures. It is important to consider that in order for nesting to be successful in the mid-Atlantic, fall and winter temperatures need to be warm enough to support the successful rearing of eggs and sea temperatures must be warm enough for hatchlings to survive when they enter the water. Predicted increases in water temperatures over the next fifty years are not great enough to allow successful rearing of sea turtle eggs in the action area or the survival of hatchlings that enter the water outside of the summer months. Therefore, it is unlikely that over the time period considered here, that there would be an increase in nesting activity in the action area or that hatchlings would be present in the action area.

8.0 EFFECTS OF THE ACTION

This section of the Opinion assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR § 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR§402.02). We have not identified any interdependent or interrelated actions. Because there is no critical habitat in the action area, there are no effects to critical habitat to consider in this Opinion.

This Opinion examines the likely effects (direct and indirect) of the proposed action on five DPSs of Atlantic sturgeon and loggerhead, Kemp's ridley and green sea turtles and their habitat in the action area within the context of the species current status, the environmental baseline and cumulative effects. As explained in the Description of the Action, the action under consideration in this Opinion is the use of sand borrow areas for beach nourishment, coastline stabilization and hurricane protection. Each of the thirteen projects considered here was authorized for 50 years. Some of the projects have already been underway for several years while others have not yet begun. Thus, each activity has a slightly different timeframe. However, the longest time period considered here is for projects that begin in 2014 and extend through 2064.

The effects of dredging on listed species will be different depending on the type of dredge used. As such, the following discussion of effects of dredging will be organized by dredge type (sand bypass, hopper or cutterhead). Below, the discussion will consider the effects of dredging, including the risk of impingement or entrainment of Atlantic sturgeon and sea turtles. We also consider effects of dredging and disposal on water quality, including turbidity/suspended sediment. Last, there is a discussion of other effects that are not specific to the type of equipment used. This includes effects on prey and foraging, changes in the characteristics of the dredged area and effects of dredge vessel traffic.

8.1 Effects to Sea Turtles and Atlantic sturgeon from Dredging Equipment

8.1.1 Indian River Inlet Sand Bypass

Jetties were constructed by the US Army Corps of Engineers on the north and south sides of the Indian River Inlet to stabilize the inlet as a navigable channel. When the construction occurred in the mid 1930s the shoreline was relatively even on both sides. The net longshore transport of sand along the beach from Bethany Beach to Cape Henlopen is to the north. Therefore over time, sand has built up on the south side of the inlet and a deficit has occurred on the north side of the inlet. In order to mitigate the erosion on the north side and to protect the Indian River Inlet Bridge, a sand bypass system was installed on the south side of the jetties.

A crane holds an eductor in the surf zone on the south side of the inlet. Eductors are hydraulic pumps. They operate by using a supply water pump to provide a high pressure flow at the eductor nozzle. As the jet contacts the surrounding fluid, momentum is exchanged in the mixer where the jet slows and the surrounding fluid is accelerated, thus entraining additional fluid into the jet. As the surrounding fluid is entrained by the jet, it pulls in additional fluid from outside the eductor. Through a pump house the sand is sucked up by the eductor and is pushed through a pipe attached to the bridge over to the north side, where it is deposited close to the surf zone (DENRC 2012, Gregory 1994). The bypass system is operated on a 5-days-per-week schedule during the period between Labor Day and Memorial Day. Because of the heavy recreational use of the adjacent beaches during the summer months, bypassing is restricted to the off-season.

The pump operates when buried in the sand in the intertidal zone. Atlantic sturgeon and green, loggerhead and Kemp's ridley sea turtles do not occur in the intertidal zone where the pump operates. Therefore, these species are not exposed to any effects of the Indian River Inlet sand bypass system. Effects of placement of sand on beaches is discussed below.

8.1.2 Hopper Dredge (Impingement/Entrainment and Increased Turbidity/Suspended Sediment)

Dredged material is raised by dredge pumps through dragarms connected to drags in contact with the channel bottom and discharged into hoppers built in the vessel. Hopper dredges are equipped with large centrifugal pumps similar to those employed by other hydraulic dredges. Suction pipes (dragarms) are hinged on each side of the vessel with the intake (drag) extending downward toward the stern of the vessel. The drag is moved along the bottom as the vessel moves forward at speeds up to 3 mph. The dredged material is sucked up the pipe and deposited and stored in the hoppers of the vessel.

Most sea turtles and sturgeon are able to escape from the oncoming draghead due to the slow speed that the draghead advances (up to 3mph or 4.4 feet/second). Interactions with a hopper dredge result primarily from crushing when the draghead is placed on the bottom or when an aminal is unable to escape from the suction of the dredge and becomes stuck on the draghead (impingement). Entrainment occurs when organisms are sucked through the draghead into the hopper. Mortality most often occurs when animals are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper.

Interactions with the draghead can also occur if the suction is turned on while the draghead is in the watercolumn (i.e., not seated on the bottom). USACE implements procedures to minimize the operation of suction when the draghead is not properly seated on the bottom sediments which reduces the risk of these types of interactions.

There is some evidence to indicate that turtles can become entrained in trunions or other water intakes (see Nelson and Shafer 1996). For example, a large piece of a loggerhead sea turtle was found in a UXO screening basket on Virginia Beach in 2013. The hopper dredge was operated with UXO screens on the draghead designed to prevent entrainment of any material with a diameter greater than 1.25". The pieces of turtle found were significantly larger. Because an inspection of the UXO screens revealed no damage, it is suspected that the sea turtle was entrained in another water intake port. There are also several examples of relatively large sturgeon (2-3' length) detected in inflow screening alive and relatively uninjured. Given the damage anticipated from passing through the pumps, it is possible that these sturgeon were entrained somewhere other than the draghead. The USACE is currently investigating potential sources of entrainment and exploring the use of screening to minimize possible entrainment in areas other than the draghead.

8.1.2.1 Impingement/Entrainment in Hopper Dredges – Sea Turtles

Sea turtles have been killed in hopper dredge operations along the East and Gulf coasts of the United States. Documented turtle mortalities during dredging operations in the USACE South Atlantic Division (SAD; i.e., south of the Virginia/North Carolina border) are more common than in the USACE North Atlantic Division (NAD; Virginia-Maine) presumably due to the greater abundance of turtles in these waters and the greater frequency of hopper dredge operations. For example, in the USACE SAD, over 480 sea turtles have been entrained in hopper dredges since 1980 and in the Gulf Region over 200 sea turtles have been killed since 1995. Records of sea turtle entrainment in the USACE NAD began in 1994. Through May 2014, 74 sea turtles deaths (see Table 13) related to hopper dredge activities have been recorded in waters north of the North Carolina/Virginia border (USACE Sea Turtle Database[8]); 64 of these turtles have been entrained in dredges operating in Chesapeake Bay.

Interactions are likely to be most numerous in areas where sea turtles are resting or foraging on the bottom. When sea turtles are at the surface, or within the water column, they are not likely to interact with the dredge because there is little, if any, suction force in the water column. Sea turtles have been found resting in deeper waters, which could increase the likelihood of interactions from dredging activities. In 1981, observers documented the take of 71 loggerheads by a hopper dredge at the Port Canaveral Ship Channel, Florida (Slay and Richardson 1988). This channel is a deep, low productivity environment in the Southeast Atlantic where sea turtles are known to rest on the bottom, making them extremely vulnerable to entrainment. The large number of turtle mortalities at the Port Canaveral Ship Channel in the early 1980s resulted in part from turtles being buried in the soft bottom mud, a behavior known as brumation. Since 1981, 77 loggerhead sea turtles have been taken by hopper dredge operations in the Port Canaveral Ship Channel, Florida. Chelonid turtles have been found to make use of deeper, less productive channels as resting areas that afford protection from predators because of the low energy, deep water conditions. Habitat in the action area is not consistent with areas where sea turtle brumation has been documented; therefore, we do not anticipate any sea turtle brumation in the action area. Very few interactions with sea turtles have been recorded in offshore borrow areas such as the ones considered in this Opinion. This may be because the area where the dredge is operating is more wide-open providing more opportunities for escape from the dredge as compared to a narrow river or harbor entrance. Sea turtles may also be less likely to be resting or foraging at the bottom while in open ocean areas, which would further reduce the potential for interactions.

Before 1994, endangered species observers were not required on board hopper dredges and dredge baskets were not inspected for sea turtles or sea turtle parts. The majority of sea turtle takes in the NAD have occurred in the Norfolk district. This is largely a function of the large number of loggerhead and Kemp's ridley sea turtles that occur in the Chesapeake Bay each summer and the intense dredging operations that are conducted to maintain the Chesapeake Bay

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[8] The USACE Sea Turtle Data Warehouse is maintained by the USACE's Environmental Laboratory and contains information on USACE dredging projects conducted since 1980 with a focus on information on interactions with sea turtles.

entrance channels and for beach nourishment projects at Virginia Beach. Since 1992, the take of 10 sea turtles (all loggerheads) has been recorded during hopper dredge operations in the Philadelphia, Baltimore and New York Districts. Hopper dredging is relatively rare in New England waters where sea turtles are known to occur, with most hopper dredge operations being completed by the specialized Government owned dredge Currituck which operates at low suction and has been demonstrated to have a very low likelihood of entraining or impinging sea turtles. To date, no hopper dredge operations (other than the Currituck) have occurred in the New England District in areas or at times when sea turtles are likely to be present.

Table 13. Sea Turtle Takes in USACE NAD Dredging Operations

Project Location	**Year of Operation**	**Cubic Yardage Removed**	**Observed Takes**
Cape Henry Channel	2012	1,190,004	1 loggerhead
York Spit	2012	145,332	1 Loggerhead
Thimble Shoal Channel	2009	473,900	3 Loggerheads
York Spit	2007	608,000	1 Kemp’s Ridley
Cape Henry	2006	447,238	3 Loggerheads
Thimble Shoal Channel	2006	300,000	1 loggerhead
Delaware Bay	2005	50,000	2 Loggerheads
Thimble Shoal Channel	2003	1,828,312	7 Loggerheads 1 Kemp’s ridley 1 unknown
Cape Henry	2002	1,407,814	6 Loggerheads 1 Kemp’s ridley 1 green
VA Beach Hurricane Protection Project (Cape Henry)	2002	1,407,814	1 Loggerhead
York Spit Channel	2002	911,406	8 Loggerheads 1 Kemp’s ridley
Cape Henry	2001	1,641,140	2 loggerheads 1 Kemp’s ridley
VA Beach Hurricane Protection Project (Thimble Shoals)	2001	4,000,000	5 loggerheads 1 unknown
Thimble Shoal Channel	2000	831,761	2 loggerheads 1 unknown
York River Entrance Channel	1998	672,536	6 loggerheads
Atlantic Coast of NJ	1997	1,000,000	1 Loggerhead
Thimble Shoal	1996	529,301	1 loggerhead

Channel			
Delaware Bay	1995	218,151	1 Loggerhead
Cape Henry	1994	552,671	4 loggerheads 1 unknown
York Spit Channel	1994	61,299	4 loggerheads
Delaware Bay	1994	NA	1 Loggerhead
Delaware Bay	1993	NA	1 Loggerhead
Off Ocean City MD	1992	1,592,262	3 Loggerheads
			TOTAL = 74 Turtles

Typically, endangered species observers are required to observe at least 50% of the dredge activity (i.e., 6 hours on watch, 6 hours off watch). To address concerns that some loads would be unobserved, procedures have been in place since at least 2002 to insure that inflow cages were only inspected and cleaned by observers. This maximizes the potential that any entrained sea turtles were observed and reported.

It is possible that not all sea turtles killed by dredges are observed onboard the hopper dredge. Several sea turtles stranded on Virginia shores with crushing type injuries from May 25 to October 15, 2002. The Virginia Marine Science Museum (VMSM) found 10 loggerheads, 2 Kemp's ridleys, and 1 leatherback exhibiting injuries and structural damage consistent with what they have seen in animals that were known dredge takes. While it cannot be conclusively determined that these strandings were the result of dredge interactions, the link is possible given the location of the strandings (e.g., in the southern Chesapeake Bay near ongoing dredging activity), the time of the documented strandings in relation to dredge operations, the lack of other ongoing activities which may have caused such damage, and the nature of the injuries (e.g., crushed or shattered carapaces and/or flipper bones, black mud in mouth). In 1992, three dead sea turtles were found on an Ocean City, Maryland beach while dredging operations were ongoing at a borrow area located 3 miles offshore. Necropsy results indicate that the deaths of all three turtles were dredge related. Because there were no observers on board the dredge, it is unknown if turtles observed on the beach with these types of injuries were crushed by the dredge and subsequently stranded on shore or whether they were entrained in the dredge, entered the hopper and then were discharged onto the beach with the dredge spoils. Further analyses need to be conducted to better understand the link between crushed strandings and dredging activities, and if those strandings need to be factored into an incidental take level. Regardless, it is possible that dredges are taking animals that are not observed on the dredge which may result in strandings on nearby beaches. However, there is not enough information at this time to determine the number of injuries or mortalities that are not detected.

Because interactions between sea turtles and hopper dredges are rare events, it is difficult to predict the number of interactions that are likely to occur from a particular dredging operation. Projects that occur in an identical location with the same equipment year after year may result in interactions in some years and none in other years as noted above in the examples of sea turtle takes. Dredging operations may go on for months, with sea turtle takes occurring intermittently throughout the duration of the action. For example, dredging occurred at Cape Henry over 160 days in 2002 with 8 sea turtle takes occurring over 3 separate weeks while dredging at York Spit in 1994 resulted in 4 sea turtle takes in one week. In Delaware Bay, dredge cycles have been conducted during the May-November period with no observed entrainment; in contrast, as many as two sea turtles have been entrained in as little as three weeks. Even in locations where thousands of sea turtles are known to be present (i.e., Chesapeake Bay) and where dredges are operating in areas with preferred sea turtle depths and forage items (as evidenced by entrainment of these species in the dredge), the numbers of sea turtles entrained is an extremely small percentage of the likely number of sea turtles in the action area. This is likely due to the distribution of individuals throughout the action area, the relatively small area which is affected at any given moment and the ability of some sea turtles to avoid the dredge even if they are in the immediate area.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used (sea turtles are apparently capable of avoiding pipeline and mechanical dredges as no takes of sea turtles have been reported with these types of dredges). The number of interactions may also be influenced by the terrain in the area being dredged, with interactions more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

Hopper dredging has occurred at several of the borrow areas considered in this Opinion. Ten dredging events have had observer coverage. The only recorded interaction with a sea turtle was the entrainment of one “old” loggerhead bone (Cape May 2002). Due to the age of the bone it was determined to be from a turtle that died previously and was unrelated to the dredging operations. Of these ten events, two events (Dewey Beach, June 2009; Dewey/Rehobeth, March-July 2005) operated with UXO screening which we expect would have prevented any turtle pieces larger than 1.25” diameter from becoming entrained. These two projects did have endangered species observers on board. We reviewed the daily load reports prepared by the observers and there was very little biological material recorded in the intake screens. This is likely due to the presence of the UXO screens. The use of UXO screens greatly reduces the likelihood that the observers would have detected any sea turtle parts if they were entrained because any entrained parts would be so small. We also suspect that UXO screens may make entrainment (meaning actual uptake of turtle parts into the hopper) less likely.

While there have been no recorded interactions with sea turtles on a hopper dredges operating in the action area, monitoring of projects in other areas (e.g., Chesapeake Bay, Delaware Bay) indicates that interactions are likely to occur. The concentration of sea turtles in Chesapeake Bay is much higher than we anticipate for the action area; therefore, it is not reasonable to estimate the number of interactions for the projects considered here based on a Chesapeake Bay interaction rate. However, by combining hopper dredge projects operating in Delaware Bay and in borrow areas on the Mid-Atlantic OCS (without UXO screens and with endangered species observers) with the projects that have occurred in the action area, we can generate a reasonable estimate of the likely interaction rate for the action area. These projects are combined in the table below.

Considering the projects in the table below. all of which occurred at a time of year when sea turtles are likely in the action area, we have calculated an entrainment rate of 1 sea turtle for every 3.8 MCY removed with a hopper dredge.

Table 14. Hopper dredging projects in the action area without UXO screens and with endangered species observers.

Project Name	Year	CY Removed	Sea Turtle Interactions
Wallops Island, VA (OCS Borrow Area)	2013	1,000,000	0
Delaware Bay (Reach D)	2013	1,149,946	0
Wallops Island, VA (OCS Borrow Area)	2012	3,200,000	0
LBI Surf City	2006-2007	880,000	0
Delaware Bay - Channel Maintenance	2006	390,000	0
Delaware Bay - Channel Maintenance	2005	50,000	1
Delaware Bay - Channel Maintenance	2005	167,982	0
Delaware Bay	2005	162,682	0
Fenwick Island	2005	833,000	0
Cape May	2004	290,145	0
Delaware Bay - Channel Maintenance	2004	50,000	0
Cape May Meadows	2004	1,406,000	0

Cape May	2002	267,000	0
Delaware Bay - Channel Maintenance	2002	50,000	0 (bone)
Delaware Bay - Channel Maintenance	2001	50,000	0
Cape May City	1999	400,000	0
Delaware Bay - Channel Maintenance	1995	218,151	1
Bethany Beach and South Bethany Beach	1994	184,451	0
Delaware Bay - Channel Maintenance	1994	2,830,000	1
Dewy Beach	1994	624,869	0
Cape May	2005	300,000	0
Fenwick Island*	1998	141,100	0
Delaware Bay - Channel Maintenance (Brandywine)	1993	415,000	1
Bethany Beach*	1992	219,735	0
		15,280,061	**4**

This calculation has been based on a number of assumptions including the following: that sea turtles are evenly distributed throughout all borrow areas, that all dredges will take an identical number of sea turtles, and that sea turtles are equally likely to be encountered throughout the April to November time frame. Based on these calculations, we expect that for any hopper dredging project in any of the borrow areas considered in this Opinion during the time of year when sea turtles are likely to be present, one sea turtle is likely to be entrained for every 3.8 million CY of material removed by a hopper dredge. While this estimate is based on several assumptions, it is reasonable because it uses the best available information on entrainment of sea turtles from past dredging operations in the action area, includes multiple projects over several years, and all of the projects have had observer coverage.

In a hopper dredge operating without a UXO screen it may be possible for a small sea turtle to become entrained in the dragarm and not be killed. However, given that all hopper dredges operating in the action area will have UXO screening welded to the dragarm and that all other water intakes will also be screened, any sea turtle that is impinged on the dragarm or otherwise interacts with the dredge would either be crushed or would have to pass through the small openings of the screening. This makes survival extremely unlikely. Based on this, we expect all sea turtles that interact with the hopper dredge will be killed.

8.1.2.2 Hopper Dredge Interactions – Atlantic Sturgeon

Sturgeon are vulnerable to interactions with hopper dredges. The risk of interactions is related to both the amount of time sturgeon spend on the bottom and the behavior the fish are engaged in (i.e., whether the fish are overwintering, foraging, resting or migrating) as well as the intake velocity and swimming abilities of sturgeon in the area (Clarke 2011). Intake velocities at a typical large self-propelled hopper dredge are 11 feet per second. As noted above, exposure to the suction of the draghead intake is minimized by not turning on the suction until the draghead is properly seated on the bottom sediments and by maintaining contact between the draghead and the bottom.

A significant factor influencing potential entrainment is based upon the swimming stamina and size of the individual fish at risk (Boysen and Hoover, 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger sturgeon such as the ones in the action area, is less likely due to the increased swimming performance and the relatively small size of the draghead opening. Juvenile entrainment is possible depending on the location of the dredging operations and the time of year in which the dredging occurs. Typically major concerns of juvenile entrainment relate to fish below 200 mm (Hoover et al., 2005; Boysen and Hoover, 2009). Juvenile sturgeon are not powerful swimmers and they are prone to bottom-holding behaviors, which make them vulnerable to entrainment when in close proximity to dragheads (Hoover et al., 2011). Juvenile sturgeon do not occur in the action area. The estimated minimum size for sturgeon that out-migrate from their natal river is greater than 50cm; therefore, that is the minimum size of sturgeon anticipated in the action area.

In general, entrainment of large mobile animals, such as the Atlantic sturgeon in the action area, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. The risk of entrainment is likely to be higher in areas where the movements of animals are restricted (e.g., in narrow rivers or confined bays) where there is limited opportunity for animals to move away from the dredge than in unconfined areas such as wide rivers or open bays. The hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. Sturgeon at or near the bottom could be vulnerable to entrainment if they were unable to swim away from the draghead. Information suggests that Atlantic sturgeon migrating in the marine environment do not move along the bottom, but move further up in the water column. If Atlantic sturgeon are up off the bottom while in offshore areas, such as the action area, the potential for interactions with the dredge are further reduced. Based on this information, the likelihood of an interaction of an Atlantic sturgeon with a hopper dredge operating in the action area is expected to be low.

Entrainment of sturgeon during hopper dredging operations appears to be relatively rare. The USACE and NMFS have documented a total of 41 incidents of sturgeon entrainment or capture of sturgeon species (all sturgeon species) on monitored projects for all types of dredge plant (mechanical, hydraulic pipeline, and hopper dredge; see Table in Appendix A). Two of these fish (both Atlantic sturgeon) were likely killed prior to entrainment based on the degree of decomposition. Of the remaining records, , 22 were reported as Atlantic sturgeon (20 individuals; two individuals were observed in 2 separate pieces), with 19 of these entrained in hopper dredges. Of the entrained Atlantic sturgeon for which size is available, all were subadults (larger than 50cm but less than 150cm). Given the large size of adults (greater than 150cm) and the size of the openings on the dragheads, adult Atlantic sturgeon are unlikely to be vulnerable to entrainment. The USACE and their contractors remove millions of CY of material from rivers and coastal navigation channels, as well as offshore sand borrow areas, every year. Interactions with sturgeon remain a rare event, even in areas where sturgeon are relatively numerous. A table presenting the observed sturgeon entrained or captured on monitored USACE projects between 1990 and May 2014 is presented as Appendix A.

While endangered species observers have been present at several of the hopper dredge operations in the action area, prior to the 2012 ESA listing of Atlatnic sturgeon there was no requirement to report any observations of sturgeon. No interactions with Atlantic sturgeon have been reported for dredges operating in the action area since 2012; however, all hopper and cutterhead dredges have operated with UXO screens in place (see below). The only load-specific observer logs (which require a record of all observed aquatic life) we were able to review from the action area for projects conducted prior to 2012, were from two projects that operated with UXO screens in place (Dewey Beach 2005 and Dewey Beach 2009). While no sturgeon or sturgeon parts were recorded during these projects, the use of UXO screens prevented entrainment of any material with a diameter larger than 1.25". This likely severly limited the ability of the observers to have detected any sturgeon or sturgeon parts that may have been entrained during dredging. In addition to the general difficulty in detecting biological materials of this size, the inflow screening that captures material for inspection by the observer is 4" x 4" which would mean that any biological material small enough to pass through the UXO screen on the draghead would also be small enough to pass through the inflow screening and not be captured in the screening basket. Additionally, the UXO screens themselves may have prevented any sturgeon that were impinged on the screens from becoming entrained. Although an Atlantic sturgeon was recently observed entrained on a hopper dredge operating with UXO screen in place, an inspection revealed damage to the screen which resulted in a large opening in the screen. If the screen was intact, it would have precluded anything larger than 1.25" diameter from entering the hopper. We do not expect that observers would be able to identify the pieces. Because we do not know the volume of material that was removed with the damaged screen in place, we can not accurately estimate the interaction rate for that project. As such, we have excluded that project from the table below.

Because we cannot rely on observer reports from the action area to generate an interaction rate, we have estimated an interaction rate based on observed dredging operations in areas where we anticipate sturgeon distribution to be similar to the action area. We have considered projects where hopper dredges operated without UXO screens and with endangered species observers and where we expect the observers would have reported any observations of sturgeon. We have limited the projects considered to those that are outside of rivers or other inland areas as the size class of sturgeon present in those areas would be different from the action area and we expect behavior of sturgeon to be different in those areas. As such, the level of entrainment in these areas would not be comparable to the level of interactions that may occur in the action area. Outside of rivers/harbors, only 4 Atlantic sturgeon have been observed entrained in a hopper dredge (inclusive of the one entrained on the damaged UXO screen mentioned above).

Table 15: Hopper Dredging Operations in areas within the USACE NAD similar to the action area (only projects that operated without UXO screens, and carried observers and complete records available are included)

Project Location	Year of Operation	Cubic Yards Removed	Observed Entrainment
Wallops Island offshore VA borrow area	2013	1,000,000	0
Wallops Island offshore VA borrow area	2012	3,200,000	0
York Spit Channel, VA	2011	1,630,713	2
Cape Henry Channel, VA	2011	2,472,000	0
York Spit Channel, VA	2009	372,533	0
Sandy Hook Channel, NJ	2008	23,500	1
York Spit Channel, VA	2007	608,000	0
Atlantic Ocean Channel, VA	2006	1,118,749	0
Thimble Shoal Channel, VA	2006	300,000	0
Cape May	2004	290,145	0
Thimble Shoal Channel, VA	2004	139,200	0
VA Beach Hurricane Protection Project	2004	844,968	0
Thimble Shoal Channel	2003	1,828,312	0
Cape May	2002	267,000	0
Cape Henry Channel, VA	2002	1,407,814	0

York Spit Channel, VA	2002	911,406	0
East Rockaway Inlet, NY	2002	140,000	0
Cape Henry Channel, VA	2001	1,641,140	0
Thimble Shoal Channel, VA	2000	831,761	0
Cape Henry Channel, VA	2000	759,986	0
Cape May City	1999	400,000	0
York Spit Channel, VA	1998	296,140	0
Cape Henry Channel, VA	1998	740,674	0
Thimble Shoal Channel, VA	1996	529,301	0
East Rockaway Inlet, NY	1996	2,685,000	0
Cape Henry Channel, VA	1995	485,885	0
East Rockaway Inlet, NY	1995	412,000	0
York Spit Channel, VA	1994	61,299	0
Cape Henry Channel , VA	1994	552,671	0
	TOTAL	25,950,197	3

In the absence of observer reports from the action area, it is reasonable to consider other projects that have been conducted in a comparable environment to that of the action area (see Table 15). As noted above, based on what we know about Atlantic sturgeon behavior in environments comparable to the action area, it is reasonable to consider that the risk of entrainment at this site is similar to that of the projects identified in Table 15. At this time, this is the best available information on the potential for interactions with Atlantic sturgeon.

Using this method, and using the dataset presented in Table 15, we have calculated an interaction rate of 1 Atlantic sturgeon is likely to be injured or killed for approximately every 8.6 million CY of material removed during hopper dredging operations in the action area. This calculation is based on a number of assumptions including the following: that Atlantic sturgeon are evenly distributed throughout the action area, that all hopper dredges will have the same entrainment rate, and that Atlantic sturgeon are equally likely to be encountered throughout the time period when dredging will occur. While this estimate is based on several assumptions, it is reasonable because it uses the best available information on entrainment of Atlantic sturgeon from past dredging operations, including dredging operations in the vicinity of the action area, it includes multiple projects over several years, and all of the projects have had observers present which we expect would have documented any entrainment of Atlantic sturgeon.

8.1.2.3 Interactions with the Sediment Plume- Hopper Dredge

Physical and biological impairments to the water column can occur from increases in turbidity which can alter light penetration. The proposed dredging will cause temporary increases in turbidity and suspension of sediments during dredging operations. As a result, the increase in turbidity can impact primary productivity and respiration of organisms within the project area. The re-suspension of sediments from dredging and dredged material placement can prevent or reduce gas-water exchanges in the gills of fish (Germano and Cary, 2005; Clarke and Wilber, 2000). The amount of impact that this can have on a species is dependent on the sensitivity of that species. This increase in turbidity can also impact prey species' predator avoidance response ability due to the decreased clarity in the water column.

Increased suspended sediment resulting from dredging can also reduce dissolved oxygen. Low dissolved oxygen conditions can be generated by the dredging operations from the resuspension of sediments and the biochemical oxygen demand of the surrounding water (Johnston, 1981). This can be particularly important during the summer months when water temperatures are warmer and less capable of holding dissolved oxygen. Dredging during the warmer months can exacerbate low dissolved oxygen conditions (Hatin et al., 2007*a*).

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the water, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including : the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

Resuspension of fine-grained dredged material during hopper dredging operations is caused by the dragheads as they are pulled through the sediment, turbulence generated by the vessel and its prop wash, and overflow of turbid water during hopper filling operations. During the filling operation, dredged material slurry is often pumped into the hoppers after they have been filled with slurry in order to maximize the amount of solid material in the hopper. The lower density turbid water at the surface of the filled hoppers overflows and is usually discharged through ports located near the waterline of the dredge. In the vicinity of hopper dredge operations, a near-bottom turbidity plume of resuspended bottom material may extend 2,300 to 2,400 ft down current from the dredge (USACE 1983). In the immediate vicinity of the dredge, a well-defined upper plume is generated by the overflow process. Approximately 1,000 ft behind the dredge, the two plumes merge into a single plume (USACE 1983). Suspended solid concentrations may be as high as several tens of parts per thousand (ppt; grams per liter) near the discharge port and as high as a few parts per thousand near the draghead. In a study done by Anchor Environmental (2003), nearfield concentrations ranged from 80.0-475.0 mg/l. Turbidity levels in the near-surface plume appear to decrease exponentially with increasing distance from the dredge due to settling and dispersion, quickly reaching concentrations less than 1 ppt. By a distance of 4,000 feet from the dredge, plume concentrations are expected to return to background levels (USACE 1983). Studies also indicate that in almost all cases, the vast majority of resuspended sediments resettle close to the dredge within one hour, and only a small fraction takes longer to resettle (Anchor Environmental 2003).

Overall, water quality impacts are anticipated to be minor and temporary in nature. Once dredging operations are complete the project area will soon return to ambient conditions due to the dilution or re-deposition of suspended sediments along with the strong littoral currents of the Atlantic Ocean.

No information is available on the effects of total suspended solids (TSS) on juvenile and adult sea turtles. Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). TSS is most likely to affect sea turtles if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting sea turtle prey. As sea turtles are highly mobile they are likely to be able to avoid any sediment plume and any effect on sea turtle movements is likely to be insignificant. While an increase in suspended sediments may cause sea turtles to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movement to alter course out of the sediment plume, which is expected to be limited to the immediate area surrounding the draghead and be present at any location for no more than a few minutes to one hour. Based on this information, any increase in suspended sediment is not likely to affect the movement of sea turtles between foraging areas or while migrating or otherwise negatively affect listed species in the action area. Based on this information, it is likely that the effect of the suspension of sediment resulting from dredging operations will be insignificant.

The life stages of sturgeon most vulnerable to increased sediment are eggs and non-mobile larvae which are subject to burial and suffocation. As noted above, no Atlantic sturgeon eggs and/or larvae will be present in the action area. Any Atlantic sturgeon in the action area during dredging would be capable of avoiding any sediment plume by swimming around it. Laboratory studies (Niklitschek 2001 and Secor and Niklitschek 2001) have demonstrated Atlantic sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. While the increase in suspended sediments may cause sturgeon to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movement further up in the water column, or movement to an area just outside of the navigation channel. Based on this information, any increase in suspended sediment is not likely to affect the movement of Atlantic sturgeon between foraging areas and/or concentration areas during any phase of dredging or otherwise negatively affect sturgeon in the action area. Effects to sea turtle and sturgeon prey are considered below.

8.1.3 Hydraulic Cutterhead Dredge

Hydraulic pipeline dredges tend to be more efficient than the hopper style dredges because the pipeline conveys sand directly to the placement site. However, hydraulic pipeline dredges are not well-adapted to work in environments with high wave energy. Most pipeline dredges have a cutterhead on the suction end. A cutterhead is a mechanical device that has rotating blades or 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. Pipeline dredges are mounted (fastened) to barges and are not usually self-powered, but are towed to the dredging site and secured in place by special anchor piling, called spuds. To move the dredge, the operator's raises and lowers opposite spuds to crab crawl the dredge along at a much slower pace than hopper style dredges and are subsequently less maneuverable. A hydraulic pipeline dredge removes material by controlling the dragline on which the suction cutterhead is attached. This style of dredge works more efficiently when it can move slowly and remove deeper materials as it moves along using the spuds. Material is directly mixed with water as it is sucked into the pipeline and hydraulically pumped and sent directly to the spoil disposal site. This makes this style dredge more efficient than a hopper style dredge that is required to move to a pump-out site to dispose of material. The suction is created by hydraulic pumps either located on board or in route along the pipeline acting as a booster and creates the same low pressure around the drag heads as a hopper dredge to force the material along the pipeline. As with the hopper style dredge, the more closely the cutterhead is maintained in contact with the sediment, the more efficient the dredging.

Sea turtles are not known to be vulnerable to entrainment in cutterhead dredges. This is thought to be due to the size of sea turtles and their swimming ability that allows them to escape the intake velocity near a cutterhead. There are no records of any sea turtles being entrained in cutterhead dredges in the action area or anywhere else. Based on the available information, we do not anticipate any entrainment of sea turtles any time a cutterhead dredge is used.

8.1.3.1 Available Information on the Risk of Entrainment of Sturgeon in Cutterhead Dredge

As noted above, a cutterhead dredge operates with the dredge head buried in the sediment; however, a flow field is produced by the suction of the operating dredge head. The amount of suction produced is dependent on linear flow rates inside the pipe and the pipe diameter (Clausner and Jones 2004). High flow rates and larger pipes create greater suction velocities and wider flow fields. The suction produced decreases exponentially with distance from the dredge head (Boysen and Hoover 2009). With a cutterhead dredge, material is pumped directly from the dredged area to a disposal site. As such, there is no opportunity to monitor for biological material on board the dredge; rather, observers work at the disposal site to inspect material.

It is generally assumed that sturgeon are mobile enough to avoid the suction of an oncoming cutterhead dredge and that any sturgeon (with the exception of eggs and immobile larvae) in the vicinity of such an operation would be able to avoid the intake and escape. However, in mid-March 1996, two shortnose sturgeon were found in a dredge discharge pool on Money Island, near Newbold Island in the upper Delaware River. The dead sturgeon were found on the side of the spoil area into which the hydraulic pipeline dredge was pumping. An assessment of the condition of the fish indicated that the fish were likely alive and in good condition prior to entrainment and that they were both adult females. The area where dredging was occurring was a known overwintering area for shortnose sturgeon and large numbers of shortnose sturgeon were known to be concentrated in the general area. A total of 509,946 CY were dredged between Florence and the upper end of Newbold Island during this dredge cycle. Since that time, dredging occurring in the winter months in the Newbold – Kinkora range of the Delaware River required that inspectors conduct daily inspections of the dredge spoil area in an attempt to detect the presence of any sturgeon. In January 1998, three shortnose sturgeon carcasses were discovered in the Money Island Disposal Area. The sturgeon were found on three separate dates: January 6, January 12, and January 13. Dredging was being conducted in the Kinkora and Florence ranges at this time which also overlaps with the shortnose sturgeon overwintering area. A total of 512,923 CY of material was dredged between Florence and upper Newbold Island during that dredge cycle. While it is possible that not all shortnose sturgeon killed during dredging operations were observed at the dredge disposal pool, USACE has indicated that due to flow patterns in the pool, it is expected that all large material (i.e., sturgeon, logs etc.) will move towards the edges of the pool and be readily observable. Monitoring of dredge disposal areas used for deepening of the Delaware River with a cutterhead dredge has occurred. Dredging in Reach C occurred from March – August 2010 with 3,594,963 CY of material removed with a cutterhead dredge. Dredging in Reach B occurred in November and December 2011, with 1,100,000 CY of material removed with a cutterhead dredge. In both cases, the dredge disposal area was inspected daily for the presence of sturgeon. No sturgeon were detected.

In an attempt to understand the behavior of sturgeon while dredging is ongoing, the USACE worked with sturgeon researchers to track the movements of tagged Atlantic and shortnose sturgeon while cutterhead dredge operations were ongoing in Reach B of the Delaware River (ERC 2011). The movements of acoustically tagged sturgeon were monitored using both passive and active methods. Passive monitoring was performed using 14 VEMCO VR2 and VR2W single-channel receivers, deployed through the study area. These receivers are part of a network that was established and cooperatively maintained by Environmental Research and Consulting, Inc. (ERC), Delaware State University (DSU), and the Delaware Department of Natural Resources and Environmental Control (DNREC). Nineteen tagged Atlantic sturgeon and three tagged shortnose sturgeon (all juveniles) were in the study area during the time dredging was ongoing. Eleven of the 19 juvenile Atlantic sturgeon detected during this study remained upriver of the dredging area and showed high fidelity to the Marcus Hook anchorage. Three of the juvenile sturgeon detected during this study (Atlantic sturgeons 13417, 1769; shortnose sturgeon 58626) appeared to have moved through Reach B when the dredge was working. The patterns and rates of movement of these fish indicated nothing to suggest that their behavior was affected by dredge operation. The other sturgeon that were detected in the lower portion of the study area either moved through the area before or after the dredging period (Atlantic sturgeons 2053, 2054), moved through Reach B when the dredge was shut down (Atlantic sturgeons 1774, 58628, 58629), or moved through the channel on the east side of Cherry Island Flats (shortnose sturgeon 2090, Atlantic sturgeon 2091) opposite the main navigation channel. It is unknown whether some of these fish chose behaviors (routes or timing of movement) that kept them from the immediate vicinity of the operating dredge. In the report, Brundage speculates that this could be to avoid the noisy area near the dredge but also states that on the other hand, the movements of the sturgeon reported here relative to dredge operation could simply have been coincidence.

A similar study was carried out in the James River (Virginia) (Cameron 2012). Dredging occurred with a cutterhead dredge between January 30 and February 19, 2009 with 166,545 CY of material removed over 417.6 hours of active dredge time. Six subadult Atlantic sturgeon (77.5 – 100 cm length) were caught, tagged with passive and active acoustic tags, and released at the dredge site. The study concluded that: tagged fish showed no signs of impeded up- or downriver movement due to the physical presence of the dredge; fish were actively tracked freely moving past the dredge during full production mode; fish showed no signs of avoidance response (e.g., due to noise generated by the dredge) as indicated by the amount of time spent in close proximity to the dredge after release (3.5 – 21.5 hours); and, tagged fish showed no evidence of attraction to the dredge.

Several scientific studies have been undertaken to understand the ability of sturgeon to avoid cutterhead dredges. Hoover *et al.* (2011) demonstrated the swimming performance of juvenile lake sturgeon and pallid sturgeon (12 – 17.3 cm FL) in laboratory evaluations. The authors compared swimming behaviors and abilities in water velocities ranging from 10 to 90 cm/second (0.33-3.0 feet per second). Based on the known intake velocities of several sizes of cutterhead dredges. At distances more than 1.5 meters from the dredges, water velocities were negligible (10 cm/s). The authors conclude that in order for a sturgeon to be entrained in a dredge, the fish would need to be almost on top of the drag head and be unaffected by associated disturbance (e.g., turbidity and noise). The authors also conclude that juvenile sturgeon are only at risk of entrainment in a cutterhead dredge if they are in close proximity, less than 1 meter, to the cutterhead.

Boysen and Hoover (2009) assessed the probability of entrainment of juvenile white sturgeon by evaluating swimming performance of young of the year fish (8-10 cm TL). The authors determined that within 1.0 meter of an operating dredge head, all fish would escape when the pipe was 61 cm (2 feet) or smaller. Fish larger than 9.3 cm (about 4 inches) would be able to avoid the intake when the pipe was as large as 66 cm (2.2 feet). The authors concluded that regardless of fish size or pipe size, fish are only at risk of entrainment within a radius of 1.5 – 2 meters of the dredge head; beyond that distance, velocities decrease to less than 1 foot per second.

Clarke (2011) reports that a cutterhead dredge with a suction pipe diameter of 36" has an intake velocity of approximately 95 cm/s at a distance of 1 meter from the dredge head and that the velocity reduces to approximately 40cm/s at a distance of 1.5 meters, 25cm/s at a distance of 2.0 meters and less than 10cm/s at a distance of 3.0 meters. Clarke also reports on swim tunnel performance tests conducted on juvenile and subadult Atlantic, white and lake sturgeon. He concludes that there is a risk of sturgeon entrainment only within 1 meter of a cutterhead dredge head with a 36" pipe diameter and suction of 4.6m/second.

8.1.3.2 Predicted Entrainment of Atlantic sturgeon in a cutterhead dredge

The risk of an individual sturgeon being entrained in a cutterhead dredge is difficult to calculate. While a large area overall will be dredged, the dredge operates in an extremely small area at any given time (i.e., the ocean bottom in the immediate vicinity of the intake). An individual would need to be in the immediate area where the dredge is operating to be entrained (i.e., within 1 meter of the dredge head). The overall risk of entrainment is very low. It is likely that the nearly all Atlantic sturgeon in the action area will never encounter the dredge as they would not occur within 1 meter of the dredge. Information from the tracking studies in the James and Delaware river supports these assessments of risk, as none of the tagged sturgeon were attracted to or entrained in the operating dredges.

Beginning in 2007, all cutterhead dredges operating in the action area were outfitted with 15’ x 15’ baskets at the end of the discharge pipe. The baskets are screened with mesh that prevents the discharge of anything with a diameter greater than 0.75” from passing onto the beach. These baskets are inspected and cleaned out at least once every 12 hours. No sturgeon or sturgeon parts (which we expect to be identifiable because they are the only fish in the action area with scutes) have been observed. The discharge of over 15 million CY of sand onto NJ and DE Beaches that was removed from the action area has been monitored in this way. These projects have used 12 different borrow areas over a 4 year period. However, these dredges were also outfitted with screening at the cutterhead that prevented entrainment of any material with a diameter greater than 1.25” diameter. Given the small size of any biological material that could be captured in the discharge basket, it is hard to know if the inspectors would have been able to identify it as belonging to a sturgeon.

Prior to 2007 when the requirement for UXO screening was implemented, discharge of dredged material from cutterhead dredges was not monitored for entrained aquatic species, including sturgeon. We are not aware of any projects in areas that would be comparable to the action area that could be used to provide an estimate. While cutterhead operations in the Delaware River have been monitored, we do not anticipate the interaction rate would be directly comparable. This is because of the geography of the channel being dredged in the River as well as the difference in life stages and sizes of individuals that are present in the River. We expect the interaction rate to be lower in the action area than in the Delaware River.

Based on the available information presented here, including the monitoring of movements of subadult Atlantic sturgeon near cutterhead dredges operating in the James and Delaware River which indicates an ability to avoid the dredge, and information on sturgeon swimming ability and entrainment risk in cutterhead dredges (indicating a sturgeon needs to be within 1m of the cutterhead for there even to be a risk of entrainment), we have determined that the risk of entrainment in a cutterhead dredge operating in the action area is low. The available information indicates that the risk of interaction between a sturgeon and a hopper dredge is higher than the risk of an ineraction with a cutterhead dredge. In the absence of any other means to estimate interactions, we expect no more than 1 Atlantic sturgeon will be injured or killed for approximately every 8.6 million CY of material removed during cutterhead dredging operations in the action area.

8.1.3.3 Interactions with the Sediment Plume

The increased turbidity and suspended sediments related to the dredging and placement activities are anticipated to have short term, temporary impacts to water quality. Placement of sand at the designated beach nourishment site will be via hydraulic pipeline. Sand will be deposited directly on the beach and graded to profile. Fine particles that may be present in the sand will be transported and dispersed in the swash zone.

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the river, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. Dredging with a pipeline dredge minimizes the amount of material re-suspended in the water column as the material is essentially vacuumed up and transported to the disposal site in a pipe.

As reported by USACE, a near-field water quality modeling of dredging operations in the Delaware River was conducted in 2001. The purpose of the modeling was to evaluate the potential for sediment contaminants released during the dredging process to exceed applicable water quality criteria. The model predicted suspended sediment concentrations in the water column at downstream distances from a working cutterhead dredge in fine-grained dredged material. Suspended sediment concentrations were highest at the bottom of the water column, and returned to background concentrations within 100 meters downstream of the dredge.

In 2005, FERC presented NMFS with an analysis of results from the DREDGE model used to estimate the extent of any sediment plume associated with the proposed dredging at the Crown Landing LNG berth (FERC 2005). The model results indicated that the concentration of suspended sediments resulting from hydraulic dredging would be highest close to the bottom and would decrease rapidly downstream and higher in the water column. Based on a conservative (i.e., low) TSS background concentration of 5mg/L, the modeling results indicated that elevated TSS concentrations (i.e., above background levels) would be present at the bottom 2 meters of the water column for a distance of approximately 1,150 feet. Based on these analyses, elevated suspended sediment levels are expected to be present only within 1,150 feet of the location of the cutterhead. Turbidity levels associated with cutterhead dredge sediment plumes typically range from 11.5 to 282 mg/L with the highest levels detected adjacent to the cutterhead and concentrations decreasing with greater distance from the dredge (see U. Washington 2001).

Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580 mg/L to 700,000 mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993).

The life stages of sturgeon most vulnerable to increased sediment are eggs and non-mobile larvae which are subject to burial and suffocation. As noted above, no sturgeon eggs and/or larvae will be present in the action area. Subadult and adult Atlantic sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. All sturgeon in the action area would be sufficiently mobile to avoid any sediment plume. Therefore, any Atlantic sturgeon in the action area during dredging would be capable of avoiding any sediment plume by swimming around it.

8.1.4 Estimated Number of Interactions with Dredges

8.1.4.1 Sea Turtles

A total of approximately 139.5million CY of sand will be removed over the life of the projects considered here. No sea turtles are expected to interact with a cutterhead dredge or the Indian River Inlet sand bypass educator. Up to 119 MCY of sand will be removed with hopper dredges during the activities considered in this Opinion. Using the calculated interaction rate (1 sea turtle/3.8 MCY), we expect a total of 32 sea turtles to be entrained. These activities will be carried out between 2014 and 2064; we expect this entrainment to occur over this period.

The only sea turtle entrainment recorded in the action area was a loggerhead. However, because we know Kemp's ridley and green sea turtles also occur in the action area and are also vulnerable to entrainment in hopper dredges, it would not be reasonable to expect all of the entrained turtles to be loggerheads. Of the 74 entrained sea turtles observed in the NAD, 70 have been identifiable to species; 64 were loggerheads, 5 Kemp's ridley and 1 green. Overall, of those identified to species, 91% were loggerheads, 7% Kemp's ridley and 2% green. The high percentage of loggerheads is likely due to several factors including their tendency to forage on the bottom where the dredge is operating and the fact that this species is the most numerous of the sea turtle species in Northeast and Mid-Atlantic waters. It is likely that the documentation of only one green sea turtle entrainment in NAD dredging operations is a reflection of the low numbers of green sea turtles that occur in waters north of North Carolina. We expect distribution of sea turtles to be similar in the action area to the areas where these entrainments have been recorded. Therefore, it is reasonable to use these percentages to predict the species entrained in the hopper dredging activities considered here. As such, of the 32 sea turtles we expect to be entrained, we expect 29 loggerheads, 2 Kemp's ridley and 1 green.

8.1.4.2 Atlantic sturgeon

The majority of the 139.566 MCY of sand will be removed with a cutterhead or hopper dredge. Up to 800,000 CY of sand may be moved with the Indian River inlet bypass educator. This leaves approximately 138.7 MCY of sand to be removed with a cutterhead or hopper dredge. As explained above, we have calculated an expected interaction rate of 1 Atlantic sturgeon for every 8.6 MCY of sand removed with a hopper or cutterhead dredge. Using this interaction rate (1 Atlantic sturgeon/8.6 MCY), we expect interactions with up to 16 Atlantic sturgeon between now and 2064. Only subadult and adult Atlantic sturgeon occur in the action area. Based on the size of Atlatnic sturgeon observed during other hopper dredge operations, we expect that all interactions with Atlantic sturgeon will be subadults. Given the size of the openings of the UXO screening that will be installed on all hopper and cutterhead dredges, we expect all interactions with a hopper or cutterhead dredge to result in serious injury or death.

Based on mixed-stock analysis, we have determined that subadult and adult Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 58%; Chesapeake Bay 18%; South Atlantic 17%; Gulf of Maine 7%; and Carolina 0.5%. We anticipate that interactions with Atlantic sturgeon will occur at similar frequencies and therefore expect the 16 Atlantic sturgeon to be killed to consist of 9 NYB, 3 Chesapeake, 3 South Atlantic, Bay and 1 Gulf of Maine. Given the small number of Carolina DPS Atlantic sturgeon in the action area and the low interaction rate, it is extremely unlikely that there will be any interactions with Carolina DPS Atlantic sturgeon.

8.2 On Shore Dredged Material Disposal

We have considered whether the disposal of sand along the shoreline areas will affect sea turtles. As noted above, there is the potential for a northward shift in nesting by sea turtles over the time period considered in this Opinion. The furthest north that leatherbacks nest is southeastern Florida. Kemp's ridleys only nest in Mexico. It is more likely that any shift in nesting to Delaware Bay beaches would be from loggerheads (which nest as far north as Virginia) and/or green sea turtles (which normally nest as far north as North Carolina. Nesting in the mid-Atlantic generally is extremely rare and no nesting has been documented at any beach in the action area. In 2010, one green sea turtle came up on the beach in Sea Isle City, New Jersey; however, it did not lay any eggs. In August 2011, a loggerhead came up on the beach in Stone Harbor, New Jersey but did not lay any eggs. On August 18, 2011, a green sea turtle laid one nest at Cape Henlopen Beach in Lewes, Delaware near the entrance to Delaware Bay. The nest contained 190 eggs and was transported indoors to an incubation facility on October 7. A total of twelve eggs hatched, with eight hatchlings surviving. In December, seven of the hatchlings were released in Cape Hatteras, North Carolina. We expect that if the nest had not been moved indoors no eggs would have hatched (due to cold temperatures). It is important to consider that in order for nesting to be successful in the mid-Atlantic, fall and winter temperatures need to be warm enough to support the successful rearing of eggs and sea temperatures must be warm enough for hatchlings to survive when they enter the water. Predicted increases in water temperatures between now and 2064 are not great enough to allow successful rearing of sea turtle eggs in the action area. Therefore, it is unlikely that over the time period considered here, that there would be an increase in nesting activity in the action area or that hatchlings would be present in the action area.

Given existing nesting locations and the amount of climatological change that would be necessary to result in beaches in the action area serving as viable nesting sites (i.e., with air and water temperatures warm enough to support successful incubation and hatching), it seems extremely unlikely that the range of leatherback or Kemp's ridley sea turtle nesting would shift enough so that nesting would occur on beaches in the action area. The disposal of material along beaches in New Jersey and Delaware is meant to stabilize and restore eroding habitats and maintain existing beach. None of the activity is likely to reduce the suitability of these beaches for potential future nesting.

All material removed from the borrow areas will be disposed of at a beach location. Dredged material is piped directly from the cutterhead dredge or pumpout location to an onshore disposal area. The pipe will extend up to 3 miles, depending on the distance between the dredge site and the disposal site. The pipe will be approximately 30" in diameter and be laid on the ocean bottom. While the presence of the pipe will cause a small amount of benthic habitat to be unavailable to sturgeon and sea turtles, the extremely small area affected will cause any effects to be insignificant and discountable. While this could cause a small increase in suspended sediment in the immediate vicinity of sand placement, any effects are likely to be minor and temporary. Impacts associated with this action include a short term localized increase in turbidity during disposal operations. During the discharge of sediment at a disposal site, suspended sediment levels have been reported as high as 500 mg/L within 250 feet of the disposal vessel and decreasing to background levels (i.e., 15-100mg/L depending on location) within 1,000-6,500 feet (USACE 1983).

The placement of dredged material along beaches or shorelines will cause an increase in localized turbidity in the nearshore environment. Nearshore turbidity impacts from fill placement are directly related to the quantity of fines (silt and clay) in the nourishment material. As the material from the borrow areas is comprised consists of beach quality sand of similar grain size and composition as indigenous beach sands, short suspension time and containment of sediment during and after placement activities is expected. As such, turbidity impacts are expected to be short-term (i.e., within several hours of the cessation of operations (Greene 2002)) and spatially limited to the vicinity of the dredge outfall pipe, the pump-out station, and dredge anchor points.

The Atlantic States Marine Fisheries Commission (Greene 2002) review of the biological and physical impacts of beach nourishment cites several studies that report that the turbidity plume and elevated total suspended sediment levels drop off rapidly seaward of the sand placement operations. Wilber *et al*. (2006) evaluated the effects of a beach nourishment project along the coast of northern New Jersey and reported that maximum bottom surf zone and nearshore total suspended sediment concentrations related to nourishment activities were 64 mg/L and 34 mg/L, which were only slightly higher than background maximum bottom total suspended sediment concentrations in the surf and nearshore zones on unnourished portions of the beach (i.e., less than 20 mg/L). Additionally, Wilber *et al*. (2006) reported that elevated total suspended sediment concentrations associated with the active beach nourishment site were limited to within 400 m (1,310 feet) of the discharge pipe in the swash zone (defined as the area of the nearshore that is intermittently covered and uncovered by waves), while other studies found that the turbidity plume and elevated total suspended sediment levels are expected to be limited to a narrow area of the swash zone up to 500 m (1,640 feet) down current from the discharge pipe (Schubel *et al*. 1978; Burlas *et al*. 2001). Based on this and the best available information, turbidity levels created by the beach fill operations along the shoreline are expected to be between 34-64 mg/l; limited to an area approximately 500 meters down current from the discharge pipe, with dissipation occurring within several hundred meters along the shore; and, are expected to be short term, only lasting several hours.

For this project, the USACE has reported that because the dredged material is clean sand, the material will settle out within minutes and any sediment plume will be localized and temporary. Any sea turtles or sturgeon in the vicinity of the beach disposal sites during disposal may temporarily avoid the disposal area; however, as any effects to movements will be small and temporary, these effects will be insignificant. Similar effects of suspended sediment and turbidity will be experienced at the ocean disposal sites; as such, effects to sturgeon and sea turtles will be insignificant and discountable. Effects of disposal on prey resources are considered in section 8.5.

8.3 Shoreline Activities

*8.3.1 Extension of Stormwater Outfall Pip*es

The Great Egg to Townsend Inlet project will include the extension of two outfall pipes, located at 84th and 88th Street in Sea Isle City by 150 feet. The existing pipes carry stormwater from a residential area to the ocean. There will be no change in the material discharged by these pipes; USACE states there will be no alteration in water quality from existing conditions (USACE 2013). Work to extend the pipes will occur along the shoreline and intertidal zone, with most work occurring on the beach in the dry. Effects are limited to minor and localized increases in suspended sediment due to substrate disturbance. Due to the location of this work in an area where sea turtles and Atlantic sturgeon do not occur, no effects to listed sea turtles, Atlantic sturgeon, or their prey are anticipated.

8.3.2 Absecon Inlet Bulkhead

Approximately 0.3 miles of bulkhead will be installed along the shoreline of Absecon Inlet in Atlantic City, New Jersey. All work will occur in the shallow intertidal zone. Effects are limited to minor and localized increases in suspended sediment due to substrate disturbance. Due to the location of this work in an area where sea turtles and Atlantic sturgeon do not occur, no effects to listed sea turtles, Atlantic sturgeon, or their prey are anticipated.

8.4 Effects on Habitat including Benthic Resources and Foraging

All of the areas to be dredged have substrate consisting of beach compatible sand. The USACE conducts regular investigations of all active borrow areas in order to assess any changes in substrate type or topographical features resulting from dredging activities. All efforts are made to ensure that dredging in the borrow areas does not result in a change in substrate type that could lead to a change in community composition. Similarly, efforts are made to protect any unique features including shoals. Depths in the borrow areas will be increased due to the removal of sand resources. However, depth is not a limiting factor for the use of these areas by listed species; therefore, the change in depth is not likely to result in any change in use of the action area by listed species. Given the dynamic, open ocean environment of the borrow areas, no changes to salinity, dissolved oxygen or other water chemistry parameters are anticipated. Impacts to forage items are discussed below.

Since dredging involves removing the bottom material down to a specified depth, the benthic environment will be impacted by dredging operations. No sea grass beds occur in the areas to be dredged with a hopper dredge, therefore green sea turtles will not use the areas as foraging areas. Thus, we anticipate that the dredging activities are not likely to disrupt normal feeding behaviors for green sea turtles. Records from previous dredge events occurring in the action area indicate that some benthic resources, including whelks, horseshoe crabs, blue crabs and rock crabs are entrained during dredging. Other sources of information indicate that potential sea turtle forage items are present in the action area, including clams, mussels, sea urchins, whelks, horseshoe crabs, blue crabs and rock crabs.

Loggerhead and Kemp's ridley sea turtles are likely to utilize the borrow areas for feeding on benthic species, namely crabs and mollusks (Morreale and Standora 1992, Bjorndal 1997). As noted above, suitable sea turtle forage items occur in some of the areas to be dredged. As preferred sea turtle and sturgeon foraging items are present and depths are suitable for use by sea turtles, some foraging by these species likely occurs at these sites. Dredging can cause indirect effects on sea turtles by reducing prey species through the alteration of the existing biotic assemblages. Kemp's ridley and loggerhead sea turtles typically feed on crabs, other crustaceans and mollusks. Some of the prey species targeted by turtles, including crabs, are mobile; therefore, some individuals are likely to avoid the dredge; however, there is likely to be some entrainment of sea turtle prey items. Atlantic sturgeon prey on a variety of benthic invertebrates and may also be foraging in the borrow areas. The proposed dredging is likely to entrain and kill at least some of these potential forage items. Given the limited mobility of most benthic invertebrates that sturgeon feed on, most are unlikely to be able to actively avoid the dredge.

Previous studies in the borrow areas have demonstrated rapid recovery and resettlement by benthic biota and similar biomass and species diversity to pre-dredging conditions (Johnston, 1981; Diaz, 1994; USACE 2014). Similar studies in the lower portions of the Chesapeake Bay produced rapid resettlement of dredging and placement areas by infauna (Sherk, 1972). McCauley et al. (1977) observed that while infauna populations declined significantly after dredging, infauna at dredging and placement areas recovered to pre-dredging conditions within 28 and 14 days, respectively. Therefore, the direct and indirect impacts to benthic communities are anticipated to be minimal. Rapid recovery and resettlement of benthic species is expected.

Species that sea turtles and sturgeon feed on may be affected by discharge of dredged material along the shoreline. In general, the environment in which the material is to be placed can be characterized as an area exposed to high wave energy and thus, erosion, and one devoid of high densities or colonies of benthic organisms (e.g., shellfish beds, mollusks, crabs, SAV). Instead, these sites consist primarily of benthic infaunal communities (e.g., polycheates) that can withstand the variable and continually changing environment. Preferred prey items or habitat for Atlantic sturgeon and sea turtles (e.g., shellfish beds, crabs, mollusks, areas of SAV) are therefore, rarely established in these areas. Thus, it is extremely unlikely that the placement of dredged material in the nearshore waters of Delaware and New Jersey, will result in the removal of critical amounts of prey resources from the area. Should any prey items be removed from the area in which dredged material is to be placed, depending on the species, recolonization of a newly renourished beach can begin in as short as 2-6 months (Burlas *et al*. 2001) when there is a good match between the fill material and the natural beach sediment. As the sand being placed along shorelines is similar in grain size to the indigenous beach sand, it is expected that recolonization of the nearshore benthos will occur within 2-6 months after initial beach renourishment or shoreline restoration cycles are complete. As such, no long term impacts on the numbers of species or community composition of the beach infauna is expected (USACE 1994; Burlas *et al*. 2001). As such, the effects of these operations on foraging or migrating sea turtles or Atlantic sturgeon will be insignificant.

8.5 Dredge and Disposal Vessel Traffic

There have not been any reports of dredge vessels colliding with listed species but contact injuries resulting from dredge movements could occur at or near the water surface and could therefore involve any of the listed species present in the area. Because the dredge is unlikely to be moving at speeds greater than three knots during dredging operations, blunt trauma injuries resulting from contact with the hull are unlikely during dredging. It is more likely that contact injuries during actual dredging would involve the propeller of the vessel. Contact injuries with the dredge are more likely to occur when the dredge is moving from the dredging area to port, or between dredge locations. While the distance between these areas is relatively short, the dredge in transit would be moving at faster speeds than during dredging operations, particularly when empty while returning to the borrow area.

The dredge vessel may collide with sea turtles when they are at the surface. Sea turtles have been documented with injuries consistent with vessel interactions. It is reasonable to believe that the dredge vessels considered in this Opinion could inflict such injuries on sea turtles, should they collide. As mentioned, sea turtles are found distributed throughout the action area in the warmer months, generally from May through mid-November.

Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9% of living and dead stranded sea turtles had propeller or other boat strike injuries (Lutcavage et al. 1997). According to 2001 STSSN stranding data, at least 33 sea turtles (loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the northeast (Maine through North Carolina) were struck by a boat. This number underestimates the actual number of boat strikes that occur since not every boat struck turtle will strand, every stranded turtle will not be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem (NMFS SEFSC 2001).

Information is lacking on the type or speed of vessels involved in turtle vessel strikes. However, there does appear to be a correlation between the number of vessel struck turtles and the level of recreational boat traffic (NRC 1990). Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. The speed of the dredge is not expected to exceed 3 knots while dredging or while transiting to the pump out site with a full load and it is expected to operate at a maximum speed of 10 knots while empty. In addition, the risk of ship strike will be influenced by the amount of time the animal remains near the surface of the water. For the proposed action, the greatest risk of vessel collision will occur during transit between shore and the areas to be dredged. The presence of an experienced endangered species observer who can advise the vessel operator to slow the vessel or maneuver safely when sea turtles are spotted will further reduce the potential risk for interaction with vessels.

Information regarding the risk of vessel strikes to Atlantic sturgeon is discussed in the Status of the Species and Environmental Baseline sections above. As explained there, we have limited information on vessel strikes and many variables likely affect the potential for vessel strikes in a given area.

Assuming that the risk of vessel strike increases with an increase in vessel traffic, we have considered whether an increase in vessel traffic in the action area during dredging and disposal (one to two slow moving vessels per day) would increase the risk of vessel strike for listed species in the action area. Given the large volume of traffic in the action area and the wide variability in traffic in any given day, the increase in traffic of one to two vessels per day is negligible and the increased risk to Atlantic sturgeon or loggerhead, Kemp's ridley or green sea turtles is insignificant. We do not anticipate any Atlantic sturgeon or sea turtles will be struck by project related vessels.

8.6 Unexploded Ordinance and Munitions of Concern

The United States Army Environmental Command (USAEC) defines unexploded ordnance (UXO) or munitions of explosive concern (MEC) as military munitions that have been (1) primed, fused, armed or otherwise prepared for action; (2) fired, dropped, launched, projected, or placed in such a manner to constitute a hazard to operations, installations, personnel, or material, and (3) remain unexploded either by malfunction, design, or any other case. UXO/MEC comes in many shapes and sizes, may be completely visible or partially or completely buried, and may be easy or virtually impossible to recognize as a military munition. UXO/MEC can be found in the ocean. UXO/MEC may look like a bullet or bomb, or be in many pieces, but even small pieces of UXO/MEC can be dangerous. If disturbed, (touched, picked up, played with, kicked, thrown, etc.) UXO/MEC may explode without warning, resulting in serious injury or even death. The borrow areas considered here occur in an area associated with past and current military activities and has produced UXO/MEC during dredging operations.

The presence of UXO in dredged material presents two unique challenges. First, it poses a potential explosive safety hazard to dredging or observer personnel and potential damage to equipment and vessel. Second, any subsequent beneficial use of dredged material must also address the possibility of the presence of UXO and/or its removal.

As a safety precaution, in all borrowe areas used for placement of sand on beaches, the USACE will install special intake screening to be permanently placed over the drag head to effectively prevent any UXO from entering the dredge. The UXO screens placed on the draghead prevent entrainment of any material with a diameter greater than 1.25". The screens are inspected regularly. Additionally 15' x 15' cages are placed around the discharge pipe that are equipped with screening that prevents anything with a diameter of 0.75" or greater from passing through the basket and ending up on the beach. These cages are inspected and cleaned every 8-12 hours. and/or being subsequently placed within the associated placement site. While use of this screening poses challenges for monitoring interactions with listed species (see section 11 below), its use is not expected to change the interaction rates calculated above. That is because, while it may prevent turtles or sturgeon from entering the intake pipes, it does not change the way the dredge operates or the suction power at the intake. So, while sea turtles or sturgeon may be less likely to be sucked through the dredge plant (as this could be prevented by the small size of the intakes as caused by the screening), the risk of an interaction does not change.

9.0 CUMULATIVE EFFECTS

Cumulative effects, as defined in 50 CFR § 402.02, are those effects of future State or private activities, not involving Federal activities, which are reasonably certain to occur within the action area. Future Federal actions are not considered in the definition of "cumulative effects."

Actions carried out or regulated by the States of New Jersey and Delaware within the action area that may affect sea turtles and Atlantic sturgeon include the authorization of state fisheries and the regulation of dredged material discharges through CWA Section 401-certification and point and non-point source pollution through the National Pollutant Discharge Elimination System. We are not aware of any local or private actions that are reasonably certain to occur in the action area that may affect listed species. It is important to note that the definition of "cumulative effects" in the section 7 regulations is not the same as the NEPA definition of cumulative effects[9].

Future recreational and commercial fishing activities in state waters may take Atlantic sturgeon. Information on interactions with sea turtles and Atlantic sturgeon for state fisheries operating in the action area is summarized in the Environmental Baseline section above, and it is not clear to what extent these future activities would affect listed species differently than the current state fishery activities described in the Status of the Species/Environmental Baseline sections. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the status of the species/environmental baseline sections.

State NPDES Permits – New Jersey and Delaware have been delegated authority to issue NPDES permits by the EPA. These permits authorize the discharge of pollutants in the action area. Permitees include municipalities for sewage treatment plants and other industrial users. The states will continue to authorize the discharge of pollutants through the SPDES permits. However, this Opinion assumes effects in the future would be similar to those in the past and are therefore reflected in the anticipated trends described in the status of the species/environmental baseline section.

10.0 INTEGRATION AND SYNTHESIS OF EFFECTS

In the effects analysis outlined above, NMFS considered potential effects from operation of hopper and cutterhead dredges to remove sand for placement along the New Jersey and Delaware coast. We considered the potential for interactions between sea turtles and Atlantic sturgeon and the dredges as well as effects of exposure to increased suspended sediment/turbidity and impacts to prey. We also considered the the potential for collisions between listed species and project vessels. We anticipate the mortality of a small number of loggerhead, Kemp's ridley and green sea turtles, and Atlantic sturgeon from the NYB, CB, SA and GOM DPSs. Mortality of sea turtles will result from interactions with hopper dredges and mortality of Atlantic sturgeon will result from interactions with hopper dredges or cutterhead dredges. As explained in the "Effects of the Action" section, effects of the action on habitat and benthic resources will be insignificant

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[9] Cumulative effects are defined for NEPA as "the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

and discountable. We do not anticipate any take of Atlantic sturgeon or sea turtles due to any of the other effects including vessel traffic and dredge disposal.

In the discussion below, we consider whether the effects of the proposed actions reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of the listed species that will be adversely affected by the action. The purpose of this analysis is to determine whether the proposed action, in the context established by the status of the species, environmental baseline, and cumulative effects, would jeopardize the continued existence of any listed species in the action area. In the NMFS/USFWS Section 7 Handbook, for the purposes of determining jeopardy, survival is defined as,

> "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter." Recovery is defined as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act."

Below, for the listed species that may be affected by the proposed action, we summarize the status of the species and consider whether the proposed action will result in reductions in reproduction, numbers or distribution of these species and then considers whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of these species, as those terms are defined for purposes of the federal Endangered Species Act.

10.1 Atlantic sturgeon

As explained above, the proposed action is likely to result in the mortality of a total of 16 Atlantic sturgeon from the Gulf of Maine, New York Bight, Chesapeake Bay and South Atlantic DPSs through 2064. We expect that there will be no more than one mortality per year and that all mortalities will be subadults. All other effects to Atlantic sturgeon, including effects to habitat and prey due to dredging and dredge disposal, will be insignificant and discountable.

10.1.1 Determination of DPS Composition

We have considered the best available information to determine from which DPSs individuals that will be killed are likely to have originated. Using mixed stock analysis explained above, Atlantic sturgeon exposed to other effects of the proposed action originate from the five DPSs at the following frequencies: NYB 58%; Chesapeake Bay 18%; South Atlantic 17%; Gulf of Maine 7%; and Carolina 0.5%. Given these percentages, we expect that of the 16sturgeon likely to be killed during dredging, 9 will originate from the New York Bight DPS, 3 from the Chesapeake Bay DPS, 3 from the South Atlantic DPS and one from the Gulf of Maine DPS. Given the low numbers of Carolina DPS fish in the action area and the low number of mortalities anticipated, it is unlikely that there will be any mortality of any Carolina DPS Atlantic sturgeon.

10.1.2 Gulf of Maine DPS

While GOM DPS Atlantic sturgeon occur in several rivers in the Gulf of Maine, recent spawning has only been documented in the Kennebec and Androscoggin rivers. No total population estimates are available for any river population or the DPS as a whole. As discussed in section 4.7, we have estimated a total of 7,544 GOM DPS adults and subadults in the ocean (1,864 adults and 5,591 subadults). This estimate is the best available at this time and represents only a percentage of the total GOM DPS population as it does not include young of the year or juveniles and does not include all adults and subadults. GOM origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

Based on mixed-stock analysis, we expect that 7% of the subadult and adult Atlantic sturgeon in the action area will originate from the GOM DPS. All of these fish are expected to be subadults. While some adults from the GOM DPS are expected to be present in the action area, no mortality of adult Atlantic sturgeon is anticipated to result from the proposed action. We expect that no more than one GOM DPS Atlantic sturgeon will be killed during dredging. This mortality will occur between now and the end of 2064.

The number of subadult GOM DPS Atlantic sturgeon we expect to be killed due to the ongoing project (one between now and the end of 2064) represents an extremely small percentage of the GOM DPS. While the death of one subadult GOM DPS Atlantic sturgeon over this period will reduce the number of GOM DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the GOM DPS population of subadults and an even smaller percentage of the overall DPS as a whole. Even if there were only 5,591 subadults in the GOM DPS, this loss would represent only 0.02% of the subadults in the DPS. The percentage would be much less if we also considered the number of young of the year, juveniles, adults, and other subadults not included in the NEAMAP-based oceanic population estimate.

Because there will be no loss of adults, the reproductive potential of the GOM DPS will not be affected in any way other than through a reduction in numbers of individual future spawners as opposed to current spawners. The loss of one female subadult would have the effect of reducing the amount of potential reproduction as any dead GOM DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of a male subadult may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning. The proposed action will also not affect the spawning grounds within the rivers where GOM DPS fish spawn.

The proposed action is not likely to reduce distribution because while sturgeon may temporarily avoid areas where dredging or disposal activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will impact how GOM DPS sturgeon use the action area.

Based on the information provided above, the death of no more than one subadult GOM DPS Atlantic sturgeon over 50 years, will not appreciably reduce the likelihood of survival of the GOM DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect GOM DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the death of one subadult GOM DPS Atlantic sturgeon represents an extremely small percentage of the species; (2) the death of this GOM DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of this GOM DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of this subadult GOM DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have only an insignificant effect on individual foraging or sheltering GOM DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can rebuild to a point where listing as threatened is no longer warranted.

No Recovery Plan for the GOM DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for GOM Atlantic sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the GOM DPS likelihood of recovery.

This action will not change the status or trend of the GOM DPS as a whole. The proposed action will result in a small amount of mortality (one subadult from a population estimated to have at least 5,000 subadults) and a subsequent small reduction in future reproductive output. This reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the trend of the population. The proposed action will have only insignificant effects on habitat and forage and will not affect the way individual GOM DPS Atlantic sturgeon use the action area or cause any effects to habitat that makes additional growth of the population less likely. This is because the impact to forage will be limited to temporary loss of prey in areas being dredged and most foraging occurs outside of the areas where dredging and disposal will occur. Impacts to habitat will be limited to temporary increases in suspended sediment during dredging and disposal and increased water depth; however, as discussed in the Opinion, we do not anticipate any changes to substrate type and we anticipate any changes to water quality to be minor and temporary. We do not anticipate that any impacts to habitat will impact how sturgeon use the action area. For these reasons, the action will not reduce the likelihood that the GOM DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

10.1.3 New York Bight DPS

The NYB DPS is listed as endangered. Based on Mixed Stock Analysis, we expect that 58% of the subadult and adult Atlantic sturgeon in the action area will originate from the NYB DPS. No mortality of adult Atlantic sturgeon is anticipated. Over the course of the actions considered here, (through 2064), we anticipate the mortality of up to 9 NYB DPS Atlantic sturgeon. These fish could be a Delaware River origin juvenile or a subadult originating from the Delaware or Hudson River.

While NYB DPS Atlantic sturgeon occur in several rivers in the NYB DPS, recent spawning has only been documented in the Hudson and Delaware rivers. No total population estimates are available for any river population or the DPS as a whole. As discussed in section 4.7, we have estimated there to be 34,566 NYB DPS adults and subadults in the ocean (8,642 adults and 25,925 subadults). This estimate is the best available at this time and represents only a percentage of the total NYB DPS population as it does not include young of the year or juveniles and does not include all adults and subadults. NYB origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

The overall ratio of Delaware River to Hudson River fish in the DPS as a whole is unknown. Some Delaware River fish have a unique genetic haplotype (the A5 haplotype); however, whether there is any evolutionary significance or fitness benefit provided by this genetic makeup is unknown. Genetic evidence indicates that while spawning continued to occur in the Delaware River and in some cases Delaware River origin fish can be distinguished genetically from Hudson River origin fish, there is free interchange between the two rivers. This relationship is recognized by the listing of the New York Bight DPS as a whole and not separate listings of a theoretical Hudson River DPS and Delaware River DPS. Thus, while we can consider the loss of Delaware River fish on the Delaware River population and the loss of Hudson River fish on the Hudson River population, it is more appropriate, because of the interchange of individuals between these two populations, to consider the effects of this mortality on the New York Bight DPS as a whole.

The mortality of up to 9 subadult Atlantic sturgeon from the NYB DPS over a 50-year period represents a very small percentage of the subadult population. While the death of these subadult Atlantic sturgeon will reduce the number of NYB DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the juvenile and subadult population and an even smaller percentage of the overall population of the DPS (juveniles, subadults and adults combined).

The reproductive potential of the NYB DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of 9 female subadults over a 50 year period (average of less than one per year) would have the effect of reducing the amount of potential reproduction as any dead NYB DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by these individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of 9 male subadult sturgeon may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year.

The proposed action will also not affect the spawning grounds within the Hudson or Delaware River where NYB DPS fish spawn. The action will also not prevent or delay any adult Atlantic sturgeon from reaching the spawning grounds. Further, we do not anticipate the disruption, injury or mortality of any spawning adults.

We do not anticipate that any impacts to habitat will impact how sturgeon use the action area. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Based on the information provided above, the death of NYB DPS Atlantic sturgeon over a 50-year period, will not appreciably reduce the likelihood of survival of the New York Bight DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect NYB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the death of these subadult NYB DPS Atlantic sturgeon represents an extremely small percentage of the species; (2) the death of these NYB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of these NYB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these subadults will not result in the loss of any age class; (5) the loss of these NYB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (6) the action will have only a minor and temporary effect on the distribution of NYB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (7) the action will have no effect on the ability of NYB DPS Atlantic sturgeon to shelter and only an insignificant effect on individual foraging NYB DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of extinction through all or a significant part of its range.

No Recovery Plan for the NYB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the NYB DPS likelihood of recovery.

This action will not change the status or trend of the Hudson or Delaware River population of Atlantic sturgeon or the status and trend of the NYB DPS as a whole. The proposed action will result in a small amount of mortality (no more than 9 individuals over a 50 year period) and a subsequent small reduction in future reproductive output. This reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the trend of the population. The proposed action will have only insignificant effects on habitat and forage and will not impact the action area in a way that makes additional growth of the population less likely. This is because the impact to forage will be limited to temporary loss of prey in areas being dredged and most foraging occurs outside of the areas where dredging will occur. Impacts to habitat will be limited to temporary increases in suspended sediment during dredging and disposal and increased water depth; however, as discussed in the Opinion, we do not anticipate any changes to habitat will impact how sturgeon use the action area. Because it will not reduce the likelihood that the Hudson or Delaware River population can recover, it will not reduce the likelihood that the NYB DPS as a whole can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

10.1.4 Chesapeake Bay DPS

Individuals originating from the CB DPS are likely to occur in the action area. The CB DPS has been listed as endangered. We expect that 18% of the subadult and adult Atlantic sturgeon in the action area will originate from the CB DPS. No mortality of adult Atlantic sturgeon is anticipated. We expect that no more than 16 Atlantic sturgeon will be killed during hopper dredging operations (through 2064) and that no more than three of these will originate from the CB DPS. These fish are likely to be subadults as juvenile CB DPS fish would not be present in the action area.

While CB DPS Atlantic sturgeon occur in several rivers, recent spawning has only been documented in the James River. No total population estimates are available for any river population or the DPS as a whole. As discussed in section 4.7, we have estimated a total of 8,811 CB DPS adults and subadults in the ocean (2,203 adults and 6,608 subadults). This estimate is the best available at this time and represents only a percentage of the total CB DPS population as it does not include young of the year or juveniles and does not include all adults and subadults. CB origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

The number of subadult CB DPS Atlantic sturgeon we expect to be killed due to the ongoing deepening and maintenance (3 over a 50-year period) represents an extremely small percentage of the CB DPS. While the death of 3 subadult CB DPS Atlantic sturgeon over the next 50 years will reduce the number of CB DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the CB DPS population of subadults and an even smaller percentage of the overall DPS as a whole. Even if there were only 6,608 subadults in the CB DPS, this loss would represent only 0.05% of the subadults in the DPS. The percentage would be much less if we also considered the number of young of the year, juveniles, adults, and other subadults not included in the NEAMAP-based oceanic population estimate.

Because there will be no loss of adults, the reproductive potential of the CB DPS will not be affected in any way other than through a reduction in numbers of individual future spawners as opposed to current spawners. The loss of 3 female subadults would have the effect of reducing the amount of potential reproduction as any dead CB DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of male subadults may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year. Additionally, we have determined that for any sturgeon that are not killed, any impacts to behavior will be minor and temporary and there will not be any delay or disruption of movements to the spawning grounds or actual spawning. Further, the proposed action will also not affect the spawning grounds within the rivers where CB DPS fish spawn.

The proposed action is not likely to reduce distribution because while sturgeon may temporarily avoid areas where dredging or disposal activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will impact how CB DPS sturgeon use the action area.

Based on the information provided above, the death of no more than 3 subadult CB DPS Atlantic sturgeon over 50 years, will not appreciably reduce the likelihood of survival of the CB DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect CB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the death of these subadult CB DPS Atlantic sturgeon represents an extremely small percentage of the species; (2) the death of these CB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of these CB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these subadult CB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of CB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have only an insignificant effect on individual foraging or sheltering CB

DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of extinction through all or a significant part of its range.

No Recovery Plan for the CB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the CB DPS likelihood of recovery.

This action will not change the status or trend of the CB DPS as a whole. The proposed action will result in a small amount of mortality (four subadults from a population estimated to have at least 6,000 subadults) and a subsequent small reduction in future reproductive output. This reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the trend of the population. The proposed action will have only insignificant effects on habitat and forage and will not impact the action areain a way that makes additional growth of the population less likely. This is because the impact to forage will be limited to temporary loss of prey in areas being dredged and most foraging occurs outside of the areas dredging and disposal will occur. Impacts to habitat will be limited to temporary increases in suspended sediment during dredging and disposal and increased water depth.. We do not anticipate that any impacts to habitat will impact how sturgeon use the action area. For these reasons, the action will not reduce the likelihood that the CB DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

10.1.5 South Atlantic DPS

Individuals originating from the SA DPS are likely to occur in the action area. The SA DPS has been listed as endangered. We expect that 17% of the subadult and adult Atlantic sturgeon in the action area will originate from the SA DPS. Most of these fish are expected to be subadults, with few adults from the SA DPS expected to be present in the action area. No mortality of adult Atlantic sturgeon is anticipated. We expect that no more than 16 Atlantic sturgeon will be killed during hopper or cutterhead dredging (through 2064) and that no more than 3 of these will originate from the SA DPS. These fish are likely to be subadults as juvenile SA DPS fish would not be present in the action area.

No total population estimates are available for any river population or the SA DPS as a whole. As discussed in section 4.7, NMFS has estimated a total of 14,911 SA DPS adults and subadults in the ocean (3,728 adults and 11,183 subadults). This estimate is the best available at this time and represents only a percentage of the total SA DPS population as it does not include young of the year or juveniles and does not include all adults and subadults. SA origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

The number of subadult SA DPS Atlantic sturgeon we expect to be killed due to the dredging and disposal operations (3 over a 50-year period) represents an extremely small percentage of the SA DPS. While the death of3 subadult SA DPS Atlantic sturgeon over the next 50 years will reduce the number of SA DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the SA DPS population of subadults and an even smaller percentage of the DPS as a whole. Even if there were only 11,183 subadults in the SA DPS, this loss would represent less than 0.03% of the subadults in the DPS. The percentage would be much less if we also considered the number of young of the year, juveniles, adults, and other subadults not included in the NEAMAP-based oceanic population estimate.

Because there will be no loss of adults, the reproductive potential of the SA DPS will not be affected in any way other than through a reduction in numbers of individual future spawners as opposed to current spawners. The loss of up to three female subadults would have the effect of reducing the amount of potential reproduction as any dead SA DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of male subadults may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year. Additionally, we have determined that for any sturgeon that are not killed, any impacts to behavior will be minor and temporary and there will not be any delay or disruption of movements to the spawning grounds or to actual spawning. Further, the proposed action will also not affect the spawning grounds within the rivers where SA DPS fish spawn.

The proposed action is not likely to reduce distribution because while sturgeon may temporarily avoid areas where dredging or disposal activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will impact how SA DPS sturgeon use the action area.

Based on the information provided above, the death of no more than three subadult SA DPS Atlantic sturgeon over 50 years, will not appreciably reduce the likelihood of survival of the SA DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect SA DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the death of these subadult SA DPS Atlantic sturgeon represents an extremely small percentage of the species; (2) the death of these SA DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of these SA DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these subadult SA DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of SA DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have only an insignificant effect on individual foraging or sheltering SA DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that SA DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of extinction through all or a significant part of its range.

No Recovery Plan for the SA DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the SA DPS likelihood of recovery.

This action will not change the status or trend of the SA DPS as a whole. The proposed action will result in a small amount of mortality (3 subadults from a population estimated to have at least 11,000 subadults) and a subsequent small reduction in future reproductive output. This reduction in numbers will be small and the impact on reproduction and future year classes will also be small enough not to affect the trend of the population. The proposed action will have only insignificant effects on habitat and forage and will not impact the action area in a way that makes additional growth of the population less likely,. This is because the impact to forage will be limited to temporary loss of prey in areas being dredged and most foraging occurs outside of the areas where dredging will occur. Impacts to habitat will be limited to temporary increases in suspended sediment during dredging and disposal and increased water depth We do not anticipate that any impacts to habitat will impact how sturgeon use the action area. For these reasons, the action will not reduce the likelihood that the SA DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

10.1.6 Carolina DPS

As explained in section 4.7, no Carolina DPS fish have been documented in the action area. This is based on genetic sampling of fish captured in Delaware coastal waters (n=105). However, Carolina DPS fish have been documented in Long Island Sound (0.5% of samples). Because Carolina fish would swim past Delaware Bay on their way to Long Island Sound, we considered the possibility that up to 0.5% of the Atlantic sturgeon in the action area would originate from the Carolina DPS. However, given the low level of take anticipated (16 over a 50 year period) and the expected rarity of Carolina fish in the action area, it is extremely unlikely that any of the fish that will be killed during the deepening or subsequent maintenance will originate from the Carolina DPS. All other effects to Atlantic sturgeon, including habitat and prey, will be insignificant and discountable. Therefore, the action considered in this Opinion is not likely to adversely affect the Carolina DPS of Atlantic sturgeon.

10.2 Green sea turtles

Green sea turtles are listed as both threatened and endangered under the ESA. Breeding colony populations in Florida and on the Pacific Coast of Mexico are considered endangered while all others are considered threatened. Due to the inability to distinguish between these populations away from the nesting beach, for this Opinion, green sea turtles are considered endangered wherever they occur in U.S. waters. Green sea turtles are distributed circumglobally and can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea (NMFS and USFWS 1991; Seminoff 2004; NMFS and USFWS 2007d). As is also the case with the other sea turtle species, green sea turtles face numerous threats on land and in the water that affect the survival of all age classes.

A review of 32 Index Sites distributed globally revealed a 48% to 67% decline in the number of mature females nesting annually over the last three generations (Seminoff 2004). For example, in the eastern Pacific, the main nesting sites for the green sea turtle are located in Michoacan, Mexico, and in the Galapagos Islands, Ecuador, where the number of nesting females exceeds 1,000 females per year at each site (NMFS and USFWS 2007d). Historically, however, greater than 20,000 females per year are believed to have nested in Michoacan alone (Cliffton *et al.* 1982; NMFS and USFWS 2007d). However, the decline is not consistent across all green sea turtle nesting areas. Increases in the number of nests counted and, presumably, the numbers of mature females laying nests were recorded for several areas (Seminoff 2004; NMFS and USFWS 2007d). Of the 32 index sites reviewed by Seminoff (2004), the trend in nesting was described as: increasing for 10 sites, decreasing for 19 sites, and stable (no change) for 3 sites. Of the 46 green sea turtle nesting sites reviewed for the 5-year status review, the trend in nesting was described as increasing for 12 sites, decreasing for 4 sites, stable for 10 sites, and unknown for 20 sites (NMFS and USFWS 2007d). The greatest abundance of green sea turtle nesting in the western Atlantic occurs on beaches in Tortuguero, Costa Rica (NMFS and USFWS 2007d). Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007d). One of the largest nesting sites for green sea turtles worldwide is still believed to be on the beaches of Oman in the Indian Ocean (Hirth 1997; Ferreira *et al.* 2003; NMFS and USFWS 2007d). However, nesting data for this area has not been published since the 1980s and updated nest numbers are needed (NMFS and USFWS 2007d).

The results of genetic analyses show that green sea turtles in the Atlantic do not contribute to green sea turtle nesting elsewhere in the species' range (Bowen and Karl 2007). Therefore, increased nesting by green sea turtles in the Atlantic is not expected to affect green sea turtle abundance in other ocean basins in which the species occurs. However, the ESA-listing of green sea turtles as a species across ocean basins means that the effects of a proposed actions must, ultimately, be considered at the species level for section 7 consultations. NMFS recognizes that the nest count data available for green sea turtles in the Atlantic clearly indicates increased nesting at many sites. However, NMFS also recognizes that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future. Given the late age to maturity for green sea turtles (20 to 50 years) (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004), caution is urged regarding the trend for any of the nesting groups since no area has a dataset spanning a full green sea turtle generation (NMFS and USFWS 2007d).

As described in the Status of the Species, Environmental Baseline and Cumulative Effects sections above, green sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration and other factors that result in mortality of individuals at all life stages.

In the “Effects of the Action” section above, we determined that green sea turtles could be entrained in a hopper dredge operating in any of the borrow areas considered in this consultation. We have estimated that the proposed actions are likely to result in the mortality of 1 green sea turtle over the 50 year project life. We determined that all other effects of these actions on this species will be insignificant and discountable. While this estimate is based on the best available information, it is likely that this is an overestimate of the number of green sea turtles that will be encountered during hopper dredging because it: (1) assumes that all dredging will occur in the April – November time period when sea turtles are present in the action area; and (2) that any dredging that could occur with a hopper or cutterhead dredge, occurs with a hopper dredge. The number of mortalities would be less than 1 if some of the dredging occurred between December and March and if more of it was carried out with a cutterhead dredge, both of which are likely to occur. No mortalities of green sea turtles are expected whenever a cutterhead dredge is used. No green turtles are present in the action area from December – March, therefore, hopper dredging that occurs during this time of year will not result in the mortality of any green sea turtles. All other effects to greens, including effects to habitat and prey due to dredging and dredge disposal, will be insignificant and discountable.

The lethal removal of 1 green sea turtle from the action area over a fifty year period would reduce the number of green sea turtles as compared to the number of green sea turtles that would have been present in the absence of the proposed actions (assuming all other variables remained the same). However, this does not necessarily mean that the species will experience reductions in reproduction, numbers or distribution in response to these effects to the extent that survival and recovery would be appreciably reduced.

The lethal removal of one green sea turtle over 50 years, whether male or female, immature or mature animal, would reduce the number of green sea turtles as compared to the number of green that would have been present in the absence of the proposed actions assuming all other variables remained the same; the loss of one green sea turtle represents a very small percentage of the species as a whole. Even compared to the number of nesting females (17,000-37,000), which represent only a portion of the number of greens worldwide, the mortality of 1 green represents less than 0.006% of the nesting population. The loss of this sea turtle would be expected to reduce the reproduction of green sea turtles as compared to the reproductive output of green sea turtles in the absence of the proposed action. As described in the “Status of the Species” section above, we consider the trend for green sea turtles to be stable. However, as explained below, the death of one green sea turtle will not appreciably reduce the likelihood of survival for the species for the following reasons.

Generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species. This is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of greens because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of greens is likely to be increasing or at worst is stable. These actions are not likely to reduce distribution of greens because the actions will not impede greens from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors.

Based on the information provided above, the death of 1 green sea turtle over 50 years will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect green sea turtles in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring. It will not result in effects to the environment which would prevent green sea turtles from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is increasing; (2) the death of 1 green sea turtle represents an extremely small percentage of the species as a whole; (3) the loss of 1 green sea turtle will not change the status or trends of the species as a whole; (4) the loss of 1 green sea turtle is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of 1 green sea turtle is likely to have an undetectable effect on reproductive output of the species as a whole; (6) the actions will have no effect on the distribution of greens in the action area or throughout its range; and (7) the actions will have no effect on the ability of green sea turtles to shelter and only an insignificant effect on individual foraging green sea turtles.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that green sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the species can rebuild to a point where listing is no longer appropriate. A Recovery Plan for Green sea turtles was published by NMFS and USFWS in 1991. The plan outlines the steps necessary for recovery and the criteria which, once met, would ensure recovery. In order to be delisted, green sea turtles must experience sustained population growth, as measured in the number of nests laid per year, over time. Additionally, "priority one[10]" recovery tasks must be achieved and nesting habitat must be protected (through public ownership of nesting beaches) and stage class mortality must be reduced. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed actions will not appreciably reduce the likelihood of survival of green sea turtles. Also, it is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of green sea turtles in any geographic area and since it will not affect the overall distribution of green sea turtles other than to cause minor temporary adjustments in movements in the action area. The proposed actions are likely to result in the mortality of a total of 1 green sea turtle; however, as explained above, the loss of this one

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[10] The recovery plan contains a list of 62 recovery actions. Eight are designated as "Priority 1" defined as "An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future." The Priority 1 actions relate to enfocement of laws regulating coastal construction, acquiring nesting beaches in Florida, monitoring nesting trends, protecting nests, determining abundance, and implementing and enforcing TED regulations.

individual over the 50 year time period is not expected to affect the persistence of green sea turtles or the species trend. The actions will not affect nesting habitat and will have only an extremely small effect on mortality. The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of greens and a small reduction in the amount of potential reproduction due to the loss of one individual, these effects will be undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the population or its potential for recovery. The actions will have no impact on the ability to accomplish priority one recovery tasks. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that green sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual green sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of 1 green sea turtles over 50 years, is not likely to appreciably reduce the survival and recovery of this species.

10.3 Kemp's ridley sea turtles

In the "Effects of the Action" section above, we determined that up to 2 Kemp's ridleys could be killed during hopper dredge operations over the 50 year period considered here. Kemp's Ridley sea turtles are listed as a single species classified as "endangered" under the ESA. Kemp's ridleys occur in the Atlantic Ocean and Gulf of Mexico. The only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; USFWS and NMFS 1992; NMFS and USFWS 2007c).

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with the other sea turtle species discussed above, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles. In addition, the estimates do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females, and the age structure of the Kemp's ridley population, nest counts cannot be used to estimate the total population size (Meylan 1982; Ross 1996; Zurita et al. 2003; Hawkes et al. 2005; letter to J. Lecky, NMFS Office of Protected Resources, from N. Thompson, NMFS Northeast Fisheries Science Center, December 4, 2007). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (USFWS and NMFS 1992; TEWG 2000). From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3% per year

(TEWG 2000). Current estimates suggest an adult female population of 7,000-8,000 Kemp's ridleys (NMFS and USFWS 2007c).

The most recent review of the Kemp's ridleys suggests that this species is in the early stages of recovery (NMFS and USFWS 2007b). Nest count data indicate increased nesting and increased numbers of nesting females in the population. NMFS also takes into account a number of recent conservation actions including the protection of females, nests, and hatchlings on nesting beaches since the 1960s and the enhancement of survival in marine habitats through the implementation of TEDs in the early 1990s and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico in general (NMFS and USFWS 2007b). We expect this increasing trend to continue over the time period considered in this Opinion.

The mortality of 2 Kemp's ridleys over a 50year time period represents a very small percentage of the Kemp's ridleys worldwide. Even taking into account just nesting females, the death of 2 Kemp's ridley represents less than 0.03% of the population. While the death of 2 Kemp's ridley will reduce the number of Kemp's ridleys compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species or its stable to increasing trend as this loss represents a very small percentage of the population (less than 0.03%). Reproductive potential of Kemp's ridleys is not expected to be affected in any other way other than through a reduction in numbers of individuals. A reduction in the number of Kemp's ridleys would have the effect of reducing the amount of potential reproduction as any dead Kemp's ridleys would have no potential for future reproduction. In 2006, the most recent year for which data is available, there were an estimated 7-8,000 nesting females. While the species is thought to be female biased, there are likely to be several thousand adult males as well. Given the number of nesting adults, it is unlikely that the loss of 2 Kemp's ridleys over a 50 year period would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable to increasing trend of this species. Additionally, the proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because the action will not impede Kemp's ridleys from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the dredging, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

Generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species. This is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of Kemp's ridleys because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of Kemp's ridleys is likely to be increasing and at worst is stable.

Based on the information provided above, the death of two Kemp's ridley sea turtles between now and 2064 will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect Kemp's ridleys in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent Kemp's ridleys from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is increasing; (2) the death of 2 Kemp's ridleys represents an extremely small percentage of the species as a whole; (3) the death of 2 Kemp's ridleys will not change the status or trends of the species as a whole; (4) the loss of these Kemp's ridleys is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of these Kemp's ridleys is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (6) the action will have only a minor and temporary effect on the distribution of Kemp's ridleys in the action area and no effect on the distribution of the species throughout its range; and, (7) the action will have no effect on the ability of Kemp's ridleys to shelter and only an insignificant effect on individual foraging Kemp's ridleys.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that Kemps ridley sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that Kemp's ridleys can rebuild to a point where listing is no longer appropriate. In 2011, NMFS and the USFWS issued a recovery plan for Kemp's ridleys (NMFS and USFWS 2011). The plan includes a list of criteria necessary for recovery. These include:

1. An increase in the population size, specifically in relation to nesting females[11];
2. An increase in the recruitment of hatchlings[12];
3. An increase in the number of nests at the nesting beaches;
4. Preservation and maintenance of nesting beaches (i.e. Rancho Nuevo, Tepehuajes, and Playa Dos); and,
5. Maintenance of sufficient foraging, migratory, and inter-nesting habitat.

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[11] A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos) is attained in order for downlisting to occur; an average of 40,000 nesting females per season over a 6-year period by 2024 for delisting to occur

[12] Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos).

Kemp's ridleys have an increasing trend; as explained above, the loss of 2 Kemp's ridley during the proposed actions (50 years) will not affect the population trend. The number of Kemp's ridleys likely to die as a result of the proposed actions are an extremely small percentage of the species. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed actions will not affect the likelihood that criteria one, two or three will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; therefore, the proposed actions will have no effect on the likelihood that recovery criteria four will be met. All effects to habitat will be insignificant and discountable; therefore, the proposed actions will have no effect on the likelihood that criteria five will be met.

The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction. Further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of Kemp's ridleys and a small reduction in the amount of potential reproduction (2 individuals over 50 years), these effects will be undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that Kemp's ridley sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual Kemp's ridley sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of up to 2 Kemp's ridley sea turtles between now and 2064, is not likely to appreciably reduce the survival and recovery of this species.

10.4 Northwest Atlantic DPS of Loggerhead sea turtles

In the "Effects of the Action" section above, we determined that up to 29 loggerheads could be entrained in a hopper dredge working in any of the borrow areas. We determined that all other effects of the action on this species will be insignificant and discountable.

The Northwest Atlantic DPS of loggerhead sea turtles is listed as "threatened" under the ESA. It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS and USFWS 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in the Status of the Species, Environmental Baseline and Cumulative Effects sections above, loggerhead sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration, dredging, power plant intakes and other factors that result in mortality of individuals at all life stages. Negative impacts causing death of various age classes occur both on land and in the water. Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, many remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but for which success cannot be quantified.

The SEFSC (2009) estimated the number of adult females in the NWA DPS at 30,000, and if a 1:1 adult sex ratio is assumed, the result is 60,000 adults in this DPS. Based on the reviews of nesting data, as well as information on population abundance and trends, NMFS and USFWS determined in the September 2011 listing rule that the NWA DPS should be listed as threatened. They found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats. This stable trend is expected to continue over the time period considered in this Opinion.

As stated above, we expect the mortality of 29 loggerheads over the 50 year time period considered here; with an average mortality rate of less than one loggerhead per year. The lethal removal of up to 29 loggerhead sea turtles from the action area over this time period would be expected to reduce the number of loggerhead sea turtles from the recovery unit of which they originated as compared to the number of loggerheads that would have been present in the absence of the proposed actions (assuming all other variables remained the same). However, this does not necessarily mean that these recovery units will experience reductions in reproduction, numbers or distribution in response to these effects to the extent that survival and recovery would be appreciably reduced. The final revised recovery plan for loggerheads compiled the most recent information on mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (i.e., nesting groups). They are: (1) for the NRU, a mean of 5,215 loggerhead nests per year with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit.

It is likely that the loggerhead sea turtles in the action area originate from several of the recovery units. Limited information is available on the genetic makeup of sea turtles in the mid-Atlantic, where the majority of sea turtle interactions are expected to occur. Cohorts from each of the five western Atlantic subpopulations are expected to occur in the action area. Genetic analysis of samples collected from immature loggerhead sea turtles captured in pound nets in the Pamlico-Albemarle Estuarine Complex in North Carolina from September-December of 1995-1997 indicated that cohorts from all five western Atlantic subpopulations were present (Bass *et al.* 2004). In a separate study, genetic analysis of samples collected from loggerhead sea turtles from Massachusetts to Florida found that all five western Atlantic loggerhead subpopulations were represented (Bowen *et al.* 2004). Bass *et al.* (2004) found that 80 percent of the juveniles and sub-adults utilizing the foraging habitat originated from the south Florida nesting population, 12 percent from the northern subpopulation, 6 percent from the Yucatan subpopulation, and 2 percent from other rookeries. The previously defined loggerhead subpopulations do not share the exact delineations of the recovery units identified in the 2008 recovery plan. However, the PFRU encompasses both the south Florida and Florida panhandle subpopulations, the NRU is roughly equivalent to the northern nesting group, the Dry Tortugas subpopulation is equivalent to the DTRU, and the Yucatan subpopulation is included in the GCRU.

Based on the genetic analysis presented in Bass *et al.* (2004) and the small number of loggerheads from the DTRU or the NGMRU likely to occur in the action area it is extremely unlikely that the loggerheads likely to be killed will originate from either of these recovery units. The majority, at least 80% of the loggerheads killed, are likely to have originated from the PFRU, with the remainder from the NRU and GCRU. As such, of the 29 loggerheads likely to be killed, 23 are expected to be from the PFRU, with 4 from the NRU and 2 from the GCRU. Below, we consider the effects of these mortalities on these three recovery units and the species as a whole.

As noted above, the most recent population estimates indicate that there are approximately 15,735 females nesting annually in the PFRU and approximately 1,272 females nesting per year in the NRU. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit; however, the 2008 recovery plan indicates that the Yucatan nesting aggregation has at least 1,000 nesting females annually. As the numbers outlined here are only for nesting females, the total number of loggerhead sea turtles in each recovery unit is likely significantly higher.

The loss of 23 loggerheads over a 50-year period represents an extremely small percentage of the number of sea turtles in the PFRU. Even if the total population was limited to 15,735 loggerheads, the loss of 23 individuals would represent approximately 0.1% of the population. Similarly, the loss of 4 loggerheads from the NRU represents an extremely small percentage of the recovery unit. Even if the total population was limited to 1,272 sea turtles, the loss of 4 individuals would represent approximately 0.3% of the population. The loss of 2 loggerhead from the GCRU, which is expected to support at least 1,000 nesting females, represents less than 0.1% of the population. The loss of such a small percentage of the individuals from any of these recovery units represents an even smaller percentage of the species as a whole. The impact of these losses is even less when considering that these losses will occur over a span of 50 years. Considering the extremely small percentage of the populations that will be killed, it is unlikely that these deaths will have a detectable effect on the numbers and population trends of loggerheads in these recovery units or the number of loggerheads in the population as a whole.

All of the loggerheads that are expected to be killed will be juveniles. Thus, any effects on reproduction are limited to the loss of these individuals on their year class and the loss of future reproductive potential. Given the number of nesting adults in each of these populations, it is unlikely that the expected loss of loggerheads would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable trend of this species. Additionally, the proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because the action will not impede loggerheads from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the dredgingthere is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of loggerheads because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of loggerheads is likely to be stable or increasing over the time period considered here.

Based on the information provided above, the death of up to 29 loggerheads between now and 2064 will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect loggerheads in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring. It will not result in effects to the environment which would prevent loggerheads from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is stabilizing; (2) the death of 29 loggerheads represents an extremely small percentage of the species as a whole; (3) the death of 29 loggerheads will not change the status or trends of the species as a whole; (4) the loss of these loggerheads is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of these loggerheads is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of loggerheads in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of loggerheads to shelter and only an insignificant effect on individual foraging loggerheads.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that loggerhead sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the NWA DPS of loggerheads can rebuild to a point where listing is no longer appropriate. In 2008, NMFS and the USFWS issued a recovery plan for the Northwest Atlantic population of loggerheads (NMFS and USFWS 2008). The plan includes demographic recovery criteria as well as a list of tasks that must be accomplished. Demographic recovery criteria are included for each of the five recovery units. These criteria focus on sustained increases in the number of nests laid and the number of nesting females in each recovery unit, an increase in abundance on foraging grounds, and ensuring that trends in neritic strandings are not increasing at a rate greater than trends in in-water abundance. The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Loggerheads have an increasing trend; as explained above, the loss of 29 loggerheads over 50-years as a result of the proposed actions will not affect the population trend. The number of loggerheads likely to die as a result of the proposed actions is an extremely small percentage of any recovery unit or the DPS as a whole. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed actions will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; all effects to habitat will be insignificant and discountable; therefore, the proposed actions will have no effect on the likelihood that habitat based recovery criteria will be achieved. The proposed actions will also not affect the ability of any of the recovery tasks to be accomplished.

In summary, the effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of loggerheads and a small reduction in the amount of potential reproduction due to the loss of these individuals, these effects will be undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that loggerhead sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual loggerhead sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of other threats, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of the NWA DPS of loggerhead sea turtles.

11.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under our jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is NMFS' biological opinion that the proposed actions may adversely affect but are not likely to jeopardize the continued existence of the Gulf of Maine, New York Bight, Chesapeake Bay and South Atlantic DPS of Atlantic sturgeon, Kemp's ridley or green sea turtles or the Northwest Atlantic DPS of loggerhead sea turtles and is not likely to adversely affect leatherback sea turtles, the Carolina DPS of Atlantic sturgeon, right, fin or humpback whales. Because no critical habitat is designated in the action area, none will be affected by the proposed action.

12.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. "Fish and wildlife" is defined in the ESA "as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof." 16 U.S.C. 1532(8). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA Section 9 (51 FR 19936, June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person "to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA.]" 16 U.S.C. 1538(g). See also 16 U.S.C. 1532(13)(definition of "person"). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by USACE so that they become binding conditions for the exemption in section 7(o)(2) to apply. USACE has a continuing duty to regulate the activity covered by this Incidental Take Statement. If USACE (1) fails to assume and implement the terms and conditions or (2) fails to require any contractors to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to contracts or other documents as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, USACE must report the progress of the action and its impact on the species to us as specified in the Incidental Take Statement [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

12.1 Amount or Extent of Incidental Take

The activities considered in this Opinion are expected to result in incidental take of green, loggerhead and Kemp's ridley sea turtles, and individuals from the New York Bight, Gulf of Maine, Chesapeake Bay, South Atlantic DPSs of Atlantic sturgeon. This incidental take will occur as a result of interactions with hopper or cutterhead dredges operating in the borrow areas. All interactions are likely to result in mortality. While right, humpback and fin whales, leatherback sea turtles and Carolina DPS Atlantic sturgeon may occur in the action area, we do not anticipate any incidental take of these species. No other species listed by NMFS occur in the action area; thus incidental take of other species is not anticipated.

The activities considered in this Opinion will occur between 2014 and 2064. The amount of incidental take in any one year will depend on the amount of dredging activity occurring in that year. We anticipate the mortality of 29 loggerhead, 2 Kemp's ridley and 1 green sea turtle. We also anticipate the mortality of 9 NYB, 3 SA, 3 CB, and 1 GOM DPS Atlantic sturgeon. All Atlantic sturgeon are likely to be subadults.

Monitoring Incidental Take

The only incidental take anticipated will result from interactions with hopper or cutterhead dredges. Typically, an observer is used to monitor the inflow of material from the draghead into the hopper. Screening is placed over the inflow such that material with a diameter greater than 4" is captured in a basket. The baskets are inspected and cleaned out following each dredge load. In some instances, overflow screens are also used which prevent large pieces of material from overflowing out of the hopper. When UXO screening is in place on the draghead, the screen prevents any material with a diameter larger than 1.25" from passing through the screen. Thus, if the normal 4x4 screening was used on the intake, any biological material that was small enough to pass through the UXO screen would be small enough to pass through the openings of the intake screen. The use of intake screening with spacing small enough to trap material with a diameter smaller than 1.25" is not practicable due to issues of clogging and dredge performance. Given these facts, we do not expect an observer to be able to detect any biological material that is small enough to pass through the UXO screens. Therefore, it is not reasonable to require an observer to monitor the inflow or overflow on the dredge. There is no means for an observer to monitor the intake on a cutterhead dredge. Typically, an observer would monitor the disposal site. However, the UXO screening presents similar problems as to those discussed for hopper dredges.

We have considered whether monitoring of the baskets at the discharge location could serve to monitor take. While we expect that any biological material that passed through the UXO screen would be trapped within the discharge basket, the size of material will still be very small (between 0.75 and 1.25" diameter) and is likely to consist primarily of soft parts which would make detection and identification to species difficult. Additionally, we expect that the UXO screens prevent entrainment of biological material; thus, most interactions would not result in entrainment of body parts. Therefore, while inspection and documentation of material captured in the discharge baskets will provide some information on interactions with listed species, it is not likely to provide an accurate assessment of all interactions with listed species.

The USACE and NMFS considered the following alternatives to (1) monitor take of listed species during dredge operations with UXO screening in place or (2) modify the activity to eliminate the potential for take, thereby eliminating the need to monitor take.

1. Install a camera near the draghead: A camera installed on a draghead would allow users at the surface to observe underwater interactions. However, there are technical challenges to using video, including visibility due to water clarity and available light, improper focus, inappropriate camera angle, and the range of the viewing field. The use of video would require additional resources, and it is unlikely that it would be effective for monitoring this type of dredge work. For these dredges, turbidity levels (i.e., up to 450 mg/l) near the draghead while dredging operations are underway are too high to visually detect any animal impinged on or within the vicinity of the draghead. Therefore, this is not a reasonable and appropriate means to monitor take.

2. Use of sonar/fish finder: Sonar can be used to detect animals within the water and within the vicinity of the dredge. However, studies would need to take place to establish the signatures of sea turtles and sturgeon so that they could be readily identified electronically; this information is not currently available. As such, at this time, sonar alone could not indicate the take of an individual animal or identify the species potentially being taken. As such, the use of such devices would not be reasonable or appropriate for monitoring take.

3. Placement of observers on the shoreline: Observers placed on the shoreline may be able to detect stranded animals either in the water or on the shore. However, animals may not strand in the direct vicinity of the operation. Injured or deceased animal may not float to the surface immediately (i.e., it may take days for this to occur) or may drift far from the incident where injury occurred. Therefore, an injured or deceased stranded animal often cannot be definitively attributed to a specific action. The distance between the borrow areas and the shoreline further reduces the viability of this method to monitor take. As such, this is not a reasonable and appropriate means to monitor take.

4. Relocation trawling: While relocation could reduce the number of sea turtles and Atlantic sturgeon in the area being dredged and therefore minimize take, using relocation trawling would not serve to monitor the number of animals affected during dredging. Additionally, while relocation trawling may minimize the number of animals in the area to be dredged and minimize the potential for interactions with the dredge, it does not eliminate the potential for take. Therefore, we could not require relocation trawling and assume that no interactions with the dredge would occur. We would also need to consider the potential for injury or mortality to result from being captured in the trawl. Therefore, while in certain circumstance this may be a good method to minimize hopper dredge takes it is not a reasonable and appropriate means to monitor take.

5. Time of year restriction: If there was a time of year when no listed species were likely to occur in the action area, dredging could be scheduled to occur in that time of year. This would eliminate the potential for take and negate the need for monitoring. However,

because Atlantic sturgeon occur in the action area year round and safety and navigational concerns require dredging year-round, this is not practicable.

6. Use of alternate dredge types: The use of a mechanical dredge would eliminate the potential for sea turtle takes and would greatly reduce the number of Atlantic sturgeon takes; similar benefits could be obtained by requiring the use of a cutterhead dredge. However, the USACE chooses the type of dredge based on practical and technological constraints, including water depth, oceanic conditions, vessel traffic and maneuverability, substrate type and distance to the disposal area. Therefore, while use of alternate dredge types may minimize take, it is not practicable to require that cutterhead dredges be used in all instances.

Both agencies agreed that none of these methods would serve to eliminate the potential for take or were reasonable or appropriate for monitoring take. In situations where individual takes cannot be observed, a proxy must be considered. This proxy must be rationally connected to the taking and provide an obvious threshold of exempted take that, if exceeded, provides a basis for reinitiating consultation. As explained in section 8.0 of this Opinion, the estimated number of sea turtles and Atlantic sturgeon to be adversely affected by this action is related to the volume of material removed via dredge, the time of year and the duration of dredging activity.

Therefore, the volume of material removed from the action area can serve as a proxy for monitoring actual take. As explained in the Effects of the Action, we anticipate one sea turtle will be killed for every 3.8 MCY of material dredged with a hopper dredge; one Atlantic sturgeon is likely to be killed for every 8.6 MCY dredged with a hopper or cutterhead dredge. This estimate provides a proxy for monitoring the amount of incidental take during dredging operations when UXO screening is in place and direct observations of interactions cannot occur. This will be used as the primary method of determining whether incidental take has occurred; that is, we will consider that one sea turtle has been taken for every 3.7 MCY material removed during hopper dredging operations. Similarly, we will consider that one subadult Atlantic sturgeon has been taken for every 8.6 million CY of material removed during hopper or cutterhead dredging operations. There is a possibility that a sea turtle or an Atlantic sturgeon may remain impinged on UXO screens after the suction has been turned off. These animals can be visually observed, via a lookout, when the draghead is lifted above the water. Animals documented on the draghead by the lookout will be considered a take and this monitoring will be considered as a part of the monitoring of the actual take level. Monitoring of the discharge cages will also be used as part of the monitoring. Similarly, should we receive any reports of injured or killed sea turtles or sturgeon in the area (i.e., via the STSSN) and necropsy documents that detail interactions with the hopper dredge operating during this project was the cause of death, we will consider those animals to be taken by these activities.

As soon as the estimated number of sea turtles are observed or believed to be taken (e.g., if the total was six turtles: five takes via proxy or one observed impinged and four via proxy, etc.), any additional entrainment of a sea turtle will be considered to exceed the exempted level of take. We expect exceedance of the exempted amount of take to be unlikely given the conservative assumptions made in calculating this estimate. Lookouts will be present on the vessel and volumes of material removed will be continuously monitored during dredge operations.

Therefore, take levels can be detected and assessed early in the project and, if needed, consultation can be reinitiated. Further, we will be meeting with the USACE annually to assess the volume of material to be removed each year which will provide an early indication of whether an exceedence of take is likely to occur. Additionally, the monitoring of the discharge baskets provides a means for collecting and identifying any biological material that is entrained on the dredges.

12.2 Reasonable and prudent measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize and monitor impacts of incidental take resulting from the proposed action:

RPMs Applicable for All Dredge Activities

1. NMFS must be contacted prior to the commencement of dredging and again upon completion of the dredging activity.

2. All dredges must be operated in a manner that will reduce the risk of interactions with sea turtles.

3. All Atlantic sturgeon must have a fin clip taken for genetic analysis. This sample must be transferred to NMFS.

4. All dead loggerhead sea turtles must have a sample taken for genetic analysis. This sample must be transferred to NMFS.

5. Any dead sea turtles or sturgeon must be held in cold storage until proper disposal procedures can be discussed with NMFS.

6. All sturgeon and turtle captures, injuries or mortalities associated with any dredging activity and any sturgeon and sea turtle sightings in the action area must be reported to NMFS within 24 hours.

7. The USACE shall ensure that for all dredge operations where UXO screening is in place, a lookout/bridge watch, knowledgeable in listed species identification, will be present on board the hopper dredge at all times to serve as a lookout during transits and to inspect the draghead each time it is removed from the water.

8. The USACE shall continue to implement measures to ensure UXO screens are properly in place and in a manner that will reduce the risk of interactions with sea turtles or Atlantic sturgeon.

9. All material discharge cages must be inspected at least every 12 hours by someone knowledgeable in listed species identification. All biological material that may be a sea turtle or sturgeon must be reported to NMFS. Any sea turtle or sturgeon parts or potential parts must be placed into cold storage until further instructions can be provided by NMFS.

12.3 Terms and conditions

In order to be exempt from prohibitions of section 9 of the ESA, the USACE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline mandatory reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To implement RPM #1, prior to November 1 of each year, the USACE must set up a conference call or meeting with NMFS to present proposed dredging operations for the following calendar year. This meeting will serve to alert NMFS to upcoming dredging operations, allow for discussions of any interactions with listed species that occurred in that year, and review the amount of material removed from the borrow areas to date and predicted for the upcoming year which will allow us to determine if an exceedance of the ITS is likely. USACE will discuss with NMFS whether any new management measures could be implemented to prevent the total incidental take level from being exceeded and will work with NMFS to determine whether the level of take that has occurred or is anticipated represents new information revealing effects of the action that may not have been previously considered.

2. To implement RPM #1, the USACE must contact NMFS (Julie Crocker: by email (julie.crocker@noaa.gov) or phone (978) 282-8480 or (978)-281-9328)) within 3 days of the commencement of each dredging cycle and again within 3 days of the completion of dredging activity. This correspondence will serve both to alert NMFS of the commencement and cessation of dredging activities and to give NMFS an opportunity to provide USACE with any updated contact information or reporting forms.

3. To implement RPM #2, if sea turtles are observed during dredging or material transport, vessels transiting the area must post a bridge watch and the vessel operator must avoid intentional approaches closer than 100 yards and reduce speeds to below 4 knots.

4. To implement RPM#2, measures must be taken to minimize the use of suction when the hopper draghead or cutterhead is not properly seated in the bottom sediments.

5. To implement RPM #2, USACE must identify water intake ports on the dredges and take all reasonable and appropriate measures to screen these ports/trunions to minimize the potential for entrainment of listed species. Screen opening should not exceed 4”x4”.

6. To implement RPM #2, the USACE must ensure that all contracted personnel involved in operating hopper dredges receive thorough training on measures of dredge operation that will minimize takes of sea turtles. Training shall include measures discussed in Appendix B.

7. To implement RPM #3, the USACE must ensure that fin clips are taken (according to the procedure outlined in Appendix C) of any sturgeon captured during the project and that the fin clips are sent to NMFS for genetic analysis. Fin clips must be taken prior to preservation of other fish parts or whole bodies.

8. To implement RPM #4, if a dead loggerhead sea turtle is taken, a genetic sample must be taken following the procedure outlined in Appendix D.

9. To implement RPM #5, in the event of any lethal takes of Atlantic sturgeon, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS. The form included as Appendix E (sturgeon incident form) must be completed and submitted to NMFS.

10. To implement RPM #5, in the event of any lethal takes of sea turtles, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.

11. To implement RPM #6, if a decomposed turtle or turtle part is entrained during dredging operations, an incident report must be completed and the specimen must be photographed. Any turtle parts that are considered 'not fresh' (i.e., they were obviously dead prior to the dredge take and USACE anticipates that they will not be counted towards the ITS) must be held in cold storage until disposal procedures are provided by NMFS. This may include transportation to a nearby stranding or rehabilitation facility for review. USACE must submit the incident report for the decomposed turtle part, as well as photographs, to NMFS within 24 hours of the take (see Appendix F) and request concurrence that this take should not be attributed to the Incidental Take Statement. NMFS shall have the final say in determining if the take should count towards the Incidental Take Statement.

12. To implement RPM #6, the USACE must contact NMFS within 24 hours of any interactions with sturgeon or sea turtles, including non-lethal and lethal takes. NMFS will provide updated contact information when alerted of the start of dredging activity. Until alerted otherwise, the USACE should provide reports by e-mail (julie.crocker@noaa.gov) or phone (978) 282-8480 or the Section 7 Coordinator by phone (978)281-9328 or fax 978-281-9394). Take information should also be reported by e-mail to: incidental.take@noaa.gov.

13. To implement RPM #6, the USACE must photograph and measure any sturgeon or sea turtles observed during project operations (including whole sturgeon or sea turtles or body parts observed at the disposal location or on board the dredge, hopper or scow) and the corresponding form (Appendix G) must be completed and submitted to NMFS **within 24 hours** by fax (978-281-9394) or e-mail (incidental.take@noaa.gov).

14. To implement RPM #6, the USACE must submit a final report summarizing the results of dredging. The report must identify the dates dredging was carried out, the name and location of the borrow area, the volume of material removed and any takes of listed species. The report should be sent to NMFS within 30 working days of the completion of each dredging contract (by mail to the attention of the Section 7 Coordinator, NMFS Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930 or e-mail: incidental.take@noaa.gov).

15. To implement RPM #7, the lookout will inspect the draghead for impinged sea turtles or Atlantic sturgeon each time it is brought up from completing a dredge cycle. Should a sea turtle or Atlantic sturgeon be found impinged on the draghead, the incident should be recorded (Appendix G) and NMFS contacted within 24 hours.

16. To implement RPM #8 the USACE will continue to implement procedures to ensure that the UXO screen is properly in place. Should the screen not be able to be properly placed, the necessary steps should be taken to resolve any problems with the UXO screen before any dredging begins.

17. To implement RPM #8 UXO screens must be inspected and/or adjusted by a designated expert (someone with experience deploying and operating the draghead) prior to a dredge operation to ensure proper installment and operation during the dredging. For hopper dredges, the UXO screen must be checked after every load throughout the dredge operation to ensure that proper installation is maintained. For cutterhead dredges, the UXO screens must be checked whenever practicable.

18. To implement RPM #9, discharge cages must be inspected at least every 12 hours by someone knowledgable about listed species identification. Any biological material that may be a part of a sea turtle or sturgeon must be photographed and retained in cold storage until disposal can be discussed with NMFS. All biological material that may belong to a sturgeon or turtle must be reported to NMFS within 24 hours (incidental.take@noaa.gov).

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will keep us informed of when and where dredging activities are taking place and will require USACE to report any take in a reasonable amount of time, as well as implement measures to monitor for interactions with listed species during dredging. USACE has reviewed the RPMs and Terms and Conditions outlined above and has agreed to implement all of these measures as described herein and in the referenced Appendices. We have determined that all of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and represent only a minor change to the action as proposed by the USACE.

13.0 CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that all projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species." Conservation Recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. As such, NMFS recommends that the USACE consider the following Conservation Recommendations:

(1) To the extent practicable, the USACE should schedule dredging operations at times of year when listed species are least likely to be present in the borrow area.

(2) Whenever it is possible to outfit a hopper dredge with a rigid deflector draghead as designed by the USACE Engineering Research and Development Center, formerly the Waterways Experimental Station (WES), or if that is unavailable, a rigid sea turtle deflector, one should be attached to the draghead.

(3) To the extent practicable, USACE should minimize the use of hopper dredges in favor of cutterhead dredges.

(4) The USACE should conduct studies in conjunction with cutterhead dredging where disposal occurs on the beach to assess the potential for improved screening to: (1) establish the type and size of biological material that may be entrained in the cutterhead dredge, and (2) verify that monitoring the disposal site without screening is providing an accurate assessment of entrained material.

(5) The USACE should support studies to determine the effectiveness of using a sea turtle deflector to minimize the potential entrainment of sturgeon during hopper dredging.

(6) The USACE should explore alternative means for monitoring for interactions with listed species when UXO screening is in place including exploring the potential for video or other electronic monitoring and consider designing pilot studies to test the efficiency of innovative monitoring and screening techniques.

14.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, Section 7 consultation must be reinitiated immediately. If there is any incidental take of individuals from the Carolina DPS of Atlantic sturgeon, or leatherback sea turtle, right, humpback, or fin whales, reinitiation would be required.

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Appendix A.
Historical Take Records of Sturgeon

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
1	30 Oct 90	SAC	Winyah Bay Georgetown	A	H *Ouchita*	Dead	~69cm, rear half	Overflow Screening	N	Chris Slay pers com Observer report DACW 60-90-C-0067
2	15 Jan 94	SAS	Savannah Harbor	A	H *RN Weeks*	NA	NA	Found by Turtle observer	No	Steve Calver pers com 14 Jun 05 Observer load sheet and final rpt #DACW21-93-C-0072
3	07 Dec 94	SAS	Savannah Harbor	A	H *Dodge Island*	Live released	71cm, whole fish	Starboard Skimmer Screening	Yes We have efile	Chris Slay pers com Observer report
4	07 Dec 94 Different Load	SAS	Savannah Harbor	A	H *Dodge Island*	Dead	77.5cm, whole fish	Starboard Skimmer Screening	Yes We have efile	Chris Slay pers com Observer report
5	Feb 96	NAP	Delaware River Newbold Island	S	P *Ozark*	Dead	83cm, female w/eggs	In DMA Money Island		NMFS memo for record From Laurie Silva 19 Apr 96
6	Feb 96	NAP	Delaware River Newbold Island	S	P *Ozark*	Dead	63cm, mature male	In DMA Money Island		NMFS memo for record From Laurie Silva 19 Apr 96
7	06 Jan 98	NAP	Delaware River Kinkora Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
8	12 Jan 98	NAP	Delaware River Florence Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
9	13 Jan 98	NAP	Delaware River Florence Range	S	P *??*	Dead	Either 657mm or 573mm **???**	In DMA Money Island	Y Not e-file	Memo for file 20 Jan 98 From Greg Wacik NAP
10	7 Sep 98	SAW	Wilmington Har Cape Fear River	A	H *McFarland*	Dead	Head only (1 ft long)	In turtle Inflow screen		Observer incident report Pers com Bill Adams- SAW 26 Jul 04
11	01 Mar 00	SAC	Charleston Harbor	A	H *Stuyvesant*	Dead	Missing head and tail	Main Overflow Screening	No	Chris Slay pers com Observer reporting forms
12	12 Apr 00	SAC	Charleston Harbor	A	H *Stuyvesant*	Dead	71.6cm, whole fish	Starboard Overflow screening	No	Chris Slay pers com Observer reporting forms
13	03 Dec 00	SAW	Wilmington Har MOTSU	A	C *New York*	Dead	82.5cm, whole fish decomposing	In bucket	Y Not e-file Payonk? ?	Chris Slay pers com Phil Payonk pers com 30 Jul 04 Bill Adams pers com 28 Jul 04 #DACW54-00-C-0013

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
14	24 Feb 01	SAS	Brunswick Harbor	A	H *RN Weeks*	Dead	Head only	Just mentions take on all forms, no other info.	No	Daily and Weekly Reports, Load sheet.
15	19 Jun 01	NAE	Kennebec River Bath Iron Works	A	C *??*	Live released		Put in scow, released unharmed		Julie Crocker NMFS pers com 19 Jul 04 2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001
16	30 Apr 03	NAE	Kennebec River Bath Iron Works	S	C Reed and Reed dredge company	Dead	Fish nearly cut in half		Y We have e-file	Julie Crocker NMFS pers com 19 Jul 04 2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001
17	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	38.1inches	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
18	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	37.0 inches	In hopper Did not dive Probably died	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
19	6 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Live	Swam away	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
20	06 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Dead	Found alive	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
21	08 Oct 03	NAE	Kennebec River Doubling Point	S	H *Padre Island*	Live	Good condition	In hopper	Y We have e-file	Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04
22	07 Jan 04	SAC	Charleston Harbor	A	H *Manhattan Island*	Live	Whole fish 49 inches total length May have died later when released	Found by Coastwise turtle observers	Yes (We Have e-file)	Robert Chappell pers com 28 Jun 04 Observer daily report 7 Jan 04
23	13 Dec 04	SAM	Gulfport Harbor Channel	G	H *Bayport*	Dead	Trunk of fish 59.5cm	Found by turtle observers		Observer incident report Susan Rees pers com 7 Jan 05
24a	28 Dec 04	SAM	Mobile Bar Channel	G	H *Padre Island*	Dead	Trunk of fish 2 ft, 1inch	Found by Turtle observers	Yes (We Have e-file)	Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049
24b	01 Jan 05	SAM	Mobile Bar Channel	G	H *Padre Island*	Dead	Head only of fish 22.5cm	2nd part of take on 28 Dec 04	Yes taken But we Have not received	Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049
25	2 Mar 05	SAS	Brunswick Harbor	A	H *RN Weeks*	Dead	Posterior section only 60 cm section w/tail	Found by turtle observer	Yes (We Have e-file)	Chris Slay pers com 7 Jun 05 Steve Calver pers com 14 Jun 05
26	26 Dec 06	SAS	Brunswick	A	H *Newport*	Dead	Head only	Caught in port screen and	Black and	Incident and load report

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
								turtle part caught in starboard screen	White	
27	17 Jan 07	SAS	Savannah Entrance Channel	A	H *Glenn Edwards*	Dead	Whole fish, FL 104 cm	Fresh Dead, 60 Horseshoe crab in with load	Coastwise took photo	Incident and Load report
28	2 Mar 09	SAS	Savannah Entrance Channel	A	H *Dodge Island*	Dead	Total Length 111 cm	Fresh Dead, found in starboard aft inflow box, load #42		Incident, Load and Daily report
29	6 Feb 10	SAS	Brunswick Entrance Channel	A	H *Glenn Edwards*	Dead	No measurements	Fore screen contents, Load #19 with 12 Horseshoe crab		No incident report, just listed on load sheet and daily summary
30	7 Feb 10	SAS	Brunswick Entrance Channel	A	H *Glenn Edwards*	Dead	No measurements	Fore screen contents, Load #25 with 20 Horseshoe crab		No incident report, just listed on load sheet and daily summary
31	2 Feb 10	SAS	Brunswick Entrance Channel	A	H *Bayport*	Dead	No measurements, head to mid body in load #193 and mid body to tail recovered in load #194.	Stbd screen contents, load #193 and overflow screen in #194,		No incident report, just listed on load sheet and daily summary
32	7 Dec 10	SAW	Wilmington Harbor	A	H Terrapin Island	Dead	Whole fish, FL 61 cm	Fresh Dead, water temp 12 C, air 2 C, load 6	Coastwise took photo	Incident and Load report
33	10 Apr 11	NAO	York Spit Channel	A	H Terrapin Island	Dead	Total Length 24.5" in, Fork Length 13.5", Middle of anus to Anal Fin 3.8"	During Clean up. Torn in half, only posterior from pectoral region to tail, no head. Fins and tail torn but complete		Hopper daily report from, QCR, e-mail, incident report, daily report, load sheets

Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

Take #	Date	Corps District	Location	Sp	Dredge Type/ Name	Status	Specimen Description	Notes	Photos	Documentation
34	11Apr 11	NAO	York Spit Channel	A	H Liberty Island	Dead		During cleanup. Another piece taken on 4/13/11 matches perfectly.	Y	E-mail
35	14 Mar 12	SAC	Charleston Harbor Channel	A	H Glenn Edwards	Dead	Fresh dead, body part 26”-30” long X 13” width, no head or tail	Load 129 (0024-0345) found in starboard draghead, during cleanup mode. Given to South Carolina DNR	Yes	E-mail, load sheet, incident report
NT	25 May 05	NAO	York Spit Channel	?	H *McFarland*	Dead	Approx. 2 ft estimate from photos	Too decomposed to identify	Yes (We Have e-file)	Observer final report, REMSA 2004
NDNEF	26 Jun 96	NAN	East Rock Away Long Island	?	H Dodge Island	Dead	(~3'), couldn't identify and doesn't mention condition (fresh or dead already)? Chris Starbird.	Load sheet states Carp or sturgeon	No	Load sheet, Daily and Weekly Summary mentions. No way to confirm.
NDNEF	About 98	SAW	Wilmington Har Cape Fear River	A	P *??*	Dead				NMFS 1998 Shortnose Recovery Plan p. 53
NDNEF	About 98	SAW	Wilmington Har Cape Fear River	A	C	Dead				NMFS 1998 Shortnose Recovery Plan p. 53
NDNEF	About 98	SAJ or SAS	Kings Bay	A	H ??	Dead				NMFS 1998 Shortnose Recovery Plan p. 52 Chris Slay pers com

Sp=sturgeon species
A=Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*)
S=Shortnose sturgeon (*Acipenser brevirostrum*)

G=Gulf sturgeon (*Acipenser oxyrhynchus desotoi*)
NT = Non-take incident by dredge
SAC=Charleston

SAW=Wilmington
SAS=Savannah
SAJ=Jacksonville
SAM=Mobile
NAE=New England
NAO=Norfolk
NAN=New York
NAP=Philadelphia
H=Hopper
P=Hydraulic Cutterhead pipeline
C=Mechanical clamshell or bucket, bucket and barge
DMA=Dredged material disposal area
NDNEF=No documentation, no evidence found to confirm citation

APPENDIX B.

SPECIFICATIONS FOR HOPPER DREDGES

A Draghead

The draghead of the dredge shall remain on the bottom **at all times** during a pumping operation, except when:

1) the dredge is not in a pumping operation, and the suction pumps are turned completely off;
2) the dredge is being re-oriented to the next dredge line during borrow activities; and
3) the vessel's safety is at risk (i.e., the dragarm is trailing too far under the ship's hull).

At initiation of dredging, the draghead shall be placed on the bottom during priming of the suction pump. If the draghead and/or dragarm become clogged during dredging activity, the pump shall be shut down, the dragarms raised, whereby the draghead and/or dragarm can be flushed out by trailing the dragarm along side the ship. If plugging conditions persist, the draghead shall be placed on deck, whereby sufficient numbers of water ports can be opened on the draghead to prevent future plugging.

Upon completion of a dredge track line, the drag tender shall:

1) throttle back on the RPMs of the suction pump engine to an idling speed (e.g., generally less than 100 RPMs) **prior to** raising the draghead off the bottom, so that no flow of material is coming through the pipe into the dredge hopper. Before the draghead is raised, the vacuum gauge on the pipe should read zero, so that no suction exists both in the dragarm and draghead, and no suction force exists that can impinge a turtle on the draghead grate;
2) hold the draghead firmly on the bottom with no flow conditions for approximately 10 to 15 seconds before raising the draghead; then, raise the draghead quickly off the bottom and up to a mid-water column level, to further reduce the potential for any adverse interaction with nearby turtles;
3) re-orient the dredge quickly to the next dredge line; and
4) re-position the draghead firmly on the bottom prior to bringing the dredge pump to normal pumping speed, and re-starting dredging activity.

B. Intervals between dredging

Sufficient time must be allotted between each dredging cycle to inspect the draghead and UXO screening for biological material. All biological material must be documented.

C. Sea Turtle or Sturgeon or their Parts

If any whole (alive or dead) or turtle parts are taken incidental to the project(s), NMFS Protected Resources Division must be contacted by phone (978-281-9328) and e-mail (incidental.take@noaa.gov) within 24 hours of the take. An incident report for sea turtle/shortnose sturgeon take shall also be completed by the observer and sent via FAX (978) 281-9394 or e-mail (incidental.take@noaa.gov) within 24 hours of the take. Incident reports shall be completed for every take regardless of the state of decomposition. NMFS will determine if the take should be attributed to the incidental take level, after the incident report is received. Every incidental take (alive or dead, decomposed or fresh) should be photographed, and photographs shall be sent to NMFS either electronically (incidental.take@noaa.gov) or through the mail. Weekly reports, including all completed load sheets, photographs, and relevant incident reports, as well as a final report, shall be submitted to NMFS NER, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930-2298.

Information to be Collected

For each sighting of any endangered or threatened marine species (including whales as well as sea turtles), record the following information on the Endangered Species Observation Form (Appendix E):

1) Date, time, coordinates of vessel
2) Visibility, weather, sea state
3) Vector of sighting (distance, bearing)
4) Duration of sighting
5) Species and number of animals
6) Observed behaviors (feeding, diving, breaching, etc.)
7) Description of interaction with the operation

Disposition of Parts

If any whole turtles or sturgeon (alive or dead, decomposed or fresh) or turtle or shortnose sturgeon parts are taken incidental to the project(s), NMFS Protected Resources must be contacted within 24 hours of the take (phone: 978-281-9328 or e-mail (incidental.take@noaa.gov). All whole dead sea turtles or sturgeon, or turtle or shortnose sturgeon parts, must be photographed and described in detail on the Incident Report of Sea Turtle Mortality (Appendix E). The photographs and reports should be submitted by email (incidental.take@noaa.gov) or mail (Attn: Section 7 Coodinator, NMFS, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930-2298). After NMFS is notified of the take, it may instruct the observer to save the animal for future analysis if there is freezer space. Disposition of dead sea turtles/ sturgeon will be determined by NMFS at the time of the take notification. If the species is unidentifiable or if there are entrails that may have come from a turtle, the subject should be photographed, placed in plastic bags, labeled with location, load number, date and time taken, and placed in cold storage.

Live turtles (both injured and uninjured) should be held onboard the dredge until transported as soon as possible to the appropriate stranding network personnel for rehabilitation. No live turtles should be released back into the water without first being checked by a qualified veterinarian or a rehabilitation facility. The NMFS Stranding Network Coordinator ((978) 282-8470) should also be contacted immediately for any marine mammal injuries or mortalities.

APPENDIX C

Procedure for obtaining fin clips from sturgeon for genetic analysis

Obtaining Sample

1. Wash hands and use disposable gloves. Ensure that any knife, scalpel or scissors used for sampling has been thoroughly cleaned and wiped with alcohol to minimize the risk of contamination.

2. For any sturgeon, after the specimen has been measured and photographed, take a one-cm square clip from the pelvic fin.

3. Each fin clip should be placed into a vial of 95% non-denatured ethanol and the vial should be labeled with the species name, date, name of project and the fork length and total length of the fish along with a note identifying the fish to the appropriate observer report. All vials should be sealed with a lid and further secured with tape Please use permanent marker and cover any markings with tape to minimize the chance of smearing or erasure.

Storage of Sample

1. If possible, place the vial on ice for the first 24 hours. If ice is not available, please refrigerate the vial. Send as soon as possible as instructed below.

Sending of Sample

1. Vials should be placed into Ziploc or similar resealable plastic bags. Vials should be then wrapped in bubble wrap or newspaper (to prevent breakage) and sent to:

Julie Carter NOAA/NOS – Marine Forensics
219 Fort Johnson Road Charleston, SC 29412-9110
Phone: 843-762-8547

Prior to sending the sample, contact NMFS Protected Resources Division (978-281-9328) to report that a sample is being sent and to discuss proper shipping procedures.

Certification, Identification and Chain of Custody Form for Submitting Sturgeon Genetic Tissue Samples.[1],[2]

(A) CERTIFICATION OF SPECIES (Collector)

I, ______________________________, **hereby certify that I have positively identified the**
Full Name

fish or fishes sampled in this shipment as: **Δshortnose sturgeon; ΔAtlantic sturgeon; Δ other Δ unknown**
based on my knowledge and experience as a ______________________________.
Position Job Title

Signature: ____________________ **Date Identified**: ____________________
Address: ____________________
____

Phone Number: ____________________

(B) SAMPLE IDENTIFICATION

Species Identification: **Δshortnose sturgeon; ΔAtlantic sturgeon; Δunknown**
Unique ID No: __________; **Tissue Type:** __________; **Preservative:** __________;
Location: **(River:** __________; **River-km**: ______; **Lat/Long:** __________;
River Location Description: ____________________**);**
Total Length (TL) of Specimen (mm): ________**Weight of Specimen (g):** ________ **; Sex (if known)** ______

Specific comments on take: ______________________________

Δ Check here if multiple samples are submitted and use *Field Collection Report* (Appendix 3b) with the data fields listed in this section.

(C) EVIDENCE OF CHAIN OF CUSTODY

1. ____________________ __________ ____________________ __________
Release Signature **NMFS Permit No.** **Method of Transfer** **Date**

____________________ __________ __________
Receipt Signature **NMFS Permit No.** **Date**

2. ____________________ __________ ____________________ __________
Release Signature **NMFS Permit No.** **Method of Transfer** **Date**

____________________ __________ __________
Receipt Signature **NMFS Permit No.** **Date**

3. ____________________ __________ ____________________ __________
Release Signature **NMFS Permit No.** **Method of Transfer** **Date**

____________________ __________ __________
Receipt Signature **NMFS Permit No.** **Date**

---

[1] Instructions on next page.
[2] If multiple samples are shipped, attach summary sheet in Appendix 3b.

I[redacted]

[redacted]:

For each shipment a "*Certification of Species Identification*" (Section A) must be provided. This form documents the collector has identified the fish or fishes sampled in the shipment as either a shortnose or Atlantic sturgeon. If there is any doubt about the identity of a sample, then mark unknown and include comments on the take.

2. [redacted]:

Assign a unique number identifying each individual fish captured and subsequently sampled. This number must be recorded in Section B and on the collection vial for each sample taken. Record tissue type; preservative used; date of capture; location of capture (river & description, lat/long, river km, and nearest city); length of specimen; weight; and sex, if known. Check the box provided if you are submitting multiple samples, and provide a hard- copy and/or email a copy of the sample spreadsheet with information for each of the data fields listed above.

3. [redacted]:

a. Cleanliness of Samples: Cross contamination should be avoided. For each fish, use a clean cutting tool, syringe, etc. for collecting and handling samples.

b. Preserving & Packaging Samples:

- i. Label vial with fish's unique ID number.
- ii. Place a 1-2 cm^2 section of pelvic fin clip in vial with preservative (95% absolute ETOH (un-denatured), recommended).
- iii. Seal individual vials or containers with leak proof positive measure (e.g., tape).
- iv. Package vials and absorbent within a double sealed container (e.g., zip lock baggie).
- v. Label air package properly identifying ETOH warning label (**See Appendix 3c**).

c. Shipping Instructions:

When shipping samples, place separately Appendix 3a, 3b and 3c (Sample ID and Chain of Custody Forms and Shipping Training Form) in container and seal the shipping box to maintain the chain of custody. (Note: A copy of the ESA permit authorizing the collection of the sample(s) must also accompany the sample(s)).

Important Notice: You must be certified before shipping tissue samples preserved with 95% ETOH in "excepted quantities" (A Class 3 Hazardous Material Due to Flammable Nature). See Appendix 3c: "NMFS Guidelines for Air-Shipment of Excepted Quantities of Ethanol Solutions" to comply with the DOT/IATA federal regulations.

4. [redacted]

The "*Chain of Custody*" (Section C) should be maintained for each shipment of tissue samples and must accompany the sample(s) at all times. To maintain the chain of custody, when sample(s) are transferred, the sample(s) and the documentation should be packaged and sealed together to ensure that no tampering has occurred. All subsequent handlers breaking the seal must also sign and document the chain of custody section.

5. [redacted]

A. NMFS, Office of Protected Resources:

- **i. Primary Contact**: **(Northeast)** Shortnose Sturgeon Recovery Coordinator (Jessica Pruden, jessica.pruden@noaa.gov, 978/282-8482); Atlantic Sturgeon Recovery Coordinator (Lynn Lankshear, lynn.lankshear@noaa.gov, 978/282-8473)
- **ii. Primary Contact: (Southeast)** Shortnose Sturgeon Recovery Coordinator (Stephania Bolden stephania.bolden@noaa.gov ,727/824-5312); Atlantic Sturgeon Recovery Coordinator (Kelly Shotts, kelly.shotts@noaa.gov, 727/551-5603)
- **i. Secondary Contact:** Malcolm Mohead (malcolm.mohead@noaa.gov) Phone: 301/713-2289
- **ii. Secondary Contact:** Colette Cairns (colette.cairns@noaa.gov) Phone: 301/713-2289

B. NOS Archive:

- **i. Primary Contact**: Julie Carter (julie.carter@noaa.gov) Phone: 843/762-8547

Summary Sheet for Genetic Tissue Samples Collected[1,2]

Date	Species	Unique ID No.	Genetic Tissue Type	Preservative	Location: (River)	Location (River-km)	Location (Lat/Long)	Total Length (mm)	Weight (g)	Sex	Comments

1. Please coordinate with NMFS to receive a file copy of this appendix in spreadsheet format and include file on disk with shipment.
2. If multiple samples are shipped, attach this form to supplement Appendix 3a.

The U.S. Department of Transportation (DOT: 49 CFR 173.4) and the International Air Transport Association (IATA: 2007 Dangerous Goods Regulations, Sec. 2.7) regulate shipments of ethanol (ETOH) in *excepted quantities*. As a result, specific procedures must be followed as well as certifying proper training of individuals prior to packaging and shipping specimens preserved in ETOH. These guidelines will inform proper shipping and also satisfy certifying requirements. Failure to meet such requirements could result in regulatory fines and/or imprisonment.

Therefore, prior to submitting ETOH preserved samples and appropriate documentation (*e.g.*, a FedEx Airbill) to a carrier, please read, initial and sign this document, affirming you have understood the requirements as outlined. Please include this document in the shipping package and retain a copy for your records.

1) Packages and documents submitted to a carrier must not contain any materials other than those described in this document (*i.e.* containers holding ethanol-preserved specimens and related absorbent and packaging materials). Also, laboratory or sampling equipment, *unrelated documents*, or other goods must be packaged and shipped in separate boxes. (Note: ETOH solutions are not permitted to be transported in checked baggage, carry-on baggage, or airmail.) **I understand (______)**

2) Please read the manufacturer's Material Safety Data Sheet (MSDS) for ETOH recognizing ETOH (55 - 100%) is classed as hazardous flammable material (NFPA Rating = 3). Note also, its vapor is capable of traveling a considerable distance to an ignition source causing "flashback." Properly packaging and labeling shipments of ethanol solutions will minimize the chance of leakage, and would also communicate the potential hazard to transport workers in the event of a leak. **I understand (______)**

a) ________________ Small quantities (inner container less than 30 ml, with a maximum net quantity of 500 ml for the entire package) of ETOH can be shipped with "Excepted Quantities" labels without completion of a Dangerous Goods Declaration. (e.g., If shipping vials having a maximum volume of 10 ml each, you may put up to 50 vials in one box.) **I understand (______)**

b) ______________________

i. ***Inner (primary) packaging (e.g., vial, tube, jar, etc.)*:** Do not completely fill inner packaging; allow 10% head-space for liquid expansion. Liquids must not completely fill inner packaging at a temperature of 55°C (130°F). Closures of inner packaging (e.g., vials with tops) must be held securely in place with tape or other positive means. **I understand (______)**

ii. ***Intermediate (secondary) packaging (e.g. Ziplock or other plastic bag)*:** Place inner container(s) (*e.g.,* vials with ETOH) into a high-quality plastic bag. Then add an absorbent material cable of absorbing any spillage without reacting with the ethanol. Seal the first bag tightly and then tape the locking seals. Next, seal the inner bag within a second bag for added safety. **I understand (______)**

iii. ***Outer packaging (e.g., cardboard box)*:** Ethanol solutions may not be shipped in envelopes, Tyvek® sleeves, or other non-rigid mailers. The dimensions of the outer box must be at least 100 mm (~4 inches) on two sides. Any space between the inner packing containers placed in the outer packaging should be eliminated with additional filler. **I understand (______)**

c) ________________

i. *Dangerous Goods in Excepted Quantities Label* **(Figure 1.):** The label must display a "3" as the ethanol hazard class number using a black marker. You may obtain self-adhesive labels from NMFS, or else, order online. **I understand (_____)**

i. *Name and Address:* The outer container must display the name and address of the shipper and consignee. When re- using shipping boxes, completely remove or black out all unnecessary labels or marks. **I understand (______)**

Figure 1. Dangerous Goods in Excepted Quantities label

Package T

A representative example of packaging used for excepted quantities of ethanol solutions must pass a drop test and compressive load test without any breakage or leakage of any inner packaging and without any significant reduction in package effectiveness. Perform the following ests on a representative example of your packaging and keep a record of the results.

ii. *Drop Test*: Drop a representative package from a height of 1.8 m (5.9 feet) directly onto a solid unyielding surface:

Test Results

a. One drop flat on the base; One (________________________________)
b. drop flat on top; (________________________________)
c. One drop flat on the longest side; (________________________________)
d. One drop flat on the shortest side; and (________________________________)
e. One drop on a corner. (________________________________)

iii. *Compressive Load Test*: Apply a force to the top surface of a representative package for a duration of 24 hours, equivalent to the total weight of identical packages if stacked to a height of 3 meters. (________________________________)

d) ____________________

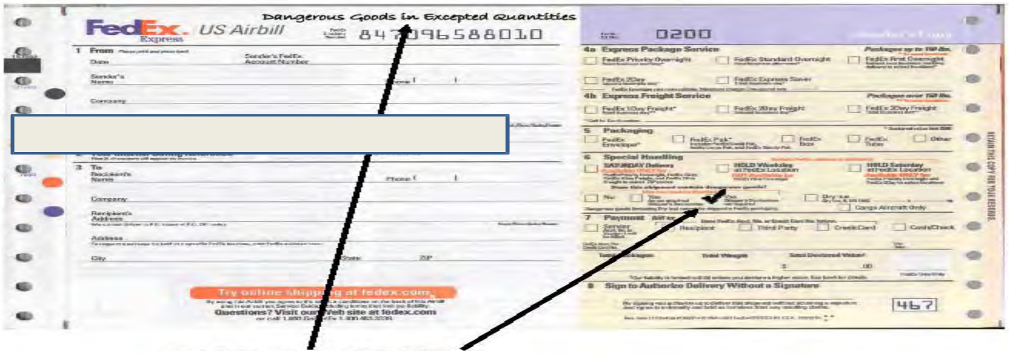
Proper documentation is required for all shipments of hazardous materials. Incorrect documentation is the most common cause for package efusal. If using documentation for couriers other than FedEx, UPS and DHL, please contact NMFS for assistance.

i. *FedEx*: For domestic shipments with FedEx Express, fill out the standard US Airbill. Fill out the form completely including the following information:

a. In Section 6, Special Handling, check the box "Yes, Shipper's Declaration not required."
b. On the top of the form above the FedEx tracking number, include the statement, "*Dangerous Goods in Excepted Quantities*" See example in **Figure 2.** **I understand (______)**

ii. *DHL*: The "*Nature and Quantity of Goods*" box of the air waybill must include "**Dangerous Goods in Excepted Quantities.**" **I understand (______)**

Figure 2. Exan



Dangerous Goods in Excepted Quantities

nclude this sta

By signing this document, I affirm I understand the hazards associated with ethanol and the shipping requirements for ethanol solutions, as outlined in this guide. I also understand I am required to include a copy of this document in the package and that it should be appended to an ESA permit (if listed samples are shipped).

Print Name:		**Signature:**	
Employer:		**Employer Address:**	
Date:			**Phone:**

APPENDIX D
Protocol for Collecting Tissue from Sea Turtles for Genetic Analysis

Materials for Collecting Genetic Tissue Samples

<surgical gloves
<alcohol swabs
<betadine swabs
<sterile disposable biopsy punches
<sterile disposable scalpels
<permanent marker to externally label the vials
<scotch tape to protect external labels on the vials
<pencil to write on internal waterproof label
<waterproof label, 1/4" x 4"
<screw-cap vial of saturated NaCl with 20% DMSO*, wrapped in parafilm
<piece of parafilm to wrap the cap of the vial after sample is taken
<vial storage box

* The 20% DMSO buffer within the vials is nontoxic and nonflammable. Handling the buffer without gloves may result in exposure to DMSO. This substance soaks into skin very rapidly and is commonly used to alleviate muscle aches. DMSO will produce a garlic/oyster taste in the mouth along with breath odor. The protocol requires that you wear gloves each time you collect a sample and handle the buffer vials. DO **NOT** store the buffer where it will experience extreme heat. The buffer must be stored at room temperature or cooler, such as in a refrigerator.

Please collect two small pieces of muscle tissue from all live, comatose, and dead stranded loggerhead, green, leatherback, and hybrid sea turtles (and any hawksbills, although this would be a rare incident). A muscle sample can be obtained no matter what stage of decomposition a carcass is in. Please utilize the equipment in these kits for genetic sampling of **turtles only** and contact the NMFS sea turtle stranding coordinator when you need additional biopsy supplies.

Sampling Protocol for Dead Turtles

1. Put on a pair of surgical gloves. The best place to obtain the muscle sample is on the ventral side where the front flippers insert near the plastron. It is not necessary to cut very deeply to get muscle tissue.

2. Using a new (sterile and disposable) scalpel cut out two pieces of muscle of a size that will fit in the vial.

3. Transfer both samples directly from the scalpel to a single vial of 20% DMSO saturated with salt.

4. Use the pencil to write the stranding ID, date, species ID and SCL on the waterproof label and place it in the vial with the samples.

5. Label the outside of the vial using the permanent marker with stranding ID, date, species ID and SCL .

6. Apply a piece of clear scotch tape over the what you have written on the outside of the vial to protect the label from being erased or smeared.

7. Wrap parafilm around the cap of the vial by stretching as you wrap.

8. Place the vial in the vial storage box.

9. Complete the Sea Turtle Biopsy Sample Collection Log.

10. Attach a copy of the STSSN form to the Collection Log - be sure to indicate on the STSSN form that a genetic sample was taken.

11. Dispose of the used scalpel and gloves. It is very important to use a new scalpel for each animal to avoid cross contamination.

At the end of the calendar year submit all genetic samples to:
Sea Turtle Stranding Coordinator
NMFS Protected Resources
Division 55 Great Republic Drive
Gloucester, MA 01930
(978)281-9328

APPENDIX E

Incident Report of Sturgeon Take

Photographs should be taken and the following information should be collected from all sturgeon (alive and dead)

Date ____________________ Time (specimen found) ________________

Geographic Site____

Location: Lat/Long____

Dredge Vessel Name _________________________

Disposal Site ______________________________

Begin dredge time ___________________________

End dredge time_____________________________

HOPPER ☐ MECHANICAL ☐ CUTTERHEAD ☐

Time of last disposal site inspection: ____

Location where specimen recovered ____

____

____

Weather conditions_ ____

____

Water temp (at dredge site) : Surface ________________
Bottom (if known) ________________

Species ID: ____

Fill out "Sturgeon Data Collection Form" and Return to NMFS within 24 hours via email (incidental.take@noaa.gov) or fax (978-281-9394)

Comments/other (include justification on how species was identified)
____
____
____

Inspector/Observer's Name _________________________

Signature____

APPEDNDIX E

STURGEON DATA COLLECTION FORM

For use in documenting interactions with listed sturgeon resulting from Federal actions that have undergone sec 7 consultation

REPORTER'S CONTACT INFORMATION
Name: First ________________ Last ______________________
Agency Affiliation ________________ Email______________________
Address ____
____
Area code/Phone number ______________________________

UNIQUE IDENTIFIER (Assigned by NMFS)

DATE REPORTED:
Month ☐☐ Day☐☐ Year 20☐☐
DATE EXAMINED:
Month ☐☐ Day☐☐ Year 20☐☐

SPECIES: (check one)
- ☐ shortnose sturgeon
- ☐ Atlantic sturgeon
- ☐ Unidentified *Acipenser* species

Check "Unidentified" if uncertain . See reverse side of this form for aid in identification.

LOCATION FOUND: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)
River/Body of Water________________ City________________________ State ____
Descriptive location (be specific)____
____
____
Latitude _______________N (Dec. Degrees) Longitude _______________ W (Dec. Degrees)

CARCASS CONDITION at time examined: (check one)
- ☐ 1 = Fresh dead
- ☐ 2 = Moderately decomposed
- ☐ 3 = Severely decomposed
- ☐ 4 = Dried carcass
- ☐ 5 = Skeletal, scutes & cartilage

SEX:
- ☐ Undetermined
- ☐ Female ☐ Male

How was sex determined?
- ☐ Necropsy
- ☐ Eggs/milt present when pressed
- ☐ Borescope

MEASUREMENTS: Circle unit
Fork length _________ cm / in
Total length _________ cm / in
Length ☐ actual ☐ estimate
Mouth width (inside lips, see reverse side) _________ cm / in
Interorbital width (see reverse side) _________ cm / in
Weight ☐ actual ☐ estimate _________ kg / lb

TAGS PRESENT? Examined for external tags including fin clips? ☐ Yes ☐ No Scanned for PIT tags? ☐ Yes ☐ No

Tag #	Tag Type	Location of tag on carcass

CARCASS DISPOSITION: (check one or more)
- ☐1 = Left where found
- ☐2 = Buried
- ☐3 = Collected for necropsy/salvage
- ☐4 = Frozen for later examination
- ☐5 = Other (describe) _________________________

Carcass Necropsied?
☐Yes ☐No
Date Necropsied:_____________
Necropsy Lead:
____

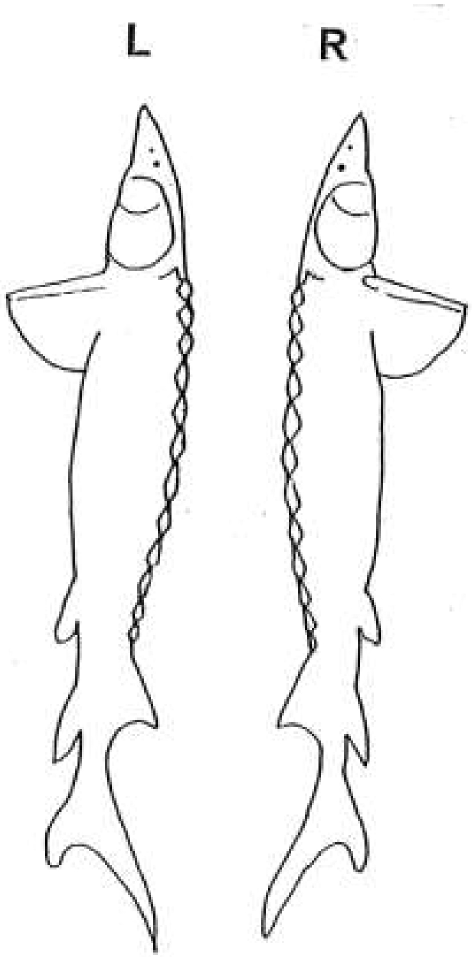
PHOTODOCUMENTATION:
Photos/vide taken? ☐ Yes ☐ No
Disposition of Photos/Video:___________
____
____

SAMPLES COLLECTED? ☐ Yes ☐ No

Sample	How preserved	Disposition (person, affiliation, use)

Comments:
____
____
____

Draw wounds, abnormalities, tag locations on diagram and briefly describe below



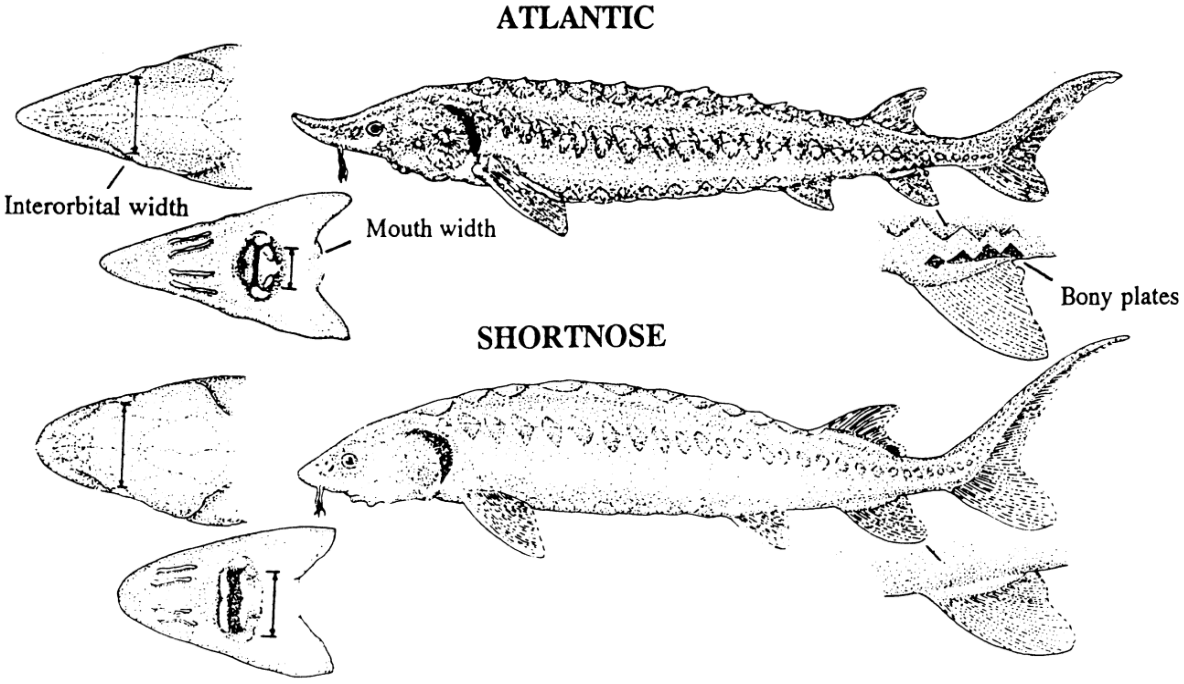
Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). **Please note if no wounds / abnormalities are found.**

Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 07-20-2009)

Characteristic	Atlantic Sturgeon, *Acipenser oxyrinchus*	Shortnose Sturgeon, *Acipenser brevirostrum*
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth bony interorbital width	Football shaped and small. Width inside lips < 55% of	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates anal fin.	Paired plates posterior to the rectum & anterior to the	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range marine existence	Anadromous; spawn in freshwater but primarily lead a	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004



APPENDIX F

Incident Report of Sea Turtle Take

Date_________________Time (specimen found) _________________

Species ____

Geographic Site ____
Location: Lat/Long ____
Vessel Name __________________________ Load # _______________________________
Begin load time_________________________End load time__________________________
Begin dump time________________________End dump time ________________________

Condition of screening ____
Location where specimen recovered____
____

Draghead deflector used? YES NO Rigid deflector draghead? YES NO

Condition of deflector ____
____

Weather conditions_ ____
____

Water temp: Surface ________________Below midwater (if known) _____________________

Species Information: *(please designate cm/m or inches.)*
Head width ______ Plastron length ______
Straight carapace length ______ Straight carapace width______
Curved carapace length _________________ Curved carapace width _____________________

Condition of specimen/description of animal (please complete attached diagram)
____
____
____

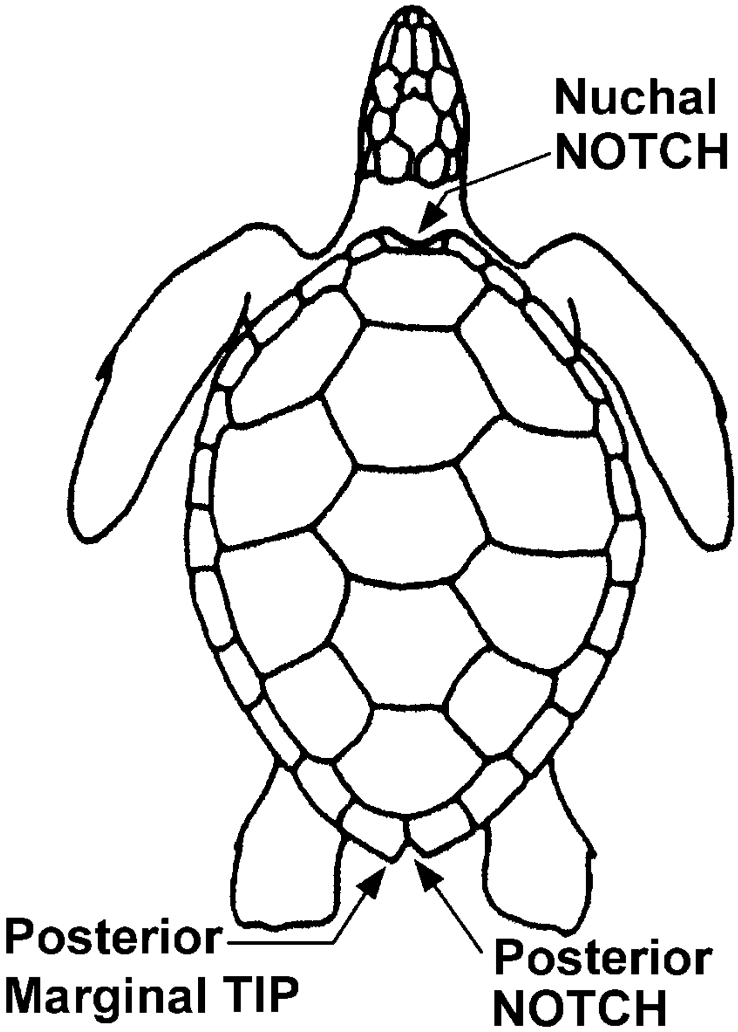
Turtle Decomposed: NO SLIGHTLY MODERATELY SEVERELY

Turtle tagged: YES NO *Please record all tag numbers.* Tag # ______________________
Genetic sample taken: YES NO
Photograph emailed to NMFS: YES NO

Comments/other (include justification on how species was identified) ______________________
____
____
Observer's Name ________________________Observer's Signature

Incident Report of Sea Turtle Take

Draw wounds, abnormalities, tag locations on diagram and briefly describe below.



Description of animal:

APPENDIX G

ENDANGERED SPECIES INCIDENT REPORT FORM

Date: ______________________________

Dredge Vessel Name ___________________________

Hopper ☐ Cutterhead ☐

Incident Location: On Board Dredge ☐ Disposal Site ☐

Borrow Area being Dredged:____

Disposal Site: ___________________________

Dredge Location: Lat/Long _____________________

Weather conditions:____

____

Water temperature: Surface ____________ Below midwater (if known) ____________

Condition of screening apparatus: ____

____

Comments (type of material, biological specimens, unusual circumstances, etc:)

____

____

____

Reporter's Name: ____

Signature: ____

<u>Species</u>	<u># of Sightings</u>	<u># of Animals</u>	<u>Comments</u>