OCS EIS/EA
BOEM 2012-005

Atlantic OCS
Proposed Geological and Geophysical Activities

Mid-Atlantic and South Atlantic Planning Areas

Draft Programmatic Environmental Impact Statement

Volume I: Chapters 1-8

U.S. Department of the Interior
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

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Author

Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

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by
Continental Shelf Associates International Inc.
8502 SW Kansas Avenue
Stuart, Florida 34997

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DEPARTMENT NOTE

As part of the Conference Report for Department of the Interior, Environment, and Related Agencies Act, 2010, this Agency was directed to complete a Programmatic Environmental Impact Statement (EIS) to evaluate potential significant environmental effects of multiple geological and geophysical activities on the Atlantic OCS, pursuant to the National Environmental Policy Act. This Draft Programmatic EIS follows through on that direction and now provides the opportunity for public comment on our evaluation. It was prepared using the best information that was publicly available.

Our goal in the Bureau of Ocean Energy Management (BOEM) has always been to provide factual, reliable, and clear analytical statements in order to inform decisionmakers and the public about the environmental effects of proposed OCS activities and their alternatives. We view the EIS process as providing a balanced forum for early identification, avoidance, and resolution of potential conflicts. It is in this spirit that we welcome comments on this document from all concerned parties.

At the completion of this EIS process, a decision will be published in the *Federal Register* for the geological and geophysical permit applications pending before BOEM.

Alan D. Thornhill, Ph.D.
Chief Environmental Officer
Office of Environmental Programs

COVER SHEET

Programmatic Environmental Impact Statement
for
Atlantic OCS Proposed Geological and Geophysical Activities
in the Mid-Atlantic and South Atlantic Planning Areas

Draft (x) **Final ( )**

Type of Action: Administrative (x) Legislative ( )

Area of Potential Impact: Offshore Marine Environment and Coastal Counties of Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida

Agency	Washington Contact	Region Contacts
U.S. Department of the Interior Bureau of Ocean Energy Management Gulf of Mexico OCS Region (MS 5410) 1201 Elmwood Park Boulevard New Orleans, LA 70123-2394	Jill Lewandowski U.S. Department of the Interior Bureau of Ocean Energy Management (MS 4042) 381 Elden Street Herndon, VA 20170-4817 (703) 787-1703	Thomas Bjerstedt (504) 736-5743 Gary Goeke (504) 736-3233

ABSTRACT

This Draft Programmatic Environmental Impact Statement covers the potential significant environmental effects of multiple geological and geophysical (G&G) activities on the Atlantic Outer Continental Shelf (OCS). It evaluates the types of geological and geophysical surveys and activities in the three program areas managed by the Bureau of Ocean Energy Management (BOEM): oil and gas exploration and production; renewable energy; and marine minerals.

This evaluation under the National Environmental Policy Act (NEPA) was directed by the U.S. Congress in the Conference Report (111-316) for Department of the Interior, Environment, and Related Agencies Act, 2010, appropriation.

The proposed action is a major Federal action requiring an EIS. This document provides information required by NEPA and its implementing regulations at 40 CFR Part 1500, and it will be used in making decisions on the proposed action and on the permit applications for G&G activity now pending before BOEM. This Draft Programmatic EIS includes the purpose and background of the proposed action, identification of the alternatives, a scenario for the level of anticipated activity in the program areas to 2020, a description of the factors and impacts caused by the proposed activities, a description of the affected environment, and an analysis of the potential environmental impacts under routine and nonroutine conditions for the proposed action and alternatives. The proposal's impact contributions to other cumulative impacts are also analyzed, and measures that act to mitigate potential effects are identified.

Additional copies of this Draft Programmatic EIS may be obtained from the Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, Public Information Office (MS 5034), 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394, or by telephone at 504-736-2519 or 1-800-200-GULF. This Draft Programmatic EIS may be accessed on the Internet at our dedicated project page at http://www.boem.gov/Oil-and-Gas-Energy-Program/GOMR/GandG.aspx or on our NEPA documents page at http://www.boem.gov/Environmental-Stewardship/Environmental-Assessment/NEPA/nepaprocess.aspx.

SUMMARY

The Bureau of Ocean Energy Management (BOEM) is issuing this Draft Programmatic Environmental Impact Statement (EIS) to describe and evaluate the potential environmental impacts of geological and geophysical (G&G) survey activities in Federal waters of the Mid- and South Atlantic Outer Continental Shelf (OCS) and adjacent State waters. This Programmatic EIS examines G&G survey activities for three program areas (oil and gas, renewable energy, and marine minerals) during the 2012-2020 time period. This Programmatic EIS evaluates impacts to Atlantic resources that could occur as a result of G&G activities and identifies mitigation and monitoring measures to avoid, reduce, or minimize impacts. Preparation of this Programmatic EIS will help ensure compliance with the National Environmental Policy Act (NEPA) and other laws such as the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA).

This Programmatic EIS was prepared because BOEM currently has no programmatic NEPA coverage for permitting G&G activities in Atlantic OCS waters. The BOEM has received nine permit requests for seismic airgun surveys in support of oil and gas exploration, and industry has expressed interest in expanding activities into Atlantic offshore waters. Given the scope of the proposed surveys and their potential impacts, BOEM has determined a programmatic EIS under NEPA is needed prior to permitting any new, large-scale G&G surveys. This Programmatic EIS establishes a framework for future NEPA evaluations of site-specific actions while identifying and analyzing mitigation measures for future programmatic use.

The purpose of the proposed action is to gather state-of-the-practice data about the ocean bottom and subsurface. These data would provide information about the location and extent of oil and gas reserves, seafloor conditions for oil and gas or renewable energy installations, and marine minerals deposits off the U.S. Atlantic Coast. State-of-the-practice G&G data and information are required for business decisions in furtherance of prospecting for OCS oil and gas in an orderly manner, assessing sites for renewable energy facilities, or using marine mineral resources in the area. The G&G surveys acquired during the period when Atlantic oil and gas leasing took place in the 1970's and 1980's have been eclipsed by newer instrumentation and technology that make seismic data of that era inadequate for business decisions to lease and develop these OCS lands or to evaluate the environmental impacts of leasing and development.

The need for the proposed action is to use the information obtained by G&G surveys to make informed business decisions regarding oil and gas reserves, engineering decisions regarding the construction of renewable energy projects, and informed estimates regarding the composition and volume of marine mineral resources. This information would also be used to ensure the proper use and conservation of OCS energy resources and the receipt of fair market value for the leasing of public lands.

This Draft Programmatic EIS will be used by BOEM and the National Marine Fisheries Service (NMFS) in support of ongoing Essential Fish Habitat (EFH) and ESA Section 7 consultations. It is expected that Incidental Take Authorizations for marine mammals under the MMPA would be made on the basis of future specific survey applications.

This summary is only a brief overview of the alternatives, issues, resources, potential impacts, and proposed mitigation measures discussed in this Programmatic EIS. To obtain the full perspective, it is necessary to read the entire analysis. Relevant discussions can be found in the following main chapters of this Programmatic EIS:

- **Chapter 1** (Introduction) – describes the purpose of and need for the proposed action, provides background information, and explains the regulatory context.
- **Chapter 2** (Alternatives Including the Proposed Action) – describes alternatives that were evaluated in detail, identifies additional alternatives that were eliminated from further analysis, identifies mitigation to avoid or minimize impacts, and summarizes the findings of the impact analysis for each alternative from **Chapter 4**.
- **Chapter 3** (G&G Activities and Proposed Action Scenario) – describes the G&G activities included in each of the program areas and their expected level of effort during the 2012-2020 time period, identifies and describes impact-producing factors (IPFs), and provides a cumulative activity scenario for impact analysis.
- **Chapter 4** (Description of the Affected Resources and Impact Analysis) – describes the affected environment and analyzes potential impacts of each main alternative.

- **Chapter 5** (Consultation and Coordination) – describes the consultation and coordination activities with Federal, State, and local agencies and other interested parties that occurred during the development of this Programmatic EIS.

Area of Interest

The Area of Interest (AOI) for this Programmatic EIS includes U.S. Atlantic waters from the mouth of Delaware Bay to just south of Cape Canaveral, Florida, and from the shoreline (excluding estuaries) to 350 nautical miles (nmi) (648 kilometers [km]) from shore. It includes the Mid- and South Atlantic Planning Areas, as well as adjacent State waters outside of estuaries. The seaward boundary is based on the maximum constraint line for the Extended Continental Shelf under Article 76 of the United Nations Convention on the Law of the Sea. The total size of the AOI is 854,779 km^2 (330,032 mi^2), and water depths range from 0 to 5,629 meters (m) (0 to 18,468 feet [ft]). Resources that migrate through the AOI and resources in adjacent areas are included to the extent that they may be affected by the proposed action.

While G&G activities in State waters are not within the jurisdiction of BOEM, the AOI encompasses adjacent State waters because G&G activities under all three program areas could extend into State waters or introduce acoustic energy into those waters. The U.S. Army Corps of Engineers (COE) has jurisdiction over G&G activities in State waters under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act and has established a Nationwide Permit program to regulate these activities in State waters. Depending on location, State-issued permits may be required for G&G activities in State waters.

Types of G&G Activities Analyzed

A variety of G&G techniques are used to characterize the shallow and deep structure of the shelf, slope, and deepwater ocean environments. Geological and geophysical surveys are conducted to (1) obtain data for hydrocarbon exploration and production; (2) aid in siting renewable energy structures; (3) locate potential sand and gravel resources; (4) identify possible seafloor or shallow depth geologic hazards; and (5) locate potential archaeological resources and potential hard bottom habitats for avoidance. The selection of a specific technique or suite of techniques is driven by data needs and the target of interest. The following types of G&G activities are included in this Programmatic EIS:

- various types of deep penetration seismic airgun surveys used almost exclusively for oil and gas exploration and development;
- other types of surveys and sampling activities used only in support of oil and gas exploration and development, including electromagnetic surveys, deep stratigraphic and shallow test drilling, and various remote sensing methods;
- high-resolution geophysical (HRG) surveys used in all three program areas to detect geohazards, archaeological resources, and certain types of benthic communities; and
- geological and geotechnical bottom sampling used in all three program areas to assess the suitability of seafloor sediments for supporting structures (e.g., platforms, pipelines, cables, wind turbines) or to evaluate the quantity and quality of sand for beach nourishment projects.

Deep penetration seismic airgun surveys, in which a survey vessel tows an array of airguns that emit acoustic energy pulses into the seafloor over long durations and over large areas, are the most extensive G&G activities that would be conducted and are the most important activities analyzed in this Programmatic EIS. These surveys would occur almost exclusively in support of oil and gas exploration and development and would be conducted mainly within the Mid- and South Atlantic Planning Areas. The two planning areas collectively account for 79 percent of the AOI. Geological and geophysical activities in support of renewable energy development would consist mainly of HRG and geotechnical surveys in both Federal and State waters less than 100 m (328 ft) deep; this area represents about 15 percent of the AOI. Geological and geophysical activities in support of marine mineral uses (e.g., sand and gravel mining) would consist mainly of HRG and geotechnical surveys in both Federal and State waters less than 30 m (98 ft) deep; this area represents about 9 percent of the AOI. Geological and geophysical activities beyond the outer boundary of the two planning areas have not been determined but could include geophysical surveys in support of the U.S. Extended Continental Shelf Project.

This Programmatic EIS includes an activity scenario for potential future G&G activities in the AOI during the period from 2012-2020. The year 2020 is a practical limit for making activity projections and does not imply that impacts on resources that have been evaluated are no longer valid beyond this date.

Alternatives

Three alternatives are analyzed in detail in this Programmatic EIS:

- **Alternative A** – The Proposed Action;
- **Alternative B** – Additional Time-Area Closures and Separation of Simultaneous Seismic Airgun Surveys; and
- **Alternative C** – No Action for Oil and Gas, Status Quo for Renewable Energy and Marine Mineral G&G Activity.

Alternatives A and B are identical with respect to the G&G activities that could be conducted and the expected activity levels during the 2012-2020 period. They differ only with respect to certain mitigation measures as summarized in the next section. Briefly, Alternative B would expand the time-area closure for North Atlantic right whales that was developed for Alternative A; add a time-area closure offshore Brevard County, Florida, to protect nesting sea turtles; require a 40-km (25-mi) separation distance between concurrent seismic airgun surveys; and require the use of passive acoustic monitoring (PAM) as part of the seismic airgun survey protocol.

Alternative C is the No Action Alternative required by the regulations implementing NEPA. Under this alternative, no G&G activities associated with oil and gas exploration would occur in the AOI. However, permitting and postlease G&G activities for renewable energy development and marine minerals use would continue to occur on a case-by-case basis.

Several additional alternatives were identified during the scoping process, but were eliminated from detailed analysis for the reasons identified in **Chapter 2.5**. Examples include limiting permitting of G&G activities to renewable energy and marine minerals; expanding permitted G&G activities into the North Atlantic Planning Area; reprocessing existing G&G data; delaying the permitting process; consolidating and coordinating surveys; and requiring non-airgun acoustic sources.

Mitigation Measures

All G&G activities authorized under the proposed action would be required to comply with existing laws and regulations. In addition to such requirements, the alternatives are crafted with mitigation elements that minimize impacts by avoiding them or by the design of proposed G&G work. Also, during the MMPA authorization process for specific surveys, the NMFS may require additional or different mitigation measures to avoid/minimize impacts on marine mammals.

Alternatives A and B differ with respect to certain mitigation measures (**Table S-1**). Specifically, Alternative B would expand the time-area closure for North Atlantic right whales that was developed for Alternative A; add a time-area closure offshore Brevard County, Florida, to protect nesting sea turtles; require a 40-km (25-mi) separation distance between concurrent seismic airgun surveys; and require the use of PAM as part of the seismic airgun survey protocol.

Alternatives A and B have several other mitigation measures in common (**Table S-1**), including a seismic airgun survey protocol; an HRG survey protocol (for renewable energy and marine minerals sites); guidance for vessel strike avoidance; guidance for marine debris awareness; avoidance and reporting requirements for historic and prehistoric sites; avoidance of sensitive benthic communities; guidance for activities in or near National Marine Sanctuaries (NMSs); and guidance for military and National Aeronautics and Space Administration (NASA) coordination.

Table S-1

Summary of Mitigation Measures Included in Alternatives A and B

Measure	Description	Alternative A	Alternative B
Time-Area Closure for North Atlantic Right Whales	No G&G surveys using air guns would be authorized within the right whale critical habitat area from November 15 through April 15 nor within the Mid-Atlantic and Southeast U.S. Seasonal Management Areas (SMAs) during the times when vessel speed restrictions are in effect under the Right Whale Ship Strike Reduction Rule (50 CFR 224.105). However, HRG surveys proposed in critical habitat and SMAs from November 15 through April 15 may be considered on a case-by-case basis only if (1) they are proposed for renewable energy or marine minerals operations and (2) they use acoustic sources other than air guns. The coincidence is necessary because of other biological use windows or project monitoring requirements. Any such authorization may include additional mitigation and monitoring requirements to avoid or significantly reduce impacts on right whales. Other supporting surveys (e.g., biological surveys) would not be affected by this restriction.	Yes	Yes (Expanded to a continuous zone extending to 20 nmi offshore from Delaware Bay to southern edge of AOI)
Time-Area Closure to Protect Nesting Sea Turtles Offshore Brevard County, Florida	No airgun surveys would be authorized in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 to October 31). Other surveys in the closure area would be reviewed on a case-by-case basis, and authorizations may include additional mitigation and monitoring requirements.	No	Yes
Separation Between Simultaneous Seismic Airgun Surveys	A 40-km (25-mi) separation distance would be maintained between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.	No	Yes
Passive Acoustic Monitoring (PAM)	The use of PAM would be part of the seismic airgun survey protocol to improve detection of marine mammals and avoid impacts by shutting down or delaying startup of airgun arrays until the animals are outside the exclusion zone.	Optional	Required
Seismic Airgun Survey Protocol	All authorizations for seismic airgun surveys would include a survey protocol that specifies mitigation measures for protected species, including ramp-up, visual monitoring of an exclusion zone by protected species observers, and startup and shutdown requirements.	Yes	Yes
High-Resolution Geophysical (HRG) Survey Protocol	All authorizations for non-airgun HRG surveys would include a survey protocol that specifies mitigation measures for protected species, including visual monitoring of an exclusion zone by protected species observers and startup and shutdown requirements.	Yes	Yes
Guidance for Vessel Strike Avoidance	All authorizations for shipboard surveys would include guidance addressing protected species identification, vessel strike avoidance, and injured/dead protected species reporting and incorporating elements of the NMFS Compliance Guide for the Right Whale Ship Strike Reduction Rule.	Yes	Yes
Guidance for Marine Debris Awareness	All authorizations for shipboard surveys would include guidance for marine debris awareness highlighting the environmental and socioeconomic impacts of marine trash and debris and operator responsibilities for ensuring that trash and debris are not discharged into the marine environment.	Yes	Yes
Avoidance and Reporting of Historic and Prehistoric sites	All authorizations for seafloor-disturbing activities would include requirements for operators to report suspected historic and prehistoric archaeological resources to BOEM and to take precautions to protect the resource. The BOEM would also require reporting and avoidance for any previously undiscovered suspected archaeological resource and precautions to protect the resource.	Yes	Yes
Avoidance of Sensitive Benthic Communities	All authorizations for seafloor-disturbing activities would be subject to restrictions to protect sensitive benthic communities (e.g., hard/live bottom areas, deepwater coral communities, and chemosynthetic communities), including requirements for mapping and avoidance.	Yes	Yes

Measure	Description	Alternative A	Alternative B
Guidance for Activities In or Near National Marine Sanctuaries (NMSs)	All authorizations for G&G activities would include instructions to minimize impacts on NMS resources and users. If proposed activities involve seafloor disturbance near an NMS or moving the surface marker buoys for the Sanctuary, the operator would be required to contact the Sanctuary Manager for instructions. The BOEM would not authorize seafloor-disturbing activities within an NMS, and seafloor-disturbing activities proposed near the boundaries of an NMS would be assigned a setback distance by BOEM in consultation with the Sanctuary Manager.	Yes	Yes
Guidance for Military and National Aeronautics and Space Administration (NASA) Coordination	All authorizations for permitted activities would include guidance for military and NASA coordination. Vessel and aircraft operators would be required to establish and maintain early contact and coordination with the appropriate military command headquarters or NASA point of contact.	Yes	Yes

Alternative C does not include any programmatic mitigation measures because it would involve continued permitting and postlease G&G activities for renewable energy development and marine minerals use on a case-by-case basis. However, best management practices have been developed for the renewable energy program, and a site-specific NEPA evaluation would be part of the approval process for any G&G survey authorizations under either program. Through the NEPA process, BOEM may identify mitigation measures to avoid/minimize environmental impacts during G&G surveys. Additional mitigation measures may be required as a result of consultations under the ESA or MMPA.

Issues

The following issues were identified for detailed analysis:

- impacts of underwater noise on marine mammals, sea turtles, fishes, birds, and other marine life;
- impacts of underwater noise on commercial and recreational fishing (fish catch);
- impacts of vessel traffic (risk of ship strikes) on marine mammals and sea turtles, birds, and threatened and endangered fish species;
- impacts of vessel traffic on fishing, shipping, and other marine uses;
- impacts of aircraft traffic and noise on marine mammals, sea turtles, birds, and other marine uses;
- impacts of seafloor-disturbing activities on sensitive benthic communities including coral and hard/live bottom communities, chemosynthetic communities, and deepwater canyon benthos;
- impacts of seafloor-disturbing activities on EFH, Habitat Areas of Particular Concern (HAPCs), and Marine Protected Areas (MPAs);
- impacts of seafloor-disturbing activities on archaeological resources including historic shipwrecks and prehistoric archaeological sites;
- impacts of exclusion zones on commercial and recreational fishing, shipping, recreational resources, and other marine uses;
- impacts of marine trash and debris on benthic communities, marine mammals, sea turtles, birds, endangered or threatened fish species, and recreational resources; and
- impacts of accidental spills on benthic communities, marine mammals, sea turtles, birds, fishes and EFH, archaeological resources, recreational resources, MPAs, other marine uses, and human resources and land use.

Impact-Producing Factors and Significance Criteria

Based on the activity scenario for G&G activities for the three program areas (oil and gas exploration, renewable energy, and marine minerals), the following IPFs have been identified for the proposed action: active acoustic sound sources (airguns and electromechanical sources); vessel and equipment noise; vessel traffic; aircraft traffic and noise; vessel exclusion zones; trash and debris; seafloor disturbance; drilling discharges; onshore support activities; and accidental fuel spills.

The following significance categories were developed for the impact analysis:

- **Negligible**: Little or no measurable/detectable impact.
- **Minor**: Impacts are detectable, short-term, extensive or localized, but less than severe;
- **Moderate**: Impacts are detectable, short-term, extensive, and severe; ***or*** impacts are detectable, short-term or long-lasting, localized, and severe; ***or*** impacts are detectable, long-lasting, extensive or localized, but less than severe.
- **Major**: Impacts are detectable, long-lasting, extensive, and severe.

These general significance categories were tailored as needed to evaluate impacts of each relevant IPF on each resource.

Impact Conclusions for the Proposed Action (Alternative A)

Impacts on Marine Mammals

There are 38 species of marine mammals occurring within the AOI, including 34 cetacean species, one sirenian (the Florida subspecies of the West Indian manatee), and three pinnipeds (gray seal, harbor seal, and hooded seal). The manatee and the three seal species are unlikely to occur within the AOI based on their reported distribution. Seven of the marine mammal species are endangered species, including five baleen whales (North Atlantic right whale, blue whale, fin whale, sei whale, and humpback whale), one toothed whale (sperm whale), and the manatee.

Relevant IPFs for marine mammals are active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills.

The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. The term "take," as defined in the MMPA, means to harass, hunt, capture, or kill any marine mammal or to attempt such activity. The MMPA defines harassment as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) or disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Impacts of Active Acoustic Sound Sources

The proposed action includes extensive seismic airgun surveys for oil and gas exploration and development, as well as HRG surveys in both the renewable energy and marine minerals programs. Airguns produce acoustic pulses that are within the hearing range of all marine mammals. HRG surveys for renewable energy and marine minerals sites typically would use only electromechanical sources such as side-scan sonars, boomer and chirp subbottom profilers, and multibeam depth sounders, some of which are beyond the functional hearing range of marine mammals.

Based on the scope of the proposed action, seismic airgun surveys and non-airgun HRG surveys could affect individuals from all marine mammal species within the AOI except the West Indian manatee and the three pinniped species, which are considered extralimital and are unlikely to be affected.

Incidental take of marine mammals was estimated for the proposed action scenario using the Acoustic Integration Model©. The modeling used both the current NMFS criteria for Level A and Level B harassment, as well as the Southall et al. (2007) criterion for injury. The NMFS currently uses precautionary thresholds that would indicate when the potential for Level A or Level B harassment cannot be dismissed. The NMFS criteria for Level A harassment for impulsive sounds are 180 dB re 1 μPa for cetaceans and 190 dB re 1 μPa for pinnipeds. The NMFS criteria for Level B harassment are 160 dB re 1 μPa for pulsed sounds (e.g., airgun pulses) and 120 dB re 1 μPa for non-pulsed sound (e.g., ship noise). The Southall et al. (2007) criteria for impulsive sounds (e.g., airgun pulses) are sound exposure levels (SELs) of 198 dB re 1 μPa^2-s for cetaceans and 186 dB re 1 μPa^2-s for pinnipeds. Southall criteria for nonpulse sounds (e.g., side-scan sonars, boomer and chirp subbottom profilers, multibeam depth sounders, etc.) are 215 dB re 1 μPa^2-s for cetaceans and 203 dB re 1 μPa^2-s for pinnipeds. Southall et al. (2007) also concluded that receipt of an instantaneous flat-weighted peak pressure exceeding 230 dB re 1 μPa (peak) for cetaceans or 218 dB re 1 μPa (peak) for pinnipeds might also lead to auditory injury even if the aforementioned SEL criterion was not exceeded. The Southall et al. (2007) criteria are not currently used by NMFS within the framework of the MMPA.

Seismic Airgun Surveys: For seismic airgun surveys, total numbers of Level A and Level B incidental takes were estimated for each year included in the 2012-2020 time period covered by this Programmatic EIS. The modeling predicts Level A harassment of all marine mammal species except the West Indian manatee and the three pinnipeds (all values are zero due to low densities in the AOI). Using the NMFS 180-dB criterion, the five species with the highest numbers of annual Level A takes are estimated to be

- bottlenose dolphin (up to 11,748 individuals/year);
- short-beaked common dolphin (up to 6,147 individuals/year);
- Atlantic spotted dolphin (up to 5,848 individuals/year);
- short-finned pilot whale (up to 4,631 individuals/year); and
- striped dolphin (up to 3,993 individuals/year).

Using the Southall et al. (2007) criteria, estimated Level A takes are much lower, with the following top five species:

- Atlantic spotted dolphin (up to 1,496 individuals/year);
- striped dolphin (up to 1,020 individuals/year);
- Risso's dolphin (up to 731 individuals/year);
- pantropical spotted dolphin (up to 263 individuals/year); and
- short-beaked common dolphin (up to 225 individuals/year);

The modeling also predicts Level B harassment of all marine mammal species except the West Indian manatee and the three pinnipeds. Using the NMFS 160-dB criterion, the five species with the highest annual Level B take estimates are

- bottlenose dolphin (up to 1,151,442 individuals/year);
- short-beaked common dolphin (up to 602,424 individuals/year);
- Atlantic spotted dolphin (up to 573,121 individuals/year)
- short-finned pilot whale (up to 453,897 individuals/year); and
- striped dolphin (up to 391,376 individuals/year);

Seven marine mammal species that occur in the AOI are endangered species (North Atlantic right whale, blue whale, fin whale, sei whale, humpback whale, sperm whale, and West Indian manatee). The modeling predicts Level A and B incidental takes of all species except the West Indian manatee. Of the endangered species, the humpback whale has the highest estimated numbers of both Level A takes (up to 12 individuals/year using the 180-dB criterion and up to 6 individuals/year using the Southall et al. [2007] criterion) and Level B takes (up to 1,131 individuals/year using the 160-dB criterion).

The modeling also predicts the possibility of a small number of Level A incidental takes of North Atlantic right whales, including 0-2 individuals/year using the 180-dB criterion and less than one individual using the Southall et al. (2007) criterion. However, most Level A incidental takes predicted by the modeling are expected to be avoided by mitigation as explained in the next paragraph. Level B incidental takes are estimated to range from 0 to 476 individuals/year. The proposed action includes a time-area closure for North Atlantic right whales that has been factored into the incidental take calculations. It reduces estimated Level A and Level B incidental takes of North Atlantic right whales by about 67 percent (as compared with no time-area closures).

The Level A incidental takes predicted by the modeling do not take into account the mitigation measures included in the seismic airgun survey protocol to ensure that marine mammals are not present within a 180-dB exclusion zone around airgun arrays. Although these measures are not expected to be 100 percent effective, they are expected to significantly reduce the risk of Level A harassment to marine mammals. The exclusion zone could extend up to 2.1 km (1.3 mi) from a large airgun array and up to 186 m (610 ft) from a small airgun array. Because the mitigation measures would not be 100 percent effective, there is the potential to expose some animals to sound levels exceeding the 180-dB criterion, which would constitute Level A harassment and could result in injury. The mitigation measures during seismic airgun surveys would not fully prevent Level B harassment (as defined by the 160-dB zone), which could extend up to 15 km (9.3 mi) from a large airgun array and up to 3 km (1.9 mi) from a small airgun array, depending on the geographic location and season modeled.

In conclusion, seismic airgun surveys have the potential to result in both Level A and Level B harassment of marine mammals. No mortalities would be expected, but Level A incidental takes of nearly all marine mammal species in the AOI are predicted by the modeling. Although these impacts are expected to be avoided to the maximum extent practicable, the mitigation measures included in the proposed action would not be 100 percent effective and therefore there is the possibility of numerous Level A incidental takes. The most likely and extensive effects of underwater noise on marine mammals are behavioral responses (Level B harassment). Most acoustic impacts on North Atlantic right whales (and some impacts on most other marine mammals) are expected to be avoided by the right whale time-area closure included in the proposed action. Manatees and pinnipeds are unlikely to come into contact with active acoustic sound sources, and no acoustic harassment is expected for those species. Due to the spatial and temporal extent of the surveys in the proposed action, the total number of Level B harassments predicted, and the likelihood that some degree of Level A harassment would not be prevented, overall impacts on marine mammals from seismic airgun surveys are expected to be **moderate**.

Non-Airgun HRG Surveys: The HRG surveys for renewable energy and marine minerals sites typically would use only electromechanical sources such as side-scan sonars, boomer and chirp subbottom profilers, and multibeam depth sounders. Boomer pulses are expected to be within the hearing range of all marine mammals. However, the operating frequency of the representative multibeam system selected for this Programmatic EIS analysis is above the hearing range of all cetaceans. For the representative side-scan sonar and chirp subbottom profiler systems, some frequencies are within the hearing range of cetaceans, but others are not. Frequencies emitted by individual equipment may differ from these representative systems selected for programmatic analysis.

Based on the scope of the renewable energy and marine minerals activities, any marine mammal species within the AOI could be affected. However, it is unlikely that the West Indian manatee or the three pinniped species (gray seal, harbor seal, and hooded seal) would be affected because of their low densities within the AOI. In addition, marine mammals inhabiting primarily shelf-edge or deepwater habitats (e.g., sperm whales, spinner dolphins, etc.) would be unlikely to be exposed to noise from renewable energy or marine minerals surveys because these surveys would be limited to relatively nearshore waters. Renewable energy surveys are expected to occur in water less than 100 m (328 ft) deep, and marine minerals surveys are expected to occur in waters less than 30 m (98 ft) deep.

For non-airgun HRG surveys, modeling of incidental take predicts low numbers (a few individuals per year) of Level A harassment for all marine mammal species except the West Indian manatee and the three pinnipeds (all values are zero due to low densities in the AOI). The modeling also predicts Level B harassment of each marine mammal species except the West Indian manatee and the three pinnipeds, with numbers ranging up to several hundred individuals per year (e.g., 92-632 individuals/year for bottlenose dolphin, the species with the highest numbers). All seven of the endangered marine mammal species are predicted to have essentially zero Level A incidental takes using both the NMFS 180-dB criterion and the Southall et al. (2007) criteria. Of the endangered species, the highest estimated Level B incidental takes are estimated for the sperm whale (0-12 individuals/year). All of the endangered mysticete whales have estimated Level B incidental takes of less than one individual/year, with the highest estimate being North Atlantic right whale (0.19-0.87 individuals/year).

In conclusion, it is expected that there would be little or no Level A harassment resulting from non-airgun HRG surveys. Depending on the operating frequencies and source levels of the electromechanical sources used for a particular survey, the underwater noise may be above the hearing range of marine mammals or cause impacts only at very close range. The most likely and extensive effects of HRG surveys on marine mammals would be behavioral responses (Level B harassment). Manatees and pinnipeds are unlikely to come into contact with active acoustic sound sources, and no acoustic harassment is expected for those species. Because most or all Level A harassment would likely be avoided and because of the low numbers of Level B harassments predicted, overall impacts on marine mammals from non-airgun HRG surveys are expected to be **minor**.

Other Impacts on Marine Mammals

Vessel noise has been observed to elicit a variety of behavioral responses in marine mammals. These behavioral responses may include evasive maneuvers such as diving or changes in swimming direction and/or speed. The proposed action includes a time-area closure for G&G surveys deploying airguns in the right whale critical habitat and in the Mid-Atlantic and Southeast Seasonal Management Areas (SMAs) in the periods when vessel speed restrictions are in force under the Right Whale Ship Strike Reduction Rule (from November 1 through April 30), Authorizations for other (non-airgun) HRG surveys in these areas for the North Atlantic right whale may include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. These measures would be expected to reduce vessel-related noise impacts to this species during its seasonal migration and calving/nursing periods. The time-area closure would also reduce impacts on other marine mammals during these time periods. Based on the expected volume of vessel traffic associated with project activities within the AOI and the presumption that marine mammals within the AOI are familiar with common vessel-related noises, the effects of vessel noise on marine mammals are expected to be **negligible** to **minor**.

Other sound sources associated with the proposed activity include drilling-related equipment noise during the completion of up to three deep stratigraphic test wells and up to five shallow test wells during the time period of this Programmatic EIS. These noise sources may elicit behavioral responses such as changes in swimming direction or speed. However, considering the small number of drilling operations, the continuous nature of sounds produced during these activities, and the mitigation measures in place for Alternative A, it is expected that the noise impacts on marine mammals would be **minor**.

Marine mammals are vulnerable to vessel strikes. However, all authorizations for shipboard surveys would include guidance for vessel strike avoidance. It is unlikely that G&G survey vessels would strike marine mammals because they would travel slowly during surveys and would be towing active acoustic sound sources (airguns) that are detectable by most marine mammals. In addition, during surveys, waters surrounding survey vessels would be visually monitored by protected species observers for marine mammals and turtles. Vessel movements would be subject to BOEM guidance for vessel strike avoidance, and vessel operators would be required to reduce speed in certain areas to comply with the Right Whale Ship Strike Reduction Rule. Vessel traffic impacts are expected to be **negligible**.

The proposed action scenario includes one or two aeromagnetic surveys and the possibility of helicopter traffic in support of drilling of deep stratigraphic and shallow test wells. Low-flying aircraft can disturb marine mammals because of both the noise and the visual disturbance. However, the exposure of individual marine mammals to aircraft-related noise would be expected to be brief in duration. Considering the relatively low level of aircraft activity included in the proposed action, along with the short duration of potential exposure noise and visual disturbance, potential impacts from this activity are expected to be **negligible** to **minor**.

Impacts to marine mammals from discarded trash and debris are expected to be avoided through vessel operators' compliance with U.S. Coast Guard (USCG) and U.S. Environmental Protection Agency (USEPA) regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Therefore, impacts are expected to be **negligible**.

An accidental fuel spill could affect marine mammals through various pathways: direct contact, inhalation of volatile components, ingestion (directly or indirectly through the consumption of fouled prey species), and (for mysticetes) impairment of feeding by fouling of baleen. Cetacean skin is highly impermeable and is not seriously irritated by brief exposure to diesel fuel; direct contact is not likely to produce a significant impact. A small fuel spill would not be likely to result in the death or life-threatening injury of individual marine mammals, or the long-term displacement of these animals from preferred feeding or breeding habitats or migratory routes. It is expected that marine mammals would avoid areas with heavy fuel sheen, and the fuel would disperse and weather rapidly. The impacts would be **negligible** to **minor**.

Impacts on Sea Turtles

Five sea turtle species occur in the AOI: the loggerhead turtle, green turtle, hawksbill turtle, Kemp's ridley turtle, and leatherback turtle. The hawksbill, Kemp's ridley, and leatherback turtles are listed under the ESA as endangered. The green turtle is listed as threatened, except for the Florida breeding population, which is endangered. The Northwest Atlantic population of the loggerhead turtle is classified as threatened. Loggerhead, leatherback, and green turtles are more commonly found within the AOI at certain periods (nesting season) and life stages. Kemp's ridley and particularly hawksbill turtles are less common within the AOI. Green, leatherback, and loggerhead turtles use coastal beaches within the AOI as primary nesting sites, with the main nesting beaches in southeast Florida. However, loggerhead turtles also nest along the southeast coast as far north as Virginia.

Relevant IPFs for sea turtles are active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills.

Impacts of Active Acoustic Sound Sources

The proposed action includes extensive seismic airgun surveys for oil and gas exploration and development, as well as HRG surveys in both the renewable energy and marine minerals programs. Airguns produce low-frequency pulses that are within the hearing range of sea turtles. However, HRG surveys for renewable energy and marine minerals sites typically would use only electromechanical sources such as side-scan sonars, boomer and chirp subbottom profilers, and multibeam depth sounders. Acoustic signals from electromechanical sources other than boomers are not likely to be detectable by sea turtles, and impacts of boomer pulses may be limited to areas very near or beneath a survey vessel; therefore, impacts would range from **negligible** to **minor**.

Based on the scope of the proposed action, seismic airgun surveys could affect individuals from all sea turtle species within the AOI, potentially including hawksbill turtles within the southernmost part of the AOI. Subadult and adult turtles may be more likely to be affected by seismic airgun noise than post-hatchling turtles, due to the time that the former remain submerged and at depth. Post-hatchling turtles generally reside at or near the sea surface and may be less likely to be injured by the sound field produced by an airgun array. Seismic airgun surveys in nearshore waters would affect a greater number of individual turtles, particularly species other than leatherbacks. Deepwater surveys are likely to affect fewer individual turtles but are more likely to affect leatherback turtles, particularly within areas of upwelling where individuals may be found in feeding aggregations. Surveys conducted during summer sea turtle nesting periods may affect greater numbers of adult turtles, particularly loggerhead, green, and leatherback turtles, than surveys conducted during non-nesting periods.

Mitigation measures included in the seismic airgun survey protocol include ramp-up of airgun arrays, visual monitoring of an exclusion zone by protected species observers, and startup and shutdown requirements. These measures are expected to prevent injury to sea turtles by ensuring that they are not present within an exclusion zone around the airgun array. The most likely impacts would be short-term behavioral responses; no deaths or life-threatening injuries would be expected. In general, impacts of seismic airgun surveys on sea turtles are expected to range from **negligible** to **minor**.

However, seismic airgun surveys offshore heavily used nesting beaches during the nesting season could temporarily displace breeding and nesting adult turtles and potentially disrupt time-critical activities. Beaches of southeast Florida have been identified as the most important nesting area for loggerhead turtles in the western hemisphere. The northern segment of the Archie Carr National Wildlife Refuge (NWR) borders the AOI, and it has been estimated that 25 percent of all loggerhead nesting in the U.S. occurs there. During the 2010 nesting season, there were over 31,000 loggerhead nests in Brevard County, where the Archie Carr NWR is located. It is likely that large numbers of sea turtles would be present in nearshore waters of Brevard County during the nesting season from May 1 to October 31. Many adult females linger near the nesting beaches before and between nesting events, resting under rocky ledges and outcrops in inner shelf waters for periods of weeks. Depending on the duration and intensity of survey effort in this area, breeding adults, nesting adult females, and hatchlings could be exposed to airgun seismic pulses that could interfere with time-critical behaviors associated with nesting. For surveys offshore Brevard County during the nesting season, seismic airgun survey impacts on sea turtles are expected to range from **minor** to **moderate**.

Other Impacts on Sea Turtles

Survey vessel activities would generate vessel and equipment noise that could disturb sea turtles or contribute to auditory masking. The most likely effects would include behavioral changes such as diving or changes in swimming direction and/or speed. This evasive behavior is not expected to adversely affect these individuals or the population, and so the impacts are expected to be **negligible**.

Survey vessels could strike and injure or kill sea turtles. However, all authorizations for shipboard surveys would include guidance for vessel strike avoidance. It is unlikely that G&G survey vessels would strike sea turtles because they would travel slowly during surveys and would be towing active acoustic sound sources (airguns) that are detectable by sea turtles. In addition, during surveys, waters surrounding survey vessels would be visually monitored by protected species observers for sea turtles and marine mammals. Vessel movements would be subject to BOEM guidance for vessel strike avoidance, and vessel operators would be required to reduce speed in certain areas to comply with the Right Whale Ship Strike Reduction Rule. Vessel traffic impacts are expected to be **negligible**.

The proposed action scenario includes one or two aeromagnetic surveys and the possibility of helicopter traffic in support of drilling of deep stratigraphic and shallow test wells. Low-flying aircraft can disturb sea turtles because of both the noise and the visual disturbance. However, the exposure of individual sea turtles to aircraft-related noise would be expected to be brief in duration. Considering the relatively low level of aircraft activity included in the proposed action, along with the short duration of potential exposure noise and visual disturbance, potential impacts on sea turtles from this activity are expected to be **negligible**.

Impacts to sea turtles from discarded trash and debris are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Therefore, impacts are expected to be **negligible**.

An accidental fuel spill could affect sea turtles through various pathways including direct contact, inhalation of the fuel and its volatile components, and ingestion (directly or indirectly through the consumption of fouled prey species). Several aspects of sea turtle biology and behavior place them at risk, including lack of avoidance behavior, indiscriminate feeding in convergence zones, and inhalation of large volumes of air before dives. Studies have shown that direct exposure of sensitive tissues (e.g., eyes, or other mucous membranes) and soft tissues to diesel fuel or volatile hydrocarbons may produce irritation and inflammation. Diesel fuel can adhere to turtle skin or shells. Turtles surfacing within or near a diesel release may inhale petroleum vapors, causing respiratory stress. Ingested diesel fuel, particularly the lighter fractions, can be acutely toxic to sea turtles. However, a small fuel spill would not be likely to result in the death or life-threatening injury of individual turtles or hatchlings, or the long-term displacement of adult turtles from preferred feeding, breeding, or nesting habitats or migratory routes. It is unlikely that a small diesel fuel spill in the ocean would reach turtle nests, which are usually positioned above the high tide line. Therefore, potential impacts to sea turtles from an accidental fuel spill are expected to range from **negligible** to **minor**.

Impacts on Marine and Coastal Birds

The Atlantic Coast supports a diverse avifauna and includes a variety of coastal habitats that are important to the ecology of coastal and marine bird species. This Programmatic EIS analysis focuses on seabirds, waterfowl, and shorebirds. In addition, there are three threatened and endangered species of marine and coastal birds occurring within the AOI (the piping plover, roseate tern, and Bermuda petrel) and one candidate species (the red knot). Relevant IPFs for marine and coastal birds are active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills.

Only birds that plunge dive would be at risk of exposure to active acoustic sound sources. Investigations into the effects of airguns on seabirds are extremely limited, but no mortality, injury, or effects on distribution or abundance have been observed. Underwater noise impacts on birds are expected to be **negligible** to **minor** for airguns and **negligible** for noise from electromechanical sources.

Birds could be briefly disturbed by vessel traffic, vessel and equipment noise, and aircraft traffic and noise. However, it is not expected that vessels or aircraft would be operating near important nesting or roosting areas; impacts would be **negligible** to **minor**.

Impacts of trash and debris to marine and coastal birds are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Therefore, impacts on marine and coastal birds from trash and debris are expected to be **negligible**.

If the accidental fuel spill occurred in offshore waters, there is the potential for some oceanic and pelagic seabirds to be directly and indirectly affected by spilled diesel fuel. Direct impacts would include oiling of plumage and ingestion (resulting from preening). Indirect impacts could include oiling of foraging habitats and displacement to secondary locations. Impacts are expected to be **negligible** to **minor** for most bird species, but potentially **negligible** to **moderate** for listed species such as piping plover, roseate tern, red knot, and Bermuda petrel.

Impacts on Fish Resources and Essential Fish Habitat

The AOI encompasses demersal and pelagic habitats ranging from the shoreline to the open ocean that support approximately 600 fish species. This Programmatic EIS analysis focuses on demersal fishes (including hard bottom and soft bottom fishes) and pelagic fishes (including coastal pelagic, epipelagic, and mesopelagic fishes). Within the demersal classes, assemblages are characterized by cross-shelf distribution or depth-related patterns. Ichthyoplankton and EFH are also included in the analysis.

Relevant IPFs for fish resources and EFH are active acoustic sound sources, vessel and equipment noise, seafloor disturbance, drilling discharges, and accidental fuel spills.

Potential impacts of active acoustic sound sources (e.g., airguns) on fishes may include behavioral responses, masking of biologically important sounds, temporary hearing loss, and physiological effects. Based on the scope of the proposed action, it is possible that fishes near an airgun array could be exposed to sound levels that could result in temporary hearing loss (there is no permanent hearing loss in fishes). No mortality or injury is expected because there has been no observation of direct physical injury or death to fishes from airguns. Impacts are expected to be **minor**.

All vessels produce underwater noise, and it is likely that fishes in the AOI have habituated to this noise. Sound sources are below levels that can cause temporary hearing loss or injury. Masking and short-term behavior modifications are possible effects. Impacts on fish behavior are expected to be short-term and localized to areas of survey vessel activity; the effects would be **minor**.

Several types of G&G survey activities (e.g., bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) could disturb the seafloor and result in localized impacts on demersal fishes and EFH. In addition, drilling discharges from drilling of deep stratigraphic and shallow test wells could result in localized impacts. The area affected would be a negligible percentage of the benthic habitat in the AOI. Because BOEM would require prior approval of G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, impacts on sensitive benthic habitats that serve as EFH are expected to be avoided. Impacts of seafloor disturbance and drilling discharges are expected to be **negligible**.

A small fuel spill at the sea surface could affect fish resources and EFH. Numerous federally managed species have pelagic eggs and larvae that would be at risk if they encountered a diesel spill. The EFH most likely to be affected would be pelagic *Sargassum*. Drifting in windrows or mats, *Sargassum* supports numerous fishes and invertebrates including the young of several federally managed species such as greater amberjack, almaco jack, gray triggerfish, blue runner, dolphin, and wahoo. However, because the exposure of spilled diesel fuel on early life stages and *Sargassum* is expected to last for a day or less and have limited spatial extent, the impacts of a small accidental fuel spill would be **minor**.

Impacts on Threatened or Endangered Fish Species

Marine fishes occurring in the AOI include two endangered species, one proposed threatened/endangered species, and two candidate species. The smalltooth sawfish is an endangered species occurring mainly in nearshore Florida waters. The shortnose sturgeon is an endangered anadromous species that inhabits rivers along the Atlantic Coast but rarely ventures into coastal marine waters. The Atlantic sturgeon is a proposed threatened/endangered species found in shelf waters (including areas offshore of Virginia and North Carolina) during fall and winter months. Two anadromous species, the blueback herring and the alewife, are candidate species currently undergoing a status review to be listed as threatened.

Relevant IPFs for threatened or endangered fish species are active acoustic sound sources, vessel and equipment noise, vessel traffic, trash and debris, seafloor disturbance, drilling discharges, and accidental fuel spills.

Due to their rare occurrence in the AOI, the smalltooth sawfish and shortnose sturgeon are unlikely to be exposed to active acoustic sound sources, including airguns; impacts are expected to be **negligible**. For similar reasons of limited distribution, potential impacts on alewife are expected to be **minor**. The Atlantic sturgeon and blueback herring are more likely to be exposed to these sound sources due to their distribution. Impacts could include behavioral responses, masking of biologically important sounds, temporary hearing loss, and physiological effects. No mortality or injury is expected because there has been no observation of direct physical injury or death to fishes from airguns. Impacts on Atlantic sturgeon and blueback herring are expected to be **minor**.

Smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon are all demersal species that are unlikely to be affected by vessel and equipment noise (**negligible** impact). Blueback herring and alewife are more likely to be exposed to this noise source, but impacts are expected to be **minor**. Impacts of vessel traffic per se on all five species are expected to be **negligible**.

Impacts of trash and debris releases on the water column and benthic environment are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Impacts from trash and debris on threatened or endangered fishes are expected to be **negligible**.

Several types of G&G survey activities (e.g., bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) could disturb the seafloor and result in localized impacts on demersal fishes, which could include the three demersal species (smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon). In addition, drilling discharges from drilling of deep stratigraphic and shallow test wells could result in localized smothering and burial of benthic communities. The total area of seafloor disturbance would be a negligible percentage of the benthic habitat in the AOI. Because BOEM would require prior approval of G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, impacts on listed demersal fishes and their habitat are expected to be avoided. Impacts of seafloor disturbance and drilling discharges are expected to be **negligible** for all of the listed fish species.

In the event of an accidental fuel spill, the three demersal listed species (smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon) are the least likely to be affected because a small fuel spill would be unlikely to reach the seafloor or contaminate bottom sediments. Because of their life histories, none of the threatened or endangered fish species would have sensitive eggs or larvae in the water column of the AOI where they would be exposed to accidently spilled diesel fuel. Impacts are expected to be **negligible** for all five of these species.

Impacts on Commercial Fisheries

The AOI supports regionally and nationally important commercial fisheries. In 2009, the latest year for which data are available, total commercial landings within the AOI were 276,909.4 metric tons, which were valued at approximately $380.5 million. Commercial fisheries support not only numerous directly related jobs (fishing crews) but also many indirectly related industries such as seafood distributors, restaurants, and suppliers of commercial fishing gear. Several ports within the AOI have among the highest commercial fishing revenues in the U.S. Fisheries within the AOI support 108 fishing communities located along the coast from Delaware to Florida.

Applicable IPFs for commercial fisheries are active acoustic sound sources, vessel traffic and vessel exclusion zones, seafloor disturbance, and accidental fuel spills.

Sounds from active acoustic sound sources such as airguns may result in behavioral changes in some fishes. Fish exposed to seismic airgun sound may exhibit an initial startle response, followed by habituation to the sound source and, after a period of time, resumption of normal behavior. Temporary avoidance behavior could result in a short-term, localized reduction in fish catch (**minor** impact).

Survey vessel traffic has the potential to temporarily interrupt commercial fishing operations, including setting of fishing gear. During seismic airgun surveys, a vessel exclusion zone is maintained around the survey vessel(s) and their towed airgun arrays. Vessel exclusion zones would be temporary, with the duration and areal extent dependent on the type of activity. Prior to conducting a seismic airgun survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to Mariners specifying the survey dates and locations and the recommended avoidance requirements. Impacts of vessel traffic and vessel exclusion zones would be **minor**.

Seafloor disturbance could potentially affect commercial fisheries operations within the AOI, specifically the potential for damage to bottom-founded fishing gear. However, most passive gears such as traps, pots, and bottom longlines are well marked by surface buoys. The total area of seafloor disturbance would be a negligible percentage of the seafloor area in the AOI. Because BOEM would require prior approval of G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures, most impacts on commercial fishing gear and activities are expected to be avoided (**negligible** impact).

The impacts of an accidental fuel spill on commercial fisheries would depend on the location of the spill, in addition to the meteorological and oceanographic conditions, which would affect the rate of weathering and transport. Response vessel activity could temporarily interrupt commercial fishing operations. However, given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts to commercial fisheries activities from a small diesel fuel spill are expected to be **negligible**.

Impacts on Recreational Fisheries

Recreational fishing is an important social and economic activity in the AOI. During 2006-2009, the annual mean number of recreational fishing trips for the seven states adjacent to the AOI was 4.4 million. Saltwater recreational fisheries in states adjacent to the AOI are among the most valuable in the U.S. Relevant IPFs for recreational fisheries are active acoustic sound sources, vessel traffic, vessel exclusion zones, and accidental fuel spills.

Active acoustic sound sources such as airguns may result in behavioral changes in some fishes. Temporary avoidance behavior could result in a short-term, localized reduction in fish catch. The impacts on recreational fisheries are expected to be **negligible** to **minor**.

G&G survey vessel traffic may temporarily interrupt recreational fishing activities including the possibility of a fishing vessel having to change course or temporarily depart from a preferred fishing location. Any impacts would be localized and short-term and are expected to be **negligible** to **minor**.

During seismic airgun surveys, a vessel exclusion zone is maintained around the survey vessel(s) and their towed airgun arrays. The vessel exclusion zones would be temporary, with the duration and areal extent dependent on the type of activity. Prior to conducting a seismic airgun survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to Mariners specifying the survey dates and locations and the recommended avoidance requirements. G&G vessel traffic and vessel exclusion zones may temporarily interrupt fishing activities including setting of fishing gear. Impacts would be localized and short-term and are expected to be **negligible**.

The impacts of an accidental fuel spill on recreational fishing would depend on the location of the spill, in addition to the meteorological and oceanographic conditions, which would affect the rate of weathering and transport. Response vessel activity could temporarily interrupt recreational fishing activities. However, given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts to recreational fisheries activities from a small diesel fuel spill are expected to be **negligible**.

Impacts on Recreational Resources

Coastal and marine habitats within and adjacent to the AOI make the Mid-Atlantic and South Atlantic Coasts popular destinations for visitors from local communities and around the globe. Most recreational activities in the region occur either along the coast or in nearshore (State) waters. Relevant IPFs for recreational resources are vessel exclusion zones, trash and debris, and accidental fuel spills.

During seismic airgun surveys, a vessel exclusion zone is maintained around the survey vessel(s) and their towed airgun arrays. The vessel exclusion zones would be temporary, with the duration and areal extent dependent on the type of activity. Prior to conducting a seismic airgun survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to

Mariners specifying the survey dates and locations and the recommended avoidance requirements. Any impacts would be of short duration, and potential impacts are expected to be **negligible**.

Impacts of trash and debris on recreational resources (e.g., trash washing up on beaches) are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Impacts from trash and debris on recreational resources are expected to be **negligible** to **minor**.

The impacts of an accidental fuel spill on recreational resources would depend on the location of the spill, in addition to the meteorological and oceanographic conditions, which would affect the rate of weathering and transport. Response vessel activity could temporarily interrupt recreational use of some areas. However, given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts to recreational uses from a small diesel fuel spill are expected to be **negligible** to **minor**.

Impacts on Benthic Communities

The benthic environment of the AOI includes parts of two broad eco-regions: (1) the Mid-Atlantic Bight (MAB), which extends from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina; and (2) the South Atlantic Bight (SAB), which extends from Cape Hatteras, North Carolina, to Cape Canaveral, Florida. The seafloor in the MAB consists predominantly of soft sediments, but some hard bottom habitats are sparsely distributed over the MAB shelf and are composed of bare rock, gravel, shell hash, and artificial reefs. In contrast, there are extensive areas of hard/live bottom on the SAB shelf. In deeper water, hard bottom habitats are associated with canyon walls in the MAB and with deepwater coral bioherms along the Blake Plateau and Florida-Hatteras slope in the SAB. Locations of canyons and some hard bottom features are well known (e.g., Gray's Reef). In other areas where the presence of deepwater corals is known but the distribution of coral sites is not well documented, broad areas have been designated as HAPCs by the South Atlantic Fishery Management Council (SAFMC) to protect these communities from physical damage by fishing gear.

The main IPF for benthic communities is seafloor disturbance; other relevant IPFs include drilling discharges, active acoustic sound sources, trash and debris, and accidental fuel spills.

Several types of G&G survey activities (e.g., bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) could disturb the seafloor and result in localized burial or crushing of soft bottom benthic organisms. In addition, drilling discharges from drilling of deep stratigraphic and shallow test wells could result in localized smothering and burial of benthic communities. The total area of seafloor disturbance in soft bottom areas would be a negligible percentage of the benthic habitat in the AOI. Because BOEM would require prior approval of G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, impacts on sensitive benthic communities such as coral, hard/live bottom, chemosynthetic, and deepwater canyon communities are expected to be avoided. Impacts of seafloor disturbance under Alternative A are expected to be **negligible** to **minor**, and impacts of drilling discharges are expected to be **negligible**.

Impacts of other IPFSs on benthic communities are expected to be **negligible**. Active acoustic sound sources are expected to have little or no impact. Benthic impacts of trash and debris deposition on the seafloor are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations, and all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. A small fuel spill would be unlikely to reach the seafloor or contaminate bottom sediments.

Impacts on Archaeological Resources

Submerged archaeological resources within the AOI include shipwrecks that date from early exploration and settlement of North America by Europeans as early as the 16th and 17th centuries. Submerged prehistoric sites dating between 30,000 and 3,000 B.P. may also be present within the AOI, depending on regional landform variation. Relevant IPFs for archaeological resources are seafloor disturbance, drilling discharges, and accidental fuel spills.

Several types of G&G survey activities (e.g., anchoring, bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) could disturb the seafloor. In addition, drilling discharges from drilling of deep stratigraphic and shallow test wells could result in localized sediment deposition on the seafloor. However, BOEM would require site-specific information regarding potential archaeological resources prior to approving G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures in the AOI. The BOEM would use this information to ensure that impacts to archaeological resources are avoided. All authorizations for G&G activities that involve seafloor-disturbing activities would include requirements for operators to report suspected historic and prehistoric archaeological resources to BOEM and take precautions to protect the resource. Therefore, impacts on archaeological resources would be **negligible**.

An accidental event could result in release of fuel or diesel by a survey vessel. A small fuel spill would be unlikely to reach the seafloor or contaminate bottom sediments. Impacts on archaeological resources would be expected to be **negligible**.

Impacts on Marine Protected Areas

The MPAs within the AOI include two NMSs, six deepwater MPAs designated by the SAFMC, and numerous Federal fishery management areas. Coastal (onshore) MPAs adjacent to the AOI include five national seashores, one National Estuarine Research Reserve site that extends into Atlantic waters, 10 NWRs, and numerous State-designated MPAs. Applicable IPFs for MPAs are active acoustic sound sources, trash and debris, seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of active acoustic sound sources on benthic communities have been discussed previously and are expected to be **negligible**. Impacts on benthic communities within offshore MPAs would be similar. No direct acoustic impacts would be expected on coastal MPAs. However, certain coastal MPAs such as the Archie Carr NWR in Florida support a high level of sea turtle nesting during the summer months, and the impact analysis identified seismic airgun surveys as having the potential to disrupt time-critical activities. Therefore, for surveys offshore Brevard County during the nesting season, airgun impacts on MPAs are evaluated as **minor** to **moderate**.

Impacts of trash and debris on coastal MPAs (e.g., trash washing up on beaches) are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Impacts from trash and debris on MPAs are expected to be **negligible**.

Seafloor disturbance and drilling discharges have the potential to affect benthic resources within offshore MPAs. However, Federal regulations prohibit seafloor-disturbing activities within the two NMSs, and BOEM would not authorize such activities within MPAs; therefore, those impacts would not take place. Because BOEM would require prior approval of G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, impacts on sensitive benthic communities within other MPAs are expected to be avoided. Impacts of seafloor disturbance and drilling discharges would be **negligible**.

An accidental fuel spill is expected to have **negligible** impacts on benthic resources within offshore MPAs because the spill would float and disperse on the sea surface and is unlikely to reach the seafloor. Depending on spill location, a small fuel spill could affect coastal MPAs. However, given the small size of the spill in the proposed action scenario, impacts are expected to be **negligible** to **minor**.

Impacts on Other Marine Uses

Other existing marine uses in the AOI include shipping and marine transportation, military range complexes and civilian space program uses, sand and gravel mining, renewable energy development, oil and gas exploration, dredged material disposal, research activities from bottom-founded structures, and known sea bottom obstructions. The IPFs applicable to other marine uses are vessel traffic and vessel exclusion zones, aircraft traffic and noise, seafloor disturbance, and accidental fuel spills.

Vessel traffic and vessel exclusion zones have the potential for space-use conflicts with existing marine uses such as shipping and marine transportation. During seismic airgun surveys, vessel exclusion zones are maintained around the survey vessel(s) and their towed airgun arrays. The vessel exclusion zones would be temporary, with the duration and areal extent dependent on the type of activity. Prior to conducting a seismic airgun survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to Mariners specifying the survey dates and locations and the recommended avoidance requirements. Overall, impacts on other marine uses would be of relatively short duration and are expected to be **negligible** to **minor** for vessel traffic and vessel exclusion zones.

The proposed action scenario includes one or two aeromagnetic surveys and the possibility of helicopter traffic in support of drilling of deep stratigraphic and shallow test wells. Aircraft traffic has the potential for space-use conflicts with existing marine uses such as military and NASA use. All aircraft flights would originate from existing shore-based facilities and would file flight plans with the FAA before departure. Potential use conflicts with military range complexes and civilian space program use are expected to be avoided through coordination with military commanders and NASA prior to surveys. All authorizations for permitted activities would include BOEM guidance for military and NASA coordination. Impacts are expected to be **negligible**.

Several types of G&G survey activities (e.g., bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) involve seafloor disturbance. The BOEM would require prior approval of G&G surveys involving seafloor-disturbing activities or placement of bottom-founded equipment or structures. Therefore, conflicts with other marine uses of the seafloor (e.g., artificial reef sites, dredged material disposal sites, military use areas, etc.) are expected to be avoided, and impacts would be **negligible**.

The impacts of an accidental fuel spill on other marine uses would depend on the location of the spill, in addition to the meteorological and oceanographic conditions, which would affect the rate of weathering and transport. Response vessel activity could temporarily interrupt other marine uses in some areas. However, given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts to other marine uses from a small diesel fuel spill are expected to be **negligible**.

Impacts on Human Resources and Land Use

Seismic survey vessels are large, dedicated vessels that can remain offshore for weeks or months, with supply vessel support originating from ports along the Atlantic Coast. Five potential support bases were identified in support of oil and gas program seismic survey activity – Norfolk, Virginia; Wilmington, North Carolina; Charleston, South Carolina; Savannah, Georgia; and Jacksonville, Florida. In contrast, vessels conducting G&G surveys for renewable energy or marine minerals would operate mainly at specific sites in water depths less than 100 m (328 ft) and along potential cable routes to shore. Typically, these are smaller vessels that would return to their shore base daily. Vessel trips for these surveys areas would likely be divided among several existing ports in Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. Depending on the location of the survey area, the vessels could operate from one of the five larger ports in the AOI, or any of numerous smaller ports along the coast, depending on whatever is convenient.

Applicable IPFs for human resources and land use are onshore support activities and accidental fuel spills. Based on the projected level of G&G survey activity and associated demands for shore base space, supplies, and services, impacts from onshore activities on human resources and land use under Alternative A are expected to be **negligible**.

An accidental diesel fuel spill would be expected to have minimal to no impact to either the local economies or populations of the ports and surrounding communities. Based on the small size of the spill in the proposed action scenario, impacts on human resources and land use under Alternative A are expected to be **negligible**.

Comparison of Impacts by Alternative

Alternatives A, B, and C were carried through the detailed environmental impact analysis in **Chapter 4**. Impacts of Alternative A have been summarized in the preceding sections, and impacts of Alternative B are similar except as indicated below. Alternative C would have the lowest level of impacts for all resources because the main source of impacts (seismic airgun surveys in support of oil and gas exploration) would not occur. Alternative C would eliminate several IPFs including airguns, aircraft traffic and noise, and drilling discharges.

Most impacts under all three alternatives would be **negligible** or **minor**, and no **major** impacts were identified. Only a few impacts were identified as **moderate** under one or more alternatives. These were

- impacts of airguns on marine mammals (**moderate** under both Alternatives A and B);
- impacts of airguns on sea turtles (**negligible** to **moderate** under Alternative A and **negligible** to **minor** under Alternative B);
- impacts of airguns on MPAs (**negligible** to **moderate** under Alternative A and **negligible** to **minor** under Alternative B). The **moderate** rating is based on the potential impacts of seismic airgun surveys on sea turtle nesting at a particular coastal MPA (Archie Carr NWR) and is reduced to **minor** under Alternative B; and
- impacts of accidental fuel spills on coastal and marine birds (**moderate** under all three alternatives).

Potential impacts of Alternatives A and B are broadly similar. However, there are a few important differences due to the additional mitigation measures included in Alternative B, as discussed in the following paragraphs.

The expanded time-area closure for North Atlantic right whales under Alternative B would reduce the risk of acoustic and vessel strike impacts on this species. Although incidental take was not modeled for Alternative B, it is estimated that the expanded time-area closure would avoid approximately 80 percent of the incidental takes of North Atlantic right whales over the period of this Programmatic EIS (as compared with no closures). In contrast, the Alternative A time-area closure would be expected to avoid about 67 percent of the right whale incidental takes.

The expanded time-area closure for North Atlantic right whales under Alternative B would slightly reduce the risk of acoustic and vessel strike impacts on some other marine mammals by precluding certain surveys in a portion of the AOI during certain times. Because the closure area is a small part of the AOI (7% vs. approximately 4% under Alternative A), the overall impact rating for marine mammals was the same under both Alternatives A and B (**moderate**). The expanded time-area closure may also slightly reduce other (non-marine-mammal) impacts related to the level of vessel traffic in coastal waters, but not enough to change any impact ratings.

The Brevard County time-area closure under Alternative B would reduce the risk of disrupting sea turtle nesting in an area that is estimated to support 25 percent of all loggerhead turtle nesting in the U.S. Although the closure would affect only a small portion of the AOI (3.9%), the impact reduction for sea turtles is expected to be substantial, reducing the highest rating from **moderate** to **minor**. Because the **moderate** rating for MPAs under Alternative A was based on potential impacts on sea turtle nesting at the Archie Carr NWR (which is partly within Brevard County), the highest rating for MPAs under Alternative B would also be reduced to **minor**.

The required 40-km (25-mi) separation distance between concurrent seismic airgun surveys under Alternative B may slightly reduce acoustic impacts on marine mammals, sea turtles, and other marine biota. It would ensure that some areas between concurrent surveys would not be ensonified to levels that would cause Level A or B harassment of marine mammals, and it would reduce the likelihood of multiple exposures to airgun pulses. The degree of improvement has not been estimated but would not be expected to change any impact ratings. Even without this required separation, in practice, operators typically maintain a separation of about 17.5 km (9.5 nmi) between concurrent surveys to avoid interference (i.e., overlapping reflections received from multiple source arrays).

The required use of PAM under Alternative B would be expected to improve the effectiveness of detecting marine mammals as part of the seismic airgun survey protocol. It is expected that some Level A incidental takes of marine mammals that might otherwise occur would be avoided. The degree of improvement has not been estimated but would not be expected to change any impact ratings. Some level of PAM use also would be expected under Alternative A, but it would be optional.

Preferred Alternative

Section 1502.14(e) of the NEPA implementing regulations requires the agency preparing a Draft EIS to identify the preferred alternative if one or more exists and identify such alternative in the Final EIS. The "agency's preferred alternative" is the alternative that the agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors. The BOEM does not identify a preferred alternative in this Draft Programmatic EIS but intends to identify one in the Final Programmatic EIS.

Alternatives A and B would both fulfill the statutory mission and responsibilities of this Agency for permitting G&G activities in the program areas managed by BOEM. Alternatives A and B both provide protective measures for important biological resources in the AOI that in some cases are protected species. Alternative B includes mitigation measures that would add direct costs for operators undertaking G&G activities in the AOI, for example, staff to perform passive acoustic monitoring. Alternative B includes mitigation measures that may impose indirect costs in the form of inconvenience of deploying when and where an operator desires, or the time-value of money if a field season is missed because of deployment delays. The BOEM wishes to review the totality of the record generated by this Programmatic EIS in the public review period to assist identifying an agency preferred alternative.

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ACRONYMS AND ABBREVIATIONS

°C	degree Celsius
μPa	micropascal
1D	one-dimensional
2D	two-dimensional
3D	three-dimensional
4C	four-component
4D	four-dimensional
ABR	auditory brainstem response
ac	acre
ACHP	Advisory Council on Historic Preservation
AEP	auditory evoked potential
AIM©	Acoustic Integration Model©
AN(SW)T	ambient-noise (surface-wave) tomography
AOI	Area of Interest
ARPA	Archaeological Resources Protection Act
AUV	autonomous underwater vehicle
AWC	Atlantic Wind Connection
AWOIS	Automated Wreck and Obstruction Information System
B.P.	before present
BA	Biological Assessment
bbl	barrel
BCR	Bird Conservation Region
BLM	Bureau of Land Management
BO	Biological Opinion
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	blowout preventer
BSEE	Bureau of Safety and Environmental Enforcement
CAAA	Clean Air Act Amendments
CEQ	Council on Environmental Quality
CETAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
cm	centimeter
CO_2	carbon dioxide
CO	carbon monoxide
COE	Corps of Engineers (U.S. Army)
COP	Construction and Operations Plan
COST	Continental Offshore Stratigraphic Test
CMP	coastal management program
CMSP	Coastal and Marine Spatial Planning
CPT	cone penetrometer test
CSEM	controlled source electromagnetic
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB	decibel
DHI	direct hydrocarbon indicator
DLI	daylight imaging
DOCD	Development Operations Coordination Document
DOD	Department of Defense
DPP	Development and Production Plan
DPS	discrete population segment
DTAGS	deep-towed acoustics/geophysical system
EA	Environmental Assessment
ECS	Extended Continental Shelf
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EP	Exploration Plan
EPAct	Energy Policy Act of 2005
ESA	Endangered Species Act
FAA	Federal Aviation Administration
F.A.C.	Florida Administrative Code
FCMA	(Magnuson-Stevens) Fishery Conservation and Management Act
FERC	Federal Energy Regulatory Commission
FMC	Fishery Management Council
FMP	Fishery Management Plan
FPPA	Farmland Protection Policy Act
ft	feet
FY	fiscal year
G&G	geological and geophysical
gal	gallon
GAP	General Activities Plan
GDP	Gross Domestic Product
GIS	geographic information system
GMWD	Global Maritime Wrecks Database
GPS	global positioning system
GRT	gross registered ton
GS	General Statute
GSFC	Goddard Space Flight Center
GW	gigawatt
H_2S	hydrogen sulfide
ha	hectare
HAPC	Habitat Area of Particular Concern
HESS	High Energy Seismic Survey
HMS	highly migratory species
hr	hour
HRG	high-resolution geophysical
HyMAS	hydrocarbon microtremor analysis
Hz	hertz
IBA	Important Bird Area
IHA	Incidental Harassment Authorization
in	inch
IPCC	Intergovernmental Panel on Climate Change
IPF	impact-producing factor
ISSMGE	International Society for Soil Mechanics and Geotechnical Engineering
ITA	Incidental Take Authorization
ITS	Incidental Take Statement

IUCN International Union for Conservation of Nature
IVI Industrial Vehicles International, Inc.
IWC International Whaling Commission
kg kilogram
kHz kilohertz
km kilometer
km^2 square kilometer
kn knot
kWh kilowatt-hour
L liter
LACS low-frequency acoustic source
lb pound
LET local earthquake tomography
LFPS low frequency passive seismic
LFS low-frequency spectroscopy
LISA low-impact seismic array
LNG liquefied natural gas
LOA Letter of Authorization
m meter
m^3 cubic meter
MAB Mid-Atlantic Bight
MAFMC Mid-Atlantic Fishery Management Council
MARAD Maritime Administration
MARPOL International Convention for the Prevention of Pollution from Ships
MARS Mid-Atlantic Regional Spaceport
MBTA Migratory Bird Treaty Act
mg/L milligrams per liter
MHK marine hydrokinetic
MHW mean high water
mi mile
min minute
ml milliliter
ml/L milliliter per liter
MMP Marine Minerals Program
MMPA Marine Mammal Protection Act
MMS Minerals Management Service
MOA Memorandum of Agreement
MOA Memorandum of Understanding
MPA Marine Protected Area
MSA Metropolitan Statistical Area
MSD marine sanitation device
MT magnetotelluric
mt metric ton
MW megawatt
MWh megawatt-hour
NAAQS National Ambient Air Quality Standards
NABCI North American Bird Conservation Initiative
NASA National Aeronautics and Space Administration
NavAid Aids to Navigation
NAVFAC Naval Facilities Engineering Command
NDBC National Data Buoy Center
NEFMC New England Fisheries Management Council
NEP National Estuary Program
NEPA National Environmental Protection Act
NERR National Estuarine Research Reserve
NGP Noticed General Permit
NHPA National Historic Preservation Act
NMFS National Marine Fisheries Service
nmi nautical mile
NMS National Marine Sanctuary
NMSA National Marine Sanctuaries Act
NOAA National Oceanic and Atmospheric Administration
NOI Notice of Intent
NOPP National Oceanographic Partnership Program
NOS National Oceanic Service (NOAA)
NO_x nitrogen oxides
NPDES National Pollutant Discharge Elimination System
NRC National Research Council
NRDA National Resource Damage Assessment
NRDC National Resources Defense Council
NRHP National Register of Historic Places
NRU Northern Recovery Unit
NSF National Science Foundation
NTL Notice to Lessees and Operators
NWP Nationwide Permit
NWR National Wildlife Refuge
OAEP Office of Alternative Energy Programs
OBS ocean bottom seismometer
OCD Offshore and Coastal Dispersion (model)
OCS Outer Continental Shelf
OCSLA Outer Continental Shelf Lands Act
ODMDS ocean dredged material disposal site
OECA *Oculina* Experimental Closed Area
OEIS Overseas Environmental Impact Statement
ONMS Office of National Marine Sanctuaries (NOAA)
OPAREA Operating Area
OPR Office of Protected Resources (NOAA)
OREP Office of Renewable Energy Programs
OSC Orbital Sciences Corporation
OSWinD Offshore Wind Innovation and Demonstration
PGS Petroleum Geo-Services
P.L. Public Law
PAH polycyclic aromatic hydrocarbon
PAM passive acoustic monitoring
PBR Potential Biological Removal
PCB polychlorinated biphenyl
PCPT piezocone penetration test
PFRU Peninsular Florida Recovery Unit
ppm parts per million
PSD Prevention of Significant Deterioration
PTS permanent threshold shift
PVC polyvinyl chloride
RHA Rivers and Harbors Act
rms root-mean-square
ROD Record of Decision
ROV remotely operated vehicle
s second
SAB South Atlantic Bight

SABSOON South Atlantic Bight Synoptic Offshore Observational Network
SAFMC South Atlantic Fishery Management Council
SAI Southwick Associates, Inc.
SAP Site Assessment Plan
SBF synthetic-based fluid
SCDNR South Carolina Department of Natural Resources
Secretary Secretary of the Interior
SEL sound exposure level
SFA Sustainable Fisheries Act
SFC seafloor compliance
SHPO State Historic Preservation Officer
SMA Seasonal Management Area
SO_x sulphur oxides
sp. species
SPL sound pressure level
spp. multiple species
SWA surface-wave amplitude
Tcf trillion cubic feet
TED turtle excluder device
THPO Tribal Historic Preservation Officer
TRC TRC Environmental Corporation
TTS temporary threshold shift
TWT two-way travel time
UAV uninhabited aerial vehicle
U.S. United States
U.S.C. United States Code
UNCLOS United Nations Convention on the Law of the Sea
USCG U.S. Coast Guard
USDHS U.S. Department of Homeland Security
USDOA U.S. Department of the Army
USDOC U.S. Department of Commerce
USDOE U.S. Department of Energy
USDOI U.S. Department of the Interior
USDOT U.S. Department of Transportation
USEPA U.S. Environmental Protection Agency
USFWS U.S. Fish and Wildlife Service
USGS U.S. Geological Survey
V.A.C. Virginia Administrative Code
VACAPES Virginia Capes (Range Complex)
VSP vertical seismic profiling
VOC volatile organic compound
WAZ wide azimuth
WBF water-based fluid
WEA Wind Energy Area
WFF Wallops Island Flight Facility
yd^3 cubic yard

CHAPTER 1

INTRODUCTION

1. INTRODUCTION

The Bureau of Ocean Energy Management (BOEM) is issuing this Draft Programmatic Environmental Impact Statement (Programmatic EIS) to describe and evaluate the potential environmental impacts related to reasonably foreseeable geological and geophysical (G&G) survey activities in Federal waters of the Mid- and South Atlantic Outer Continental Shelf (OCS) and adjacent State waters (**Figure 1-1**). The Programmatic EIS examines G&G survey activities for three program areas: oil and gas, renewable energy, and marine minerals. The Programmatic EIS determines whether significant impacts to Atlantic resources could occur as a result of G&G activities and, where needed, specifies mitigation and monitoring measures to avoid, reduce, or minimize impacts. Preparation of the Programmatic EIS will help ensure compliance with the National Environmental Policy Act (NEPA) and other applicable laws, e.g., the Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), and the Coastal Zone Management Act (CZMA).

1.1. BACKGROUND

As a bureau of the U.S. Department of the Interior (USDOI), BOEM's primary responsibilities are to manage the exploration and development of oil and gas, renewable energy, and marine minerals resources located on the Nation's OCS. The BOEM seeks to appropriately balance economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development, and environmental reviews and studies. To fulfill its responsibilities, BOEM follows the general guiding principles of (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending BOEM assistance and expertise to economic development and environmental protection.

The BOEM has prepared this Draft Programmatic EIS in compliance with the NEPA of 1969 (42 United States Code [U.S.C.] 4321 et seq.); the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations [CFR] 1500-1508); USDOI Manual Part 516; the USDOI Implementation of NEPA (43 CFR 46); and Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*. The NEPA process is designed to ensure environmental impacts of proposed major Federal actions are considered in the decision-making process. Federal agencies are encouraged to integrate the NEPA process with other planning at the earliest stage to ensure planning and decisions reflect environmental values, avoid delays, and address potential conflicts. By preparing this Draft Programmatic EIS at this preliminary stage in the establishment of a program for G&G activities on the Atlantic OCS, BOEM is acting consistently with CEQ provisions for applying NEPA early in the decision-making process (40 CFR 1501.2).

The Outer Continental Shelf Lands Act (OCSLA), as amended, mandates the Secretary of the Interior (Secretary), through the BOEM, to manage the exploration of OCS oil, gas, and marine minerals (e.g., sand and gravel) and the siting of renewable energy facilities. The Energy Policy Act (EPAct) of 2005, Public Law (P.L.). 109-58, added Section 8(p)(1)(C) to the OCSLA, which grants the Secretary the authority to issue leases, easements, or rights-of-way on the OCS for the purpose of renewable energy development (43 U.S.C. § 1337(p)(1)(C)). The Secretary delegated this authority to the former Minerals Management Service (MMS), now BOEM. On April 22, 2009, BOEM promulgated final regulations implementing this authority at 30 CFR 585. The OCSLA defines the term "exploration" as the process of searching for minerals, including geophysical surveys where magnetic, gravity, seismic, or other systems are used to detect or imply the presence of such minerals. The Offices of Environmental Programs and Renewable Energy Programs within BOEM administer mineral resources and alternative energy uses on the OCS. The BOEM will use this document as a planning and management tool to balance orderly resource development while protecting the human, marine, and coastal environments.

The OCSLA directs BOEM to ensure G&G data are obtained in a technically safe and environmentally sound manner. The BOEM regulations (30 CFR 551.6) for the oil and gas program state that permit holders for G&G activities must not:

1. interfere with or endanger operations under any lease, right-of-way, easement, right-of-use, Notice, or permit issued or maintained under the Act;
2. cause harm or damage to life (including fish and other aquatic life), property, or to the marine, coastal, or human environment;
3. cause harm or damage to any mineral resource (in areas leased or not leased);
4. cause pollution;
5. disturb archaeological resources;
6. create hazardous or unsafe conditions; or
7. unreasonably interfere with or cause harm to other uses of the area.

This document will also serve the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) as an assessment of marine resources under their jurisdiction. The NMFS has jurisdiction for Section 7 consultations regarding threatened and endangered species under the ESA and for Incidental Take Authorizations (ITAs) under the MMPA and Essential Fish Habitat (EFH) consultations under the Magnuson-Stevens Fisheries Conservation and Management Act (FCMA).

1.2. Programmatic Approach to the NEPA Process

In 1990 Congress began a moratorium as part of the USDOI's annual appropriations act prohibiting Federal spending on oil and gas development on the Atlantic OCS. In 1998 President Clinton issued an executive order that continued leasing restrictions in the Atlantic. Both Congressional and Executive Office moratoria were allowed to expire or lifted, respectively, in 2008. The primary goal in choosing not to extend the moratoria was to increase domestic OCS energy production. The decision was influenced by policies to diversify domestic energy production, including renewable energy programs, as well as by the availability of new technology enabling activity in deeper waters.

The absence of congressional moratoria was expected to lead to increased coordination between State and Federal levels of government to address economic and environmental issues related to Atlantic OCS energy development. To begin that process, President Obama established an Interagency Ocean Policy Task Force in 2009 to develop recommendations for a national policy that ensures the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources. On July 19, 2010, President Obama signed EO 13547, Stewardship of the Ocean, Our Coasts, and the Great Lakes, adopting recommendations of the Interagency Ocean Policy Task Force for developing a recommended framework for effective coastal and marine spatial planning.

In the 2010 USDOI, Environment, and Related Agencies Appropriation Act (P.L. 111-88), the Conference Report to the Congress stated that it supports "the Administration's efforts to secure a balanced energy portfolio that carefully weighs what is in the best interest of our energy-dependent nation with what is in the best interest of our natural environment. Future coordinated efforts to pursue additional oil and gas resources in the OCS must include the opportunity to apply advanced technologies, be based on the best available science, and take into account the potential environmental impacts of such potential development. Therefore, the conferees direct BOEM, pursuant to the National Environmental Policy Act, to conduct a Programmatic EIS to evaluate potential significant environmental effects of multiple G&G activities in the Atlantic OCS."

The BOEM currently has no programmatic NEPA coverage for permitting G&G activities in Federal waters of the Atlantic. The G&G permits for renewable energy and marine minerals activity are processed as received, but until now have had no programmatic level evaluation. The BOEM has received nine permit requests for G&G activities in support of oil and gas exploration, and industry has expressed interest in expanding activities into the Atlantic offshore waters. Given the scope of proposed oil and gas surveys and their potential cumulative impacts, BOEM has determined a Programmatic EIS under NEPA is required prior to permitting any new, large-scale G&G surveys. Coverage of these activities under a Programmatic EIS will reduce duplication of effort in future environmental documentation while providing a format for comprehensive cumulative impacts analysis by examining G&G activities as a whole. This document analyzes a broad range of direct, indirect, and cumulative impacts associated with marine G&G activities in addition to other past, present, and reasonably foreseeable projects in the area.

This Programmatic EIS establishes a framework for subsequent environmental documents for site-specific actions while identifying and analyzing appropriate mitigation measures to be used during future G&G activities. The impacts of future site-specific actions will be addressed in subsequent NEPA evaluations, per CEQ regulations (40 CFR 1502.20) by tiering from this programmatic evaluation.

The scope of this Programmatic EIS does not include a NEPA analysis that evaluates a specific proposal for oil and gas leasing in the AOI and does not authorize an OCS lease sale. The procedures under the OSCLA to set up a lease sale include a specific NEPA evaluation for that proposed action. A NEPA evaluation for approving the OCS plans that actualize leases for oil and gas exploration and development are also not part of this proposed action.

Certain G&G activities are necessary precursor steps needed to judge whether or not there is industry interest for oil and gas leasing in the AOI. The scope of this Programmatic EIS includes a NEPA analysis of specific types of G&G activity that can take place either before leasing or after. It includes the G&G activities needed for operators to make business decisions about acquiring leases and the G&G activities that can take place on a lease once it has been acquired by an operator.

This Programmatic EIS has been reviewed by NMFS to ensure it adequately addresses impacts to marine resources under their jurisdiction. This Programmatic EIS assesses impacts to species of marine mammals listed as threatened or endangered under the ESA. In a separate process, a Biological Assessment (BA) (to be provided under separate cover; see **Appendix A**) will be used by BOEM in initiating and conducting informal or formal consultation with NMFS Office of Protected Resources (OPR) and/or U.S. Fish and Wildlife Service (FWS) under Section 7(a)(2) of the ESA. Following review of the BA, if NMFS and FWS determine listed species are likely to be adversely affected, they will issue a Biological Opinion (BO) that will include any recommendations or modifications to the proposed action, terms and conditions, and protective measures. The Programmatic EIS also provides an EFH assessment under the Magnuson-Stevens FCMA.

As part of the broad review of impacts, this Programmatic EIS provides incidental take estimates for species protected under the MMPA. Future site-specific actions proposed by operators will follow the MMPA procedures for issuance of an ITA with project-specific mitigation measures, including publication of a proposed ITA notice in the *Federal Register*, solicitation of comments on that notice, and publication of a notice of issuance in the *Federal Register*. Mitigation measures specified in an ITA may differ from those contained in this Programmatic EIS.

1.3. Objectives and Scope

1.3.1. Objectives

The objectives of this Programmatic EIS are to

- characterize potential future G&G activities in Federal and State waters on the Atlantic OCS (over the period from 2012-2020);
- describe the proposed action;
- identify and analyze direct, indirect, and cumulative impacts that could result from the proposed action; and
- evaluate mitigation measures that are practical and feasible to ensure impacts to the human and natural environments are minimized.

1.3.2. Area of Interest

The Area of Interest (AOI) includes the Mid- and South Atlantic OCS Planning Areas, as well as adjacent State waters (outside of estuaries) and waters beyond the Exclusive Economic Zone (EEZ) extending to 350 nautical miles (nmi) (648 kilometers [km]) from shore (**Figure 1-1**). For purposes of supporting the impact analysis, resources that migrate through the AOI and resources in adjacent areas, if they may be affected by the proposed action, are included.

The United Nations Convention on the Law of the Sea (UNCLOS) confers on every coastal nation the automatic right to a continental shelf out to 200 nmi (370 km). The U.S., like most countries, established its EEZ (declared in Proclamation No. 5030; *Federal Register*, 1983) to the 200-nmi limit. Article 76 of UNCLOS has provisions allowing a nation to claim authority over an area of the continental shelf beyond 200 nmi, referred to as the Extended Continental Shelf (ECS), if certain criteria are met. The U.S. Extended Continental Shelf Task Force is currently collecting data at areas around the U.S. to define the limits of its ECS (U.S. Extended Continental Shelf Task Force, 2010). The ECS is an important area, as coastal nations may exercise sovereign rights over the natural resources of their continental shelf, including the seabed and subsurface. These rights include control over minerals, petroleum, and sedentary organisms such as clams, crabs, and corals.

For purpose of this Programmatic EIS, the seaward limit of the AOI shall be defined as a line 350 nmi (648 km) from shore. Article 76 of UNCLOS provides two constraint lines for defining the limit of the ECS: the seaward limit of Federal jurisdiction may be set at the farthest of 200 nmi seaward of the baseline from which the breadth of the territorial sea is measured or, if the continental shelf can be shown to exceed 200 nmi, a distance not greater than a line 100 nmi from the 2,500-meter (m) isobaths, or a line 350 nmi from the baseline. There are six areas where the U.S. and possessions likely have ECSs, the Atlantic margin being one of them (U.S. Extended Continental Shelf Task Force, 2010).

To ensure all potentially affected resources are addressed, the landward limit of the AOI has been established at the mean high water (MHW) line. The AOI boundary follows the shoreline along most of the coast but extends across the mouths of estuaries and bays as necessary. While State waters are not within the jurisdiction of BOEM, the AOI encompasses adjacent State waters for three reasons: (1) the energy introduced into the environment during G&G surveys could affect resources in State waters; (2) NMFS, which has jurisdiction and permitting authority in State waters, requires an assessment of potential impacts to resources under its jurisdiction; and (3) G&G activities under all three program areas could include surveys in State waters. The U.S. Army Corps of Engineers (COE) has jurisdiction over such activities in State and Federal waters under Section 10 of the Rivers and Harbors Act (RHA) and Section 404 of the Clean Water Act (CWA). The COE has established a Nationwide Permit (NWP) (NWP 6 Survey Activities) to regulate G&G activities in State waters. Depending on location, State-issued permits may be required (see **Chapter 1.6.16**).

1.3.3. Types of G&G Activities Analyzed

A variety of G&G techniques are used to characterize the shallow and deep structure of the shelf, slope, and deepwater ocean environments. Geological and geophysical surveys are conducted to (1) obtain data for hydrocarbon exploration and production; (2) aid in siting renewable energy structures; (3) locate potential sand and gravel resources; (4) identify possible seafloor or shallow depth geologic hazards; and (5) locate potential archaeological resources and potential hard bottom habitats for avoidance.

Detailed descriptions of G&G techniques are provided in **Chapter 3**. The selection of a specific technique or suite of techniques is driven by data needs and the target of interest. The activities include the following:

- various types of deep penetration seismic surveys used almost exclusively for oil and gas exploration and development;
- other types of surveys and sampling activities used only in support of oil and gas exploration and development, including electromagnetic surveys, deep stratigraphic and shallow test drilling, and various remote sensing methods;
- high-resolution geophysical (HRG) surveys used in all three program areas to detect geohazards, archaeological resources, and certain types of benthic communities; and
- geological and geotechnical bottom sampling used in all three program areas to assess the suitability of seafloor sediments for supporting structures (e.g., platforms, pipelines, cables, wind turbines) or to evaluate the quantity and quality of sand for beach nourishment projects.

Deep penetration seismic surveys, in which a survey vessel tows an array of airguns that emit acoustic energy pulses into the seafloor over long durations and over large areas, are the most extensive G&G activities that would be conducted and are the most important activities analyzed in this Programmatic

EIS. These surveys would occur almost exclusively in support of oil and gas exploration and development and would be conducted mainly within the Mid- and South Atlantic Planning Areas (**Figure 1-1**). The two planning areas collectively account for 79 percent of the AOI. Geological and geophysical activities in support of renewable energy development would consist mainly of HRG and geotechnical surveys in both Federal and State waters less than 100 m (328 feet [ft]) deep (USDOI, MMS, 2007a); this area represents about 15 percent of the AOI. Geological and geophysical activities in support of marine mineral uses (e.g., sand and gravel mining) would consist mainly of HRG and geotechnical surveys in both Federal and State waters less than 30 m (98 ft) deep; this area represents about 9 percent of the AOI. Geological and geophysical activities beyond the outer boundary of the two planning areas have not been determined but could include geophysical surveys in support of the U.S. Extended Continental Shelf Project.

1.4. Purpose of and Need for the Proposed Action

1.4.1. Background

The Secretary oversees the OCS oil and gas, renewable energy, and marine minerals (e.g., sand and gravel) programs and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources.

This NEPA evaluation was directed under the Conference Report accompanying the Fiscal Year 2010 USDOI, Environment, and Related Agencies Appropriations Act, with the intention that it encompass all environmental compliance procedures needed to authorize G&G activities within the Mid- and South Atlantic Planning Areas. Within the USDOI, the BOEM has been delegated responsibility for management of Federal resources on the OCS. There are three program areas within which G&G activities would be carried out: oil and gas (conventional resources); renewable energy resources; and marine minerals resources. Because potential resources in these program areas in the OCS Mid- and South Atlantic Planning Areas are currently not well known, the USDOI will move forward with an environmental analysis for potential G&G surveys and activities to support orderly development in these areas.

Oil and Gas: Federal jurisdiction over submerged lands seaward of State boundaries was established by the OSCLA of 1953, as amended (43 U.S.C. 1331 et seq. [2008]). The USDOI is required to manage the leasing, exploration, development, and production of oil and gas and marine minerals resources on the Federal OCS. Certain G&G surveys are required before operators determine to lease Federal land, and after leasing for operators to determine sea bottom conditions; the physical extent or economic valuation of oil, gas, or minerals on their lease; efficient production from their leases; or completion of decommissioning activities.

Orderly development of the Mid- and South Atlantic would help reduce the Nation's need for oil imports and lessen a growing dependence on foreign oil. The U.S. Congress placed a no-lease moratorium on the Mid-Atlantic Planning Area in 1990 followed by one placed on the South Atlantic Planning Area in 1991. All Atlantic planning areas have been subject to yearly moratoria extensions that have been included in the annual Interior and Environment and Related Agencies Appropriations bill. On September 30, 2008, Congress let expire the USDOI appropriations measure that had annually extended the Atlantic moratoria. On July 14, 2008, President Bush opened all OCS planning areas for leasing and lifted an EO issued by President Clinton in June 1998 that had continued restrictions on leasing in Atlantic Planning Areas.

Oil serves as the feedstock for liquid hydrocarbon products, among them transportation fuels and various petrochemicals. Natural gas is generally considered an environmentally preferable alternative to oil to generate electricity or for residential and industrial heating, and is an important feedstock for manufacturing fertilizers, pharmaceuticals, plastics, and packaging.

In 2009, the U.S. consumed 18.8 million barrels (bbl) of oil per day; net import (imports minus exports) of petroleum into the U.S. was 9.0 million bbl per day (U.S. Department of Energy [USDOE], 2011a). Of that total, 49 percent was produced domestically and 51 percent originated from foreign sources (USDOE, 2011a). In 2009, the U.S. also consumed approximately 22.8 trillion cubic feet (Tcf) of natural gas from all sources (USDOE, 2011b). Almost 12 percent of U.S. natural gas resources were imported in 2009, mostly from Canada (USDOE, 2011c).

Renewable Energy: Federal jurisdiction for renewable energy facilities on the OCS was established by the EPAct of 2005 (P.L. 109-58). The USDOI is required to manage the leasing, site assessment, installation, and production of renewable energy on the Federal OCS. Certain G&G surveys are required before operators determine to lease Federal lands, and after leasing for operators to characterize sea bottom conditions before installing a renewable energy facility or to verify completion of decommissioning activities. A Final Programmatic EIS for the OCS renewable energy program was released in 2007 (USDOI, MMS, 2007a), and a record of decision was published in 2008 (*Federal Register*, 2008a).

In 2009, the U.S. used 97,946 megawatt-hours (MWh) of electrical energy, 10,407 MWh of which were generated by non-hydroelectric renewable energy in the states along the seaboard of the Mid- and South Atlantic Planning Areas (USDOE, 2011d). In 2011, the USDOI considered two to four wind facility projects in the Mid- and South Atlantic Planning Areas for renewable electrical energy on the OCS. In 2010, the USDOE initiated a formal Offshore Wind Innovation and Demonstration (OSWinD) initiative to promote and accelerate responsible commercial offshore wind development in the U.S. (USDOE, 2010). The OSWinD supports the development of a world-class offshore wind industry in the U.S. able to achieve 54 gigawatts (GW) of offshore wind deployment at a cost of 7-9 cents per kilowatt-hour (kWh) by the year 2030, with an interim target of 10 GW at 13 cents/kWh by 2020 (USDOE, 2010).

Marine Minerals: Federal jurisdiction over submerged lands seaward of State boundaries was established by the OCSLA of 1953 and included non-energy mineral resources. Since 1995, the U.S. has conveyed over 19 million cubic yards (yd^3) (14,526,540 cubic meters [m^3]) of OCS sand and gravel for authorized projects in several states along the seaboard of the Mid- and South Atlantic Planning Areas: Delaware, Maryland, Virginia, South Carolina, and northern Florida. Sand has been identified offshore of Delaware, North Carolina, and Georgia, with proposals for conveyance in Delaware and North Carolina (USDOI, BOEM, 2011a). The Secretary completed cooperative agreements with six of these states (Delaware, Maryland, Virginia, North Carolina, South Carolina, and Florida) for development of OCS sand and gravel resources, although only the agreement with Florida remains current.

1.4.2. Purpose and Need

The purpose of the proposed action is to gather state-of-the-practice data about the ocean bottom and subsurface. These data, collected through G&G surveys, would provide information about the location and extent of oil and gas reserves, bottom conditions for oil and gas or renewable energy installations, and marine minerals off the Atlantic coast of the U.S. State-of-the-practice G&G data and information are required for business decisions in furtherance of prospecting for OCS oil and gas in an orderly manner, assessing sites for renewable energy facilities, or using marine mineral resources in the Mid- and South Atlantic Planning Areas (**Figure 1-1**). The G&G surveys acquired during the period when Atlantic oil and gas leasing took place in the 1970's and 1980's have been eclipsed by newer instrumentation and technology that make seismic data of that era inadequate for business decisions to lease and develop these OCS lands or to evaluate the environmental impacts of potential leasing and development.

The need for the proposed action is to use the information obtained by the G&G surveys to make informed business decisions regarding oil and gas reserves, engineering decisions regarding the construction of renewable energy projects, and informed estimates regarding the composition and volume of marine mineral resources. This information would also be used to ensure the proper use and conservation of OCS energy resources and the receipt of fair market value for the leasing of public lands. The development of the Programmatic EIS enables Government agencies to fulfill statutory responsibilities that include conducting an environmental impact analysis, meeting listed species consultation requirements, and incorporating measures to protect benthic and archaeological resources. This Draft Programmatic EIS will be used by BOEM and NMFS in support of ongoing EFH and ESA Section 7 consultations; incidental take authorizations under the MMPA will be made on the basis of future specific proposed survey applications.

1.5. COOPERATING AGENCIES

The BOEM is the proponent in providing guidelines for implementing an oil and gas exploration and development program on the Atlantic OCS and the lead agency for the preparation of this Draft

Programmatic EIS. Per CEQ regulations (40 CFR 1508.5), a cooperating agency may be any Federal agency that has jurisdiction by law or special expertise with respect to environmental impacts expected from a proposal. An agency's jurisdiction by law (40 CFR 1508.15) refers to an agency's authority to approve, veto, or finance all or part of a proposal. An agency's special expertise (40 CFR 1508.26) refers to its statutory responsibility, agency mission, or program experience. The responsibilities of a cooperating agency (40 CFR 1501.6b) include early participation in the NEPA process; participation in the scoping process; developing information and preparing portions of the Programmatic EIS for which the cooperating agency has special expertise, at the request of the lead agency; and providing staff support to enhance the lead agency's interdisciplinary capability. The lead and cooperating agencies will execute a Memorandum of Agreement (MOA) based on the summary of ground rules provided by BOEM. The MOA will delineate the roles and responsibilities of each agency in accordance with CEQ's January 30, 2002, Memorandum for the Heads of Federal Agencies: Cooperating Agencies in Implementing the Procedural Requirements of the National Environmental Policy Act.

It has been this Agency's practice to invite interest in cooperating agency relationships in the Notice of Intent to prepare an EIS that is published in the *Federal Register*. The NMFS requested to be a cooperating agency for the development of the Programmatic EIS on April 25, 2011. An MOA was executed between the two agencies on January 3, 2012. The nature and scope of the proposed action involving the use of acoustic sources and the potential impacts to marine resources under the jurisdiction of NMFS, particularly marine mammals and sensitive marine species, including those listed or proposed for listing as threatened or endangered under the ESA, led to NMFS's decision to participate as a cooperating agency. Therefore, in addition to the regulations and requirements discussed elsewhere in this document, this Draft Programmatic EIS has been reviewed in accordance with NMFS environmental review procedures for implementing NEPA (U.S. Department of Commerce [USDOC], NOAA, 1999). The FWS and the COE were contacted to gauge their interest in becoming cooperating agencies, but neither agency expressed an interest in doing so.

1.6. REGULATORY FRAMEWORK

Federal laws mandate the OCS leasing program (i.e., OCSLA) and the environmental review process (i.e., NEPA). The OCSLA establishes guidelines for exploration of minerals (which, as defined by the OCSLA, is the process of searching for minerals, including geophysical surveys where magnetic, gravity, seismic, or other systems are used to detect or imply the presence of such minerals) on the OCS. Section 388 of the EPAct of 2005, P.L. 109-58, expanded the USDOI's authority to issue leases, easements, and rights-of-way on the OCS for activities that produce energy from sources other than oil and gas, i.e., alternative energy projects. All of these actions are subject to the environmental review process under NEPA.

Several Federal regulations establish specific consultation and coordination processes with Federal, State, and local agencies (i.e., CZMA, ESA, Magnuson-Stevens FCMA, and MMPA). In addition, the OCS leasing process and all activities and operations on the OCS must comply with other Federal, State, and local laws and regulations. **Table 1-1** (from Matthews and Cameron, 2010) lists the major Federal laws and regulations and EOs that apply to the three program areas: (1) oil and gas; (2) renewable energy; and (3) marine minerals. The following are summaries of selected applicable Federal laws and regulations.

1.6.1. Rule Changes for Reorganization of Title 30: Bureaus of Safety and Environmental Enforcement and Ocean Energy Management

All regulatory citations in this Programmatic EIS are concordant with the regulation changes made following the effectiveness date of October 1, 2011, for the reorganization of BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) (*Federal Register*, 2011a).

On May 19, 2010, USDOI Secretary Salazar announced in Secretarial Order 3299 (USDOI, 2010a) that this Agency would reorganized into two new bureaus within the USDOI, each reporting to the Assistant Secretary Land and Minerals Management. These bureaus were to be known as the BSEE and the BOEM. The mission of these new agencies was announced by the Secretary (USDOI, 2010a). The BOEM is to administer leasing and plans, environmental studies, NEPA analysis, resource evaluation, economic analysis, and the renewable energy and marine mineral programs. The mission of the BSEE is to administer all field operations including permitting and research, inspections, research, offshore regulatory programs, oil spill response, and newly formed training and environmental compliance functions (*Federal Register*, 2011a).

After the new organizations were announced as the Secretary's intention, on June 18, 2010 (USDOI, 2010b) the Secretary issued Secretarial Order 3302 that, for the interim, announced the name change of the former MMS to Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). In the period between the Secretary's announcement (USDOI, 2010b) and the beginning of fiscal year 2012 (October 1, 2011) the BOEMRE planned for the reorganization and the separation of responsibilities under Title 30, Minerals Resources that had pertained to the former MMS. Regulations that are to be administered by BSEE remain in Title 30 CFR Chapter II under this Agency name, and regulations that are to be administered by BOEM have been grouped into a new Title 30 CFR Chapter V under this Agency name. An announcement (*Federal Register*, 2011a) promulgated a new rule that mapped the Title 30 regulations that will be under the authority of the two newly formed bureaus among those now existing. The rule pertained solely to the organization and codification of existing rules and related technical changes necessitated by a division of one agency into two separate agencies and made no changes to the substantive legal rights, obligations, or interests of affected parties and therefore had no public comment period. A future proposed rulemaking is planned for joint issue by BOEM and BSEE to address regulatory anomalies created by splitting the functions of one agency into two that will have a public comment period before finalization.

1.6.2. Outer Continental Shelf Lands Act

The OSCLA of 1953 (43 U.S.C. 1331 *et seq*.), as amended, established Federal jurisdiction over submerged lands on the OCS seaward of State boundaries (which were defined in the Submerged Lands Act of 1953). The Act, as amended, provides guidelines for implementing an OCS oil and gas exploration and development program. The basic goals of the Act include the following:

1. Establish policies and procedures for managing the oil and natural gas resources of the OCS that are intended to result in expedited exploration and development of the OCS in order to achieve national economic and energy policy goals, assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade;
2. Preserve, protect, and develop oil and natural gas resources of the OCS in a manner that is consistent with the need (a) to make such resources available to meet the Nation's energy needs as rapidly as possible; (b) to balance orderly resource development with protection of the human, marine, and coastal environments; (c) to ensure the public a fair and equitable return on the resources of the OCS; and (d) to preserve and maintain free enterprise competition;
3. Encourage development of new and improved technology for energy resource production, which will eliminate or minimize risk of damage to the human, marine, and coastal environments; and
4. Ensure that affected States and local governments have timely access to information regarding OCS activities and opportunities to review, comment, and participate in policy and planning decisions.

The Secretary is responsible under the OCSLA for the administration of mineral exploration and development of the OCS. Within the USDOI, BOEM is charged with the responsibility of managing and regulating the development of OCS oil and gas resources in accordance with the provisions of the OCSLA. The BOEM operating regulations are under 30 CFR 550 for oil and gas and 30 CFR 585 for renewable energy. Regulations shared between BOEM and BSEE are under 30 CFR 251 and 30 CFR 254.

The EPAct of 2005 amended Section 8 of the OCSLA to authorize the USDOI to grant leases, easements, or rights-of-way on the OCS for the development and support of energy resources from sources other than oil and gas and to allow for alternate uses of existing facilities on the OCS.

Section 20 of the OCSLA states the Secretary shall ". . . conduct such additional studies to establish environmental information as he deems necessary and shall monitor the human, marine, and coastal environments of such area or region in a manner designed to provide time-series and data trend information which can be used for comparison with any previously collected data for the purpose of identifying any significant changes in the quality and productivity of such environments, for establishing trends in the area studied and monitored, and for designing experiments to identify the causes of such changes." The BOEM's Regional Assessment Section is responsible for conducting analyses, such as this Draft Programmatic EIS, to assess the environmental impacts of OCS Program activities, involve all stakeholders in the process, and inform the public.

1.6.3. National Environmental Policy Act

The NEPA, signed into law on January 1, 1970, was the first major environmental law in the U.S. and established this country's national environmental policies. Implementing NEPA policies occurs through what Congress called "the environmental impact assessment process." The NEPA requires all Federal agencies to use a systematic, interdisciplinary approach to protection of the human environment and to ensure the integrated use of the natural and social sciences in any planning and decision-making that may have an impact upon the environment.

In 1979, the CEQ established uniform guidelines for implementing the procedural provisions of NEPA. These regulations (40 CFR 1500-1508) provide for the use of the NEPA process to identify and assess reasonable alternatives to a proposed action that avoid or mitigate adverse effects of a given action upon the quality of the human environment. The USDOI regulations to implement NEPA can be found in 43 CFR 46 (*Federal Register*, 2008b).

NEPA requires a detailed Environmental Impact Statement (EIS) be prepared for major Federal actions that may have a significant impact on the environment. The EIS shall fully discuss significant environmental impacts and inform decision-makers and the public of reasonable alternatives, and it must address any adverse environmental effects that cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term uses and long-term productivity of the environment, and any irreversible and irretrievable commitments of resources involved in the proposed action. The NEPA requirement for analysis of major Federal actions is the underlying driver for the production of this Programmatic EIS.

The Federal regulations discussed in the following sections establish specific consultation and coordination processes with Federal, State, and local agencies.

1.6.4. Executive Order 12114, Environmental Effects Abroad of Major Federal Actions

Issued on January 4, 1979, by President Jimmy Carter, EO 12114 directs Federal agencies to provide for informed decision-making for major Federal actions with effects that occur outside the 50 states, territories, and possessions of the U.S., including marine waters seaward of U.S. territorial seas, the global commons, the environment of a nonparticipating foreign nation, or effects to protected global resources. Global commons are defined as "geographical areas that are outside of the jurisdiction of any nation, and include the oceans outside territorial limits and Antarctica. Global commons do not include contiguous zones and fisheries zones of foreign nations" (32 CFR 187.3).

An Overseas Environmental Impact Statement (OEIS) is required when an action has the potential to significantly harm the environment of the global commons. The procedural requirements under EO 12114 largely mirror those of NEPA, except EO 12114 does not require scoping. For this action, the EIS and OEIS have been combined into one document, as permitted under NEPA and EO 12114, in order to reduce duplication. The majority of the AOI for this proposed action is within the EEZ, within the Mid- and South Atlantic Planning Areas as currently defined, or is within an area under consideration for a U.S. ECS. Therefore, the concept of an OEIS as applicable to the global commons is in spirit only.

1.6.5. Coastal Zone Management Act

The CZMA of 1972 (16 U.S.C. 1451 et seq.) was enacted to develop a national coastal management program that comprehensively manages and balances competing uses of and impacts to any coastal use or resource. The national coastal management program is implemented by individual State coastal management programs in partnership with the Federal Government. The CZMA Federal consistency regulations require that Federal activities (e.g., OCS lease sales) be consistent to the maximum extent practicable with the enforceable policies of a State's coastal management program. The Federal consistency regulations also require that other federally approved activities (e.g., activities requiring Federal permits, such as activities described in OCS plans) be consistent with a State's federally approved coastal management program. The CZMA is administered by the Office of Ocean and Coastal Resource Management within NOAA's National Oceanic Service (NOS). The NOS implementing regulations are found at 15 CFR 930, with the latest revision published in *Federal Register* (2006a).

The overall program objectives of CZMA are to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." The 34 coastal States each have programs to address the balance in competing land and water issues in the coastal zone. A State's jurisdictional purview typically extends 3 nmi (5.6 km) offshore of the coast and coastal islands (Texas and the Gulf coast of Florida are the exceptions). Federal actions within these areas are evaluated under NEPA and are subject to additional State regulations when Federal sovereign immunity has been waived by Congress. **Appendix B** provides information about coastal zone management agencies in states adjacent to the AOI.

1.6.6. Endangered Species Act

The ESA, enacted in 1973 (16 U.S.C. 1531), provides a program for the conservation of threatened and endangered plants and animals and the ecosystems on which they depend. The ESA was designed to protect and recover critically imperiled species as a "consequence of economic growth and development untempered by adequate concern and conservation" and is administered by FWS and NMFS. The NMFS handles marine species, while FWS has responsibility over freshwater fishes and all other species. Species occurring in both habitats (e.g., sea turtles and Atlantic sturgeon) are jointly managed. The ESA defines the "take" of a listed species as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting to do these things to that species. Federal agencies may be allowed a limited take of species through interagency consultations with NMFS or FWS and by issuance of an Incidental Take Statement (ITS).

Section 7(a)(1) of the ESA directs agencies to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Federal agencies must consult with NMFS and FWS, under Section 7(a)(2), on activities that may affect a listed species. These interagency, or Section 7, consultations are designed to assist Federal agencies in fulfilling their duty to ensure Federal actions do not jeopardize the continued existence of a species or destroy or adversely modify critical habitat.

Under Section 7, to initiate consultation, a Federal agency would submit a consultation package, usually referred to as a BA, to FWS and/or NMFS for proposed actions that may affect listed species or critical habitat. If a listed species or critical habitat is likely to be affected by a proposed Federal action, the Federal agency must provide FWS and NMFS with an evaluation regarding whether or not the effect on the listed species or critical habitat is likely to be adverse. After NMFS and FWS review the BA, they provide a determination regarding the nature of any effects on each listed species or critical habitat. For each species likely to be adversely affected (i.e., subject to take or adverse effect on critical habitat), formal consultation is required, ending with the agency issuing a BO containing the necessary and sufficient terms and conditions under which the action can proceed. Informal consultation is required for species not likely to be adversely affected and concludes with agency concurrence with the findings, including any additional measures mutually agreed upon as necessary and sufficient to minimize adverse impacts to listed species and/or designated critical habitat.

In the Draft BA, BOEM has made a determination regarding the effect of the proposed action on listed species and their habitats (to be provided under separate cover; see **Appendix A**). If, after reviewing the BA, NMFS and FWS determine that listed species are likely to be adversely affected, they will issue a BO that will include any recommendations or modifications to the proposed action, terms and conditions, and protective measures. The BO would include an ITS, if necessary. The BO may be included as an appendix in the Final Programmatic EIS.

1.6.7. Marine Mammal Protection Act

The MMPA was enacted on October 21, 1972, and protects all marine mammals (USDOC, NMFS, 2011a). The MMPA was passed by Congress based on the following findings and policies: some marine mammal species or stocks may be in danger of extinction or depletion as a result of human activities; these species or stocks must not be permitted to fall below their optimum sustainable population level (depleted); measures should be taken to replenish these species or stocks; there is inadequate knowledge of the ecology and population dynamics; and marine mammals have proven to be resources of great international significance.

The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. The term "take," as defined in the MMPA, means to harass, hunt, capture, or kill any marine mammal or to attempt such activity. The MMPA defines harassment as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) or disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

The MMPA provides a mechanism for allowing, upon request, the incidental (i.e., not intentional) taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographic region. In 1981, Congress amended the MMPA to provide for incidental take authorizations for maritime activities, provided NMFS found the takings would be of small numbers and have no more than a negligible impact on those marine mammal species not listed as depleted under the MMPA (i.e., not listed under the ESA) and not having an unmitigable adverse impact on subsistence harvests of these species. These "incidental take" authorizations, also known as Letters of Authorization (LOAs), require that regulations be promulgated and published in the *Federal Register* outlining (i) Permissible methods and the specified geographical region of taking; (ii) The means of effecting the least practicable adverse impact on the species or stock and its habitat and on the availability of the species or stock for subsistence uses; and, (iii) Requirements for monitoring and reporting, including requirements for the independent peer-review of proposed monitoring plans where the proposed activity may affect the availability of a species or stock for taking for subsistence uses. In 1986, Congress amended both the MMPA, under the incidental take program, and the ESA to authorize takings of depleted (and endangered or threatened) marine mammals, again provided the taking (lethal, injurious, or harassment) was small in number and had a negligible impact on marine mammals. In 1994, MMPA Section 101(a)(5) was amended to establish an expedited process by which citizens of the U.S. can apply for an authorization to incidentally take small numbers of marine mammals by harassment, referred to as Incidental Harassment Authorizations (IHAs). It established specific time limits for public notice and comment on any requests for authorization that would be granted under this new provision. Because the IHA process has eliminated the need for promulgating specific regulations on the incidental taking, IHAs have been of increasing interest since 1994 for those individuals with relatively short-term activities that might inadvertently harass marine mammals.

The NMFS and FWS believe an ITA under the MMPA is warranted in an area where marine mammal species are likely to occur because seismic survey sounds have the potential to harass marine mammals. The NMFS cannot issue an ITS unless appropriate MMPA incidental take is authorized. Because a BO, including an ITS, is issued under the ESA once the requirements of Section 101(a)(5) of the MMPA have been met, seismic surveys that could affect ESA-listed marine mammals shall not commence until such time that FWS and NMFS issue the appropriate MMPA ITA and coordinate its requirements with those in the ITS.

While this Programmatic EIS contains extensive information about the AOI relevant to an application for an ITA, including estimates of take, its review of G&G activities is programmatic in nature and therefore will not result in an application for an ITA under Section 101(a)(5) of the MMPA. Rather, this document shall serve as a reference for environmental documentation regarding future site-specific actions. Such future documentation will tier off this document in a similar fashion to that under NEPA.

1.6.8. Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens FCMA, P.L. 94-265, was enacted to address impacts to fisheries on the U.S. continental shelf. It established U.S. fishery management over fishes within the fishery conservation zone from the seaward boundary of the coastal States out to 200 nmi (370 km) (i.e., boundary of the U.S. EEZ). The Magnuson-Stevens FCMA also established regulations for foreign fishing within the fishery conservation zone and issued national standards for fishery conservation and management to be applied by eight regional fishery management councils. Each Council is responsible for developing Fishery Management Plans (FMPs) for domestic fisheries within its geographic jurisdiction. In 1996, Congress enacted amendments to the Magnuson-Stevens FCMA known as the Sustainable Fisheries Act (SFA) (P.L. 104-297) to address substantially reduced fish stocks resulting from direct and indirect habitat loss.

The SFA requires that the BOEM and other agencies consult with NMFS concerning actions that may adversely impact EFH. Essential Fish Habitat is defined as those waters and substrate necessary to fishes or invertebrates for spawning, breeding, feeding, or growth to maturity. Areas designated as EFH contain habitat essential to the long-term survival and health of U.S. fisheries. Essential Fish Habitat for managed fisheries is described in the FMPs.

Federal agencies that authorize, fund, or undertake actions that might adversely affect EFH must consult with the Secretary of Commerce, through NMFS, regarding potential effects to EFH. To streamline the process, NMFS combines EFH consultations with existing environmental reviews required by other laws such as NEPA, and as a result most consultations are completed within the time frames for review of other documents. The BOEM will request consultation under the Magnuson-Stevens FCMA in conjunction with this Draft Programmatic EIS. The Draft Programmatic EIS contains the information required for this document to serve as an EFH assessment; that information will be relevant and applicable to support future consultations on EFH for site-specific G&G actions.

1.6.9. Clean Air Act

The OCSLA (43 U.S.C. 1334[a][8]) requires the Secretary to promulgate and administer regulations that comply with the National Ambient Air Quality Standards (NAAQS) pursuant to the Clean Air Act (CAA) (42 U.S.C. 7401 *et seq.*) and to the extent that authorized activities significantly affect the air quality of any State. Under provisions of the Clean Air Act Amendments (CAAA) of 1990, the U.S. Environmental Protection Agency (USEPA) Administrator, in consultation with the Secretary and the Commandant of the U.S. Coast Guard (USCG), established requirements to control air pollution in OCS areas of the Arctic, Atlantic, Pacific, and parts of the Gulf of Mexico.

Outer Continental Shelf sources within 25 nmi (40.2 km) of the States' seaward boundaries are subject to the same Federal and State requirements as sources located onshore. Outer Continental Shelf sources beyond 25 nmi of the States' boundaries are subject to Federal requirements for Prevention of Significant Deterioration (PSD) promulgated pursuant to Part C of Title 1 of the CAAA. The CAAA also establish procedures to allow the USEPA Administrator to exempt any OCS source from a control technology requirement if it is technically infeasible or poses an unreasonable threat to health or safety.

The BOEM air quality regulations (30 CFR 250 Subpart C) assess and control OCS emissions that may impact air quality in onshore areas. The BOEM applies defined criteria to determine which OCS plans require an air quality review and performs an impact-based analysis on the selected plans to determine whether the emission source would potentially cause a significant onshore impact. If an emission source is determined to be significant and therefore requires air quality modeling, the USEPA-preferred model (the steady-state Gaussian, Offshore and Coastal Dispersion [OCD] model) should be used.

Because the review under this document is programmatic in nature and does not address project-specific information regarding air quality issues, it will not result in a permit application under the CAA. Future, site-specific proposals will be reviewed by BOEM to ensure CAA standards or permit requirements are met and that agreed-upon measures will avoid, minimize, or mitigate potential adverse effects.

1.6.10. Clean Water Act

The Clean Water Act (CWA) is a 1977 amendment to the Federal Water Pollution Control Act of 1972. The CWA establishes the basic structure for regulating discharges of pollutants to waters of the U.S. Under the CWA, it is unlawful for any person to discharge any pollutant from a point source into navigable waters without a National Pollutant Discharge Elimination System (NPDES) permit. All waste streams generated from offshore oil and gas activities are regulated by the USEPA, primarily by general permits. The USEPA may not issue a permit for a discharge into ocean waters unless the discharge complies with the guidelines established under Section 403(c) of the CWA. These guidelines are intended to prevent degradation of the marine environment and require an assessment of the effect of the proposed discharges on sensitive biological communities and aesthetic, recreational, and economic values.

Other sections of the CWA also apply to offshore activities. Section 404 of the CWA requires a COE permit for the discharge or deposition of dredged or fill material in all the waters of the U.S., including ocean areas and estuaries. Approval by the COE, with consultation from other Federal and State agencies, is also required for installing and maintaining pipelines in coastal areas. Section 303 of the CWA provides for the establishment of water quality standards that identify a designated use for waters (e.g., fishing/swimming). States have adopted water quality standards for ocean waters within their jurisdiction (waters of the territorial sea extending out to 3 nmi). Operators would be required to obtain an NPDES permit from USEPA for any effluent discharges (including drilling fluids and cuttings) from a Continental Offshore Stratigraphic Test (COST) well or shallow test well.

The COE's NWP Program (U.S. Department of the Army, COE, 2007) was developed to streamline the evaluation and approval process for certain types of activities that have only minimal impacts to the aquatic environment. Most G&G survey activities qualify for one of two NWPs. NWP 5 covers the placement of Scientific Measurement Devices such as staff gauges, tide gauges, water recording devices, water quality testing and improvement devices, and similar structures, applicable to certain G&G activities such as the temporary installation of meteorological buoys or other data collection devices. NWP 6 addresses survey activities such as core sampling, seismic exploratory operations, plugging of seismic shot holes and other exploratory-type bore holes, exploratory trenching, soil surveys, sampling, and historic resources surveys. Most G&G survey activities would require a NWP 6. Drilling and discharge of excavated material from test wells for oil and gas exploration are not authorized by NWP 6 and would require a Section 404/Section 10 Permit.

Because the review under this document is programmatic in nature and does not address project-specific information regarding water quality issues, it will not result in a permit application under the CWA. Future, site-specific proposals will be reviewed by BOEM to ensure CWA standards or permit requirements are met and that agreed-upon measures will avoid, minimize, or mitigate potential adverse effects.

1.6.11. National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, as amended, established a program for the preservation of historic properties. Section 106 of the NHPA (36 CFR 800), "Protection of Historic Properties," as amended through 2004, requires that Federal agencies having direct or indirect jurisdiction over a proposed Federal, federally assisted, or federally licensed undertaking, prior to approval of the expenditure of funds or the issuance of a license, to take into account the effect of the undertaking on any district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places. The Advisory Council on Historic Preservation (ACHP), which administers Section 106, has issued regulations (30 CFR 800) defining how Federal agencies are to meet the statutory responsibilities. The head of a Federal agency shall afford the ACHP a reasonable opportunity to review and comment on the action.

An action has an effect on a historic property when that action has the potential to alter the characteristics of the property that led to its inclusion in the National Register of Historic Places. The effects can include physical disturbance, noise, or visual effects. If an adverse effect on historic properties is found, BOEM would notify the ACHP, consult with the State Historic Preservation Office, and encourage the applicant to avoid, minimize, or mitigate the adverse effects. Ground-disturbing activities associated with construction, as well as visual effects of OCS energy infrastructure (e.g., wind turbine generators), are subject to Section 106 review.

Historic properties (i.e., archaeological resources) on the OCS include historic shipwrecks, sunken aircraft, lighthouses, and prehistoric archaeological sites that have become inundated as a result of the 120-m (394-ft) rise in global sea level since the height of the last Ice Age (ca. 19,000 years ago). The OCS is not federally owned land, and the Federal Government has not claimed direct ownership of historic properties on the OCS, therefore under Section 106 of the NHPA BOEM only has the authority to ensure that their funded and permitted actions do not adversely affect significant historic properties. Beyond avoidance of adverse impacts, BOEM does not have the legal authority to manage the historic properties on the OCS.

For the activities comprising the proposed action, BOEM will make a determination as to whether the actions could affect historic properties, either those in the National Register of Historic Places or that meet the criteria for listing. If it determines the action could affect such properties, BOEM will identify the appropriate State Historic Preservation Officer/Tribal Historic Preservation Officer (SHPO/THPO) to consult with during the process. Consultation is expected to result in an MOA, outlining agreed-upon measures that the Agency will take to avoid, minimize, or mitigate adverse effects.

1.6.12. Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703–712) is the primary legislation in the U.S. established to conserve migratory birds. It implements the U.S.'s commitment to four bilateral treaties, or conventions, for the protection of a shared migratory bird resource. The MBTA prohibits the taking, killing, or possessing of migratory birds unless permitted by regulation. The bird species protected by the MBTA appear in *Federal Register* (2010a). Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds" (January 10, 2001) required that Federal agencies taking actions likely to negatively affect migratory bird populations enter into Memoranda of Understanding (MOUs) with FWS.

On June 4, 2009, this Agency entered into an MOU with FWS to comply with the EO (USDOI, 2009). The overall purpose of the MOU is to strengthen collaboration between BOEM and BSEE and FWS. Included in the MOU is the direction to expand coverage in environmental reviews mandated by NEPA of the effects of agency actions on migratory birds, with emphasis on species of concern in furtherance of conservation of migratory bird populations.

Because the review under this document is programmatic in nature and does not address project-specific information regarding impacts to migratory birds, it will not result in a permit application under the CWA. Future, site-specific proposals will be reviewed by BOEM to ensure MBTA standards or permit requirements are addressed in the manner outlined in the MOU.

1.6.13. Executive Order 13547, Stewardship of the Ocean, Our Coasts, and the Great Lakes

Signed on July 19, 2010, by President Obama, EO 13547 established a national ocean policy and the National Ocean Council (*Federal Register*, 2010b). The Order establishes a national policy to ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhance the sustainability of ocean and coastal economies, preserve our maritime heritage, support sustainable uses and access, provide for adaptive management to enhance our understanding of and capacity to respond to climate change and ocean acidification, and coordinate with U.S. national security and foreign policy interests. Where BOEM actions affect the ocean, the Order requires BOEM to take such action as necessary to implement this policy, the stewardship principles, and national priority objectives adopted by the Order, and guidance from the National Ocean Council.

Implementation of the guidelines presented in EO 13547 is still in the planning stages at BOEM and will occur in a three-stage process that will culminate with a final Coastal and Marine Spatial Planning process.

1.6.14. Rivers and Harbors Act

The RHA, enacted in 1899, was the first Federal water pollution act in the U.S. It focuses on protecting navigation, protecting waters from pollution, and acted as a precursor to the CWA of 1972. Section 10 prohibits the unauthorized obstruction or alteration of any navigable water of the U.S., that is, construction of various structures that hinder navigable capacity of any waters, without the approval of Congress. While the initial purpose of the act was to prevent obstructions to navigation, a 1959 Supreme Court decision interpreted obstruction to navigation to include water pollution. The Court found that anything which tends to destroy the navigable capacity of a navigable waterway is prohibited by the act.

Section 10 is not applicable to most actions undertaken for exploration on the OCS, the exception being drilling and discharge of excavated material from test wells, as they fall under NWP 6 described in **Chapter 1.6.10**. Because the review under this document is programmatic in nature and does not address project-specific information regarding impacts to navigable waters, it will not result in a permit application under the RHA. Future, site-specific proposals will be reviewed by BOEM to ensure Section 10 permit requirements are met and that agreed-upon measures will avoid, minimize, or mitigate potential adverse effects.

1.6.15. National Marine Sanctuaries Act

The National Marine Sanctuaries Act (NMSA; 16 U.S.C. § 1431 et seq.) was enacted in 1972 and is the legislative mandate that governs NOAA's Office of National Marine Sanctuaries (ONMS) and the National Marine Sanctuary System. Under the NMSA, the Secretary of Commerce is authorized to designate and manage areas of the marine environment as national marine sanctuaries. Such designation is based on attributes of special national significance, including conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or aesthetic qualities. Day-to-day management of national marine sanctuaries has been delegated by the Secretary of Commerce to NOAA's ONMS.

The primary mandate of the NMSA is resource protection. The NMSA provides several tools for protecting designated national marine sanctuaries. The NMSA provides the authority to issue regulations for each sanctuary and the system as a whole. The ONMS regulations, codified at 15 CFR 922, prohibit specific kinds of activities, describe and define the boundaries of the national marine sanctuaries, and set up a system of permits to allow the conduct of certain types of activities. Permits are required for any action that includes activities otherwise prohibited by sanctuary regulations. For more information on ONMS permits, see http://sanctuaries.noaa.gov/management/permits/welcome.html.

Section 304(d) of the NMSA requires that Federal agencies consult with ONMS for any Federal action internal or external to a national marine sanctuary that is "likely to destroy, cause the loss of, or injure a sanctuary resource." The purpose of the consultation is to prevent or minimize potential injury to any sanctuary resource by requiring assessment of the proposed Federal action before the initiation of any such action and allowing ONMS the opportunity to recommend alternatives that would protect sanctuary resources. To streamline the sanctuary consultation process, ONMS may combine the process with environmental reviews required by other laws, such as NEPA. Relevant sections of this Programmatic EIS will support the consultation process between BOEM and ONMS.

Because the review under this document is programmatic in nature and does not address project-specific information regarding potential impacts to sanctuaries, it will not result in a permit application under the NMSA. Future, site-specific proposals will be reviewed by BOEM to ensure NMSA standards or permit requirements are met and that agreed-upon measures will avoid, minimize, or mitigate potential adverse effects.

1.6.16. State Permitting

In addition to the CZM Federal consistency process, some States require additional authorizations for G&G survey activities. Within all states, with the exception of Georgia, many G&G survey activities would not require additional State authorization. Within State waters of Georgia, all G&G activities will require a State Revocable License for Use of Waterbottoms. A State Revocable License is permission from the State to use publicly owned lands lying below the ordinary high water mark. This permission is required for any activities, whether permanent or temporary, that would impact tidally influenced waters, salt marshes, intertidal areas, mud flats or tidal waterbottoms in Effingham, Long, Wayne, Brantley, Chatham, Glynn, Camden, McIntosh, Bryan, Liberty, and Charlton Counties (http://coastalgadnr.org/msp/ap/lic). Application for a Revocable License in Georgia is to be submitted jointly with the appropriate COE permit application.

However, G&G survey activities that include bottom-disturbing activities (e.g., geotechnical surveys, bottom sampling) that occur within State waters will require State permits. The Commonwealth of

Virginia may require a Virginia Water Protection Permit from the Virginia Department of Environmental Quality under 9 Virginia Administrative Code (V.A.C.) 25-660. For North Carolina, a Geophysical Exploration Permit is required from the North Carolina Department of Environment and Natural Resources under General Statute (GS) 113-378 to 113-415. A Critical Area and Wetland Permit is needed from the South Carolina Department of Health and Environmental Control for these types of activities in the State waters of South Carolina. The State of Florida requires a Noticed General Permit (NGP) under Rule 62-341.475(1)(c), Florida Administrative Code (F.A.C.) from the Florida Department of Environmental Protection. For all other states within the AOI, no state permits other than the CZMA requirements would be required for G&G survey activities.

1.7. ENVIRONMENTAL REVIEW PROCESS

The NEPA and CEQ regulations provide procedural guidance for the environmental review process. The primary steps in this Programmatic EIS process are identified in **Figure 1-2**.

1.7.1. Scoping

Public participation is a primary tenet of the environmental review process. The first phase, scoping, is used to identify the scope and significance of important environmental issues related to the proposed action prior to the development of an impact statement. The process is also intended to identify and eliminate from further detailed study issues that are not significant or that have been covered by prior environmental review or that do not fulfill the purpose and need for the proposed action. The scoping process is public and involves all interests—Federal, State, local, and Tribal governments; commercial interests; environmental groups; and the general public.

The NEPA process began with the Notice of Intent (NOI) to prepare a Programmatic EIS, which was published in the *Federal Register* on January 21, 2009 (*Federal Register*, 2009a). The comment period on the NOI closed on March 23, 2009; the Agency did not move forward on the Programmatic EIS at that time. During the first scoping period the agency received 17 comments by email, mostly from industry or non-governmental interest groups. On April 2, 2010, a *Federal Register* notice was published announcing the reopening of the public comment period for the Programmatic EIS and listing the dates, times, and locations of public scoping meetings (*Federal Register*, 2010c). Public scoping meetings were held at the following seven locations on the dates indicated:

- Houston, Texas – April 20, 2010;
- Jacksonville, Florida – April 21, 2010;
- Savannah, Georgia – April 23, 2010;
- Charleston, South Carolina – April 27, 2010;
- Newark, New Jersey – April 27, 2010;
- Norfolk, Virginia – April 29, 2010; and
- Wilmington, North Carolina – April 29, 2010.

The purpose of the meetings was to solicit comments from stakeholders on the scope of the Programmatic EIS, identify issues to be analyzed, and identify possible alternatives and mitigation measures. In addition to accepting oral and written comments at each public meeting, BOEM accepted written comments by mail and through a dedicated email address. The public comment period closed on May 17, 2010.

BOEM received a total of 965 comments through email (75 %), formal letters (18 %), and public meeting testimony (7 %); the latter included both oral and written comments submitted at the public meetings. Comments were received from individuals and organizations in 49 states and two foreign countries (Canada and France). Most of the comments were received from private citizens. Other sources included Federal, State, and local government agencies, members of Congress, and other stakeholders. The "other stakeholders" category comprises representatives from environmental groups, industry groups and companies, engineering and consulting firms, and oil and gas companies. The scope and content of this Draft Programmatic EIS have been formulated to ensure that the issues and concerns expressed by stakeholders during the scoping process are fully addressed.

1.7.2. Draft Programmatic Environmental Impact Statement

The purpose of an EIS is to ensure the goals of NEPA are incorporated into the actions of the Federal Government. The EIS is a concise public document specifying environmental impacts from a proposed action for which a Federal agency is responsible while providing a full and objective discussion of potential significant environmental impacts.

This Draft Programmatic EIS has been prepared by BOEM as lead agency and NMFS as a cooperating agency in accordance with CEQ regulations implementing NEPA (40 CFR 1502.20) and NMFS procedures for implementing NEPA (USDOC, NOAA, 1999). This Draft Programmatic EIS evaluates a reasonable range of alternatives as discussed in **Chapter 2**, utilizing information received during the public and agency scoping process. Following issuance of the Draft Programmatic EIS, BOEM will, in accordance with 30 CFR 556.26, hold public hearings to solicit comments on the Draft Programmatic EIS. An announcement of the dates, times, and locations of the public hearings will be included in the Notice of Availability for this Draft Programmatic EIS. The hearings will provide BOEM with information from interested parties to help in the evaluation of alternatives.

1.7.3. Final Programmatic Environmental Impact Statement

When the public comment period ends, all comments will be reviewed and responses to each will be developed. The Final Programmatic EIS will then be prepared, incorporating any changes resulting from comments. All comments and corresponding responses will be included as an appendix to the Final Programmatic EIS. The Final Programmatic EIS will then be distributed to the public.

1.7.4. Record of Decision

The environmental review process ends following a 30-day “cooling off period” after release of the Final Programmatic EIS with issuance of a Record of Decision (ROD). The ROD will state the decision of the agency; identify the alternatives considered, including the environmentally preferable; identify and discuss the factors involved in the decision; and state whether all practical means to avoid or minimize environmental harm have been adopted, and if not, why not.

CHAPTER 2

ALTERNATIVES INCLUDING THE PROPOSED ACTION

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1. ALTERNATIVE A – THE PROPOSED ACTION

2.1.1. Description

The proposed action would authorize G&G activities in support of all BOEM program areas – oil and gas exploration and development, renewable energy, and marine minerals – throughout the entire AOI, from shore (excluding estuaries) to a distance of 648 km (350 nmi) from shore. As explained in **Chapter 1** of this Draft Programmatic EIS, the seaward limit is based on the maximum constraint line for the extended continental shelf under Article 76 of the UNCLOS (U.S. Extended Continental Shelf Task Force, 2010). Until such time as an ECS is established by the U.S., the region between 370 and 648 km (200 and 350 nmi) from shore is part of the global commons, and this Agency has decided to include it within the AOI.

A variety of G&G techniques are used to characterize the shallow and deep structure of the shelf, slope, and deepwater environments of the ocean. The selection of a specific technique or suite of techniques is driven by data needs and the target of interest. The G&G activities evaluated as part of this Draft Programmatic EIS are described in **Chapter 3**. The scenario for the G&G activity levels projected in **Chapter 3** extends to 2020. The year 2020 is a practical limit for making activity projections and does not imply that impacts on resources that have been evaluated are no longer valid beyond this date. The activities include the following:

- various types of deep penetration seismic airgun surveys used almost exclusively for oil and gas exploration;
- other types of surveys and sampling activities used only in support of oil and gas exploration, including electromagnetic surveys, deep stratigraphic and shallow test drilling, and various remote sensing methods;
- HRG surveys used in all three program areas to detect geohazards, archaeological resources, and certain types of benthic communities; and
- geological and geotechnical bottom sampling used in all three program areas to assess the suitability of seafloor sediments for supporting structures (e.g., platforms, pipelines, cables, wind turbines) or to evaluate the quantity and quality of sand for beach nourishment projects.

2.1.2. Mitigation Measures

All G&G activities authorized under the proposed action would be required to comply with existing laws and regulations. Compliance with existing laws and regulations – by BOEM as well as individual operators, when required – may result in additional measures or changes to the measures described here. Alternative A includes the following mitigation measures developed specifically for this Draft Programmatic EIS (**Table 2-1**):

- a time-area closure for North Atlantic right whales;
- a seismic airgun survey protocol;
- an HRG survey protocol (for renewable energy and marine minerals sites);
- guidance for vessel strike avoidance;
- guidance for marine debris awareness;
- avoidance and reporting of historic and prehistoric sites;
- avoidance of sensitive benthic communities;
- guidance for activities in or near National Marine Sanctuaries (NMSs); and
- guidance for military and National Aeronautics and Space Administration (NASA) coordination.

The mitigation measures included in Alternative A are described in the following subsections. **Appendix C** describes and discusses the rationale for mitigation measures, including ones that were considered but not selected, as well as measures and technologies identified for possible future use when proven effective and feasible. Also, during the MMPA authorization process for specific surveys, NMFS may require additional or different mitigation measures to avoid/minimize impacts on marine mammals.

Alternative A does not require any geographic separation of concurrent seismic surveys. However, in practice, operators typically maintain a separation of about 17.5 km (9.5 nmi) between concurrent surveys to avoid interference (i.e., overlapping reflections received from multiple source arrays).

2.1.2.1. Time-Area Closure for North Atlantic Right Whales

Alternative A includes a time-area closure intended to avoid most impacts from vessel strikes or ensonification of the water column on North Atlantic right whales. It is estimated that this closure would avoid about two-thirds of the incidental takes of North Atlantic right whales by active acoustic sound sources over the period of the Draft Programmatic EIS. Although right whales could occur anywhere within the AOI, they are most likely to be found in the calving/nursery areas offshore the southeastern U.S. coast during the winter months and near the South Atlantic and Mid-Atlantic coast during their seasonal migrations (see **Chapter 4.2.2**).

The locations and timing of the closures are shown in **Figure 2-1**. The total closure area under Alternative A would be 7,589,594 acres (ac) (30,714 square kilometers [km^2]), or approximately 4 percent of the AOI. No G&G surveys using airguns would be authorized within the right whale critical habitat area from November 15 through April 15 nor within the Mid-Atlantic and Southeast U.S. Seasonal Management Areas (SMAs) during the times when vessel speed restrictions are in effect under the Right Whale Ship Strike Reduction Rule (50 CFR 224.105). However, HRG surveys proposed in critical habitat area and SMAs may be considered on a case-by-case basis only if: (1) they are proposed for renewable energy or marine minerals operations; and (2) they use acoustic sources other than air guns. The coincidence is necessary because of other biological use windows or project monitoring requirements. Any such authorization may include additional mitigation and monitoring requirements to avoid or significantly reduce impacts on right whales. Other supporting surveys (e.g., biological surveys) would not be affected by this restriction.

The Southeast U.S. SMA, with seasonal restrictions in effect from November 15 to April 15, is a continuous area that extends from St. Augustine, Florida, to Brunswick, Georgia, extending 37 km (20 nmi) from shore (**Figure 2-2**). The Mid-Atlantic U.S. SMA, with seasonal restrictions from November 1 through April 30, is a combination of both continuous areas and half circles drawn with 37-km (20-nmi) radii around the entrances to certain bays and ports. Within the AOI, the Mid-Atlantic U.S. SMA includes a continuous zone extending between Wilmington, North Carolina, and Brunswick, Georgia, as well as the entrance to Delaware Bay (Ports of Wilmington [Delaware] and Philadelphia), the entrance to Chesapeake Bay (Ports of Hampton Roads and Baltimore), and the Ports of Morehead City and Beaufort, North Carolina (**Figure 2-2**).

Exceptions for proposed HRG surveying in the right whale time-area closure could occur if a survey was needed to serve important operational or monitoring requirements for a particular project. For example, monitoring surveys for renewable energy (e.g., scour, cable burial) might need to take place at fixed intervals to capture seasonal changes or safety-related conditions. Another example would be a marine minerals project in which dredging is not seasonally restricted and real-time bathymetry data must be collected to track dredging operations or pre- and post-bathymetric surveys must be collected immediately before or after dredging to establish sand volumes borrowed.

2.1.2.2. Seismic Airgun Survey Protocol

All authorizations for seismic airgun surveys (those involving airguns as an acoustic source) would include a survey protocol that specifies mitigation measures for protected species, including an exclusion zone, ramp-up requirements, visual monitoring by protected species observers, and array shutdown requirements. The protocol requirements apply specifically to airguns, not electromechanical sources such as side-scan sonars, boomer and chirp subbottom profilers, and single beam or multibeam depth sounders that may be operating concurrently during seismic surveys. A draft protocol is included in **Appendix C**, which defines terminology, specifies requirements for protected species observers, and specifies methods for ramp-up, visual monitoring, shutdown of air gun arrays, and reporting. The seismic airgun survey protocol includes the recommended but optional use of passive acoustic monitoring (PAM) to help detect vocalizing marine mammals. The draft protocol is based on Joint BOEM-BSEE Notice to Lessees and Operators (NTL) 2012-G02 ("Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program") (USDOI, BOEM and BSEE, 2012b).

Key elements of the seismic airgun survey protocol are as follows:

1. Visually monitor the exclusion zone and adjacent waters for the absence of marine mammals and sea turtles for at least 30 min before initiating ramp-up procedures. If none are detected, you may initiate ramp-up procedures. *Do not initiate* ramp-up procedures at night or when you cannot visually monitor the exclusion zone for marine mammals and sea turtles if your minimum source level drops below 160 decibels (dB) re 1 μPa-m (root-mean-square [rms]) (see measure 5).
2. Initiate ramp-up procedures by firing a single airgun. The preferred airgun to begin with should be the smallest airgun, in terms of energy output (dB) and volume (in^3).
3. Continue ramp-up by gradually activating additional airguns over a period of at least 20 min, but no longer than 40 min, until the desired operating level of the airgun array is obtained.
4. Immediately shutdown all airguns, ceasing seismic operations at any time a marine mammal or sea turtle is detected entering or within the exclusion zone. However, shutdown would not be required for dolphins approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment. After a shutdown, you may recommence seismic operations and ramp-up of airguns only when the exclusion zone has been visually inspected for at least 30 min to ensure the absence of marine mammals and sea turtles.
5. You may reduce the source level of the airgun array, using the same shot interval as the seismic survey, to maintain a minimum source level of 160 dB re 1 μPa-m (rms) for the duration of certain activities. By maintaining the minimum source level, you will not be required to conduct the 30-min visual clearance of the exclusion zone before ramping back up to full output. Activities that are appropriate for maintaining the minimum source level are (1) all turns between transect lines, when a survey using the full array is being conducted immediately prior to the turn and will be resumed immediately after the turn; and (2) unscheduled, unavoidable maintenance of the airgun array that requires the interruption of a survey to shut down the array. The survey should be resumed immediately after the repairs are completed. There may be other occasions when this practice is appropriate, but use of the minimum source level to avoid the 30-min visual clearance of the exclusion zone is only for events that occur during a survey using the full power array. The minimum sound source level is not to be used to allow a later ramp-up after dark or in conditions when ramp-up would not otherwise be allowed.

The purpose of the seismic airgun survey protocol is to prevent injury (Level A harassment) of marine mammals to the maximum extent practicable. The radius of the exclusion zone would be based on the predicted range at which animals could be exposed to a received sound pressure level of 180 dB re 1 μPa, which is the current NMFS criterion for Level A harassment of cetaceans by pulsed sources. The radius of the exclusion zone would be calculated on a survey-specific basis but would not be less than 500 m (1,640 ft). Based on calculations in **Appendix D**, the 180-dB zone for a large airgun array (5,400 in^3) ranges from 799 to 2,109 m (2,622 to 6,920 ft), with a mean of 1,086 m (3,563 ft). For oil and gas HRG surveys using a small airgun array (90 in^3), the calculated 180-dB zone ranges from 76 to 186 m (249 to 610 ft), with a mean of 128 m (420 ft).

Although NMFS also uses a criterion of 190 dB re 1 μPa for Level A harassment of pinnipeds by pulsed sources, it is unlikely that a smaller exclusion zone based on the 190-dB criterion would be appropriate for any seismic airgun survey there, based on the rare occurrence of pinnipeds in the AOI.

Although there are no noise exposure criteria for sea turtles, the protocol is expected to similarly reduce the risk of injury in sea turtles. With these measures in place, no mortalities or injuries of marine mammals or sea turtles are expected. The operational mitigation measures included in the seismic airgun survey protocol would reduce the extent of, but not prevent, behavioral responses including Level B harassment of marine mammals. Other measures such as the time-area closure for North Atlantic right whales (described previously) would help to reduce the risk of those impacts.

2.1.2.3. HRG Survey Protocol (Renewable Energy and Marine Minerals Sites)

High-resolution geophysical surveys for oil and gas exploration and development use airgun sources and would be subject to the seismic airgun survey protocol discussed previously. The BOEM does not anticipate that airguns would be used for HRG surveys of renewable energy sites or marine minerals sites. These surveys are expected to use only electromechanical sources such as side-scan sonars, boomer and chirp subbottom profilers, and single beam or multibeam depth sounders. All authorizations for non-airgun HRG surveys would include requirements for visual monitoring of an exclusion zone by protected species observers and startup and shutdown requirements. Protocol requirements are as follows:

1. All HRG surveys must comply with requirements for vessel strike avoidance as detailed in separate guidance in **Chapter 2.1.2.4**. The recommended separation distance for North Atlantic right whales of 457 m (1,500 ft) would remain in effect during HRG surveys since it exceeds the exclusion zone radius specified below. Recommended separation distances for other whales and small cetaceans are less than, and would be superseded by, the exclusion zone radius. The exclusion zone must be initially clear of sea turtles as indicated below, but thereafter the vessel strike separation distance of 45 m (150 ft) for sea turtles would be maintained.
2. One protected species observer would be required on watch aboard HRG survey vessels at all times during daylight hours (dawn to dusk – i.e., from about 30 min before sunrise to 30 min after sunset) when survey operations are being conducted, unless conditions (fog, rain, darkness) make sea surface observations impossible. If conditions deteriorate during daylight hours such that the sea surface observations are halted, visual observations must resume as soon as conditions permit. Ongoing activities may continue but may not be initiated under such conditions (i.e., without appropriate pre-activity monitoring). Operators may engage trained third party observers, utilize crew members after training as observers, or use a combination of both third party and crew observers.
3. The following additional requirements apply only to HRG surveys in which one or more active acoustic sound sources will be operating at frequencies less than 200 kilohertz (kHz).
   a. A 200-m (656-ft) radius exclusion zone will be monitored around the survey vessel. If the exclusion zone does not encompass the 160-dB Level B harassment radius calculated for the acoustic source having the highest source level, BOEM will consult with NMFS about additional requirements. On a case-by-case basis, BOEM may authorize surveys having an exclusion zone larger than 200 m (656 ft) to encompass the 160-dB radius if the applicant demonstrates that it can be effectively monitored.

   b. Acoustic sources must not be activated until the protected species observer has reported the exclusion zone clear of all marine mammals and sea turtles for 30 min.

   c. Except as noted in (d) below, if any marine mammal is sighted within or transiting towards the exclusion zone, an immediate shutdown of the equipment will be required. Subsequent restart of the equipment may only occur following clearance of the exclusion zone for 30 min.

   d. Shutdown would not be required for dolphins approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment. If a dolphin voluntarily moves into the exclusion zone after the active acoustic sound sources are operating, it is reasoned that the sound pressure level is not negatively affecting that particular animal.

The BOEM expects that a 200-m (656-ft) radius exclusion zone can be effectively monitored from the types of coastal survey vessels expected to be used for HRG surveys of renewable energy and marine minerals sites. Unlike the large, dedicated vessels used for oil and gas seismic surveys, coastal survey vessels may not have a bridge or elevated viewing platform, and their capability for effectively monitoring a radius larger than a few hundred meters would depend on vessel size and configuration. An exclusion zone radius of 200 m (656 ft) would encompass the 180-dB Level A harassment radius calculated for all of the representative electromechanical sources included in this Draft Programmatic EIS as explained in **Appendix C**. Depending on the source levels of the equipment used on particular surveys, this radius may also encompass the 160 dB Level B harassment zone. The BOEM anticipates that if an operator can effectively monitor the 160-dB zone to prevent both Level A and B harassment of marine mammals, then it would be reasonable to assume that an ITA under the MMPA may not be necessary for that particular survey. Therefore, the protocol would allow an operator to monitor a radius larger than 200 m (656 ft) if the operator demonstrates that it can be effectively monitored.

As part of the time-area closure defined above for the North Atlantic right whale, HRG surveys of renewable energy and marine minerals sites in the SMAs for the North Atlantic right whale would be reviewed on a case-by-case basis, and authorizations may include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales.

2.1.2.4. Guidance for Vessel Strike Avoidance

All authorizations for shipboard surveys would include guidance for vessel strike avoidance. The guidance would be similar to Joint BOEM-BSEE NTL 2012-G01 ("Vessel Strike Avoidance and Injured/Dead Protected Species Reporting") (USDOI, BOEM and BSEE, 2012a), which incorporates NMFS "Vessel Strike Avoidance Measures and Reporting for Mariners" addressing protected species identification, vessel strike avoidance, and injured/dead protected species reporting. Key elements of the guidance are as follows:

1. Vessel operators and crews must maintain a vigilant watch for marine mammals and sea turtles and slow down or stop their vessel to avoid striking protected species.
2. When whales are sighted, maintain a distance of 91 m (300 ft) or greater from the whale. If the whale is believed to be a North Atlantic right whale, the vessel must maintain a minimum distance of 457 m (1,500 ft) from the animal (50 CFR 224.103).
3. When sea turtles or small cetaceans are sighted, the vessel must maintain a distance of 45 m (150 ft) or greater whenever possible.
4. When cetaceans are sighted while a vessel is underway, the vessel must remain parallel to the animal's course whenever possible. The vessel must avoid excessive speed or abrupt changes in direction until the cetacean has left the area.
5. Reduce vessel speed to 10 knots (kn) (18.5 km/h) or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity of the vessel; therefore, precautionary measures should always be exercised.
6. Whales may surface in unpredictable locations or approach slowly moving vessels. When animals are sighted in the vessel's path or in close proximity to a moving vessel, the vessel must reduce speed and shift the engine to neutral. The engines must not be engaged until the animals are clear of the area.
7. Vessel crews would be required to report sightings of any injured or dead marine mammals or sea turtles to BOEM and NMFS within 24 hr, regardless of whether the injury or death was caused by their vessel.

In addition, vessel operators would be required to comply with NMFS marine mammal and sea turtle viewing guidelines for the Northeast Region (USDOC, NMFS [2011b] for surveys offshore Delaware, Maryland, or Virginia) or the Southeast Region (USDOC, NMFS [2011c] for surveys offshore North Carolina, South Carolina, Georgia, or Florida) or combined guidance if recommended by NMFS. These measures are meant to reduce the potential for vessel harassment or collision with marine mammals or sea turtles regardless of what activity a vessel is engaged in.

The guidance will also incorporate NMFS Compliance Guide for the Right Whale Ship Strike Reduction Rule (50 CFR 224.105), which limits vessel speed to 18.5 km/h (10 kn) in the Mid-Atlantic and Southeast U.S. SMAs for North Atlantic right whales during migration (**Figure 2-2**). Vessel speed restrictions in these areas are in effect between November 1 and April 30 in the Mid-Atlantic and between November 15 and April 15 in the Southeast U.S.

2.1.2.5. Guidance for Marine Debris Awareness

All authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012). All vessel operators, employees, and contractors actively engaged in G&G surveys must be briefed on marine trash and debris awareness elimination as described in this NTL except that BSEE will not require applicants to undergo formal training or post placards. The applicant would be required to ensure that its employees and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment where it could affect protected species. The above referenced NTL provides information that applicants may use for this awareness training.

2.1.2.6. Avoidance of Sensitive Seafloor Resources

A basic mitigation philosophy for BOEM is to mitigate by avoidance. That is, this Agency must know enough about the nature of the seafloor area where activities are proposed so that the activities can be moved or offset to another area if sensitive resources are already there. This principle applies to sensitive cultural resources such as shipwrecks and prehistoric archaeological resources as well as sensitive benthic communities, and it applies to G&G activities in all three program areas.

2.1.2.6.1. Avoidance and Reporting Requirements for Historic and Prehistoric Sites

The BOEM and BSEE would require site-specific information regarding potential archaeological resources prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. The BOEM and BSEE would use this information to ensure that physical impacts on archaeological resources do not take place.

All authorizations for G&G activities that involve seafloor-disturbing activities would include requirements for operators to report suspected historic and prehistoric archaeological resources to the BOEM and BSEE and take precautions to protect the resource. The requirements are expected to be similar to NTL 2005-G07 ("Archaeological Resource Surveys and Reports") (USDOI, MMS, 2005), the enforcement for which is shared between BOEM and BSEE. The BOEM and BSEE also require reporting and avoidance for any previously undiscovered suspected archaeological resource and precautions to protect the resource from operational activities while appropriate mitigation measures are developed. Regulations have been promulgated based on the NHPA (16 U.S.C. 470 et seq.), especially Sections 106 and 110; the Archaeological Resources Protection Act (ARPA) of 1979 (16 U.S.C. 470), which prohibits the excavation and removal of items of archaeological interest from Federal lands without a permit; and the Antiquities Act of 1906 (16 U.S.C. 431). Under the oil and gas regulations, archaeological resource surveys are required as by 550.203(o), 550.204(s), and 550.1007(a)(5), and an archaeological resource report is required by 550.203(b)(15), 550.204(b)(8)(v)(A), and 550.1007(a)(5). These existing regulations are applicable to all oil and gas-related G&G operations that involve seafloor-disturbing activities, including coring, grab sampling, and placement of bottom cables or nodes. Equivalent information needs to be provided for renewable energy and marine minerals programs, although equivalent regulations do not expressly exist for renewable energy or for marine minerals. The equivalent is provided through guidance, supported by regulation and/or statutory authority (see NHPA Section 106, OCSLA, and 30 CFR 585 and 580).

If an operator discovers any archaeological resource while conducting operations authorized under a lease or pipeline right-of-way, operations within or that may affect the discovery must be immediately halted and the discovery reported to the BOEM and BSEE. If the BOEM determines that the resource is significant, based on criteria under the NHPA, the BSEE, in consultation with BOEM, will direct how the resource is to be protected during operations and activities. If BOEM determines that the resource is not significant, BOEM will so advise the BSEE. The BSEE informs the operator when operations may resume (30 CFR 250.194).

2.1.2.6.2. Avoidance Requirements for Sensitive Benthic Communities

The BOEM will require site-specific information regarding sensitive benthic communities (including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. All authorizations for seafloor-disturbing activities would be subject to restrictions to protect corals and hard/live bottom resources, including requirements for mapping and avoidance, as well as pre-deployment photographic surveys of areas where bottom-founded instrumentation and appurtenances are to be deployed.

The BOEM has not designated specific benthic locations for avoidance in the AOI. However, likely areas for avoidance would include known hard/live bottom areas, known deepwater coral locations including *Lophelia* and *Oculina* coral sites, deepwater coral Habitat Areas of Particular Concern (HAPCs), deepwater Marine Protected Areas (MPAs), Gray's Reef NMS, the Charleston Bump area, and the walls of submarine canyons. These benthic features are discussed in **Chapter 4.2.1.1.2** of the Draft Programmatic EIS. All authorizations for G&G surveys proposed within or near these areas would be subject to the review noted above to facilitate avoidance.

The BOEM has not developed specific buffer zones for sensitive benthic communities in the Atlantic, but it is expected that they would be similar to those that BOEM uses in the Gulf of Mexico, where the locations of many sensitive bottom communities are known and there is a long history of bottom surveying in association with oil and gas exploration and production. In the Gulf of Mexico, sensitive benthic features in water depths less than 300 m (~1,000 ft) are protected by NTL 2009-G39 ("Biologically-Sensitive Underwater Features and Areas") (USDOI, MMS, 2009a), and features in greater water depths are protected by NTL 2009-G40 ("Deepwater Benthic Communities") (USDOI, MMS, 2009b). Large topographic features such as the Flower Garden Banks and similar offshore "banks" are defined by "No Activity Zones" where no bottom-disturbing activity may take place within 152 m (500 ft). No seafloor-disturbing activities can occur within 30 m (100 ft) of "pinnacle trend" hard/live bottom features that have vertical relief of 2.4 m (8 ft) or more. Avoidance of low-relief hard/live bottom features is required but no buffer distance is specified; plans proposing activities near these areas must include survey coverage extending to 1,000 m (3,280 ft) from the location of proposed bottom-disturbing activity. For high-density deepwater benthic communities (including chemosynthetic and deepwater coral communities), setbacks are required of 610 m (2,000 ft) for drilling discharge locations and 76 m (250 ft) from the location of all other proposed seafloor disturbances. The application of similar setbacks as default buffer zones would be expected when G&G activities take place in the AOI.

2.1.2.7. Guidance for Activities in or Near National Marine Sanctuaries

There are two NMSs within the AOI: Monitor and Gray's Reef (see **Chapter 4.2.11.1.1** for brief descriptions). The BOEM would not authorize seafloor-disturbing activities within the boundaries of an NMS. Seafloor-disturbing activities proposed near the boundaries of an NMS would be assigned a setback distance as a condition of permit approval to be determined at the time the action is before BOEM and in consultation with the Sanctuary Manager. Setbacks of 152 m (500 ft) for seafloor-disturbing activities would be expected that could be modified by consultations with NOAA under the NMSA for specific activities in proximity to an NMS. **Chapter 1.6.15** provides information about the NMSA consultation process.

All BOEM authorizations for G&G activities would include instructions to minimize impacts on NMS resources. Operators proposing to conduct activities within or near the boundaries of Monitor NMS or Gray's Reef NMS would be instructed to exercise caution to ensure that such activities do not endanger any other users of the Sanctuary. Additionally, if proposed activities involve seafloor-disturbing activities near an NMS or moving the surface marker buoys for the Sanctuary, the operator would be required to contact the Sanctuary Manager for instructions.

Existing Federal regulations for Monitor NMS (15 CFR 922.61) prohibit certain activities including (but not limited to) anchoring, stopping, remaining, or drifting without power at any time; any type of subsurface salvage or recovery operation; diving of any type, whether by an individual or by a submersible; lowering below the surface of the water any grappling, suction, conveyor, dredging or wrecking device; detonating below the surface of the water any explosive or explosive mechanism; drilling or coring the seabed; lowering, laying, positioning or raising any type of seabed cable or cable-laying device; trawling; or discharging waster material into the water in violation of any Federal statute or regulation.

Existing Federal regulations for Gray's Reef NMS (15 CFR 922.92) prohibit certain activities including (but not limited to) anchoring; dredging; drilling; using explosives; breaking, damaging, or removing any bottom formation; constructing structures; constructing, placing, or abandoning any structure, material, or other matter on the submerged lands of the Sanctuary; and discharging or depositing any material or other matter except fish or fish parts, bait, or chumming materials, effluent from marine sanitation devices, and vessel cooling water. Under a new regulation that went into effect December 4, 2011, the southern third of the NMS is now a research area where fishing and diving is prohibited, but vessels are allowed to travel across the area as long as they do not stop (*Federal Register*, 2011b; USDOC, ONMS, 2011).

2.1.2.8. Guidance for Military and NASA Coordination

All authorizations for permitted activities would include guidance for military and NASA coordination. The guidance would be similar to NTL 2009-G06 ("Military Warning and Water Test Areas") (USDOI, MMS, 2009c). All vessel operators and contractors actively engaged in G&G surveys and permitted activities would be required to establish and maintain early contact and coordination with the appropriate military range complex or command headquarters or NASA point of contact in order to avoid or minimize conflicts with potentially hazardous military operations. In addition, the installation, location and planned periods of operation for any structures or surface uses would be subject to BOEM approval. Depending on the time and place for the activity, the vessel operator may be required to enter into a formal Operating Agreement that delineates the specific requirements and operating parameters for the proposed activities when determined necessary by military or NASA contacts.

2.1.3. Summary of Impacts

Impacts associated with Alternative A are discussed in **Chapter 4.2** and summarized by resource in the following sections. A comparative summary of impacts is presented in **Table 2-2**.

The impact analysis for each resource was organized by impact-producing factor (IPF). The following IPFs were analyzed: active acoustic sound sources; vessel and equipment noise; vessel traffic; aircraft traffic and noise; vessel exclusion zones; trash and debris; seafloor disturbance; drilling discharges; onshore support activities; and accidental fuel spills.

Table 2-2 and the impact summary text use the following impact categories:

- **Negligible**: Little or no measurable/detectable impact.
- **Minor**: Impacts are detectable, short-term, extensive or localized, but less than severe;
- **Moderate**: Impacts are detectable, short-term, extensive, and severe; ***or*** impacts are detectable, short-term or long-lasting, localized, and severe; ***or*** impacts are detectable, long-lasting, extensive or localized, but less than severe.
- **Major**: Impacts are detectable, long-lasting, extensive, and severe.

These general significance categories were tailored as needed to evaluate impacts of each relevant IPF on each resource.

2.1.3.1. Impacts on Benthic Communities (Chapter 4.2.1)

The main IPF for benthic communities is seafloor disturbance, other relevant IPFs include drilling discharges, active acoustic sound sources, trash and debris, and accidental fuel spills.

Impacts of Seafloor Disturbance and Drilling Discharges

Several types of G&G survey activities (e.g., bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) could physically disturb the seafloor and result in localized burial or crushing of soft bottom benthic organisms. In addition, drilling discharges from drilling of deep stratigraphic and shallow test wells could result in localized smothering and burial of benthic communities. The total area of seafloor disturbance in soft bottom areas would be a negligible percentage of the benthic habitat in the AOI. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, impacts on sensitive benthic communities such as coral, hard/live bottom, chemosynthetic, and deepwater canyon communities are expected to be avoided. Impacts of seafloor disturbance under Alternative A are expected to be **negligible** to **minor**, and impacts of drilling discharges are expected to be **negligible**.

Impacts of Active Acoustic Sound Sources

Most marine invertebrates do not have sensory organs that can perceive sound pressure, although many have tactile hairs or sensory organs that are sensitive to disturbances such as those caused by hydroacoustic equipment. However, the limited available data assessing physiological effects or biochemical responses of marine invertebrates to underwater noise indicate that serious pathological and physiological effects are unlikely. Impacts of active acoustic sound sources on benthic communities are expected to be **negligible**.

Impacts of Trash and Debris

Benthic impacts of trash and debris deposition on the seafloor are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Therefore, benthic community impacts from trash and debris are expected to be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface. Although particulate matter contaminated with diesel fuel could sink through the water column, given the small size of the spill and the loss of most spilled fuel through evaporation and dispersion, a small fuel spill would be unlikely to reach the seafloor or contaminate bottom sediments. Impacts on benthic communities would be expected to be **negligible**.

2.1.3.2. Impacts on Marine Mammals (Chapter 4.2.2)

Relevant IPFs for marine mammals are active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills.

Impacts of Active Acoustic Sound Sources

The proposed action includes extensive seismic airgun surveys for oil and gas exploration and development, as well as HRG surveys in both the renewable energy and marine minerals programs. Airguns used during seismic surveys produce acoustic pulses that are within the hearing range of all marine mammals. HRG surveys for renewable energy and marine minerals sites typically would use only electromechanical sources such as side-scan sonars, boomer and chirp subbottom profilers, and multibeam depth sounders, some of which are expected to be beyond the functional hearing range of marine mammals or would be detectable only at very close range. Detailed characteristics of active acoustic sound sources are described in **Appendix D**.

Based on the scope of the proposed action, seismic airgun surveys and non-airgun HRG surveys could affect individuals from all marine mammal species within the AOI except the West Indian manatee and the three pinniped species (gray seal, harbor seal, and hooded seal), which are considered extralimital and are unlikely to be affected.

Incidental take of marine mammals was estimated for the proposed action scenario using the Acoustic Integration Model© (AIM), which is a 4D, individual-based, Monte Carlo statistical model designed to predict the exposure of receivers to any stimulus propagating through space and time (**Appendix E**). The modeling used both the current NMFS criteria for Level A and Level B harassment, as well as the Southall et al. (2007) criterion for injury (Level A harassment). The NMFS currently uses precautionary thresholds that would indicate when the potential for Level A or Level B harassment cannot be dismissed. Under NMFS criteria, marine mammals exposed to impulsive sounds at or above 180 dB re 1μPa (rms) (for cetaceans) or 190 dB re 1μPa (rms) (for pinnipeds) are considered to have been taken by Level A (i.e., injurious) harassment. Behavioral harassment (Level B) would occur when marine mammals are exposed to sounds at or above 160 dB re 1μPa (rms) for pulsed sounds (e.g., airgun pulses) and 120 dB re 1μPa (rms) for non-pulsed sound (e.g., ship noise).

Southall et al. (2007) proposed that the lowest sound exposure levels (SELs) that might elicit slight auditory injury from impulsive sounds (e.g., airgun pulses) are 198 dB re 1 μPa^2-s in cetaceans and 186 dB re 1 μPa^2-s in the more sensitive pinnipeds. Corresponding values for nonpulse sounds (e.g., side-scan sonars, boomer and chirp subbottom profilers, multibeam depth sounders, etc.) are 215 dB re 1 μPa^2-s in cetaceans and 203 dB re 1 μPa^2-s in pinnipeds. Southall et al. (2007) also concluded that receipt of an instantaneous flat-weighted peak pressure exceeding 230 dB re 1 μPa (peak) for cetaceans or 218 dB re 1 μPa (peak) for pinnipeds might also lead to auditory injury even if the aforementioned SEL criterion was not exceeded. The Southall et al. (2007) criteria are not currently used by NMFS within the framework of the MMPA.

Seismic Airgun Surveys

For seismic airgun surveys, modeling of incidental take was conducted using the AIM as explained in **Appendix E**. Total numbers of Level A and Level B incidental takes were estimated for each year included in the 2012-2020 time period covered by the Programmatic EIS. The modeling predicts Level A harassment of all marine mammal species except the West Indian manatee and the three pinnipeds (all values are zero due to low densities in the AOI). Using NMFS 180-dB criterion, the five species with the highest numbers of annual Level A takes are estimated to be:

- bottlenose dolphin (0-11,748 individuals/year);
- short-beaked common dolphin (0-6,147 individuals/year);
- Atlantic spotted dolphin (0-5,848 individuals/year);
- short-finned pilot whale (0-4,631 individuals/year); and
- striped dolphin (0-3,993 individuals/year).

Using the Southall et al. (2007) criteria, estimated Level A takes are much lower, with the following top five species:

- Atlantic spotted dolphin (0-1,496 individuals/year);
- striped dolphin (0-1,020 individuals/year);
- Risso's dolphin (0-731 individuals/year);
- pantropical spotted dolphin (0-263 individuals/year); and
- short-beaked common dolphin (0-225 individuals/year);

The modeling also predicts Level B harassment of all marine mammal species except the West Indian manatee and the three pinnipeds. Using NMFS 160-dB criterion, the five species with the highest annual Level B take estimates are:

- bottlenose dolphin (0-1,151,442 individuals/year);
- short-beaked common dolphin (0-602,424 individuals/year);
- Atlantic spotted dolphin (0-573,121 individuals/year)
- short-finned pilot whale (0-453,897 individuals/year); and
- striped dolphin (0-391,376 individuals/year);

Seven marine mammal species that occur in the AOI are federally listed as endangered species (North Atlantic right whale, blue whale, fin whale, sei whale, humpback whale, sperm whale, and West Indian manatee). The modeling predicts Level A and B incidental takes of all species except the West Indian manatee. Of the endangered species, the humpback whale has the highest estimated numbers of both Level A takes (up to 12 individuals/year using the 180-dB criterion and up to 6 individuals/year using the Southall et al. [2007] criterion) and Level B takes (up to 1,131 individuals/year using the 160-dB criterion).

The modeling also predicts the possibility of a small number of Level A incidental takes of North Atlantic right whales, including 0-2 individuals/year using the 180-dB criterion and <1 individual using the Southall et al. (2007) criterion. However, most Level A incidental takes predicted by the modeling are expected to be avoided, as explained in the next paragraph. Level B incidental takes are estimated to range from 0 to 476 individuals/year. The proposed action includes a time-area closure for North Atlantic right whales that has been factored into the incidental take calculations. It reduces estimated Level A and Level B incidental takes of North Atlantic right whales by about 67 percent (as compared with no time-area closures).

The Level A incidental takes predicted by the AIM modeling do not take into account the operational mitigation measures included in the seismic airgun survey protocol to ensure that marine mammals are not present within the 180-dB exclusion zone. Although these measures are not expected to be 100 percent effective, they are expected to significantly reduce the risk of Level A harassment to marine mammals. The exclusion zone could extend up to 2.1 km (1.3 mi) from a large airgun array (5,400 in^3) and up to 186 m (610 ft) from a small airgun array (90 in^3). If the operational mitigation measures were 100 percent successful, then all Level A harassment of marine mammals would be avoided. The BOEM expects that mitigation measures would not be 100 percent effective, and therefore there is the potential to expose some animals to sound levels exceeding the 180-dB criterion, which would constitute Level A harassment and could result in injury. The operational mitigation measures during seismic airgun surveys would not fully prevent Level B harassment (as defined by the 160-dB zone), which could extend up to 15 km (9.3 mi) from a large airgun array (5,400 in^3) and up to 3 km (1.9 mi) from a small airgun array (90 in^3), depending on the geographic location and season modeled.

In conclusion, seismic airgun surveys have the potential to result in both Level A and Level B harassment of marine mammals. No mortalities would be expected because there has been no observation of direct physical injury or death to marine mammals from airguns. However, Level A incidental takes of nearly all marine mammal species in the AOI are predicted by the modeling. Although these impacts are expected to be avoided to the maximum extent practicable through the mitigation measures included in the proposed action, the mitigation would not be 100 percent effective and therefore there would be the possibility of numerous Level A takes. The most likely and extensive effects of underwater noise on marine mammals are behavioral responses (Level B harassment). Most acoustic impacts on North Atlantic right whales (and some impacts on most other marine mammals) are expected to be avoided by the right whale time-area closure included in the proposed action. Manatees and pinnipeds are unlikely to come into contact with active acoustic sound sources, and no acoustic harassment is expected for those species. Due to the spatial and temporal extent of the surveys in the proposed action, the total number of Level B harassments predicted, and the likelihood that some degree of Level A harassment would not be prevented, overall impacts on marine mammals from seismic airgun surveys are expected to be **moderate**.

Non-Airgun HRG Surveys

HRG surveys for renewable energy and marine minerals sites typically would use only electromechanical sources such as side-scan sonars, boomer and chirp subbottom profilers, and multibeam depth sounders. Detailed characteristics of representative electromechanical sources selected for this analysis are described in **Appendix D**. Boomer pulses are expected to be within the hearing range of all marine mammals. However, the operating frequency of the representative multibeam system (240 kHz) is above the hearing range of all cetaceans. For side-scan sonar, the 100 kHz operating frequency is within the hearing range of mid- and high-frequency cetaceans, but the 400 kHz frequency is above the range of all groups. For the chirp subbottom profiler, the 3.5 kHz and 12 kHz frequencies are within the hearing range of all cetaceans, but the 200 kHz is above their hearing range. Frequencies emitted by individual equipment may differ from these representative systems selected for programmatic analysis.

For non-airgun HRG surveys, modeling of incidental take was conducted using the AIM as explained in **Appendix E**. The modeling predicts low numbers of Level A harassment for all marine mammal species except the West Indian manatee and the three pinnipeds (all values are zero due to low densities in the AOI). Using NMFS 180-dB criterion, the five species with the highest numbers of estimated Level A takes are:

- bottlenose dolphin (1-6 individuals/year);
- short-beaked common dolphin (1-4 individuals/year);
- Atlantic spotted dolphin (1-5 individuals/year);
- short-finned pilot whale (0-2 individuals/year); and
- striped dolphin (0-2 individuals/year).

Using the Southall et al. (2007) criteria, estimated Level A takes are lower for most species, but the top five species are similar:

- Atlantic spotted dolphin (0-7 individuals/year);
- short-beaked common dolphin (0-5 individuals/year);
- bottlenose dolphin (0-2 individuals/year);
- Risso's dolphin (0-2 individuals/year); and
- striped dolphin (0-1 individuals/year).

The modeling also predicts Level B harassment of all of the marine mammal species except the West Indian manatee and the three pinnipeds. Using NMFS 160-dB criterion, the five species with the highest annual Level B take estimates are:

- bottlenose dolphin (92-632 individuals/year);
- Atlantic spotted dolphin (119-490 individuals/year)
- short-beaked common dolphin (119-379 individuals/year);
- short-finned pilot whale (1-227 individuals/year); and
- Risso's dolphin (9-170 individuals/year).

For the non-airgun HRG surveys, all seven of the endangered marine mammals are predicted to have essentially zero Level A incidental takes using both NMFS 180-dB criterion and the Southall et al. (2007) criteria. Of the endangered species, the highest estimated Level B incidental takes are estimated for the sperm whale (0-12 individuals/year). All of the endangered mysticete whales have estimated Level B incidental takes of <1 individual/year, with the highest being North Atlantic right whale (0.19-0.87 individuals/year).

In conclusion, it is expected that there would be little or no Level A harassment resulting from non-airgun HRG surveys, based on the model predictions and the mitigation included in the proposed action. Depending on the operating frequencies and source levels of the electromechanical sources used for a particular survey, the underwater noise may be above the hearing range of marine mammals or detectable only at very close range. The most likely and extensive effects of HRG surveys on marine mammals would be behavioral responses (Level B harassment). Most acoustic impacts on North Atlantic right whales (and some impacts on most other marine mammals) are expected to be avoided by the right whale time-area closure included in the proposed action. Manatees and pinnipeds are unlikely to come into contact with active acoustic sound sources, and no acoustic harassment is expected for those species. Because most or all Level A harassment would likely be avoided and because of the low numbers of Level B harassments predicted, overall impacts on marine mammals from non-airgun HRG surveys are expected to be **minor**.

Impacts of Vessel and Equipment Noise

Vessel noise has been observed to elicit a variety of behavioral responses in marine mammals. It is conservative to assume that noise associated with geophysical survey vessels may, in some cases, elicit behavioral changes in individual marine mammals that are in proximity to these vessels. These behavioral changes may include evasive maneuvers such as diving or changes in swimming direction and/or speed. For most of the time that seismic survey vessels are underway, they would be operating their airguns or other active acoustic sound sources; under these conditions, Level B incidental takes have already been accounted for in the impact analysis. During those periods when active acoustic sound sources are not operating, the potential for Level B harassment from vessel noise remains. The proposed action includes a time-area closure for all G&G surveys using airguns in the right whale critical habitat and SMAs from November 15 through April 15. Authorization for renewable energy or marine mineral HRG (non-airgun) surveys in critical habitat area and in the Mid-Atlantic and Southeast SMAs for the North Atlantic right whale may include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. These measures would be expected to reduce vessel-related noise impacts on this species during its seasonal migration and calving/nursing periods. The time-area closure would also reduce impacts on other marine mammals during these time periods. Based on the proposed volume of vessel traffic associated with project activities within the AOI and the presumption that marine mammals within the AOI are familiar with common vessel-related noises, the effects of vessel noise on marine mammals are expected to be **negligible** to **minor**.

Other sound sources associated with the proposed activity include drilling-related equipment noise during the completion of up to three COST wells and up to five shallow test wells during the time period of the Programmatic EIS. These noise sources may elicit alterations of behavior, i.e., changes in swimming direction or speed. However, considering the small number of drilling operations, the continuous nature of sounds produced during these activities, and the mitigation measures in place for Alternative A, it is expected that the noise impacts on marine mammals would be **minor**.

Impacts of Vessel Traffic

Marine mammals are vulnerable to vessel strikes. Under the proposed action, all authorizations for shipboard surveys would include guidance for vessel strike avoidance (see **Chapter 2.1.2**). Considering the mitigation measures that would be in place, G&G survey vessels are unlikely to strike marine mammals. Seismic survey vessels, which account for most of the vessel traffic in the proposed action, travel slowly during surveys. A typical towing speed is 4.5 kn (8.3 km/hr), much slower than the speeds reported to cause most serious or lethal injuries. Also, seismic survey vessels are towing active acoustic sound sources (airguns) that are detectable by most marine mammals. In addition, during surveys, waters surrounding survey vessels would be visually monitored by protected species observers for marine mammals and turtles. During transit to and from shore bases, seismic survey vessels and other G&G survey vessels are expected to travel at greater speeds. However, these vessel movements would be subject to BSEE guidance for vessel strike avoidance, and vessels would be required to reduce speed in certain areas to comply with the Right Whale Ship Strike Reduction Rule. Vessel traffic impacts are expected to be **negligible**.

Impacts of Aircraft Traffic and Noise

The proposed action scenario includes one or two aeromagnetic surveys and the possibility of helicopter traffic in support of drilling of deep stratigraphic and shallow test wells. Aircraft generate noise from their engines, airframe, and propellers, and the physical presence of low-flying aircraft can disturb marine mammals because of both the noise and the visual disturbance. Levels of noise received underwater from passing aircraft depend on the aircraft's altitude, the aspect (direction and angle) of the aircraft relative to the receiver, receiver depth and water depth, and seafloor type. Because of these physical variables and the expected airspeed, exposure of individual marine mammals to aircraft-related noise (including both airborne and underwater noise) would be expected to be brief in duration. Considering the relatively low level of aircraft activity included in the proposed action, along with the short duration of potential exposure noise and visual disturbance, potential impacts from this activity are expected to be **negligible** to **minor**.

Impacts of Trash and Debris

Marine debris poses two types of negative impacts on marine mammals: entanglement and ingestion. Entanglement is a far more likely cause of mortality to marine mammals than ingestion. Entanglement is most common in pinnipeds, less common in mysticete cetaceans, and rare among odontocete cetaceans. Entanglement data for mysticete cetaceans may reflect a high interaction rate with active fishing gear rather than marine debris.

Impacts on marine mammals from discarded trash and debris are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Therefore, impacts are expected to be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

Diesel fuel released accidentally into the marine environment may affect marine mammals through various pathways: direct contact, inhalation of volatile components, ingestion (directly or indirectly through the consumption of fouled prey species), and (for Mysticetes) impairment of feeding by fouling of baleen. Cetacean skin is highly impermeable and is not seriously irritated by brief exposure to diesel fuel; direct contact is not likely to produce a significant impact.

A small fuel spill would not be likely to result in the death or life-threatening injury of individual marine mammals, or the long-term displacement of these animals from preferred feeding or breeding habitats or migratory routes. It is expected that marine mammals would avoid areas with heavy fuel sheen, and the fuel would disperse and weather rapidly. The impacts would be **negligible** to **minor**.

2.1.3.3. Impacts on Sea Turtles (Chapter 4.2.3)

Relevant IPFs for sea turtles are active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills.

Impacts of Active Acoustic Sound Sources

The proposed action includes extensive seismic airgun surveys for oil and gas exploration and development, as well as HRG surveys in both the renewable energy and marine minerals programs. Airguns used during seismic surveys produce low-frequency acoustic pulses that are within the hearing range of sea turtles. However, HRG surveys for renewable energy and marine minerals sites typically would use only electromechanical sources such as side-scan sonars, boomer and chirp subbottom profilers, and multibeam depth sounders. Acoustic signals from electromechanical sources other than boomers are not likely to be detectable by sea turtles, and sea turtles are unlikely to hear boomer pulses unless they are very near or beneath a survey vessel. Detailed characteristics of active acoustic sound sources are described in **Appendix D**.

Based on the scope of the proposed action, seismic airgun surveys could affect individuals from all sea turtle species within the AOI, potentially including hawksbill turtles within the southernmost part of the AOI. Subadult and adult turtles may be more likely to be affected by seismic airgun noise than post-hatchling turtles, due to the time that the former remain submerged and at depth. Post-hatchling turtles generally reside at or near the sea surface and may be less likely to be injured by the sound field produced by an airgun array. Seismic surveys in nearshore waters would affect a greater number of individual turtles, particularly species other than leatherbacks. Deepwater surveys are likely to affect fewer individual turtles but are more likely to affect leatherback turtles, particularly within areas of upwelling where individuals may be found in feeding aggregations. Surveys conducted during summer sea turtle nesting periods may affect greater numbers of adult turtles, particularly loggerhead, green, and leatherback turtles, than surveys conducted during non-nesting periods.

Mitigation measures included in the seismic airgun survey protocol include ramp-up of airgun arrays, visual monitoring of an exclusion zone by protected species observers, and startup and shutdown requirements (**Chapter 2.1.2.2**). These measures are expected to prevent injury to sea turtles by ensuring that they are not present within an exclusion zone around the airgun array. The most likely impacts would be short-term behavioral responses of individuals in proximity to airgun arrays. No deaths or life-threatening injuries would be expected. In general, impacts of seismic airgun surveys on sea turtles are expected to range from **negligible** to **minor**.

In most areas, seismic airgun surveys would not be expected to cause long-term or permanent displacement of sea turtles from preferred coastal habitats. However, seismic airgun surveys off of heavily used nesting beaches during the nesting season could temporarily displace breeding and nesting adult turtles and potentially disrupt time-critical activities. Beaches of southeast Florida have been identified as the most important nesting area for loggerhead turtles in the western hemisphere. The northern segment of the Archie Carr National Wildlife Refuge (NWR) borders the AOI, and it has been estimated that 25 percent of all loggerhead nesting in the U.S. occurs there. During the 2010 nesting season, there were over 31,000 loggerhead nests in Brevard County, where the Archie Carr NWR is located. It is likely that large numbers of sea turtles would be present in nearshore waters of Brevard County during the nesting season from May 1 to October 31. Many adult females linger near the nesting beaches before and between nesting events, resting under rocky ledges and outcrops in inner shelf waters for periods of weeks. Depending on factors including the distance of the survey from shore (and local factors such as seafloor topography and seafloor substrate that may affect the lateral propagation of underwater sound), and the duration and intensity of survey effort in this area, breeding adults, nesting adult females, and hatchlings could be exposed to airgun seismic survey-related sound exposures at levels of 180 dB re 1 μPa or greater. Potential impacts could include auditory injuries or behavioral avoidance that interferes with nesting activities. Hatchlings may be somewhat insulated from the most harmful components of the propagated sound field because of their location at or near the sea surface. For surveys offshore Brevard County during the nesting season, seismic airgun survey impacts on sea turtles are expected to range from **minor** to **moderate**.

HRG surveys of renewable energy and marine minerals sites would use only electromechanical sources such as side-scan sonar, boomer and chirp subbottom profilers, and multibeam depth sounders. Acoustic signals from electromechanical sources other than the boomer are not likely to be detectable by sea turtles, whose best hearing is mainly below 1,000 Hz. The effects from these sources on sea turtles are expected to range from **no effect** to **negligible**, based on the audibility of the source to sea turtles. The boomer has an operating frequency range of 200 Hz–16 kHz and so may be audible to sea turtles. However, it has a very short pulse length and a low source level, with a 180-dB radius of less than 5 m (16 ft) (**Appendix C**). Therefore, impacts on sea turtles from HRG surveys using only electromechanical sources are expected to range from **negligible** to **minor**.

Impacts of Vessel and Equipment Noise

The G&G activities would generate vessel and equipment noise that could disturb sea turtles or contribute to auditory masking. The most likely effects of vessel noise on sea turtles would include behavioral changes and possibly auditory masking. Vessel noise is transitory and generally does not propagate at great distances from the vessel. The source levels are too low to cause death, injury, or threshold shifts. Because of the uncertain role of hearing in sea turtle ecology, it is unclear whether masking would realistically have any effect on sea turtles. Behavioral responses to vessels have been observed but are difficult to attribute exclusively to noise rather than to visual or other cues. It is conservative to assume that noise associated with survey vessels may elicit behavioral changes in individual sea turtles near these vessels. These behavioral changes may include evasive maneuvers such as diving or changes in swimming direction and/or speed. This evasive behavior is not expected to adversely affect these individuals or the population, and so the impacts are expected to be **negligible**.

Impacts of Vessel Traffic

The G&G survey vessels could strike and injure or kill sea turtles. Propeller and collision injuries to sea turtles arising from their interactions with boats and ships are common and are identified as a threat in several species' recovery plans. However, all authorizations for shipboard surveys would include guidance for vessel strike avoidance (**Chapter 2.1.2**). Seismic survey vessels, which account for most of the project-related vessel traffic associated with Alternative A activities, survey at a speed of approximately 4.5 kn (8.3 km/hr). In addition, waters surrounding survey vessels on survey would be monitored by protected species observers for the presence of sea turtles. During transit to and from shore bases, seismic survey vessels and other G&G survey vessels are expected to travel at greater speeds. However, these vessel movements would be subject to joint BOEM-BSEE guidance for vessel strike avoidance, and vessels would be required to reduce speed in certain areas to comply with the Right Whale Ship Strike Reduction Rule.

Because sea turtles spend most of their lives submerged, a collision between a project-related survey vessel and a sea turtle within the AOI is unlikely. In addition, the risk of vessel strikes on sea turtles is expected to be minimized due to: (1) the guidelines for vessel strike avoidance that would be part of all authorizations for shipboard surveys under the proposed action; (2) the typical slow speed of seismic survey vessels; and (3) the use of protected species observers to scan the sea surface around seismic survey vessels. Vessel traffic impacts are expected to be **negligible**.

Impacts of Aircraft Traffic and Noise

The proposed action scenario includes one or two aeromagnetic surveys and the possibility of helicopter traffic in support of drilling of deep stratigraphic and shallow test wells. Aircraft generate noise from their engines, airframe, and propellers. Also, the physical presence of low-flying aircraft can disturb sea turtles, particularly those on the sea surface. Behavioral responses to flying aircraft include diving or rapid changes in swimming speed or direction. Levels of noise received underwater from passing aircraft depend on the aircraft's altitude, the aspect (direction and angle) of the aircraft relative to the receiver, receiver depth and water depth, and seafloor type. Because of these physical variables and the expected airspeed, exposure of individual sea turtles to aircraft-related noise (including both airborne and underwater noise) would be expected to be brief in duration. Considering the relatively low level of aircraft activity included in the proposed action, along with the short duration of potential exposure noise and visual disturbance, potential impacts from this activity are expected to be **negligible**.

Impacts of Trash and Debris

Marine debris poses two types of negative impacts on sea turtles: entanglement and ingestion. Entanglement is a far more likely cause of mortality to sea turtles than ingestion. Loggerhead turtles have been found entangled in a wide variety of materials, including steel and monofilament line, synthetic and natural rope, plastic onion sacks, and discarded plastic netting. However, monofilament fishing line appears to be the principal source of entanglement for loggerheads in U.S. waters.

Impacts on sea turtles from discarded trash and debris are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Therefore, impacts are expected to be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

Diesel fuel released accidentally into the marine environment may affect sea turtles through various pathways including direct contact, inhalation of the fuel and its volatile components, and ingestion (directly or indirectly through the consumption of fouled prey species). Several aspects of sea turtle biology and behavior place them at risk, including lack of avoidance behavior, indiscriminate feeding in convergence zones, and inhalation of large volumes of air before dives. Studies have shown that direct exposure of sensitive tissues (e.g., eyes, nares, other mucous membranes) and soft tissues to diesel fuel or volatile hydrocarbons may produce irritation and inflammation. Diesel fuel can adhere to turtle skin or shells. Turtles surfacing within or near a diesel release would be expected to inhale petroleum vapors, causing respiratory stress. Ingested diesel fuel, particularly the lighter fractions, can be acutely toxic to sea turtles.

A small fuel spill would not be likely to result in the death or life-threatening injury of individual turtles or hatchlings, or the long-term displacement of adult turtles from preferred feeding, breeding, or nesting habitats or migratory routes. It is unlikely that a small diesel fuel spill in the ocean would reach turtle nests, which are usually positioned above the high tide line. Therefore, potential impacts on sea turtles within the AOI are expected to range from **negligible** (if the fuel does not contact individual turtles) to **minor** (if individual turtles encounter the dispersed windrows of the surface slick).

2.1.3.4. Impacts on Marine and Coastal Birds (Chapter 4.2.4)

Applicable IPFs for marine and coastal birds are active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills.

Impacts of Active Acoustic Sound Sources

The primary potential for impact to marine and coastal birds from airguns and other active acoustic sound sources is to seabirds and waterfowl that dive below the water surface. Only those species that plunge dive are at risk of exposure to these sound sources. Investigations into the effects of airguns on seabirds are extremely limited, but no mortality, injury, or effects on distribution or abundance have been observed. Based on the downward directionality of the sound generated from airguns and the limited study results available, it is expected that there would be no mortality or life-threatening injury and little disruption of behavioral patterns or other non-injurious effects of any diving seabirds or waterfowl. Underwater noise impacts on birds are expected to be **negligible** to **minor** for airguns and **negligible** for noise from electromechanical sources.

Impacts of Vessel and Equipment Noise

Vessel traffic and vessel and equipment noise could cause a disturbance to breeding birds if a vessel approached too close to a breeding colony. In general, G&G surveys would not occur close enough to land to affect marine and coastal bird breeding colonies during survey activities. However, some survey vessels (especially for renewable energy and marine minerals projects) would typically transit from a shore base to offshore and return daily. The expectation is that this daily vessel transit would occur at one of the shore bases identified or at other established ports, which have established transiting routes for ingress and egress in the coastal areas and existing vessel traffic. Due to this existing vessel traffic, it is not anticipated that marine and coastal birds would roost in adjacent areas, or if they did already roost nearby, the addition of G&G survey vessels would not significantly increase the existing vessel traffic. In addition, noise generated from the survey vessels would typically dissipate prior to reaching the coastline and the nesting habitats of coastal birds. Impacts of vessel traffic and associated vessel and equipment noise to marine and coastal birds would be **negligible** to **minor**.

Impacts of Aircraft Traffic and Noise

The proposed action scenario includes one or two aeromagnetic surveys and the possibility of helicopter traffic in support of drilling of deep stratigraphic and shallow test wells. Aircraft generate noise from their engines, airframe, and propellers, and the physical presence of low-flying aircraft can disturb marine and coastal birds, including those on the sea surface as well as in flight. Behavioral responses to flying aircraft include flushing the sea surface into flight or rapid changes in flight speed or direction. These behavioral responses can cause collision with the survey aircraft. It is expected that survey aircraft would follow Federal Aviation Administration (FAA) guidance recommending that aircraft maintain an altitude of at least 610 m (2,000 ft) when flying over noise sensitive areas such as parks, wildlife refuges, waterfowl areas, and wilderness areas. Considering the relatively low level of aircraft activity included in the proposed action, it is expected that potential impacts from aircraft traffic would be **negligible** to **minor**.

Impacts of Trash and Debris

Impacts of trash and debris to marine and coastal birds are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Therefore, impacts on marine and coastal birds from trash and debris are expected to be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

If the accidental fuel spill occurred in offshore waters, there is the potential for oceanic and pelagic seabirds such as members of the Alcidae, Sulidae, Phaethontidae, Hydrobatidae, and Procellariidae families to be directly and indirectly affected by spilled diesel fuel. Direct impacts would include oiling of plumage and ingestion (resulting from preening). Indirect impacts could include oiling of foraging habitats and displacement to secondary locations. Impacts are expected to be **negligible** to **minor** for most bird species, but potentially **negligible** to **moderate** for listed species such as piping plover, roseate tern, red knot, and Bermuda petrel.

2.1.3.5. Impacts on Fish Resources and Essential Fish Habitat (Chapter 4.2.5)

Relevant IPFs for fish resources and EFH are active acoustic sound sources, vessel and equipment noise, seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of Active Acoustic Sound Sources

Potential impacts of active acoustic sound sources (e.g., airguns) on fishes may include behavioral responses, masking of biologically important sounds, temporary hearing loss, and physiological effects. The proposed action includes extensive seismic airgun surveys and HRG surveys using electromechanical sources. Based on the scope of the proposed action, it is possible that fishes near airgun array could be exposed to sound levels that could result in temporary hearing loss. There is no permanent hearing loss in fishes. The proposed action does not include any mitigation measures specifically designed to reduce impacts on fishes, although ramp-up during seismic airgun surveys may provide an opportunity for fishes near airgun arrays to avoid exposure to high sound pressure levels (SPLs). No mortality or injury is expected in any case because there has been no observation of direct physical injury or death to fishes from airguns. Impacts are expected to be **minor**.

Impacts of Vessel and Equipment Noise

All vessels produce underwater noise, and it is likely that fishes in the AOI have habituated to this noise. Sound sources are below levels that can cause temporary hearing loss or injury. Masking and short-term behavior modifications are possible effects. Impacts on fish behavior are expected to be short-term and localized to areas of survey vessel activity; the effects would be **minor**.

Impacts of Seafloor Disturbance and Drilling Discharges

Several types of G&G survey activities (e.g., bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) could physically disturb the seafloor and result in localized impacts on demersal fishes and EFH. In addition, drilling discharges from drilling of deep stratigraphic and shallow test wells could result in localized impacts. The total area affected would be a negligible percentage of the benthic habitat in the AOI. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, impacts on sensitive benthic communities such as coral, hard/live bottom, chemosynthetic, and deepwater canyon communities are expected to be avoided, including the associated demersal fishes and EFH. Impacts of seafloor disturbance and drilling discharges are expected to be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

A small fuel spill at the sea surface could have an effect on fish resources and EFH. Numerous federally managed species have pelagic eggs and larvae that would be at risk if they encountered a diesel spill. The EFH most likely to be affected would be pelagic *Sargassum*. Drifting in windrows or mats, *Sargassum* supports numerous fishes and invertebrates including the young of several federally managed species such as greater amberjack, almaco jack, gray triggerfish, blue runner, dolphin, and wahoo. However, because the exposure of spilled diesel fuel on early life stages and *Sargassum* is expected to last for a day or less and have limited spatial extent, the impacts of a small accidental diesel fuel spill from G&G activities would **minor**.

2.1.3.6. Impacts on Threatened or Endangered Fish Species (Chapter 4.2.6)

Marine fishes occurring in the AOI include two endangered species, one proposed threatened/ endangered species, and two candidate species. The smalltooth sawfish (*Pristis pectinata*) is an endangered species occurring mainly in nearshore Florida waters. The shortnose sturgeon (*Acipenser brevirostrum*) is an endangered anadromous species that inhabits rivers along the Atlantic coast but rarely ventures into coastal marine waters. The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a proposed threatened/endangered species found in shelf waters (including areas offshore of Virginia and North Carolina) during fall and winter months. Two anadromous species, the blueback herring (*Alosa aestivalis*) and the alewife (*Alosa pseudoharengus*), are candidate species currently undergoing a status review to be listed as threatened.

Relevant IPFs for threatened or endangered fish species are active acoustic sound sources, vessel and equipment noise, vessel traffic, trash and debris, seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of Active Acoustic Sound Sources

Due to their rare occurrence in the AOI, the smalltooth sawfish and shortnose sturgeon are unlikely to be exposed to active acoustic sound sources, including airguns; impacts are expected to be **negligible**. For similar reasons of limited distribution, potential impacts on alewife are expected to be **minor**. The Atlantic sturgeon and blueback herring are more likely to be exposed to these sound sources due to their distribution. Impacts would be similar to those discussed above for Fish Resources, including behavioral responses, masking of biologically important sounds, temporary hearing loss, and physiological effects. Sturgeons do not have any known structures in the auditory system that would enhance hearing, and their hearing sensitivity is not very great. No mortality or injury is expected in any case because there has been no observation of direct physical injury or death to fishes from airguns. Impacts on Atlantic sturgeon and blueback herring are expected to be **minor**.

Impacts of Vessel Traffic and Vessel and Equipment Noise

Smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon are all demersal species that are unlikely to be affected by vessel and equipment noise (**negligible** impact). Blueback herring and alewife are more likely to be exposed to this noise source, but impacts are expected to be **minor**. Impacts from vessel traffic per se on all five species are expected to be **negligible**.

Impacts of Trash and Debris

Impacts of trash and debris releases on the water column and benthic environment are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Therefore, impacts from trash and debris on threatened or endangered fishes are expected to be **negligible**.

Impacts of Seafloor Disturbance and Drilling Discharges

Several types of G&G survey activities (e.g., bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) could physically disturb the seafloor and result in localized impacts on demersal fishes, which could include the three demersal species (smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon). In addition, drilling discharges from drilling of deep stratigraphic and shallow test wells could result in localized smothering and burial of benthic communities. The total area of seafloor disturbance in soft bottom areas would be a negligible percentage of the benthic habitat in the AOI. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, impacts on demersal fishes and their habitat are expected to be avoided. Impacts of seafloor disturbance and drilling discharges are expected to be **negligible** for all of the listed fish species.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

The three listed demersal species (smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon) are the least likely to be affected because a small fuel spill would be unlikely to reach the seafloor or contaminate bottom sediments. Because of their life histories, none of the threatened or endangered fish species would have sensitive eggs or larvae in the water column of the AOI where they would be exposed to accidently spilled diesel fuel. Impacts of an accidental fuel spill are expected to be **negligible** for all five of these species.

2.1.3.7. Impacts on Commercial Fisheries (Chapter 4.2.7)

Applicable IPFs for commercial fisheries are active acoustic sound sources, vessel traffic and vessel exclusion zones, seafloor disturbance, and accidental fuel spills.

Impacts of Active Acoustic Sound Sources

Sounds from active acoustic sound sources such as airguns may result in behavioral changes in some fishes. Anthropogenic sound can cause fishes to alter their movements or avoid certain areas. Fish exposed to seismic airgun sound typically exhibit an initial startle response, followed by habituation to the sound source and, after a period of time, resumption of normal behavior. Temporary avoidance of or movement out of specific areas could result in a short-term, localized reduction in fish catch. The impacts on commercial fisheries are expected to be **minor**.

Impacts of Vessel Traffic and Vessel Exclusion Zones

During seismic airgun surveys, vessel exclusion zones are maintained around the survey vessel(s) and their towed airgun arrays. The vessel exclusion zones would be temporary, with the duration and areal extent dependent on the type of activity. As an example, a typical vessel exclusion zone for a deep penetration seismic airgun survey involving a towed array would be approximately 8.5 km (4.6 nmi) long and 1.2 km (0.6 nmi) wide, covering a total of 1,021 ha (2,520 ac) of the sea surface. The length of time that any particular point would be within the vessel exclusion zone would be about 1 hr. Prior to conducting a seismic survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to Mariners. The Local Notice to Mariners would specify the survey dates and locations and the recommended avoidance requirements. The G&G vessel traffic and vessel exclusion zones may temporarily interrupt fishing activities, including setting of fishing gear. In addition, survey vessel traffic has the potential to interfere with commercial fishing operations, especially dredges, otter trawls, longlines, and purse seines. Any impacts would be localized and short-term and are expected to be **minor**.

Impacts of Seafloor Disturbance

Seafloor disturbance could potentially affect commercial fisheries operations within the AOI, specifically the potential for damage to bottom-founded fishing gear. However, most passive gears such as traps, pots, and bottom longlines are well marked by surface buoys. The total area of seafloor disturbance would be a negligible percentage of the seafloor area in the AOI. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures, most impacts on commercial fishing gear and activities are expected to be avoided. Impacts are expected to be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

The impacts of an accidental fuel spill on commercial fisheries would depend on the location of the spill, in addition to the meteorological and oceanographic conditions, which would affect the rate of weathering and transport. Response vessel activity could temporarily interrupt commercial fishing operations. However, given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts on commercial fisheries activities from a small diesel fuel spill are expected to be **negligible**.

2.1.3.8. Impacts on Recreational Fisheries (Chapter 4.2.8)

Applicable IPFs for recreational fisheries are active acoustic sound sources, vessel traffic, vessel exclusion zones, and accidental fuel spills.

Impacts of Active Acoustic Sound Sources

Active acoustic sound sources such as airguns may result in behavioral changes in some fishes. Anthropogenic sound can cause fishes to alter their movements or avoid certain areas. Fishes exposed to seismic airgun sound typically exhibit an initial startle response, followed by habituation to the sound source and, after a period of time, resumption of normal behavior. Temporary avoidance of or movement out of specific areas could result in a short-term, localized reduction in fish catch. The impacts on recreational fisheries are expected to be **negligible** to **minor** under Alternative A.

Impacts of Vessel Traffic

G&G survey vessel traffic may temporarily interrupt recreational fishing activities including the possibility of a fishing vessel having to change course or temporarily depart from a preferred fishing location. Any impacts would be localized and short-term and are expected to be **negligible** to **minor**.

Impacts of Vessel Exclusion Zones

During seismic airgun surveys, vessel exclusion zones are maintained around the survey vessel(s) and their towed airgun arrays. The vessel exclusion zones would be temporary, with the duration and areal extent dependent on the type of activity. As an example, a typical vessel exclusion zone for a deep penetration seismic airgun survey involving a towed array would be approximately 8.5 km (4.6 nmi) long and 1.2 km (0.6 nmi) wide, covering a total of 1,021 ha (2,520 ac) of the sea surface. The length of time that any particular point would be within the vessel exclusion zone would be about 1 hr. Prior to conducting a seismic survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to Mariners. The Local Notice to Mariners would specify the survey dates and locations and the recommended avoidance requirements. The G&G vessel traffic and vessel exclusion zones may temporarily interrupt fishing activities, including setting of fishing gear. Impacts would be localized and short-term and are expected to be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

The impacts of an accidental fuel spill on recreational fishing would depend on the location of the spill, in addition to the meteorological and oceanographic conditions, which would affect the rate of weathering and transport. Response vessel activity could temporarily interrupt recreational fishing activities. However, given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts on recreational fisheries activities from a small diesel fuel spill are expected to be **negligible**.

2.1.3.9. Impacts on Recreational Resources (Chapter 4.2.9)

Relevant IPFs for recreational resources are vessel exclusion zones, trash and debris, and accidental fuel spills.

Impacts of Vessel Exclusion Zones

During seismic airgun surveys, vessel exclusion zones are maintained around the survey vessel(s) and their towed airgun arrays. The vessel exclusion zones would be temporary, with the duration and areal extent dependent on the type of activity. As an example, a typical vessel exclusion zone for a deep penetration seismic airgun survey involving a towed array would be approximately 8.5 km (4.6 nmi) long and 1.2 km (0.6 nmi) wide, covering a total of 1,021 ha (2,520 ac) of the sea surface. The length of time that any particular point would be within the vessel exclusion zone would be about 1 hr. Prior to conducting a seismic survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to Mariners. The Local Notice to Mariners would specify the survey dates and locations and the recommended avoidance requirements. All impacts would be of short duration, and potential impacts are rated as **negligible**.

Impacts of Trash and Debris

Impacts of trash and debris on recreational resources (e.g., trash washing up on beaches) are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Impacts from trash and debris on recreational resources are expected to be **negligible** to **minor**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

The impacts of an accidental fuel spill on recreational resources would depend on the location of the spill, in addition to the meteorological and oceanographic conditions, which would affect the rate of weathering and transport. Response vessel activity could temporarily interrupt recreational use of some areas. However, given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts on recreational resources from a small diesel fuel spill are expected to be **negligible** to **minor**.

2.1.3.10. Impacts on Archaeological Resources (Chapter 4.2.10)

Relevant IPFs for archaeological resources are seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of Seafloor Disturbance and Drilling Discharges

Several types of G&G survey activities (e.g., anchoring, bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) could physically disturb the seafloor. In addition, drilling discharges from drilling of deep stratigraphic and shallow test wells could result in localized sediment deposition on the seafloor. However, the BOEM would require site-specific information regarding potential archaeological resources prior to approving any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures in the AOI. The BOEM would use this information to ensure that impacts on archaeological resources are avoided. All authorizations for G&G activities that involve seafloor-disturbing activities would include requirements for operators to report suspected historic and prehistoric archaeological resources to the BOEM and take precautions to protect the resource. Therefore, impacts on archaeological resources would be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface. Although particulate matter contaminated with diesel fuel could sink through the water column, given the small size of the spill and the loss of most spilled fuel through evaporation and dispersion, a small fuel spill would be unlikely to reach the seafloor or contaminate bottom sediments. Impacts on archaeological resources would be expected to be **negligible**.

2.1.3.11. Impacts on Marine Protected Areas (Chapter 4.2.11)

The MPAs within the AOI include two NMSs, six deepwater MPAs designated by the South Atlantic Fishery Management Council (SAFMC), numerous Federal fishery management areas, and a variety of coastal (onshore) MPAs. The IPFs that may affect key resources within the MPAs are active acoustic sound sources, trash and debris, seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of Active Acoustic Sound Sources

Impacts of active acoustic sound sources on benthic communities have been discussed previously and are expected to be **negligible**. Impacts on benthic communities within offshore MPAs would be similar. No direct acoustic impacts would be expected on coastal MPAs. However, certain coastal MPAs such as the Archie Carr NWR support a high level of sea turtle nesting during the summer months, and the impact analysis for Alternative A identified seismic airgun surveys as having the potential to displace breeding and nesting adult turtles or disrupt time-critical activities. Therefore, for surveys offshore Brevard County during the nesting season, airgun impacts on MPAs are evaluated as **minor** to **moderate**.

Impacts of Trash and Debris

Impacts of trash and debris on coastal MPAs (e.g., trash washing up on beaches) are expected to be avoided through vessel operators' compliance with USCG and USEPA regulations. In addition, all authorizations for shipboard surveys would include BSEE guidance for marine debris awareness. Impacts from trash and debris on MPAs are expected to be **negligible**.

Impacts of Seafloor Disturbance and Drilling Discharges

Seafloor disturbance and drilling discharges have the potential to affect benthic resources within offshore MPAs. However, Federal regulations prohibit seafloor-disturbing activities within the two NMSs, and BOEM would not authorize such activities within MPAs; therefore, those impacts would not take place. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, impacts on sensitive benthic communities within other MPAs (e.g., coral, hard/live bottom, chemosynthetic, and deepwater canyon communities) are expected to be avoided. Impacts of seafloor disturbance and drilling discharges under Alternative A would be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

An accidental fuel spill is expected to have **negligible** impacts on benthic resources within offshore MPAs because the spill would float and disperse on the sea surface and is unlikely to reach the seafloor.

Depending on spill location, a small fuel spill could affect coastal MPAs. However, given the small size of the spill in the proposed action scenario, impacts are expected to be **negligible** to **minor**.

2.1.3.12. Impacts on Other Marine Uses (Chapter 4.2.12)

The IPFs applicable to other marine uses are vessel traffic and vessel exclusion zones, aircraft traffic and noise, seafloor disturbance, and accidental fuel spills.

Impacts of Vessel Traffic and Vessel Exclusion Zones

Vessel traffic and vessel exclusion zones have the potential for space-use conflicts with existing marine uses such as shipping and marine transportation. During seismic airgun surveys, vessel exclusion zones are maintained around the survey vessel(s) and their towed airgun arrays. The vessel exclusion zones would be temporary, with the duration and areal extent dependent on the type of activity. As an example, a typical vessel exclusion zone for a deep penetration seismic airgun survey involving a towed array would be approximately 8.5 km (4.6 nmi) long and 1.2 km (0.6 nmi) wide, covering a total of 1,021 ha (2,520 ac) of the sea surface. The length of time that any particular point would be within the vessel exclusion zone would be about 1 hr. Prior to conducting a seismic survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to Mariners. The Local Notice to Mariners would specify the survey dates and locations and the recommended avoidance requirements. Overall, impacts on other marine uses would be of relatively short duration and are expected to be **negligible** to **minor**.

Impacts of Aircraft Traffic and Noise

The proposed action scenario includes one or two aeromagnetic surveys and the possibility of helicopter traffic in support of drilling of deep stratigraphic and shallow test wells. Aircraft traffic has the potential for space-use conflicts with existing marine uses such as military and NASA use. All aircraft flights would originate from existing shore-based facilities and would file flight plans with the FAA before departure. Potential use conflicts with military range complexes and civilian space program use are expected to be avoided through coordination with the Department of Defense (DOD) and NASA prior to surveys. All authorizations for permitted activities would include BOEM guidance for military and NASA coordination. Impacts are expected to be **negligible**.

Impacts of Seafloor Disturbance

Several types of G&G survey activities (e.g., bottom sampling, drilling of deep stratigraphic and shallow test wells, placement of bottom-founded equipment or structures) involve seafloor disturbance. The BOEM would require prior approval of any G&G surveys involving seafloor-disturbing activities or placement of bottom-founded equipment or structures. Therefore, conflicts with other marine uses of the seafloor (e.g., artificial reef sites, dredged material disposal sites, military use areas, etc.) are expected to be avoided and impacts would be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

The impacts of an accidental fuel spill on other marine uses would depend on the location of the spill, in addition to the meteorological and oceanographic conditions, which would affect the rate of weathering and transport. Response vessel activity could temporarily interrupt other marine uses in some areas. However, given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts on other marine uses from a small diesel fuel spill are expected to be **negligible**.

2.1.3.13. Impacts on Human Resources and Land Use (Chapter 4.2.13)

Applicable IPFs for human resources and land use are onshore support activities and accidental fuel spills.

Impacts of Onshore Support Activities

Seismic airgun surveys in support of oil and gas exploration represent over 90,000 hr (3,725 days) of vessel activity during the 2012-2020 time period. Seismic survey vessels are large, dedicated vessels that can remain offshore for weeks or months, with supply vessel support originating from ports along the Atlantic coast. For this analysis, five potential support bases were identified in support of oil and gas program seismic survey activity – Norfolk, Virginia; Wilmington, North Carolina; Charleston, South Carolina; Savannah, Georgia; and Jacksonville, Florida.

Vessels conducting G&G surveys or sampling for renewable energy would operate mainly at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Typically, these are smaller vessels that would return to their shore base daily. Vessel trips associated for renewable energy areas would be divided among several existing ports in Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. Depending on the location of the renewable energy area, the surveys could operate from one of the five larger ports in the AOI, or any of numerous smaller ports along the coast, depending on whatever is convenient.

Based on the projected level of G&G survey activity and associated demands for shore base space, supplies, and services, impacts from onshore activities on human resources and land use under Alternative A are expected to be **negligible**.

Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. A fuel spill would be expected to float, disperse, and weather on the sea surface.

An accidental diesel fuel spill would be expected to have minimal to no impact to either the local economies or populations of the ports and surrounding communities. Based on the small size of the spill in the proposed action scenario, impacts on human resources and land use under Alternative A are expected to be **negligible**.

2.2. ALTERNATIVE B – ADDITIONAL TIME-AREA CLOSURES AND SEPARATION OF SIMULTANEOUS SEISMIC AIRGUN SURVEYS

2.2.1. Description

Alternative B would authorize G&G activities in support of all program areas – oil and gas exploration and development, renewable energy, and marine minerals – throughout the entire AOI. It would include the same regulatory requirements and mitigation measures as Alternative A, but it also would include additional time-area closures for North Atlantic right whales and sea turtles, establish a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys, and require the use of PAM as part of the seismic survey protocol.

2.2.2. Mitigation Measures

The following mitigation measures in Alternative B would be identical to those previously described for Alternative A:

- HRG survey protocol (for renewable energy and marine minerals sites);
- guidance for vessel strike avoidance;
- guidance for marine debris awareness;
- avoidance and reporting requirements for historic and prehistoric sites;
- avoidance of sensitive benthic communities;

- guidance for activities in or near NMSs; and
- guidance for military and NASA coordination.

Alternative B would include the additional or revised measures listed below and described in the following subsections:

- an expanded time-area closure for North Atlantic right whales;
- a time-area closure for nesting sea turtles offshore Brevard County, Florida;
- limitations on concurrent seismic airgun surveys; and
- a seismic airgun survey protocol with required use of PAM.

2.2.2.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI (**Figure 2-3**). The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida that are adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI. The expanded closure area would add 6,823,753 ac (27,615 km^2) to the SMA closure areas described under Alternative A, totaling 14,413,356 ac (58,329 km^2), representing 7 percent of the total AOI (vs. approximately 4 percent under Alternative A).

The purpose of the expanded time area closure is to prevent impacts on right whales along their entire migration route and calving and nursery grounds. The SMAs do not provide continuous coverage of the right whale migratory route along the Mid-Atlantic coast because they focus on areas of heavy ship traffic (including entrances to certain bays and ports). Sightings data reviewed by NMFS in developing the ship strike rule indicate that approximately 83 percent of right whale sightings occur within 37 km (20 nmi) of the coast. The expanded time-area closure under Alternative B would form a continuous zone of the same width along the coast of the AOI (**Figure 2-3**).

Under the expanded time-area closure, no G&G surveys using air guns would be authorized within the right whale critical habitat area from November 15 through April 15, the Mid-Atlantic and Southeast U.S. Seasonal Management Areas (SMAs), and the expanded closure areas during the times when vessel speed restrictions are in effect under the Right Whale Ship Strike Reduction Rule (50 CFR 224.105). However, HRG surveys proposed in the critical habitat area, SMAs, and the expanded areas may be considered on a case-by-case basis only if: (1) they are proposed for renewable energy or marine minerals operations; and (2) they use acoustic sources other than air guns. The coincidence is necessary because of other biological use windows or project monitoring requirements. Any such authorization may include additional mitigation and monitoring requirements to avoid or significantly reduce impacts on right whales. Other supporting surveys (e.g., biological surveys) would not be affected by this restriction.

Exceptions for proposed HRG surveying in the right whale time-area closure could occur if a survey was needed to serve important operational or monitoring requirements for a particular project. For example, monitoring surveys for renewable energy (e.g., scour, cable burial) might need to take place at fixed intervals to capture seasonal changes or safety-related conditions. Another example would be a marine minerals project in which dredging is not seasonally restricted and real-time bathymetry data must be collected to track dredging operations or pre- and post-bathymetric surveys must be collected immediately before or after dredging to establish volumes borrowed.

2.2.2.2. Time-Area Closure for Nesting Sea Turtles Offshore Brevard County, Florida

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31) (**Figure 2-3**). No airgun surveys would be authorized within the closure area during that time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations may include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

The Brevard County time-area closure would include the portion of Brevard County that is within the AOI and would extend 11 km (5.9 nmi) offshore (**Figure 2-4**). The southern border of Brevard County is beyond the southern boundary of the AOI. The closure would also extend radially from the northern county boundary at the shoreline. The extent is based on acoustic modeling of distances that could receive sound pressure levels of 160 dB re 1 μPa from a large airgun array in this area. Supporting calculations are provided in **Appendix D**.

The purpose of the closure would be to avoid disturbing the large numbers of loggerhead turtles (and hatchlings) that are likely to be present in nearshore waters of Brevard County during turtle nesting and hatching season. As discussed in **Chapter 4.2.3**, Brevard County includes some of the world's most important nesting beaches for sea turtles. During the 2010 nesting season, there were over 31,000 loggerhead nests in Brevard County. The Archie Carr NWR, located mainly within Brevard County, has been identified as the most important nesting area for loggerhead turtles in the western hemisphere. The Archie Carr NWR is critical to the recovery and survival of loggerhead turtles; it has been estimated that 25 percent of all loggerhead nesting in the U.S. occurs in the Archie Carr NWR. Nesting densities have been estimated at 625 nests per km (1,000 nests per mile) within the Archie Carr NWR.

The sea turtle time-area closure would overlap with the right whale time-area closure (**Figure 2-4**). The overlapping area would be under closure most of the year (November 15 through April 15 for right whales and May 1 through October 31 for sea turtles). The right whale critical habitat area, the SMAs and expanded right whale closure areas, and the sea turtle closure area would be closed only to surveys deploying airguns, such as seismic surveys for oil and gas exploration and HRG surveys for oil and gas leases. Other activities such as HRG surveys for renewable energy or marine minerals programs could occur; as noted previously, applications would be reviewed on a case-by-case basis, and authorizations may include additional mitigation and monitoring requirements.

2.2.2.3. Separation between Simultaneous Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating seismic airgun surveys. This is in contrast to Alternative A, which does not require any geographic separation of concurrent seismic surveys. However, in practice, operators typically maintain a separation of about 17.5 km (9.5 nmi) between concurrent surveys to avoid interference (i.e., overlapping reflections received from multiple source arrays). The separation distance under Alternative B was created by rounding up this typical "operational" separation distance to 20 km (10.8 nmi), then doubling it.

The purpose of this measure is to limit ensonification of large areas of the AOI at the same time by specifying a conservative separation distance between simultaneous surveys. The largest exposure radii estimated for the 160-dB threshold for a large airgun array is approximately 15 km (8 nmi) (**Appendix D**). This operational separation requirement would be included as part of OCSLA authorizations (i.e., through lease stipulations, permits, and NTLs for existing leases).

2.2.2.4. Seismic Airgun Survey Protocol with Required Use of Passive Acoustic Monitoring

Under Alternative B, the use of PAM would be required as part of the seismic airgun survey protocol (rather than optional or "encouraged" as in Alternative A). The purpose would be to improve detection of marine mammals prior to and during seismic airgun surveys so that impacts can be avoided by shutting down or delaying startup of airgun arrays until the animals are outside the exclusion zone.

2.2.3. Summary of Impacts

Impacts associated with Alternative B are discussed in **Chapter 4.3** and summarized by resource in the following sections. A comparative summary of impacts is presented in **Table 2-2**. Alternative B would include the same suite of G&G survey types analyzed for Alternative A but would add an expanded time-area closure for North Atlantic right whales; a time-area closure for sea turtles offshore Brevard County, Florida; a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and required use of PAM as part of the seismic airgun survey protocol.

2.2.3.1. Impacts on Benthic Communities (Chapter 4.3.1)

Relevant IPFs for benthic communities under Alternative B are the same as for Alternative A: active acoustic sound sources, trash and debris, seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of active acoustic sound sources on benthic communities were rated as **negligible** under Alternative A, and changes in seismic survey timing in the additional closure areas under Alternative B would not alter these impacts.

Benthic impacts of trash and debris under Alternative B would be essentially identical to those under Alternative A (**negligible**). Benthic impacts of trash and debris deposition on the seafloor would be expected to be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of seafloor disturbance and drilling discharges under Alternative B would be essentially the same as for Alternative A (**negligible** to **minor** for seafloor disturbance and **negligible** for drilling discharges). The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of some surveys but would not change the ultimate extent or severity of seafloor disturbance or drilling discharge impacts. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures (including requiring site-specific information), it is expected that sensitive benthic resources would be avoided under either alternative.

An accidental fuel spill would be expected to have **negligible** impacts on benthic communities, and this conclusion would be unchanged under Alternative B.

2.2.3.2. Impacts on Marine Mammals (Chapter 4.3.2)

Alternative B includes one additional mitigation measure developed specifically to reduce impacts on marine mammals: an expanded time-area closure for North Atlantic right whales. The time-area closure would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI (**Figure 2-3**). No G&G surveys using airguns would be authorized within the designated right whale critical habitat area from November 15 through April 15, nor within the Mid-Atlantic and Southeast U.S. SMAs or the additional 37-km (20-nmi) closure areas during the times when vessel speed restrictions are in effect under 50 CFR 224.105. However, HRG surveys proposed in the critical habitat area, SMAs, and the expanded areas may be considered on a case-by-case basis only if: (1) they are proposed for renewable energy or marine minerals operations; and (2) they use acoustic sources other than air guns. The coincidence is necessary because of other biological use windows or project monitoring requirements. Any such authorization may include additional mitigation and monitoring requirements to avoid or significantly reduce impacts on right whales. Other supporting surveys (e.g., biological surveys) would not be affected by this restriction.

The following summary focuses on the effect of the expanded right whale time-area closure with respect to marine mammal impacts. The other additional mitigation measures included in Alternative B would have relatively little effect on the impact analysis. The time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31) would preclude airgun surveys in a small portion of the AOI (about 3.2%). Limits on concurrent seismic airgun surveys, including a 40-km (25-mi) separation distance between simultaneously operating surveys, could reduce impacts on marine mammals from repeated exposure to airgun pulses from multiple surveys in the same area, but the overall impact level would remain unchanged. The required use of PAM during seismic airgun surveys is intended to improve detection of vocalizing marine mammals, but it is difficult to quantify any difference in impact level relative to Alternative A.

Relevant IPFs for marine mammals under Alternative B are the same as those for Alternative A: active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills.

Airguns are the main active acoustic sound source that may affect marine mammals; electromechanical sources are expected to have relatively little effect, in part because of their frequencies, short pulse duration, and narrow beam width (depending on the source). Under Alternative A, impacts were evaluated as **moderate** for airguns and **minor** for electromechanical sources.

The expanded right whale time-area closure would reduce acoustic and vessel strike impacts on North Atlantic right whales and other marine mammals that may occur within the closure area during the specified time frame. By forming a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI, it is expected that the expanded closure area would reduce most of the potential risk of impacts on North Atlantic right whales. Sightings data reviewed by NMFS in developing the Right Whale Ship Strike Reduction Rule indicate that approximately 83 percent of right whale sightings occur within this distance of the coast. However, for marine mammals in general, only a small portion of the AOI would be excluded; the expanded closure area would represent 7 percent of the total AOI vs. approximately 4 percent under Alternative A. Therefore, the overall impact level for marine mammals would remain approximately the same as for Alternative A (**moderate** for airguns, **minor** for electromechanical sources).

Impacts of vessel and equipment noise under Alternative B would be essentially the same as those under Alternative A (**negligible** to **minor**). Vessel noise may, in some cases, elicit behavioral changes including evasive maneuvers such as diving or changes in swimming direction and/or speed. Based on the proposed volume of vessel traffic associated with project activities within the AOI and the assumption that marine mammals within the AOI are familiar with common vessel-related noises, vessel noise from G&G surveys is not expected to adversely affect individuals or marine mammal populations.

Vessel traffic impacts on marine mammals under Alternative B are expected to be essentially the same as under Alternative A (**negligible**). There is a potential risk that G&G survey vessels could strike and injure or kill marine mammals. However, the risk is low because of the typical slow speed of G&G survey vessels and the use of protected species observers to scan the sea surface around survey vessels. In addition, survey vessels would be required to reduce speed in certain areas to comply with the Right Whale Ship Strike Reduction Rule.

Impacts of aircraft traffic and noise on marine mammals under Alternative B are expected to be essentially the same as under Alternative A (**negligible** to **minor**). The physical presence of low-flying aircraft can disturb marine mammals, particularly those on the sea surface. Behavioral responses to flying aircraft include diving or changes in swimming speed or direction. The exposure of individual marine mammals to aircraft-related noise would be expected to be brief in duration and have little or no effect.

Impacts of trash and debris on marine mammals under Alternative B would be essentially identical to those under Alternative A (**negligible**). Impacts would be expected to be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of accidental fuel spills on marine mammals were rated as **negligible** to **minor** under Alternative A and would be essentially the same under Alternative B. The time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of surveys in certain areas, but would not alter the risk, severity, or extent of these impacts.

2.2.3.3. Impacts on Sea Turtles (Chapter 4.3.3)

Alternative B includes one additional mitigation measure developed specifically to reduce impacts on sea turtles: a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. In addition, non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on both marine mammals and sea turtles.

The following summary focuses on the effect of the Brevard time-area closure with respect to sea turtle impacts. The other additional measures included in Alternative B are an expanded time-area closure for North Atlantic right whales, a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys, and required use of PAM as part of the seismic airgun survey protocol. The expanded right whale closure would affect a relatively small area (7 percent of the AOI vs. approximately 4 percent under Alternative A) and would not substantially change impacts on sea turtles. Limits on concurrent seismic airgun surveys could reduce impacts on sea turtles from repeated exposure to airgun pulses from multiple surveys in the same area, but the overall impact level would remain unchanged. The required use of PAM during seismic airgun surveys is intended to improve detection of vocalizing marine mammals but would not improve detection of sea turtles, and would not affect any of the impact conclusions for them.

Relevant IPFs for sea turtles under Alternative B are the same as those for Alternative A: active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills.

Airguns are the main active acoustic sound source that may affect sea turtles; electromechanical sources are expected to have little or no detectable effect on sea turtles, based on the limited audibility of these sources to sea turtles. Under Alternative A, impacts of airguns on sea turtles were evaluated as ranging from **negligible** to **minor** for most areas and **minor** to **moderate** for heavily used nesting beaches during the nesting season. Under Alternative B, the Brevard County time-area closure would reduce the extent, severity, and/or timing of noise-related impacts on sea turtles within inner shelf waters off Brevard County, and reduce the possibility of temporarily displacing breeding and nesting adult turtles or disrupting time-critical activities. The impacts of active acoustic sound sources would be reduced to **negligible** to **minor**.

Impacts of vessel and equipment noise on sea turtles under Alternative B are expected to be essentially the same as under Alternative A (**negligible**). The most likely effects of vessel noise on sea turtles would include behavioral changes and possibly auditory masking. These impacts would not be expected to adversely affect individuals or the population. The time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of surveys in certain areas, but would not alter the severity or extent of these impacts.

Vessel traffic impacts on sea turtles under Alternative B are expected to be essentially the same as under Alternative A (**negligible**). There is a potential risk that G&G survey vessels could strike and injure or kill sea turtles. However, the risk is low because of the typical slow speed of G&G survey vessels and the use of protected species observers to scan the sea surface around survey vessels.

Impacts of aircraft traffic and noise on sea turtles under Alternative B are expected to be essentially the same as under Alternative A (**negligible**). The physical presence of low-flying aircraft can disturb sea turtles, particularly those on the sea surface. Behavioral responses to flying aircraft include diving or rapid changes in swimming speed or direction. The exposure of individual sea turtles to aircraft-related noise would be expected to be brief in duration and have little or no effect.

Impacts of trash and debris under Alternative B would be essentially identical to those under Alternative A (**negligible**). It is expected that impacts of trash and debris would be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of accidental fuel spills on sea turtles were rated as **negligible** to **minor** under Alternative A and would be essentially the same under Alternative B. The time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of surveys in certain areas but would not alter the risk, severity, or extent of these impacts.

2.2.3.4. Impacts on Marine and Coastal Birds (Chapter 4.3.4)

Relevant IPFs for marine and coastal birds under Alternative B are the same as those for Alternative A: active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills.

Impacts of active acoustic sound sources on marine and coastal birds under Alternative B are expected to be the same as for Alternative A (**negligible** to **minor** for airguns**, negligible** for electromechanical sources). Only those bird species that plunge dive could be exposed to underwater noise, and little or no impact is expected. The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of surveys in certain areas but would not alter the severity or extent of impacts.

Impacts of vessel traffic and associated vessel and equipment noise to marine and coastal birds were rated as **negligible** to **minor** under Alternative A and would be essentially the same under Alternative B. In general, G&G surveys would not occur close enough to land to affect marine and coastal bird breeding colonies during survey activities. The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of surveys in certain areas but would not alter the severity or extent of impacts.

Impacts of aircraft traffic and noise under Alternative B would be essentially the same as for Alternative A (**negligible** to **minor**). Alternative B includes one or two aeromagnetic surveys and the possibility of helicopter traffic in support of drilling of deep stratigraphic and shallow test wells. Aircraft generate noise from their engines, airframe, and propellers, and the physical presence of low-flying aircraft can disturb marine and coastal birds, including those on the sea surface as well as in flight. Considering the relatively low level of aircraft activity included in the proposed action, little or no impact on birds would be expected.

Impacts of trash and debris under Alternative B would be essentially identical to those under Alternative A (**negligible**). Impacts of trash and debris would be expected to be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of accidental fuel spills on birds were rated as **negligible** to **minor** for most bird species, but **negligible** to **moderate** for listed species such as piping plover, roseate tern, red knot, and Bermuda petrel. Under Alternative B, the risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips. However the overall impact rating remains unchanged. A change in survey scheduling due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.2.3.5. Impacts on Fish Resources and Essential Fish Habitat (Chapter 4.3.5)

Relevant IPFs for fish resources and EFH under Alternative B are the same as those for Alternative A: active acoustic sound sources, vessel and equipment noise, seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of active acoustic sound sources on fish resources and EFH would be essentially the same as those for Alternative A (**minor**). Potential impacts of airguns on fishes may include behavioral responses, masking of biologically important sounds, temporary hearing loss, and physiological effects. No mortality or injury is expected. A change in seismic survey timing in the additional closure areas would not substantially alter these impacts.

Impacts of vessel and equipment noise under Alternative B would be essentially the same as those for Alternative A (**minor**). All vessels produce underwater noise, and it is likely that fishes in the AOI have habituated to this noise. Sound sources are below levels that can cause temporary hearing loss or injury. Masking and short-term behavior modifications are possible effects. Impacts on fish behavior are expected to be short-term and localized to areas of survey vessel activity.

Impacts of seafloor disturbance and drilling discharges under Alternative B would be essentially the same as for Alternative A (**negligible**). The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of some surveys but would not change the ultimate extent or severity of seafloor disturbance or drilling discharge impacts. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, it is expected that sensitive benthic EFH resources would be avoided under either alternative.

An accidental fuel spill at the sea surface could have an effect on the planktonic early life stages of fishes and *Sargassum*; however, the effects would be expected to last for a day or less and have limited spatial extent, and therefore are rated as **minor**. A change in survey scheduling due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.2.3.6. Impacts on Threatened or Endangered Fish Species (Chapter 4.3.6)

Relevant IPFs for threatened or endangered fish species under Alternative B are the same as those for Alternative A: active acoustic sound sources, vessel and equipment noise, vessel traffic, trash and debris, seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of active acoustic sound sources under Alternative B would be essentially the same as for Alternative A (**negligible** for smalltooth sawfish and shortnose sturgeon and **minor** for alewife, Atlantic sturgeon, and blueback herring). A change in seismic survey timing due to the additional closure areas and limits on concurrent surveys would not substantially alter these impacts.

Impacts of vessel and equipment noise under Alternative B would be essentially the same as for Alternative A (**negligible** for the three demersal species [smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon] and **minor** for alewife and blueback herring). A change in seismic survey timing due to the additional closure areas and limits on concurrent surveys would not substantially alter these impacts. Impacts of vessel traffic on all five listed fish species would be essentially the same as for Alternative A (**negligible**).

Impacts of trash and debris under Alternative B would be essentially identical to those under Alternative A (**negligible**). Impacts of trash and debris in the water column and on the seafloor would be expected to be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of seafloor disturbance and drilling discharges under Alternative B would be the same as for Alternative A (**negligible**). The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of some surveys but would not change the ultimate extent or severity of seafloor disturbance impacts. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures (including requiring site-specific information), sensitive benthic habitats used by smalltooth sawfish, shortnose sturgeon, or Atlantic sturgeon would be avoided under either alternative.

Potential impacts of an accidental fuel spill are expected to be **negligible** for all of the listed fish species under Alternative B, the same as for Alternative A. The three listed demersal species (smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon) are the least likely to be affected because a small fuel spill would be unlikely to reach the seafloor or contaminate bottom sediments. Because of their life histories, none of the listed fish species would have sensitive eggs or larvae in the water column of the AOI where they would be exposed to accidently spilled diesel fuel. A change in survey scheduling due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.2.3.7. Impacts on Commercial Fisheries (Chapter 4.3.7)

Relevant IPFs for commercial fisheries under Alternative B are the same as those for Alternative A: active acoustic sound sources, vessel traffic, vessel exclusion zones, seafloor disturbance, and accidental fuel spills.

Impacts of active acoustic sound sources on commercial fisheries would be similar to those for Alternative A (**minor**). Airguns may result in behavioral changes (e.g., avoidance) in some fishes that could result in a localized and temporary decrease in catchability of one or more commercial fish species. Under Alternative B, seismic airgun survey activities would be precluded from the additional 37-km (20-nmi) right whale time-closure areas for 6 months of the year (November 1 through April 30). However, since this additional closure area is only a small portion of the AOI (3.2%), the impacts would not be substantially different.

Impacts of vessel traffic and vessel exclusion zones would be similar to those for Alternative A (**minor**). Vessel traffic and vessel exclusion zones may temporarily interrupt fishing activities, including setting of fishing gear. Under Alternative B, G&G seismic airgun survey activities would be precluded from the additional 37-km (20-nmi) closure area for 6 months of the year, and other survey activity may be precluded on a case-by-case basis, which would decrease the vessel traffic and associated exclusion zones from this area during the closure time period. Therefore, seasonal commercial fishing activities in this region of the AOI would no longer have the potential for additional vessel traffic and exclusion zones associated with G&G survey activities during the closure period. However, since this additional closure area is only a small portion of the AOI (3.2%), the impacts would not be substantially different.

Impacts of seafloor disturbance under Alternative B would be essentially the same as for Alternative A (**negligible**). This impact specifically refers to the potential for damage to bottom-founded fishing gear. The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of some surveys but would not change the ultimate extent or severity of seafloor disturbance impacts.

Impacts of accidental fuel spills on commercial fisheries were rated as **negligible** under Alternative A and would be essentially the same under Alternative B. Based on the size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. A change in survey timing due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.2.3.8. Impacts on Recreational Fisheries (Chapter 4.3.8)

Relevant IPFs for recreational fisheries under Alternative B are the same as those for Alternative A: active acoustic sound sources, vessel traffic, vessel exclusion zones, and accidental fuel spills.

Impacts of active acoustic sound sources on recreational fisheries would be similar to those for Alternative A (**negligible** to **minor**). Airguns may result in behavioral changes (e.g., avoidance) in some fishes that could result in a localized and temporary decrease in catchability of one or more recreational fish species. Under Alternative B, seismic airgun survey activities would be precluded from the additional 37-km (20-nmi) right whale time-closure areas for 6 months of the year (November 1 through April 30). However, since this additional closure area is only a small portion of the AOI (3.2%), the impacts would not be substantially different.

Survey vessel traffic and vessel exclusion zones may temporarily interrupt recreational fishing activities. The impacts under Alternative B would be similar to those for Alternative A (**negligible** to **minor** for vessel traffic and **negligible** for vessel exclusion zones). Under Alternative B, G&G seismic survey activities would be precluded from the additional 37-km (20-nmi) closure area for 6 months of the year, and other survey activity may be precluded on a case-by-case basis, which would decrease the vessel traffic and associated exclusion zones from this area during the closure time period. Therefore, seasonal recreational fishing activities in this region of the AOI would no longer have the potential for additional vessel traffic and exclusion zones associated with G&G survey activities during the closure period. However, since this additional closure area is only a small portion of the AOI (3.2%), the impacts would not be substantially different.

Impacts of accidental fuel spills on recreational fisheries were rated as **negligible** under Alternative A and would be essentially the same under Alternative B. Based on the size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. A change in survey timing due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.2.3.9. Impacts on Recreational Resources (Chapter 4.3.9)

Relevant IPFs for recreational resources under Alternative B are the same as those for Alternative A: vessel exclusion zones, trash and debris, and accidental fuel spills.

Potential impacts of vessel exclusion zones under Alternative B would be similar to those for Alternative A (**negligible**). The additional time-area closure for right whales under Alternative B could change the timing of seismic airgun surveys and the associated vessel exclusion zones in the closure areas. However, the additional time-area closure for right whales under Alternative B would not significantly alter recreational opportunities since the added closure times in most of the AOI are not high-use periods for recreational opportunities because of poor weather. The sea turtle time-area closure offshore Brevard County, Florida, would apply during warmer months (May 1 through October 31) and may slightly reduce the potential for vessel exclusion zones to interfere with offshore recreational uses.

Impacts of trash and debris on recreational resources (e.g., trash washing up on beaches) under Alternative B would be essentially the same as those under Alternative A (**negligible** to **minor**). It is expected that impacts would be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of accidental fuel spills on recreational resources under Alternative B would be essentially the same as those for Alternative A (**negligible** to **minor**). A change in survey scheduling due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.2.3.10. Impacts on Archaeological Resources (Chapter 4.3.10)

Relevant IPFs for archaeological resources under Alternative B are the same as those for Alternative A: seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of seafloor disturbance and drilling discharges under Alternative B would be essentially the same as for Alternative A (**negligible**). The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of some surveys but would not change the risk of impacts on archaeological resources. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, it is expected that impacts on archaeological resources would be avoided under either alternative.

An accidental fuel spill is expected to have **negligible** impacts on archaeological resources, and this conclusion would be unchanged under Alternative B. A change in survey scheduling due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.2.3.11. Impacts on Marine Protected Areas (Chapter 4.3.11)

Relevant IPFs for MPAs under Alternative B are the same as those for Alternative A: active acoustic sound sources, trash and debris, seafloor disturbance, drilling discharges, and accidental fuel spills.

Impacts of active acoustic sound sources on MPAs would be **negligible** to **minor** for both airguns and electromechanical sources. These impacts are reduced from those for Alternative A, which were **negligible** to **moderate** for airguns and **negligible** to **minor** for electromechanical sources. Most MPAs would not be affected at all. The highest impact ratings under under Alternative A were based on the potential for airgun impacts on sea turtle nesting at the Archie Carr NWR, which would be largely avoided under Alternative B.

Impacts of trash and debris on MPAs (e.g., trash washing up on beaches) under Alternative B would be essentially identical to those under Alternative A (**negligible**). It is expected that impacts would be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of seafloor disturbance and drilling discharges under Alternative B would be the same as for Alternative A (**negligible**). Federal regulations prohibit seafloor-disturbing activities within the two NMSs, and BOEM would not authorize such activities within MPAs; therefore, those impacts would not take place. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities, drilling discharges, or placement of bottom-founded equipment or structures, impacts on sensitive benthic communities within other MPAs (e.g., coral, hard/live bottom, chemosynthetic, and deepwater canyon communities) are expected to be avoided. The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of some surveys but would not change the ultimate extent or severity of these impacts. It is expected that impacts on sensitive benthic resources associated with MPAs would be avoided under either alternative.

An accidental fuel spill is expected to have **negligible** to **minor** impacts on MPAs, and this conclusion would be unchanged under Alternative B. Based on the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. A change in survey scheduling due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.2.3.12. Impacts on Other Marine Uses (Chapter 4.3.12)

Relevant IPFs for other marine uses under Alternative B are the same as those for Alternative A: vessel traffic, vessel exclusion zones, aircraft traffic and noise, seafloor disturbance, and accidental fuel spills.

Impacts of vessel traffic and vessel exclusion zones under Alternative B would be similar to those for Alternative A (**negligible** to **minor**). Vessel traffic has the potential for space-use conflicts with existing marine uses such as shipping and marine transportation, but any impacts would be of relatively short duration. However, prior to conducting a seismic airgun survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to Mariners specifying the survey dates and locations and the recommended avoidance requirements. Because the additional closure area under Alternative B would be only a small portion of the AOI (3.2%), the impacts would not change substantially from those analyzed for Alternative A.

Impacts of aircraft traffic and noise under Alternative B would be essentially the same as for Alternative A (**negligible**). The proposed action scenario includes one or two aeromagnetic surveys and the possibility of helicopter traffic in support of drilling of deep stratigraphic and shallow test wells. Aircraft traffic has the potential for space-use conflicts with existing marine uses such as military and NASA use. However, all authorizations for permitted activities would include BOEM guidance for military and NASA coordination, and potential use conflicts are expected to be avoided through coordination with the appropriate military commands and NASA prior to surveys.

Impacts of seafloor disturbance under Alternative B would be essentially the same as for Alternative A (**negligible**). Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures, it is expected that conflicts with other marine uses of the seafloor (e.g., artificial reef sites, dredged material disposal sites, military use areas, etc.) would be avoided. The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of some surveys, but would not change the ultimate extent or severity of seafloor disturbance impacts.

An accidental fuel spill is expected to have **negligible** impacts on other marine uses, and this conclusion would be unchanged under Alternative B. If a small diesel spill were to occur, it could interrupt or interfere with existing uses in a small area for a short time, but given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected. A change in survey scheduling due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.2.3.13. Impacts on Human Resources and Land Use (Chapter 4.3.13)

Relevant IPFs for human resources and land use under Alternative B are the same as those for Alternative A: onshore support activities and accidental fuel spills.

Based on the projected level of G&G survey activity and associated demands for shore base space, supplies, and services, impacts from onshore activities on human resources and land use under Alternative B would be expected to be the same as under Alternative A (**negligible**). The additional time-area closures and limits on concurrent seismic airgun surveys under Alternative B could change the timing of some surveys but would not substantially change the level of onshore support activities or the resulting impacts.

An accidental diesel fuel spill would be expected to have minimal to no impact to either the local economies or populations of the ports and surrounding communities. Based on the accidental diesel fuel release scenario, impacts on human resources and land use under Alternative B would be expected to be the same as under Alternative A (**negligible**). A change in survey scheduling due to the additional closure areas and limits on concurrent seismic airgun surveys would not alter the risk, severity, or extent of these impacts under Alternative B.

2.3. ALTERNATIVE C – NO ACTION FOR OIL AND GAS, STATUS QUO FOR RENEWABLE ENERGY AND MARINE MINERAL G&G ACTIVITY

2.3.1. Description

Under Alternative C, no G&G activities associated with oil and gas exploration (except for remote sensing from satellites) would occur in the Mid- and South Atlantic Planning Areas. Permitting and postlease G&G activities for renewable energy development and marine minerals use would continue to occur on a case-by-case basis.

The G&G activities expected to be conducted in support of renewable energy development in the AOI during the time period covered by the Programmatic EIS are discussed in **Chapter 3.3**. Under the renewable energy program (30 CFR 585), the need for G&G surveys in support of site characterization and foundation studies are part of a developer's planning to secure a commercial competitive or non-competitive lease on the OCS. There are several OCS plans that are part of the renewable energy program, the approval of any of which could result in G&G activities such as geophysical and geotechnical surveys for site assessment and renewable energy facility development. At present, no general activity, site assessment, or construction and operation plans for renewable energy facilities have been filed with BOEM for the Mid- and South Atlantic Planning Areas. Specific locations of future G&G surveys for renewable energy sites are not known at this time. However, for this programmatic analysis, the general areas for renewable energy projects during the time period of the Programmatic EIS have been estimated in terms of numbers of OCS lease blocks offshore Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. The distance from shore for a wind energy facility is generally defined at the outward limit of its economic viability, currently about 46 km (25 nmi) from shore or 100-m (328-ft) water depth.

The G&G activities expected to be conducted in support of marine mineral uses in the AOI during the time period covered by the Draft Programmatic EIS are discussed in **Chapter 3.4**. Under Section 11 of the OCSLA, BOEM may authorize G&G prospecting for non-energy marine minerals on the OCS, except in the case that another Federal agency is performing the survey. Prospecting for and use of sand or gravel in State waters is under jurisdiction of the COE, and G&G surveys are permitted under the NWP Program administered by each district office. The G&G surveys for the Marine Minerals Program have historically occurred (1) under cooperative agreements where State or academic researchers, funded by this Agency, regionally identified and assessed potential offshore sand resources; and (2) under prospecting authorizations and/or in support of non-competitive leasing in advance of and following dredging operations. Exact G&G survey locations and durations are not known at this time. However, sand source areas (borrow areas) are typically located in water depths between 10 and 30 m (33 and 98 ft). Much of the G&G survey activity is expected to occur in the area of known sand resources within or near existing borrow sites offshore the Mid-Atlantic and South Atlantic states (see **Chapter 4.2.12.3** for locations).

2.3.2. Mitigation Measures

At a programmatic level, there are no mitigation measures that apply to G&G activities conducted in support of renewable energy development; however, best management practices were documented in the Programmatic EIS for the renewable energy program (USDOI, MMS, 2007a, p. 2-20). A NEPA evaluation is part of the approval process for OCS plans, without exception, under the renewable energy program. A proposed action at a specific location, tool type, and intensity of G&G activity are subjected to evaluation, which may be an Environmental Assessment or an EIS. The consultations required under environmental law for protected species are part of the NEPA evaluation. Through the NEPA process, BOEM may identify mitigation measures to avoid/minimize environmental impacts during G&G surveys. Mitigation measures may be implemented as a condition for OCS plan approval, or as terms or stipulations for a lease. Additional mitigation measures may be required as a result of consultations under the ESA or MMPA.

Similarly, at a programmatic level, there are no mitigation measures that apply to G&G activities under the marine minerals program. Under Section 11 of the OCSLA, BOEM may authorize G&G prospecting for non-energy marine minerals, except in the case that another Federal agency is performing the survey on the OCS. Before authorizing any proposed prospecting, BOEM undertakes the necessary environmental review, including preparation of a NEPA document and consultations for protected species. Through the NEPA process, BOEM may identify mitigation measures to avoid/minimize environmental impacts during G&G surveys. Mitigation measures may be implemented as a condition for survey authorization.

2.3.3. Summary of Impacts

Impacts associated with Alternative C are discussed in **Chapter 4.4**. Under Alternative C, the impacts associated with G&G activities in support of oil and gas exploration would not occur. The incremental contribution of these activities to cumulative effects would also be eliminated. Permitting and postlease G&G activities for renewable energy development and marine minerals use would continue to occur on a case-by-case basis under Alternative C, and the impacts are summarized by resource in the following sections. A comparative summary of impacts is presented in **Table 2-2**.

2.3.3.1. Impacts on Benthic Communities (Chapter 4.4.1)

Relevant IPFs for benthic communities under Alternative C are active acoustic sound sources, trash and debris, seafloor disturbance, and accidental fuel spills. Because Alternative C would not include seismic airgun surveys or COST wells or shallow drilling in pursuit of oil and gas research or stratigraphic tests, airguns would be eliminated as an active acoustic sound source and drilling discharges would be eliminated as an IPF.

Impacts of active acoustic sound sources on benthic communities were rated as **negligible** under Alternative A. Under Alternative C, removal of airguns as an acoustic source would eliminate any benthic impacts from that type of acoustic source. Electromechanical sources are expected to have **negligible** impacts on benthic communities.

Benthic impacts of trash and debris under Alternative C would be essentially identical to those under Alternative A (**negligible**). Benthic impacts of trash and debris deposition on the seafloor would be expected to be avoided through vessel operators' compliance with USCG and USEPA regulations.

The extent of seafloor disturbance would be reduced slightly under Alternative C as compared with Alternative A. Most of the proposed activities under Alternative A that include bottom sampling would be associated with the renewable energy and marine minerals program areas. The elimination of G&G surveys in support of oil and gas exploration would only slightly reduce the overall number of bottom samples taken. The total area of seafloor disturbance in soft bottom areas would be a very small percentage of the benthic habitat in the AOI. Impacts of seafloor disturbance under Alternative C are expected to be **negligible**.

Impacts of accidental fuel spills on benthic communities were rated as **negligible** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C.

2.3.3.2. Impacts on Marine Mammals (Chapter 4.4.2)

Relevant IPFs for marine mammals under Alternative C are active acoustic sound sources, vessel and equipment noise, vessel traffic, trash and debris, and accidental fuel spills. Because Alternative C would not include seismic airgun surveys or aeromagnetic surveys, airguns would be eliminated as an active acoustic sound source, and aircraft traffic and noise would be eliminated as an IPF. In addition, certain continuous noise sources, such as equipment noise from drilling activities, would be eliminated.

Under Alternative C, the only active acoustic sound sources would be the electromechanical equipment used during HRG surveys for both the renewable energy and marine minerals programs. Electromechanical sources include side-scan sonars, boomer and chirp subbottom profilers, and multibeam depth sounders, some of which are expected to be beyond the functional hearing range of marine mammals or would be detectable only at very close range. Detailed characteristics of active acoustic sound sources are described in **Appendix D**.

Based on the scope of the renewable energy and marine minerals activities that could reasonably be assumed to occur under Alternative C, any marine mammal species within the AOI could be affected. However, based on the analysis in **Appendix E**, it is unlikely that the West Indian manatee or the three pinniped species (gray seal, harbor seal, and hooded seal) would be affected because of their low densities within the AOI. In addition, marine mammals inhabiting primarily shelf-edge or deepwater habitats (e.g., sperm whales, spinner dolphins, etc.) would be unlikely to be exposed to noise from renewable energy or marine minerals surveys, because these surveys would be limited to relatively nearshore waters. Renewable energy surveys are expected to occur in waters less than 100 m (328 ft) deep, and marine minerals surveys are expected to occur in waters less than 30 m (98 ft) deep.

If it is assumed that all of the renewable energy and marine minerals HRG surveys analyzed under Alternative A were conducted between 2012 and 2020 through case-by-case authorizations under Alternative C, the incidental take estimates provided previously in **Chapter 2.1.3** for non-airgun HRG surveys would be a reasonable estimate of potential impacts. The modeling predicts low numbers of Level A harassment (a few individuals per year) for each marine mammal species except the West Indian manatee and the three pinnipeds (all values are zero due to low densities in the AOI). The modeling also predicts Level B harassment of each marine mammal species except the West Indian manatee and the three pinnipeds, with numbers ranging up to several hundred individuals per year (e.g., 92-632 individuals/year for bottlenose dolphin, the species with the highest numbers). All seven of the endangered marine mammal species are predicted to have essentially zero Level A incidental takes using both NMFS 180-dB criterion and the Southall et al. (2007) criteria. Of the endangered species, the highest estimated Level B incidental takes are estimated for the sperm whale (0-12 individuals/year). All of the endangered mysticete whales have estimated Level B incidental takes of <1 individual/year, with the highest being North Atlantic right whale (0.19-0.87 individuals/year).

In conclusion, it is expected that there would be little or no Level A harassment resulting from non-airgun HRG surveys, based on the model predictions and the mitigation that would be expected to be required. Depending on the operating frequencies and source levels of the electromechanical sources used for a particular survey, the underwater noise may be above the hearing range of marine mammals or detectable only at very close range. The most likely and extensive effects of HRG surveys on marine mammals would be behavioral responses (Level B harassment). Manatees and pinnipeds are unlikely to come into contact with active acoustic sound sources, and no acoustic harassment is expected for those species. Because most or all Level A harassment would likely be avoided and because of the low numbers of Level B harassments predicted, overall impacts on marine mammals from non-airgun HRG surveys are expected to be **minor.**

Impacts of vessel and equipment noise under Alternative C would be essentially the same as those under Alternative A (**negligible** to **minor**). Vessel noise may, in some cases, elicit behavioral changes including evasive maneuvers such as diving or changes in swimming direction and/or speed. Based on the proposed volume of vessel traffic associated with project activities within the AOI and the assumption that marine mammals within the AOI are familiar with common vessel-related noises, vessel noise from G&G surveys is not expected to adversely affect marine mammal individuals or populations.

Vessel traffic impacts on marine mammals under Alternative C are expected to be essentially the same as under Alternative A (**negligible**). There is a potential risk that G&G survey vessels could strike and injure or kill marine mammals. However, the risk is low because of the typical slow speed of G&G survey vessels and the expected use of protected species observers to scan the sea surface around survey vessels. In addition, survey vessels would be required to reduce speed in certain areas to comply with the Right Whale Ship Strike Reduction Rule.

Impacts of trash and debris on marine mammals under Alternative C would be essentially identical to those under Alternative A (**negligible**). Impacts would be expected to be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of accidental fuel spills on marine mammals were rated as **negligible** to **minor** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C.

2.3.3.3. Impacts on Sea Turtles (Chapter 4.4.3)

Relevant IPFs for sea turtles under Alternative C are active acoustic sound sources, vessel and equipment noise, vessel traffic, trash and debris, and accidental fuel spills. Because Alternative C would not include seismic airgun surveys or aeromagnetic surveys, airguns would be eliminated as an active acoustic sound source, and aircraft traffic and noise would be eliminated as an IPF.

Impacts of active acoustic sound sources were rated as **negligible** to **moderate** under Alternative A, with the highest impact levels based on the potential disturbance of sea turtles near heavily-used nesting beaches. With the elimination of airguns as a source, HRG surveys of renewable energy and marine minerals sites would use only electromechanical sources such as side-scan sonar, boomer and chirp subbottom profilers, and multibeam depth sounders. Acoustic signals from electromechanical sources other than the boomer are not likely to be detectable by sea turtles, whose best hearing is mainly below 1,000 Hz. The sources are expected to have little or no detectable effect on sea turtles, based on the audibility of the source to sea turtles. The boomer has an operating frequency range of 200 Hz–16 kHz and so may be audible to sea turtles at close range. Therefore, impacts on sea turtles from HRG surveys using only electromechanical sources are expected to be **negligible**.

Impacts of vessel and equipment noise on sea turtles under Alternative C are expected to be essentially the same as under Alternative A (**negligible**). The most likely effects of vessel noise on sea turtles would include behavioral changes and possibly auditory masking. These impacts would not be expected to adversely affect individuals or the population.

Vessel traffic impacts on sea turtles under Alternative C are expected to be essentially the same as under Alternative A (**negligible**). There is a potential risk that G&G survey vessels could strike and injure or kill sea turtles. However, the risk is low because of the typical slow speed of G&G survey vessels and the expected use of protected species observers to scan the sea surface around survey vessels.

Impacts of trash and debris on sea turtles under Alternative C would be essentially identical to those under Alternative A (**negligible**). Impacts would be expected to be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of accidental fuel spills on sea turtles were rated as **negligible** to **minor** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C.

2.3.3.4. Impacts on Marine and Coastal Birds (Chapter 4.4.4)

Relevant IPFs for marine and coastal birds under Alternative C are active acoustic sound sources, vessel and equipment noise, vessel traffic, trash and debris, and accidental fuel spills. Because Alternative C would not include seismic airgun surveys or aeromagnetic surveys, airguns would be eliminated as an active acoustic sound source, and aircraft traffic and noise would be eliminated as an IPF.

Electromechanical sources are expected to have little or no effect on marine and coastal birds; impacts are expected to be **negligible**.

Impacts of vessel traffic and associated vessel and equipment noise to marine and coastal birds were rated as **negligible** to **minor** under Alternative A and would be reduced to **negligible** under Alternative C.

Impacts of trash and debris under Alternative C would be essentially identical to those under Alternative A (**negligible**). Impacts of trash and debris would be expected to be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of accidental fuel spills on birds were rated as **negligible** to **minor** for most bird species, but potentially **negligible** to **moderate** for listed species such as piping plover, roseate tern, red knot, and Bermuda petrel. Under Alternative C, the risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips. However the overall impact rating remains unchanged.

2.3.3.5. Impacts on Fish Resources and Essential Fish Habitat (Chapter 4.4.5)

Relevant IPFs for fish resources and EFH are active acoustic sound sources, vessel and equipment noise, seafloor disturbance, and accidental fuel spills. Because Alternative C would not include seismic airgun surveys or drilling activities, airguns would be eliminated as an active acoustic sound source and drilling discharges would be eliminated as an IPF.

Impacts of active acoustic sound sources were rated as **minor** under Alternative A, mostly because of the use of airguns. With the elimination of airguns as a source, the impacts of electromechanical sources on fishes during HRG surveys are expected to be **negligible**.

All vessels produce underwater noise, and it is likely that fishes in the AOI have habituated to this noise. Sound sources are below levels that can cause temporary hearing loss or injury. Masking and short-term behavior modifications are possible effects. Impacts on fish behavior are expected to be short-term and localized to areas of survey vessel activity. Impacts under Alternative C are expected to be reduced in comparison with Alternative A because of the reduction in vessel traffic and would be **negligible**.

The extent of seafloor disturbance would be reduced slightly under Alternative C as compared with Alternative A. Most of the proposed activities under Alternative A that include bottom sampling would be associated with the renewable energy and marine minerals program areas. The elimination of G&G surveys in support of oil and gas exploration would only slightly reduce the overall number of bottom samples taken. The total area of seafloor disturbance in soft bottom areas would be a very small percentage of the benthic habitat in the AOI. Impacts on demersal fishes and EFH under Alternative C are expected to be **negligible**.

Impacts of accidental fuel spills on fish resources and EFH were rated as **minor** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C.

2.3.3.6. Impacts on Threatened or Endangered Fish Species (Chapter 4.4.6)

Relevant IPFs for threatened or endangered fish species are active acoustic sound sources, vessel and equipment noise, vessel traffic, trash and debris, seafloor disturbance, and accidental fuel spills. Because Alternative C would not include seismic airgun surveys or drilling activities, airguns would be eliminated as an active acoustic sound source and drilling discharges would be eliminated as an IPF.

Impacts of active acoustic sound sources under Alternative A were rated as **negligible** for smalltooth sawfish and shortnose sturgeon because of their rare occurrence in the AOI, and **minor** for alewife, Atlantic sturgeon, and blueback herring. Under Alternative C, with the removal of airguns as an active acoustic sound source, all acoustic impacts on these fishes are expected to be **negligible**.

Impacts of vessel traffic on all five listed fish species would be essentially the same as for Alternative A (**negligible**). Smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon are all demersal species that are unlikely to be affected by vessel and equipment noise (**negligible** impact, same as for Alternative A). Potential impacts of vessel and equipment noise are also expected to be **negligible** for blueback herring and alewife (reduced from **minor** under Alternative A).

Impacts of trash and debris under Alternative C would be essentially identical to those under Alternative A (**negligible**). Benthic impacts of trash and debris deposition on the seafloor would be expected to be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of seafloor disturbance under Alternative C are expected to be essentially the same as under Alternative A (**negligible**) for all of the listed fish species. The extent of seafloor disturbance would be reduced slightly under Alternative C as compared with Alternative A. Most of the proposed activities under Alternative A that include bottom sampling would be associated with the renewable energy and marine minerals program areas. The elimination of G&G surveys in support of oil and gas exploration would only slightly reduce the overall number of bottom samples taken. The total area of seafloor disturbance in soft bottom areas would be a very small percentage of the benthic habitat in the AOI.

Impacts of accidental fuel spills on listed fishes were rated as **negligible** under Alternative A and would be essentially the same under Alternative C. The three listed demersal species (smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon) are the least likely to be affected because a small fuel spill would be unlikely to reach the seafloor or contaminate bottom sediments. Because of their life histories, none of the threatened or endangered fish species would have sensitive eggs or larvae in the water column of the AOI where they would be exposed to accidently spilled diesel fuel. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C.

2.3.3.7. Impacts on Commercial Fisheries (Chapter 4.4.7)

Relevant IPFs for commercial fisheries under Alternative C are active acoustic sound sources, vessel traffic, seafloor disturbance, and accidental fuel spills. The elimination of G&G activities in support of oil and gas exploration would remove airguns and vessel exclusion zones as IPFs.

The impacts of active acoustic sound sources on commercial fisheries were rated as **minor** under Alternative A. Removal of seismic airgun surveys from the scenario would eliminate airguns as an acoustic source, leaving only HRG surveys using electromechanical sources. Impacts on commercial fisheries would be reduced to **negligible** to **minor**.

Under Alternative C, G&G vessel traffic levels would be reduced, lessening the potential for interactions with commercial fishery activities and gear. Impacts could occur at a few locations and would be intermittent, temporary, and short-term. Impacts are expected to be **negligible**.

The extent of seafloor disturbance under Alternative C would be reduced slightly as compared with Alternative A. Most of the proposed activities under Alternative A that include bottom sampling would be associated with the renewable energy and marine minerals program areas. The elimination of G&G surveys in support of oil and gas exploration would only slightly reduce the overall number of bottom samples taken. It is expected that BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures, and therefore most impacts on commercial fishing gear and activities are expected to be avoided. Impacts are expected to be **negligible**.

Impacts of accidental fuel spills on commercial fisheries were rated as **negligible** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C.

2.3.3.8. Impacts on Recreational Fisheries (Chapter 4.4.8)

Relevant IPFs for recreational fisheries are active acoustic sound sources, vessel traffic, and accidental fuel spills. The elimination of G&G activities in support of oil and gas exploration would remove airguns and vessel exclusion zones as IPFs.

The impacts of active acoustic sound sources on recreational fisheries were rated as **negligible** to **minor** under Alternative A. Removal of seismic airgun surveys from the scenario would eliminate airguns as an acoustic source, leaving only HRG surveys using electromechanical sources. Impacts on recreational fisheries would be reduced to **negligible**.

Under Alternative C, G&G vessel traffic levels would be reduced, lessening the potential for interactions with recreational fishing activities and gear. Impacts could occur at a few locations and would be intermittent, temporary, and short-term. Impacts are expected to be **negligible**.

Impacts of accidental fuel spills on commercial fisheries were rated as **negligible** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C.

2.3.3.9. Impacts on Recreational Resources (Chapter 4.4.9)

Relevant IPFs for recreational resources under Alternative C are trash and debris and accidental fuel spills. Only activities for renewable energy development and marine minerals would occur. Because Alternative C would not include seismic airgun surveys, vessel exclusion zones would be eliminated as an IPF.

Impacts of trash and debris on recreational resources (e.g., trash washing up on beaches) under Alternative C would be essentially identical to those under Alternative A (**negligible**). It is expected that impacts would be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of accidental fuel spills on recreational resources were rated as **negligible** to **minor** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C. Given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected.

2.3.3.10. Impacts on Archaeological Resources (Chapter 4.4.10)

Relevant IPFs for archaeological resources under Alternative C are seafloor disturbance and accidental fuel spills. Because Alternative C would not include drilling activities, drilling discharges would be eliminated as an IPF.

The extent of seafloor disturbance under Alternative C would be reduced slightly as compared with Alternative A. Most of the proposed activities under Alternative A that include bottom sampling would be associated with the renewable energy and marine minerals program areas. The elimination of G&G surveys in support of oil and gas exploration would only slightly reduce the overall number of bottom samples taken. However, it is expected that BOEM would require site-specific information regarding potential archaeological resources prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. Therefore, impacts of seafloor disturbance under Alternative C are expected to be essentially the same as for Alternative A (**negligible**).

Impacts of accidental fuel spills on archaeological resources were rated as **negligible** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C.

2.3.3.11. Impacts on Marine Protected Areas (Chapter 4.4.11)

Relevant IPFs for MPAs under Alternative C are active acoustic sound sources, trash and debris, seafloor disturbance, and accidental fuel spills. These are the IPFs that may affect key resources within the MPAs. Because Alternative C would not include seismic airgun surveys or drilling activities, airguns would be eliminated as an active acoustic sound source and drilling discharges would be eliminated as an IPF.

With the removal of airguns as an active acoustic sound source, the impacts on MPAs and the associated resources are expected to be **negligible**. No direct acoustic impacts would be expected on coastal MPAs.

Impacts of trash and debris on MPAs (e.g., trash washing up on beaches) under Alternative C would be essentially identical to those under Alternative A (**negligible**). It is expected that impacts would be avoided through vessel operators' compliance with USCG and USEPA regulations.

Impacts of seafloor disturbance on MPAs under Alternative C would be essentially the same as under Alternative A (**negligible**). The extent of seafloor disturbance would be reduced slightly under Alternative C as compared with Alternative A. Most of the proposed activities under Alternative A that include bottom sampling would be associated with the renewable energy and marine minerals program areas. The elimination of G&G surveys in support of oil and gas exploration would only slightly reduce the overall number of bottom samples taken. The total area of seafloor disturbance in soft bottom areas would be a very small percentage of the benthic habitat in the AOI. Federal regulations prohibit seafloor-disturbing activities within the two NMSs, and BOEM would not authorize such activities within MPAs; therefore, those impacts would not take place. Because BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures, impacts on sensitive benthic communities within other MPAs (e.g., coral, hard/live bottom, chemosynthetic, and deepwater canyon communities) are expected to be avoided.

Impacts of accidental fuel spills on MPAs were rated as **negligible** to **minor** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C. Given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected.

2.3.3.12. Impacts on Other Marine Uses (Chapter 4.4.12)

Relevant IPFs for other marine uses under Alternative C are vessel traffic, seafloor disturbance, and accidental fuel spills. Because Alternative C would not include seismic airgun surveys, vessel exclusion zones would be eliminated as an IPF. Also, because Alternative C would not include any aeromagnetic surveys or helicopter traffic in support of COST or shallow test well drilling, there would be no impacts from aircraft traffic or noise.

Impacts of vessel traffic were rated as **negligible** to **minor** under Alternative A and would remain essentially the same under Alternative C. Vessel traffic has the potential for space-use conflicts with existing marine uses such as shipping and marine transportation, but any impacts would be of relatively short duration.

The extent of seafloor disturbance would be reduced slightly under Alternative C as compared with Alternative A. Most of the proposed activities under Alternative A that include bottom sampling would be associated with the renewable energy and marine minerals program areas. The elimination of G&G surveys in support of oil and gas exploration would only slightly reduce the overall number of bottom samples taken. It is expected that BOEM would require prior approval of any G&G surveys involving seafloor-disturbing activities or placement of bottom-founded equipment or structures. Therefore, conflicts with other marine uses of the seafloor (e.g., artificial reef sites, dredged material disposal sites, military use areas, etc.) are expected to be avoided, and impacts under Alternative C would remain **negligible**.

Impacts of accidental fuel spills on other marine uses were rated as **negligible** under Alternative A and would be essentially the same under Alternative C. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C. Given the small size of the spill in the proposed action scenario, a large-scale spill response involving multiple vessels is not expected.

2.3.3.13. Impacts on Human Resources and Land Use (Chapter 4.4.13)

Relevant IPFs for human resources and land use under Alternative C are onshore support activities and accidental fuel spills. Under Alternative C, the level of onshore support activities would be reduced because surveys in support of oil and gas exploration would not occur. The risk of accidental fuel spills would also be reduced because there would be fewer surveys and vessel trips.

Under Alternative A, impacts from onshore activities on human resources and land use under were rated as **negligible** based on the projected level of G&G survey activity and associated demands for shore base space, supplies, and services. The removal of G&G surveys in support of oil and gas exploration would substantially reduce the vessel traffic, removing over 90,000 hr (3,725 days) of vessel activity during the 2012-2020 time period. Vessels conducting G&G surveys or sampling for renewable energy would operate mainly at specific sites in water depths less than 100 m (328 ft) and along potential cable routes to shore. Typically, these are smaller vessels that would return to their shore base daily. Vessel trips associated for renewable energy areas would be divided among several existing ports in Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. Depending on the location of the renewable energy area, the surveys could operate from one of the five larger ports in the AOI, or any of numerous smaller ports along the coast, depending on whatever is convenient. Potential impacts on human resources and land use would remain **negligible** under Alternative C.

Impacts of accidental fuel spills on human resources and land use would remain **negligible** under Alternative C. An accidental diesel fuel spill would be expected to have minimal to no impact to either the local economies or populations of the ports and surrounding communities. The risk of an accidental fuel spill would be less because of the reduction in the number of surveys and vessel trips under Alternative C.

2.4. ISSUES

Issues are defined by the CEQ to represent those principal "effects" that an EIS should evaluate in-depth. Scoping identifies specific environmental resources and/or activities rather than "causes" as significant issues (CEQ, 1981). The analysis in the EIS can then show the degree of change from present conditions for each issue due to the relevant actions related to the proposed action. Selection of environmental and socioeconomic issues to be analyzed in this Draft Programmatic EIS was based on the following criteria:

- issue is identified in CEQ regulations as subject to evaluation;
- the relevant resource/activity was identified through agency expertise, through the scoping process, or from comments on past EISs; or
- the resource/activity may be vulnerable to one or more of the IPFs associated with the OCS Program; a reasonable probability of an interaction between the resource/activity and IPF should exist.

The public scoping process for this Draft Programmatic EIS was conducted from April 2 to May 17, 2010 and is described in **Chapter 5**. Public scoping meetings were held in seven cities (Houston, Texas; Jacksonville, Florida; Savannah, Georgia; Charleston, South Carolina; Newark, New Jersey; Norfolk, Virginia; and Wilmington, North Carolina). In addition to accepting oral and written comments at each public meeting, BOEM accepted written comments by mail and through a dedicated email address. The BOEM received a total of 965 comments through email (75%), formal letters (18%), and public meeting testimony (7%). Each comment was read and categorized according to its source and the nature of the information provided in the comment. The scope and content of this Draft Programmatic EIS have been structured to ensure that the issues and concerns expressed by stakeholders during the scoping process are fully addressed.

2.4.1. Issues to be Analyzed

This Draft Programmatic EIS addresses issues associated with various G&G activities, including potential IPFs and related impacts on environmental and socioeconomic resources and activities characteristic of the AOI. In addition, this Draft Programmatic EIS addresses the potential environmental and socioeconomic effects of accidents on AOI resources and considers cumulative impacts (i.e., the incremental impacts on AOI resources associated with the project alternatives).

The following issues were identified for detailed analysis:

- impacts of underwater noise on marine mammals, sea turtles, fishes, birds, and other marine life;
- impacts of underwater noise on commercial and recreational fishing (fish catch);
- impacts of vessel traffic (risk of ship strikes) on marine mammals and sea turtles, birds, and threatened and endangered fish species;
- impacts of vessel traffic on fishing, shipping, and other marine uses;
- impacts of aircraft traffic and noise on marine mammals, sea turtles, birds, and other marine uses;
- impacts of seafloor-disturbing activities on sensitive benthic communities including coral and hard/live bottom communities, chemosynthetic communities, and deepwater canyon benthos;

- impacts of seafloor-disturbing activities on EFH, HAPCs, and MPAs;
- impacts of seafloor-disturbing activities on archaeological resources including historic shipwrecks and prehistoric archaeological sites;
- impacts of exclusion zones on commercial and recreational fishing, shipping, recreational resources, and other marine uses;
- impacts of marine trash and debris on benthic communities, marine mammals, sea turtles, birds, endangered or threatened fish species, and recreational resources; and
- impacts of accidental spills on benthic communities, marine mammals, sea turtles, birds, fishes and EFH, archaeological resources, recreational resources, MPAs, other marine uses, and human resources and land use.

2.4.2. Issues Considered but Not Analyzed

As part of the scoping process, CEQ regulations require agencies to identify and eliminate from detailed study the issues that are not significant to the proposed action, have been covered by prior environmental review, or do not fulfill the purpose and need of the proposed action. **Chapter 4.1.1** describes the screening process for impact analysis and identifies issues that were considered but not analyzed in detail. Examples include impacts of underwater noise on plankton; impacts of seafloor-disturbing activities on geology and sediment quality; impacts of vessel effluents on water quality; and impacts of vessel and aircraft emissions on air quality.

2.5. ALTERNATIVES CONSIDERED BUT NOT ANALYZED

The following additional alternatives were identified during the scoping process. For the reasons identified under each, they are not considered for detailed analysis in this Draft Programmatic EIS.

2.5.1. Limit Permitting G&G Activities to Renewable Energy and Marine Minerals

Under this alternative, the BOEM would permit G&G activities for siting renewable energy and marine minerals program areas only, excluding G&G activities for oil and gas exploration and development. This alternative would be essentially identical to Alternative C (No Action for Oil and Gas, Status Quo for Renewable Energy and Marine Minerals G&G Activity).

At present, G&G activities for siting renewable energy and marine minerals are authorized in all planning areas of the Atlantic, and there is no compelling programmatic need to entertain such an evaluation unless a new and potentially significant stressor is potentially introduced. That stressor would be deep penetration seismic surveying for oil and gas exploration, which is not currently permitted in the Atlantic because these planning areas have been under moratoria for so long. There is a need for evaluating Atlantic areas now that the U.S. Congress has indicated that it is contemplating oil and gas exploration there. The BOEM elects to carry out this evaluation in context of all G&G activities potentially able to be authorized by it in the three program areas. Further, the conference report to the U.S. House of Representatives addressing appropriations (Report 111-316) notes the following:

> The conferees support the Administration's efforts to secure a balanced energy portfolio that carefully weighs what is in the best interest of our energy-dependent nation with what is in the best interest of our natural environment. Future coordinated efforts to pursue additional oil and gas resources in the Outer Continental Shelf (OCS) must include the opportunity to apply advanced technologies, be based on the best available science, and take into account the potential environmental impacts of such potential development. Therefore, the conferees direct the Minerals Management Service, pursuant to the National Environmental Policy Act, to conduct a Programmatic Environmental Impact Statement (Programmatic EIS) to evaluate potential significant environmental effects of multiple geological and geophysical activities in the Atlantic OCS and provide a detailed timeline for completion of the Programmatic EIS no later than 90 days after enactment of this Act. The conferees believe this request is consistent with the Department's stated desire to fill in information gaps relating to resource potential in the OCS.

Under Section 18 of the OCSLA, the Secretary is required to prepare and maintain a schedule of proposed OCS oil and gas lease sales determined to "best meet national energy needs for the 5-year period following its approval or reapproval." As this NEPA evaluation has been directed by the Congress using the language above, it is clearly intended that the evaluation expressly consider the G&G activities in support of oil and gas exploration. To not consider these activities would render this potential alternative identical to the current Alternative C.

2.5.2. Expand Permitted G&G Activities into the North Atlantic Planning Area

Under this alternative, BOEM would expand the AOI to include the North Atlantic Planning Area. This alternative would address an interest expressed by G&G industry representatives to expand permitted G&G operations. Industry has noted that G&G data from the North Atlantic would help to define regional geologic structures extending from Nova Scotia to the Mid-Atlantic. According to the G&G industry, this information could aid in assessing resource potential in the Mid- and South Atlantic Planning Areas.

The BOEM has eliminated this alternative from detailed analysis because there are no reasonably foreseeable oil and gas lease sales or exploration activities in the North Atlantic Planning Area over the time horizon of this Draft Programmatic EIS (10 years). There are no existing oil and gas leases anywhere in the Atlantic OCS. A December 2010 decision by the USDOI removed the North Atlantic Planning Area from leasing consideration until 2017 (USDOI, BOEM, 2010). As a consequence, BOEM projects limited oil and gas interest in this planning area. Under the current 5-year program released in November 2011 (USDOI, BOEM, 2011c), the earliest that USDOI would consider leasing in the North Atlantic or any other Atlantic planning area would be 2016, when the next 5-year national leasing program is drawn up. A change in administration could result in new OCS policies and preparation of a new 5-year leasing program.

Interest in renewable energy in the North Atlantic Planning Area has been noteworthy, including the Cape Wind installation site in Nantucket Sound, offshore Massachusetts, as well as prospective renewable energy sites offshore New Jersey, New York, Massachusetts, and Rhode Island. The BOEM website provides state-by-state summaries of renewable energy activities (USDOI, BOEM, 2012a). Especially enabling for wind energy on the North Atlantic OCS would be the Atlantic Wind Connection (AWC) proposal for a trunk line electrical cable on the OCS between Norfolk, Virginia, and the area south of New York City. The AWC would allow offshore wind facilities to tie-in to the onshore electrical grid at points adapted to receive wind-generated electricity (Dvorak, 2010). Planning with respect to renewable energy development in all of these areas is tentative, and it remains uncertain whether commercial leasing will proceed during the next several years. Commercial wind leasing projects announced in popular media may not proceed at the pace anticipated; there is a considerable learning curve for installing and operating wind facilities offshore as well as completing the regulatory approvals now required (USDOI, MMS, 2009d). Planning and G&G activities could proceed for these and other renewable energy projects on a case-by-case basis, as explained in Alternative C above. Permitting of G&G resource assessment activities for renewable energy and development of marine minerals would continue to occur on a case-by-case basis with site-specific plan review and approvals.

Expanding permitted G&G activities into the North Atlantic Planning Area would not meet the stated purpose and need as it would provide data for an area where no foreseeable oil and gas leasing or exploration activities are expected within the timeframe of this analysis.

2.5.3. Reprocess Existing G&G Data

Under this alternative, the G&G industry would reprocess existing data, collected mainly during the late 1970's and 1980's, rather than receiving permits to conduct new surveys. Under this alternative, existing G&G data would be reprocessed, made available for resource evaluation purposes, and used for decision-making.

Geological and geophysical surveys were last performed in the Atlantic nearly 20 years ago, and all of these collected two-dimensional (2D) seismic data. Advances in instrumentation, technology, and computer processing speed since that time have resulted in data gathering techniques, equipment, and imaging technology capable of providing far more accurate and dependable data. Modern oil and gas operators evaluate potential prospects on the basis of three-dimensional (3D) seismic data, which is not now available in the U.S. Atlantic OCS Area of Interest.

The existing seismic surveys in the Atlantic are suitable for identifying large geologic structures potentially suitable for economic oil and gas resources, but using such surveys to optimally site a well or a well field, or to interpret the content of formation fluids or gases, is not feasible. Risk assessment teams in modern oil and gas companies assess prospect portfolios on the basis of risk elements that cannot be reduced without modern seismic data.

No amount of digital reprocessing can add information that was not contained in the original data. New surveys conducted with current technology would significantly improve the ability of both industry and government to predict where, and in what quantity, fossil fuels can be found. Additionally, the reprocessing of existing G&G data would not alleviate the need for high-resolution, site-specific G&G data to locate bottom-founded structures for oil and gas exploration or renewable energy installations, or potential marine mineral borrow locations.

Reliance on existing data, or digitally reprocessed data, does not meet the stated purpose and need as it does not provide accurate data on which to base regulatory and industry decisions.

2.5.4. Delay the Permitting Process

Under this alternative, BOEM would delay G&G activities until more baseline information is available to evaluate impacts or until improved mitigation methods are developed and tested.

The BOEM has determined that the information available today is adequate to evaluate impacts of G&G activities for decision-making, particularly at the programmatic level. Seismic airgun surveys and other G&G activities evaluated in this Draft Programmatic EIS are conducted in the U.S. waters (e.g., in the Gulf of Mexico and Alaska and, to a limited extent, along the Atlantic coast for renewable energy, marine minerals, and other activities). These activities have been permitted (including issuance of incidental take authorizations) based on the current level of knowledge of baseline conditions and mitigation measures. Therefore, there is no reason to delay while awaiting new information. In addition, this alternative fails to meet the purpose and need as it would impede the timely environmental evaluation of exploration techniques.

The BOEM also has determined that a delay to await future mitigation developments is not necessary because the proposed action includes an adaptive management approach that would incorporate new technology and improved mitigation measures as they are developed and proven efficacious.

Delaying the permitting process, therefore, does not meet the stated purpose and need.

2.5.5. Consolidate and Coordinate Surveys

Under this alternative, 2D and 3D seismic exploration surveys would be consolidated and/or coordinated through one private or Federal entity or would be processed through an independent panel of experts (to be established) to compile applications into a survey plan that eliminates duplication of survey effort. Industry G&G operators perform roughly the same type of assessment for maximum utility for many types of surveys based on characteristics and parameters they know are desired by industry. Operators may then conduct surveys on "spec," meaning that the G&G operator sells a license to multiple users of the survey output.

The BOEM has eliminated this alternative from detailed analysis because Alternative B achieves a similar purpose by limiting concurrent surveys. In addition, although multiple applications for 2D seismic exploration surveys in the AOI have been submitted by G&G operators, BOEM expects that overlapping coverage would be minimal because of the expense of conducting large-scale surveys. Finally, this alternative would not eliminate the need for site-specific surveys in support of individual development projects (oil and gas, renewable energy, or marine minerals). As a leasing and permitting agency that administers Federal lands, BOEM acts upon requests to use it; BOEM does not direct the actions of operators in the private sector or compel business decisions. Likewise, it is not within the mission of this Agency to directly undertake the proposed G&G activities, except in the rare circumstance BOEM is part of a joint industry project. Therefore, an expectation that BOEM may directly undertake such work or direct that such work be done by private companies is not in conformance to the principles of USDOI governance.

There are more research-oriented parts of the Federal government under which actions to consolidate and coordinate exploration surveys could conceivably take place; for example, the USDOE and the U.S. Geological Survey (USGS). Such G&G work, however, would only be done in furtherance of a company or operator acquiring a lease on Federal lands to develop a resource, and neither the USGS nor USDOE are charged with the leasing of Federal OCS lands or the consolidation and coordination of exploration research on the OCS. These agencies have never sought this authority.

This alternative was not analyzed further because its main benefit (a limit on concurrent surveys) is already addressed by Alternative B. In addition, consolidating and coordinating surveys would require the creation of another untested series of regulatory controls and reviews and does not clearly fall under the mandates of this Agency or the USDOE or USGS.

2.5.6. Require Non-Airgun Acoustic Sources

Under this alternative, the BOEM would not authorize the use of airguns as sound sources for seismic surveys. Industry would have to rely on other measures to obtain accurate data on the location and extent of hydrocarbon resources, including alternative acoustic source technologies that produce less underwater noise and reduce the potential for impacts on marine life.

Alternatives to airguns are discussed briefly below, with additional details in **Appendix C** of this Draft Programmatic EIS. Examples include the following:

- marine vibrators;
- low-frequency acoustic source (LACS) (patented);
- deep-towed acoustics/geophysical system (DTAGS);
- low-frequency passive seismic methods;
- low-impact seismic array (LISA);
- fiber optic receivers allowing smaller airguns; and
- airgun modifications to lessen impacts.

The following discussion is based in part on the Okeanos Seismic Airgun Alternatives Workshop (Weilgart, 2010). In 2009, an international, multi-disciplinary group of geophysical scientists, seismologists, biologists, and regulators met in Monterey, California, to discuss potential alternatives and/or modifications to airguns and airgun array configurations in order to minimize the potential impacts from airguns (Weilgart, 2010). The Okeanos Seismic Airgun Alternatives workshop panelists discussed promising new imaging technologies that are either completely silent or that can lessen the amount of seismic sound required to gather seismic data, thereby still allowing for a reduction of the economic risk of hydrocarbon recovery. Workshop panelists acknowledged that these technologies are purpose-driven and do not work in all circumstances.

2.5.6.1. Marine Vibrators (Vibroseis)

2.5.6.1.1. Hydraulic

In 1985, Industrial Vehicles International, Inc. (IVI) offered the first commercial marine vibrator system (IVI, 2003). The developed system consists of a marine vibrator, vibrator controller, and a power unit. The marine vibrator contains a piston within a housing with power supplied to the electrical, pneumatic, and hydraulic systems by the power unit. An alternator, air compressor, and two pressure-driven hydraulic pumps are driven by an air-cooled diesel engine. The source is capable of generating modulated frequencies between 10 and 250 hertz (Hz) and can be used in water depths as shallow as 1 m (3 ft). Signals are generated by conventional land vibrator controllers (IVI, 2010).

The system has been tested in various environments from transition zones to deepwater. Acoustic performance tests conducted at the Seneca Lake Facility of the Naval Underwater Systems Center in 1988 evaluated the system and determined that the marine vibrator was deficient in the low frequencies (Johnston, 1989; Walker et al., 1996). A comparison of marine vibrator, dynamite, and airgun sources in southern Louisiana concluded that the marine vibrator was a viable source for environmentally sensitive areas (Potter et al., 1997; Smith and Jenkerson, 1998). In transition zones, when coupled with the seafloor, marine vibrators operate like a land vibrator (Christensen, 1989). The best performance is on a seafloor, which distributes the vibrator's forces.

Initial deepwater tests were conducted in the Gulf of Mexico by Geco-Prakla using a vibrator with an energy output approximately equivalent to a 1,000 in^3 airgun. Despite limitations of low-frequency energy, good definition of reflectors down to 3 s indicated that the system was viable (Haldorsen et al., 1985). In 1996, a commercial field test comparing a six-marine-vibrator array with a single 4,258 in^3 airgun was undertaken in the North Sea by Geco-Prakla with the objectives of evaluating cost, reliability, production rate and quality of the geophysical data. After 2 weeks of data collection, a comparison between the marine vibrator and the airgun data indicated that the marine vibrator data contained more frequency content above 30 Hz and less frequency content below 10 Hz than the airgun data, but overall the data were comparable. Marine vibrator production rates were slightly lower than those of the airgun, but by the end of the survey, the technical downtime of the marine vibrator was similar to the airgun (Johnson et al., 1997).

Geco-Prakla, a subsidiary of Schlumberger, operated the marine vibrator program, conducting surveys and tests until 2000 when the exclusive-use agreement between IVI and Schlumberger expired (Bird, 2003). IVI continued to further develop the system into the early 2000's, but they are no longer actively marketing the product because there is no client base for the system. The significant expense to retrofit the marine exploration companies' ships to support marine vibrators is not offset by reduced operation costs or better data quality. IVI presently has marine vibrator systems that could be used for seismic data collection, but they would require renovation prior to deployment, which could take 3 months to a year (E. Christensen, Vice President IVI, personal communications with J. Lage, BOEM, 2010).

2.5.6.1.2. Electric

Petroleum Geo-Services (PGS) began developing an electro-mechanical marine vibrator in the late 1990's. The original system consists of two transducers: the lower frequency (6-20 Hz) "Subtone" source and the higher frequency (20-100 Hz) "Triton" source (Tenghamn, 2005, 2006). Each vibrator is composed of a flextensional shell that surrounds an electrical coil, a magnetic circuit, and a spring element. The sound in the water column is generated by a current in the coil, which causes the spring elements and shell to vibrate. Mechanical resonances from the shell and spring elements allow very efficient, high power generation (Tenghamn, 2005, 2006; Spence et al., 2007). The source tow-depth, generally between 5 and 25 m (16 and 82 ft) below the sea surface, is selected depending on the frequency and enhancement from the surface reflection which, to a certain degree, directs the acoustic signal downwards.

The reduction of the overall sound level and specifically the frequencies above 100 Hz, which are beyond the useful seismic range, is a major advantage of the system. Another is the reduction of acoustic power in comparison with conventional seismic sources, which occurs because the net source energy is spread over a long period of time (Tenghamn, 2005, 2006).

This system was compared to a 760 in^3 airgun along a 2D line in shallow water. A comparison of the data demonstrates that the marine vibrator equals the penetration of the airgun down to 5.5 s two-way travel time (TWT) while emitting less acoustic energy into the water. A second test comparing dynamite to the vibrators was run in the transition zone (1.2-1.8 m [4-6 ft] of water). The transducers were mounted in a frame that was placed on the seabed. The vibrators lost the low-frequency component because of attenuation of the signal, limiting the depth of penetration to approximately 2 s TWT. However, in the shallower sections imaged by the vibrator, the two sources compared favorably (Tenghamn, 2005, 2006). Most of the trials have been conducted in shallow water (<100 m [<328 ft]); deeper water tests need to be run to determine performance depth range of the system (Tenghamn, 2010).

During the early period of development, the system proved the concept that it worked as a source for seismic data. However, unreliability prevented it from becoming a commercial system. PGS spent 2006 and 2007 conducting a feasibility study to improve reliability and testing a newly developed prototype. After that work, PGS developed three additional systems that are currently being tested. PGS does not have a commercial system available for data collection at this time. They project that, if funds were available, it would take 2-4 years to fully develop and test a system for commercial use (R. Tenghamn, VP Innovation and Business Development PGS, pers. comm. to J. Lage, BOEM, 2010).

2.5.6.2. Low-Frequency Acoustic Source (patented) (LACS)

Originally designed as a ship sound simulator for the Norwegian navy, the LACS is being promoted as an alternative source for seismic acquisition (Weilgart, 2010). The LACS system is a combustion engine with a cylinder, spark plug, two pistons, two lids, and a shock absorber. It creates an acoustic pulse when two pistons push lids vertically in opposite directions; one wave reflects from the sea surface and combines with the downward moving wave. There is no bubble noise from this system as all air is vented and released at the surface, not into the underwater environment. The absence of bubble noise allows the system to produce long sequences of acoustic pulses at a rate of 11 shots per second; this allows the signal energy to be built up in time with a lower amount of energy put into the water (Askeland et al., 2007, 2009). The system design also controls the output signal waveform, which can reduce the amount of non-seismic (>100 Hz) frequencies produced (Spence et al., 2007). The transmitted pulses are recorded by a near-field hydrophone and seafloor and sediment reflections are recorded by a far-field streamer (Askeland et al., 2007, 2009).

Two LACS systems are being offered commercially. The LACS 4A has a diameter of 400 mm (15.7 in), a height of 600 mm (24 in), and a weight of approximately 100 kilograms (kg) (220 pounds [lb]) in air. Pulse peak-peak pressure is 218 dB re 1 µPa at 1 m. Field test results of the LACS 4A system demonstrate that the system is capable of accurately imaging shallow sediments (~230 m [755 ft]) within a fjord environment (Askeland et al., 2008, 2009). This system is suitable for shallow penetration towed-streamer seismic surveys or vertical seismic profiling (Askeland et al., 2008).

The second system, the LACS 8A, theoretically has the potential to compete with a conventional deep penetration airgun seismic array. The LACS 8A system has pulse peak-peak pressure of 3 Bar meter or 230 dB re 1 µPa @ 1 m. The weight is 400 kg (880 lb), and the diameter is 800 mm (31.5 in). Several LACS units may be operated together to provide an increased pulse pressure (Bjørge Naxys AS, 2010). This system currently does not exist, and the project is presently on hold. It would take at least 18 months to build and field test one of these systems if money came available to do so (J. Abrahamsen, Managing Director Bjørge Naxys, pers. comm. to J. Lage, BOEM, 2010).

2.5.6.3. Deep-Towed Acoustics/Geophysics System (DTAGS)

The Navy developed a DTAGS to better characterize the geoacoustic properties of abyssal plain and other deepwater sediments. The system was tested and modified in the early 1990's and used in various locations around the world until it was lost at sea in 1997 (Gettrust et al., 1991; Wood et al., 2003).

The second generation DTAGS is based on the original design but with more modern electronics. It uses the same Helmholtz resonator source consisting of five concentric piezoelectric ceramic rings sealed in an oil-filled rubber sleeve to generate a broadband signal greater than 2 octaves. The optimum frequency performance range is between 220 and 1,000 Hz with a source level of 200 dB re 1 µPa @ 1 m, which is a major improvement over the original DTAGS. The source is extremely flexible, allowing for changes in waveform and decrease in sound level to produce a source amplitude, waveform, and frequency to suit specific requirements (Wood et al., 2003; Wood, 2010).

The DTAGS is towed behind a survey vessel usually at a level of 100 m (328 ft) above the seafloor and a vessel speed of 3.7 km/hr (2 kn); it can operate at full ocean depths (6,000 m [19,685 ft]). A 450-m (1,476 ft), 48-channel streamer array is towed behind the source to record the reflected signals. The DTAGS can also be configured with an aluminum landing plate, which transmits the acoustic energy directly into the seafloor. With this configuration, vertical bottom-founded hydrophone arrays are used to receive reflections (Breland, 2010).

Proximity of the acoustic source to the seafloor is an advantage of the DTAGS. The system has a limit of 1 km (0.6 mi) penetration in most marine sediments (Wood et al., 2003). It has been used successfully to map gas hydrates in the Gulf of Mexico (Wood et al., 2008), Canadian Pacific (Wood and Gettrust, 2000; Wood et al., 2002), and Blake Ridge (Wood and Gettrust, 2000).

There is only one DTAGS in existence at this time. While it has imaged shallow sediments and gas hydrate environments extremely well, the current tool design could not replace a deep penetration airgun array for oil and gas exploration at this time; DTAGS was not designed for this purpose. However, there is no physical limitation to designing a resonant cavity source to simulate the frequency band of airguns.

2.5.6.4. Low-Frequency Passive Seismic Methods for Exploration

Low-frequency passive seismic methods utilize microseisms, which are faint tremors caused by the natural sounds of the earth, to image the subsurface. A typical survey consists of highly sensitive receivers (usually broadband seismometers) placed in the area of interest to collect data over a period of time. Upon completion of the survey, the data are analyzed and filtered to remove all non-natural sounds, which is most efficiently completed using an automated process (Hanssen and Bussat, 2008).

All of the current methods use one of following three sources of natural sounds: natural seismicity, ocean waves, or microseism surface waves.

Natural seismicity uses the earth's own movements as a source of energy. Two techniques have been developed to use this energy source. Daylight imaging (DLI) uses the local seismicity of an area to produce reflection seismic profiles, similar to those recorded in active seismic surveys (Claerbout, 1968). As in active reflection seismic operations, geophones are deployed; the target can be imaged using a regularly spaced 2D line geometry (Hohl and Mateeva, 2006; Draganov et al., 2009). The seismicity of the area, geologic complexity, and receiver sensitivity control the record length. DLI can augment active seismic data, where it is difficult to collect data. Local earthquake tomography (LET) also uses local seismicity of a region to map on the reservoir scale (Kapotas et al., 2003). However, it is used to calculate the velocity structure of the subsurface in 3D by analyzing each earthquake on multiple receivers and generating ray paths instead of cross-correlating the recorded signals. This method requires a longer period of data collection than the other methods to produce results.

Ocean waves are used as a sound source for the seafloor compliance (SFC) technique. The method requires that ocean bottom seismometer (OBS) stations with highly-sensitive, broadband seismometers and differential or absolute pressure gauges be installed in water several hundred meters deep. In the right setting, a coarse one-dimensional (1D) S-wave velocity model of the subsurface down to the Moho can be generated using the measured water pressure and vertical movement of the seabed caused by large passing ocean waves (Crawford and Singh, 2008).

Ambient-noise (surface-wave) tomography [AN(SW)T] uses low-frequency (between 0.1 and 1 Hz) ambient noise records to estimate shear wave velocities and structural information about the earth. The ambient noise used consists mainly of microseism surface waves (Rayleigh and Love waves) (Bussat and Kugler, 2009). This technique requires the use of broadband seismometers to record the low-frequency surface waves, which can penetrate to depths of several kilometers (Bensen et al., 2007, 2008). Because the marine environment produces abundant, high-energy surface waves, a few hours or days of acquisition can produce good quality data. AN(SW)T can be used in areas where seismic data are difficult to collect or in environmentally sensitive areas. While this technology is new and still in need of further testing, the lateral resolution at several kilometer depths may reach a few hundred meters, and the resolution may be better than gravimetric or magnetic data, which is promising for oil and gas exploration (Bussat and Kugler, 2009).

Surface-wave amplitudes (SWAs) is a method that images the geological structure of the subsurface by analyzing passive acoustic data that have not been geophysically processed. The transformation of incoming micro-seismic surface waves, scattered at vertical discontinuities, into body waves may produce these data, but the process is not well understood (Gorbatikov et al., 2008).

Low-frequency spectroscopy (LFS), also known as low-frequency passive seismic (LFPS) or hydrocarbon microtremor analysis (HyMAS), tests for an indication of subsurface hydrocarbon accumulation using spectral signatures gathered from the ambient seismic wave field recorded by broadband seismometers. The cause of the spectral anomalies, often called direct hydrocarbon indicators (DHIs), is presently unknown, but the following reasons have been proposed: standing wave resonance, selective attenuation, resonant amplification (Graf et al., 2007), and pore fluid oscillations (Frehner et al., 2006; Holzner et al., 2009). Energy anomalies in the frequency range between 1 and 6 Hz have been observed in known hydrocarbon areas including Mexico (Saenger et al., 2009), Abu Dhabi (Birkelo et al., 2010), Brazil, Austria (Graf et al., 2007), and southern Asia (West et al., 2010). However, this methodology is highly dependent on the ability to process out all anthropogenic noise and topography (Hanssen and Bussat, 2008). This method is still in the early stage of development and has not been confirmed in the field during all studies (Ali et al., 2007; Al-Faraj, 2007).

The most successful use of low-frequency passive micro-seismic data has been on land, where it is easier to isolate the extraneous noise from the natural signal. The technique is also promising in the marine environment. To ensure success of a marine survey: (1) it is imperative that the recording instruments are in proper contact with the substrate (the natural signal may not be accurately recorded in unconsolidated material) and (2) the increase in both anthropogenic and naturally produced noise in the marine environment is correctly filtered so that it does not mask the signal of interest.

Passive seismic surveys cannot replace active seismic acquisition. However, passive acoustic data have the potential to enhance oil recovery at a better resolution than magnetic or gravimetric methods (Bussat and Kugler, 2009), especially in areas that are environmentally sensitive or where active seismic operations are difficult.

2.5.6.5. Low-Impact Seismic Array (LISA)

Nedwell (2010) describes the concept of a LISA based on the use of inexpensive but powerful and rugged electromagnetic projectors to replace airgun arrays. The prospective benefit was that since the signal could be well controlled, both in frequency content and in the direction in which the sound propagated, the possibility existed of undertaking seismic surveys in environmentally sensitive areas with little or no collateral environmental impact.

The LISA project embodies the idea of using a large array of small but powerful electromagnetic projectors to replace airgun arrays. Initial measurements were made on a small ($n = 4$) array of existing electromagnetic transducers. It was found that a source level of about 142 dB re 1 μPa per volt @ 1 m was achieved, at a peak frequency of 25 Hz. The operating frequency could be reduced to below 10 Hz with reasonable modifications, allowing use of an array for seismic exploration. The results indicate that it would be possible to achieve an array source level of about 223 dB re 1 μPa @ 1 m, which is adequate for seismic surveying.

2.5.6.6. Fiber Optic Receivers

Short of replacing seismic airguns, improvements in fiber optic sensing and telemetering could allow use of smaller airguns and airgun arrays in the future (Nash and Strudley, 2010). Fiber optic receivers are receivers that incorporate optical fibers to transmit the received acoustic signal as light. They are most frequently used in the petroleum industry for seismic permanent reservoir monitoring, a four-dimensional (4D) reservoir evaluation application. The optical receivers are permanently placed on the seafloor, ensuring consistency and repeatability of the 4D surveys, better signal-to-noise ratios, and quality of subsequently collected data. Fiber optic systems are not new. Fiber optical components have been used by the military for years in similar applications for antisubmarine warfare and area surveillance and have proven to be highly reliable.

Fiber optic receivers are more sensitive than standard receivers, which allows for smaller airgun arrays to be used. While these receivers offer a benefit to the environment through a decrease in airgun noise, this technology is not presently available for towed-streamer surveys.

Fiber optic receivers typically are used in areas with large-scale oil and gas production requiring 4D monitoring. They would not be expected to be used in the Atlantic OCS during the time period of the Draft Programmatic EIS because there are no active leases and only very limited exploration activities could occur between 2018-2020 if leasing is allowed (**Chapter 3**).

2.5.6.7. Airgun Modifications to Lessen Impacts

In addition to alternative methods for seismic data collection, industry and the public sector have actively investigated the use of technology-based mitigation measures to lessen the impacts of airguns in the water.

2.5.6.7.1. Airgun Silencers

One such measure, an airgun silencer, which has acoustically absorptive foam rubber on metal plates mounted radially around the airgun, has demonstrated 0-6 dB reductions at frequencies above and 0-3 dB reductions below 700 Hz. This system has been tested only on low pressure airguns and is not a viable mitigation tool because it needs to be replaced after 100 shots (Spence et al., 2007).

2.5.6.7.2. Bubble Curtains

Bubble curtains generally consist of a rubber hose or metal pipe with holes to allow air passage and a connector hose attached to an air compressor. They have successfully been tested and used in conjunction with pile driving and at construction sites to frighten away fishes and decrease the noise level emitted into the surrounding water (Würsig et al., 2000a; Sexton, 2007; Reyff, 2009). They have also been used as stand-alone units or with light and sound to deflect fishes away from dams or keep them out of specific areas (Pegg, 2005; Weiser, 2010).

The use of bubbles as a mitigation for seismic noise has also been pursued. During an initial test of the concept, the sound source was flanked by two bubble screens; it demonstrated that bubble curtains were capable of attenuating seismic energy up to 28 dB at 80 Hz while stationary in a lake. This two-bubble curtain configuration was field tested from a moving vessel in Venezuela and Aruba where a 12-dB suppression of low-frequency sound and a decrease in the sound level of laterally-projecting sound was documented (Sixma, 1996; Sixma and Stubbs, 1998). A different study in the Gulf of Mexico tested an "acoustic blanket" of bubbles as a method to suppress multiple reflections in the seismic data. The results of the acoustic blanket study determined that suppression of multiples was not practical using the current technology. However, the acoustic blanket measurably suppressed tube waves in boreholes and has the capability of blocking out thruster noises from a laying vessel during an ocean bottom cable survey, which would allow closer proximity of the shooting vessel and increase productivity (Ross et al., 2004, 2005).

A recent study "Methods to Reduce Lateral Noise Propagation from Seismic Exploration Vessels" was conducted by Stress Engineering Services Inc. under the BOEM Technology Assessment & Research Program (Ayers et al., 2009, 2010). The first phase of the project was spent researching, developing concepts for noise reduction, and evaluating the following three concepts: (1) an air bubble curtain; (2) focusing arrays to create a narrower footprint; and (3) decreasing noise by redesigning airguns. The air bubble curtain was selected as the most promising alternative, which led to more refined studies the second year (Ayers et al., 2009). A rigorous 3D acoustic analysis of the preferred bubble curtain design, including shallow-water seafloor effects and sound attenuation within the bubble curtain, was conducted during the second phase of the study. Results of the model indicated that the bubble curtains performed poorly at reducing sound levels and are not a viable option for mitigation of lateral noise propagation during seismic operations from a moving vessel (Ayers et al., 2010).

2.5.6.8. Evaluation

The non-airgun alternative would not meet the purpose and need specified in **Chapter 1**. Alternative acoustic sources are in various stages of development, and none of the systems with the potential to replace airguns as a seismic source are currently commercially available for use on a scale of activity considered in the proposed action scenario described in **Chapter 3**. Although some airgun alternative technologies are available now or in the next 1-5 years, none are at the stage that they can replace airgun arrays. In order to do so in the future, an increase in research and development funding by government or industry for alternative exploration technologies would be needed to accelerate development. The non-airgun alternative would not provide the oil and gas industry with sufficiently accurate data on the location, extent, and properties of hydrocarbon resources or the character of formation fluids or gases, as well as information on shallow geologic hazards and seafloor geotechnical properties, in order to explore, develop, produce, and transport hydrocarbons safely and economically. As this alternative does not meet the stated purpose and need, it has not been carried forward for detailed environmental impact analysis in this Draft Programmatic EIS.

2.6. COMPARISON OF IMPACTS BY ALTERNATIVE

Alternatives A, B, and C were carried through the detailed environmental impact analysis in **Chapter 4**. Impacts have been summarized in **Chapters 2.1.3**, **2.2.3**, and **2.3.3**, respectively. **Table 2-2** compares the three alternatives with respect to the impact significance ratings from **Chapter 4**.

Alternative C would have the lowest level of impacts for all resources because the main source of impacts (seismic airgun surveys in support of oil and gas exploration) would not occur. Alternative C would eliminate several IPFs, including airguns, aircraft traffic and noise, and drilling discharges.

Most impacts under all three alternatives would be **negligible** or **minor**, and no **major** impacts were identified. Only a few impacts were identified as **moderate** under one or more alternatives. These were:

- impacts of airguns on marine mammals (**moderate** under both Alternatives A and B);
- impacts of airguns on sea turtles (**negligible** to **moderate** under Alternative A and **negligible** to **minor** under Alternative B);
- impacts of airguns on MPAs (**negligible** to **moderate** under Alternative A and **negligible** to **minor** under Alternative B). The **moderate** rating is based on the potential impacts of seismic airgun surveys on sea turtle nesting at a particular coastal MPA (Archie Carr NWR) and is reduced to **minor** under Alternative B; and
- impacts of accidental fuel spills on coastal and marine birds (**moderate** under all three alternatives).

Potential impacts of Alternatives A and B are broadly similar. However, there are a few important differences due to the additional mitigation measures included in Alternative B:

- The expanded time-area closure for North Atlantic right whales under Alternative B would reduce the risk of acoustic and vessel strike impacts on this species. Although incidental take was not modeled for Alternative B, it is estimated that the expanded time-area closure would avoid approximately 80 percent of the incidental takes of North Atlantic right whales over the period of the Programmatic EIS (as compared with no closures). In contrast, the Alternative A time-area closure would be expected to avoid about 67 percent of the right whale incidental takes.
- The expanded time-area closure for North Atlantic right whales under Alternative B would slightly reduce the risk of acoustic and vessel strike impacts on some other marine mammals by precluding certain surveys in a portion of the AOI during certain times. Because the closure area is a small part of the AOI (7 percent vs. approximately 4 percent under Alternative A), the overall impact rating for marine mammals was the same under both Alternatives A and B (**moderate**). The expanded time-area closure may also slightly reduce other (non-marine-mammal) impacts related to the level of vessel traffic in coastal waters, but not enough to change any impact ratings.
- The Brevard County time-area closure under Alternative B would reduce the risk of disrupting sea turtle nesting in an area that is estimated to support 25 percent of all loggerhead turtle nesting in the U.S. Although the closure would affect only a small portion of the AOI (3.9%), the impact reduction for sea turtles is expected to be substantial, reducing the highest rating from **moderate** to **minor**. Because the **moderate** rating for MPAs under Alternative A was based on potential impacts on sea turtle nesting at Archie Carr NWR (which is partly within Brevard County), the highest rating for MPAs under Alternative B would also be reduced to **minor**.
- The 40-km (25-mi) separation distance between concurrent seismic surveys under Alternative B may slightly reduce acoustic impacts on marine mammals, sea turtles, and other marine biota. It would ensure that some areas between concurrent surveys would not be ensonified to levels that would cause Level A or B harassment of marine mammals, and it would reduce the likelihood of multiple exposures to airgun pulses. The degree of improvement has not been estimated but would not be expected to change any impact ratings. Even without this required separation, in practice, operators typically maintain a separation of about 17.5 km (9.5 nmi) between concurrent surveys to avoid interference (i.e., overlapping reflections received from multiple source arrays).
- The required use of PAM under Alternative B would be expected to improve the effectiveness of detecting marine mammals as part of the seismic airgun survey protocol. It is expected that some Level A incidental takes of marine mammals that might otherwise occur would be avoided. The degree of improvement has not been estimated but would not be expected to change any impact ratings. Some level of PAM use also would be expected under Alternative A, but it would be optional.

2.7. PREFERRED ALTERNATIVE

Section 1502.14(e) of the NEPA implementing regulations requires the agency preparing a Draft EIS to identify the preferred alternative if one or more exists and identify such alternative in the Final EIS. The "agency's preferred alternative" is the alternative that the agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors. This Agency does not identify a preferred alternative in this Draft Programmatic EIS but intends to identify one in the Final Programmatic EIS.

Alternatives A and B would both fulfill the statutory mission and responsibilities of this Agency for permitting G&G activities in the program areas managed by BOEM. Alternatives A and B both provide protective measures for important biological resources in the AOI that in some cases are protected species. Alternative B includes mitigation measures that would add direct costs for operators undertaking G&G activities in the AOI, for example PAM monitoring. Alternative B includes mitigation measures that may impose indirect costs in the form of inconvenience of deploying when and where an operator desires, or opportunity costs based on the time-value of money if a field season is missed because of some combination of time-area closure and deployment delays. The BOEM wishes to review the totality of the record generated by this Programmatic EIS in the public review period to assist identifying an agency preferred alternative.

CHAPTER 3

G&G ACTIVITIES AND PROPOSED ACTION SCENARIO

3. G&G ACTIVITIES AND PROPOSED ACTION SCENARIO

3.1. INTRODUCTION

A variety of G&G techniques are used to characterize the shallow and deep structure of the shelf, slope, and deepwater ocean environments. The G&G surveys are conducted to (1) obtain data for hydrocarbon exploration and production; (2) aid in siting renewable energy structures; (3) locate potential sand and gravel resources; (4) identify possible seafloor or shallow depth geologic hazards; and (5) locate potential archaeological resources and potential hard bottom habitats for avoidance. The selection of a specific technique or suite of techniques is driven by data needs and the target of interest. The G&G activities evaluated as part of this Programmatic EIS are described in this chapter, and their applicability to the three program areas (oil and gas, renewable energy, and marine minerals) is summarized in **Table 3-1**. The activities include the following:

- various types of deep penetration seismic surveys used almost exclusively for oil and gas exploration;
- other types of surveys and sampling activities used only in support of oil and gas exploration, including electromagnetic surveys, deep stratigraphic and shallow test drilling, and various remote sensing methods;
- HRG surveys used in all three program areas to detect geohazards, archaeological resources, and certain types of benthic communities; and
- geological and geotechnical bottom sampling used in all three program areas to assess the suitability of seafloor sediments for supporting structures (e.g., platforms, pipelines, cables, wind turbines) or to evaluate the quantity and quality of sand for beach nourishment projects.

The following sections describe the types of G&G activities that BOEM is proposing to authorize under the proposed action within the three broad program areas (oil and gas exploration and development, renewable energy development, and marine minerals).

3.2. OIL AND GAS G&G SURVEYS

The scope of this Programmatic EIS does not include a NEPA analysis that evaluates a specific proposal for oil and gas leasing in the AOI and does not authorize an OCS lease sale. The procedures under the OCSLA to set up a lease sale include a specific NEPA evaluation for that proposed action. A NEPA evaluation for approving the OCS plans that actualize leases for oil and gas exploration and development are also not part of this proposed action.

Certain G&G activities are necessary precursor steps needed to judge whether or not there is industry interest for oil and gas leasing in the AOI. The scope of this Programmatic EIS includes a NEPA analysis of specific types of G&G activity that can take place either before leasing or after. It includes the G&G activities needed for operators to make business decisions about acquiring leases and the G&G activities that can take place on a lease once it has been acquired by an operator.

In addition to the needs of private industry, G&G surveys provide important information for Government decisions. The BOEM's resource evaluation staff uses deep two-dimensional (2D) and three-dimensional (3D) seismic data for resource estimation and bid evaluation to ensure that the Government receives a fair market value for lease blocks offered. The BOEM's environmental staff uses G&G data to comply with various environmental laws, such as the Endangered Species Act, Marine Mammal Protection Act, Magnuson-Stevens Fishery Conservation and Management Act, and Coastal Zone Management Act, and to support mitigation measures that protect benthic, historic archaeological, and other natural resources. The Bureau of Safety and Environmental Enforcement's (BSEE) production and development staff uses 2D, 3D, and four-dimensional seismic data to map reserves and to develop evaluations for conservation of resources. The BSEE's regulatory staff specifically uses G&G data to ensure that the proposed site of bottom-founded structures is safe (i.e. geohazards review) and that the foundations are properly designed (i.e., based on engineering parameters determined from cores), thus ensuring safe operations.

The Gulf of Mexico is an important and mature oil and gas province in the U.S. The practices and processes that have been developed in the Gulf represent processes and controls that have been tested and that are available for application in the Atlantic.

3.2.1. Background and Jurisdiction

The G&G activities for oil and gas exploration are authorized on the basis of whether or not the proposed activities are as follows: (1) before leasing takes place (prelease), authorized by permits; or (2) on an existing lease (postlease) authorized by OCS plan approvals, plan revisions, or by a requirement for notification of BOEM before certain on-lease activities are undertaken. The BOEM Resource Evaluation Program oversees G&G data acquisition and permitting activities, pursuant to regulations at 30 CFR 550 and 551.

30 CFR 551 regulates prelease G&G exploratory (prospecting) operations for oil, gas, and sulphur resources or for scientific research on unleased OCS lands and across leases owned by a third party. The permit applications that BOEM received in 2009 from industry operators for G&G surveying in the Atlantic constitute this type of prelease activity. Prelease G&G surveying or stratigraphic test wells (COST wells) all require a permit under 30 CFR 551. Each permit application is subject to a site-specific NEPA evaluation, which is typically an Environmental Assessment (EA) (**Table 3-2**). In the AOI, where these activities previously have not been subject to a systematic evaluation, this Programmatic EIS provides that evaluation, from which site-specific evaluations may be tiered under the NEPA regulations (40 CFR 1502.20).

30 CFR 550 regulates oil and gas activity on the OCS once a lease is acquired. Postlease activities and G&G activities required to support them are governed by a series of OCS plans, the approval of any of which could result in G&G activities (**Table 3-2**): (1) an Exploration Plan (EP) guides the drilling of exploration and delineation wells; (2) depending on the OCS Planning Area, a Development Operations and Coordination Document (DOCD) or a Development and Production Plan (DPP) guides the drilling of development wells and installation of surface or subsurface production facilities.

A NEPA evaluation is part of the approval process for OCS plans under the oil and gas program. The evaluation includes a proposed action at a specific location with specific tool types and intensity of G&G activity, which may be an EA or an EIS. The consultations required under environmental law for protected species are typically carried out at the time of the NEPA evaluation for the proposed action of a lease sale where all actions consequent to a lease sale are examined in an EIS, and not for each and every OCS plan.

Many postlease activities are guided by NTLs, all of which are posted to BOEM regional office websites. The NTLs are formal documents that perform a variety of functions. Among these functions are the following: (1) provide clarification, description, or interpretation of a regulation or OCS standard; (2) provide guidelines on the implementation of a special lease stipulation or regional requirement; (3) provide a better understanding of the scope and meaning of a regulation by explaining BOEM interpretation of a requirement; or (4) transmit administrative information such as current telephone listings and a change in BOEM personnel or office address. The G&G information required as part of postlease OCS plans is specified in 30 CFR 550.214. Part of it consists of a shallow hazards survey and report for each proposed well. The report contains an assessment of any seafloor and subsurface geological and manmade features or conditions that may adversely affect drilling operations. The shallow hazards survey and report outputs are guided by NTL 2008-G05 ("Shallow Hazards Program") (USDOI, MMS, 2008a) and NTL 2005-G07 ("Archaeological Resource Surveys and Reports") (USDOI, MMS, 2005). All of the hardware and tools for both types of surveys are typically run during the same deployment.

Ancillary activities are postlease operations by lease owners in furtherance of developing oil and gas resources on their lease. Ancillary activities are defined in 30 CFR 550.105 and regulated in 30 CFR 550.207 through 550.210 and include geological and geotechnical, HRG, archaeological, biological, physical oceanographic, meteorological, socioeconomic, or other surveys; or various types of modeling studies. This Agency issued NTL 2009-G34 ("Ancillary Activities") (USDOI, MMS, 2009e) to provide guidance and clarification on conducting ancillary activities in BOEM's Gulf of Mexico OCS Region. The NTL provides guidance for each type of ancillary activity, the type and level of BOEM review, follow-up actions, and post-survey report requirements. Operators wishing to perform G&G work on their leases notify BOEM in writing 30 days in advance before conducting any of the following types of ancillary activities on their lease:

- involving the use of an airgun or airgun array in water depths 200 m (656 ft) or greater, or in the Gulf of Mexico's Eastern Planning Area in any water depth;
- involving the use of explosives as an energy source, independent of water depth; and
- including ocean-bottom cable surveys, node surveys, and time-lapse (4D) surveys, independent of water depth.

Additionally, NTL 2009-G34 specifies that BOEM is to be notified in writing 15 days in advance before conducting the following types of ancillary activities:

- involving the use of an airgun or airgun array in water depths 200 m (656 ft) or greater, or in the Gulf of Mexico's Eastern Planning Area in any water depth;
- involving bottom disturbance, independent of water depth, including ocean-bottom cable surveys, node surveys, and time-lapse (4D) surveys; and
- involving piston-/gravity-coring or the recovery of sediment specimens by grab-sampling or similar technique and/or any dredging or other ancillary activity that disturbs the seafloor (including deployment and retrieval of bottom cables, anchors, or other equipment).

Ancillary activities are subject to conditional NEPA reviews (**Table 3-2**) depending on what activity is being proposed. Generally any G&G survey using an airgun, or that involve explosives or bottom-disturbing activity is evaluated with an EA. If BOEM determines that the type of proposed activity necessitates revising an existing OCS plan, a NEPA review is triggered which is typically an EA. In addition to the NEPA review carried out before a lease sale, the operator would have an approved EP and/or a DOCD or DPP, each of which would have been subject to a NEPA review as part of initial plan approval.

An important point in conclusion is, whether pre- or postlease, all G&G survey types for exploration, development, or decommissioning are subject to the same types of review, especially if bottom-disturbing activity is proposed.

3.2.2. Types of Surveys

The oil and gas industry conducts a variety of G&G activities, both prelease and postlease. Typical prelease activities include deep penetration seismic surveys to explore and evaluate deep geologic formations. Two-dimensional (2D) seismic surveys usually are designed to cover thousands of square miles or entire geologic basins as a means to geologically screen large areas. Three-dimensional (3D) surveys can consist of several hundred OCS blocks and provide much better resolution to evaluate hydrocarbon potential in smaller areas or specific prospects. Other prelease surveys include largely passive data gathering methods such as electromagnetic, gravity, and magnetic surveys, as well as remote sensing surveys from aircraft and satellites.

Postlease activities conducted by operators can include additional seismic surveys, HRG surveys, and bottom sampling (including stratigraphic wells, shallow test wells, and geotechnical sampling). Examples of postlease seismic surveys include vertical seismic profiling (VSP) with geophone receivers placed in a wellbore, and four-dimensional (4D) (time-lapse) surveys to monitor reservoirs during production. The HRG surveys are conducted on leases and along pipeline routes to evaluate the potential for geohazards, archaeological resources, and certain types of benthic communities. Geotechnical sampling is conducted to assess seafloor conditions with respect to siting facilities such as platforms and pipelines.

Categories of G&G activities conducted for oil and gas exploration are listed below and discussed in the following sections:

- deep penetration seismic surveys;
- HRG surveys;

- electromagnetic surveys;
- deep stratigraphic and shallow test drilling;
- bottom sampling; and
- remote sensing surveys.

3.2.2.1. Deep Penetration Seismic Surveys

Deep penetration seismic surveys are conducted by industry to obtain data on geological formations down to several thousand meters below the seafloor. A survey vessel tows an array of airguns that emit acoustic energy pulses into the seafloor. The acoustic signals reflect (or refract) off subsurface layers having acoustic impedance contrast and are recorded by hydrophones that are towed on streamers behind the ship (**Figure 3-1**) or positioned on the seafloor as autonomous nodes or cables, or in rare instances spaced at various depths in vertically positioned cables. Data from these surveys can be used to assess potential hydrocarbon reservoirs and help to optimally locate exploration and development wells, thus maximizing extraction and production from a reservoir. Deep penetration seismic surveys are associated only with oil and gas exploration, not with renewable energy development or marine minerals extraction.

State-of-the-art computer mapping systems are used to plot the subsurface in two or three dimensions and can enhance various aspects of the dataset. A 2D dataset is acquired by using wider line spacing and is used to identify regional structural geology and to link known productive areas over large geographic areas. In contrast, 3D seismic data enable industry to identify with greater precision where the most economical prospects may be located (**Figure 3-2**). The 3D technology is also used to identify previously overlooked hydrocarbon-bearing zones and new productive horizons. However, because 3D modeling requires much denser data coverage (i.e., closer line spacing) than 2D seismic surveys, areas already covered using 2D techniques may be resurveyed. Further, 3D surveys may be repeated over producing fields to characterize production reservoirs. These 4D, or time-lapse 3D, surveys are used predominantly as a reservoir monitoring tool to evaluate post-reservoir variance over time.

A typical marine seismic source is a sleeve-type airgun array that releases compressed air into the water, creating an acoustical energy pulse that penetrates the seafloor. (See **Chapter 3.5** for more information about airguns, including sound source levels.) An integrated navigational system is used to keep track of where the airguns are fired, the position of the streamer cables, and the depth of the streamer cables. The end of the cable is tracked with global positioning system (GPS) satellites. Radar reflectors are routinely placed on tail buoys for detection by other vessels.

3.2.2.1.1. 2D Seismic Exploration Surveys

2D seismic exploration surveys are conducted by geophysical contractors either on a proprietary or speculative basis. Speculative surveys are generally conducted over large multi-block areas and can be sold to numerous clients to recover costs, whereas proprietary surveys usually cover only a few blocks for an individual client that will have exclusive use of the data. Although the number of 2D surveys is small compared to 3D surveys, they are important as 2D surveys can cover a larger area in less detail, resulting in a lower cost per area covered. Each geophysical contractor has a proprietary method of data acquisition that may vary depending on their seismic target and data processing capabilities. This makes each contractor's data set unique and does not lend itself to combining with other surveys.

Ships conducting 2D surveys are typically 60-90 m (200-300 ft) long and tow a single source array 100-200 m (328-656 ft) behind the ship and about 5-10 m (16-33 ft) below the sea surface. The source array typically consists of three subarrays of six or seven airguns each and measures approximately 12.5-18 m (41-60 ft) long and 16-36 m (52-118 ft) wide. Following behind the source array by 100-200 m (328-656 ft) is a single streamer approximately 5-10 km (2.7-5.4 nmi) long. The ship tows this apparatus at a speed of about 4.5-6 kn (8.3-11 km/hr). About every 16 s (i.e., a distance of 37.5 m [123 ft] for a vessel traveling at 4.5 kn [8.3 km/hr]), the airgun array is fired; the actual time between firings varies depending on ship speed.

While surveying, a ship travels down a track for 12-20 hr (i.e., a distance of 100-166 km [54-90 nmi] for a vessel traveling at 4.5 kn [8.3 km/hr]), depending on the size of the survey area. Upon reaching the end of the track, the ship takes 2-3 hr to turn around and start down another track. The spacing between tracks is usually on the order of 2 km (1.1 nmi). This procedure takes place day and night and may continue for days, weeks, or months, depending on the size of the survey area.

3.2.2.1.2. 3D Seismic Exploration Surveys

As with 2D surveys, almost all 3D seismic exploration surveys are conducted by geophysical contractors as speculative or multi-client surveys conducted over large, multi-block areas. Proprietary surveys are also conducted over only a few blocks. Conventional, single-vessel 3D surveys are also referred to as narrow azimuth 3D surveys.

Ships conducting 3D surveys are generally 80-90 m (262-295 ft) long, or slightly larger than those used in 2D surveys since they are towing more equipment. These ships typically tow two source arrays aligned in parallel with one another 100-200 m (328-656 ft) behind them. The two source arrays are identical to each other and are the same as those used in the 2D surveys described previously. Following another 100-200 m (328-656 ft) behind the dual source arrays are 6-12 streamer cables 3-8 km (1.6-4.3 nmi) long and spread out over a breadth of 600-1,500 m (1,969-4,922 ft).

The survey ship tows the apparatus at a speed of 4.5 kn (8.3 km/hr). About every 16 seconds (s) (i.e., a distance of 37.5 m [123 ft] for a vessel traveling at 4.5 kn [8.3 km/hr]), one of the dual airgun arrays is fired. The other array is fired 16 s later. To achieve the desired spacing, the time between firings varies depending on ship speed. While surveying, a ship travels down a track for 12-20 hr (i.e., a distance of 100-166 km [54-90 nmi] at 4.5 kn [8.3 km/hr]), depending on the size of the survey area. Upon reaching the end of the track, the ship takes 2-3 hr to turn around and start down another track. This procedure takes place day and night and may continue for days, weeks, or months, depending on the size of the survey area.

3.2.2.1.3. Wide Azimuth and Related Multi-Vessel Surveys

In single-vessel 3D surveys, only a limited subset of the reflected wave field can be recorded because of the narrow range of source-receiver azimuths. New methods such as wide azimuth (WAZ), rich azimuth, multi-azimuth, and wide azimuth towed-streamer acquisition have emerged in the last few years to improve the data resolution problems inherent in traditional marine seismic surveys. These new methods provide seismic data with better illumination, higher signal-to-noise ratio, and improved resolution.

Wide, rich, and multi-azimuth acquisition configurations involve multiple vessels operating concurrently in a variety of source vessel-to-acquisitional vessel geometries. Several source vessels (usually two to four) are used in coordination with single or dual receiver vessels either in a parallel or rectangular arrangement with a 1,200-m (3,937-ft) vessel spacing to maximize the azimuthal quality of the data acquired. It is not uncommon to have sources also deployed from the receiver vessels in addition to source-only vessels; this improves the signal-to-noise ratio, helps illuminate complex geology in sub-salt areas, and provide natural attenuation of multiple reflections from the water surface.

Coil surveys are a further refinement of the WAZ acquisition of subsalt data and are a proprietary acquisitional technique developed by WesternGeco (Schlumberger). These surveys can consist of a single source/receiver arrangement or a multi-vessel operation with multiple sources, with seismic data being acquired while the vessels follow a circular to spiral path. This method was initially developed as a single-vessel alternative to WAZ surveys but has evolved into a multi-vessel technology.

3.2.2.1.4. Nodes and Ocean Bottom Cable Surveys

Ocean bottom cable surveys were originally designed to enable seismic surveys in congested areas such as producing fields with their many platforms and production facilities. New technology has also allowed for autonomous receiving units (nodes) to be deployed by remotely operated vehicles (ROVs). These surveys have been found to be useful for obtaining four-component (4C) data (seismic pressure, as well as vertical and two horizontal motions of the water bottom, or seafloor), yielding more information about the fluids and rock characteristics in the subsurface. With standard hydrophones, these surveys can be conducted to about 183 m (600 ft), but with newer technology can be conducted at water depths of up to 2,500 m (8,200 ft) or more.

Autonomous nodes and ocean bottom cable surveys require the use of multiple ships (usually two ships for cable layout/pickup, one ship for recording, one ship for shooting, and two smaller utility boats). These ships are generally smaller than those used in streamer operations, and the utility boats can be very small. Operations begin by deploying the nodes in equally spaced grids by means of an ROV or by dropping cables off the back of the layout boat. Cable length is typically 4.2 km (2.3 nmi) but can be up to 12 km (6.5 nmi). Groups of seismic detectors (usually hydrophones and vertical motion geophones) are attached to the nodes and cable in intervals of 25-50 m (82-164 ft). Multiple nodes and cables are laid parallel to each other with a 50-m (164-ft) interval between cables. When the node or cable is in place, a ship towing a dual airgun array passes between the cables, firing every 25 m (82 ft). Sometimes a faster source ship speed of 6 kn (11 km/hr) instead of the normal 4.5 kn (8.3 km/hr) speed is used, with an increase in time between airgun firings.

After a source line is acquired, the source ship takes about 10-15 min to turn around and pass down between the next two nodes or cables. When a node or cable is no longer needed to record seismic data, it is retrieved by the ROV or cable pickup ship and moved to the next recording position. A particular node or cable can lay on the bottom anywhere from 2 hr to several days, depending on operation conditions. In some cases, nodes or cables may be left on the bottom for future 4D (time-lapse) surveys (see below).

3.2.2.1.5. Vertical Cable Surveys

Vertical cable surveys, although uncommon, are similar to ocean bottom cable surveys in that the receivers are deployed and then acoustic data are output by a source vessel. However, they are substantially different from ocean bottom surveys in that the receivers are located at several locations along a vertical cable that is anchored to the ocean bottom.

These surveys can be conducted in water depths up to about 2,500 m (8,200 ft). Two identically configured boats are used during a vertical cable survey. Both boats are used initially to place the cables. During the survey, one boat is used as a source boat and the other to recover and redeploy the cables. The vertical cables are deployed on two overlapping grids. On each grid, vertical cables are deployed every 2 km (1.1 nmi). One grid is staggered relative to the other such that any one vertical cable is no more than 1.4 km (0.75 nmi) from its closest neighbor. Normally, 28 or 32 vertical cables are deployed at a time.

At the bottom of each vertical cable is an anchor composed of 680 kg (1,500 lb) of steel. The active section of the cable is 375 m (1,230 ft) long and contains 16 specially constructed hydrophones spaced 25 m (82 ft) apart. At the top are buoyant floats to keep the cable as vertical as possible. Once the cables are in place, the source boat begins shooting in such a way that each vertical cable receives shots at a distance of 5 km (2.7 nmi) in all directions. This is accomplished by traveling down lines parallel to the grid of vertical cables. Once the shooting boat shoots a line 1 km (0.54 nmi) beyond the first row of vertical cables, that row is recovered and redeployed. Cables may be left in place for hours or days, depending on the size of the survey area and operating conditions. Vessel speed is normally 4-5 kn (7.4-9.3 km/hr). The dual airgun array is the same as normally used in 3D streamer surveys.

3.2.2.1.6. 4D (Time-Lapse) Surveys

Three-dimensional surveys may be repeated over oil and/or gas producing fields to characterize production reservoirs. These 4D, or time-lapse, surveys are becoming more frequent as the technology for analyzing the data is developed. The purpose of 4D surveys is to monitor the depletion of the reservoir and locate zones of bypassed production in an already discovered oil or gas field. A time-lapse survey requires repeated surveys with highly accurate navigation to ensure the same subsurface points are measured on each survey. Time-lapse surveys are usually repeated every 6 months to a year, but occasionally the repeat interval can be as short as 4 months.

Time-lapse surveys can use either seismic streamer cables or ocean bottom cables to house the seismic detectors. In either case, the procedure closely resembles those described previously for 3D and ocean bottom cable surveys. The main difference is in the size of the survey area. Since the oil or gas field already has been located, the survey area is much smaller and survey time is much shorter. An average survey takes 2-4 weeks and can cover 20 km^2 (5.8 nmi^2). Although the technique initially used streamer cables, the difficulty in locating sensors with suitable precision led to the use of bottom cables, then to fixed bottom cables. When fixed bottom cables are used, the survey time, after the first survey, is much shorter since all that has to be done is connect the fixed bottom cable to the recording instruments and start shooting.

3.2.2.1.7. Vertical Seismic Profile Surveys

Vertical seismic profiling is a technique carried out by placing geophone receivers down a borehole at different depths, and with an external acoustic source near the wellbore (zero-offset VSP) or on a vessel at different distances from the wellbore (walk-away VSP). These surveys are used to obtain information about the nature of the seismic signal, as well as more information about the geology surrounding the vertical array of sensors. The VSP data can be cross-correlated with ship-towed seismic survey datasets to refine identification of lithologic changes and the content of formation fluids. Zero-offset and walk-away VSP surveys are common during the development and production phases of activity.

In all VSP surveys, sensors are lowered down a borehole before production tubing is placed in the wellbore or the well is abandoned. The sensors lowered down the borehole can be connected together in strings of 16-36 receivers spaced from 15 to 150 m (49 to 492 ft) apart, depending on the survey objective and other variables. After lowering the sensor string to the lowest portion of the borehole to be surveyed, the sensors are temporarily clamped to the side of the wellbore and seismic signals are recorded. Subsequently, the sensors are repositioned and the next set of seismic signals recorded. Seismic airgun sources used in VSP surveys are the same as those used in conventional seismic airgun surveys. Zero-offset surveys are conducted using a small-volume, single airgun suspended by a crane located on the deck of the drilling rig.

Walk-away surveys utilize a workboat with only four to eight airguns. The same airgun arrays used for conventional 2D and 3D surveys are used for 3D VSP surveys. These airgun arrays can vary from 1,000 to 5,000 in^3, depending upon the depth of the objective. Typical airgun array depths are 7-10 m (23-33 ft) below the surface. One method used to provide 3D coverage is for the source vessel to travel in a spiral track. The source vessel begins the spiral track at a distance of 200 m (656 ft) from the borehole and keeps the distance between spirals equal to the number of arrays times the array separation. First, one airgun array fires, then 12-14 s later the other airgun array fires. At a typical vessel speed of 4.5-5 kn (8.3-9.3 km/hr), the distance between firings is between 28 and 36 m (92 and 118 ft). The source vessel continues on the spiral out to a distance of up to 9 km (4.9 nmi). If the borehole sensor string needs to be raised to another level, the whole procedure is repeated.

Survey duration depends on the type of survey, objectives, cost of the drilling rig, and equipment used. A zero-offset or walk-away survey can take less than a day. By comparison, a 3D survey may require up to 10 days to complete; however, 30 percent of that time may be with the airguns in standby mode.

3.2.2.2. High-Resolution Geophysical Surveys

High-resolution site surveys are conducted by industry to investigate the shallow subsurface for geohazards and soil conditions in one or more lease blocks, as well as to identify potential benthic biological communities (or habitats) and archaeological resources in compliance with 30 CFR 550.201, 30 CFR 550.207, 30 CFR 550.194, and 30 CFR 250.1007. The data are used for initial site evaluation for drilling rig emplacement and for platform or pipeline design and emplacement. The HRG survey and report outputs are guided by NTL 2008-G05 ("Shallow Hazards Program") (USDOI, MMS, 2008a) and NTL 2005-G07 ("Archaeological Resource Surveys and Reports") (USDOI, MMS, 2005).

The HRG surveys for oil and gas exploration use several tools including airgun(s), side-scan sonar, magnetometers, shallow and medium penetration subbottom profilers, and single or multibeam depth sounders. All of the tools for both hazards and archaeological surveys are typically run during the same deployment. However, for areas in water depths greater than 200 m (656 ft), BOEM may allow operators to substitute previously collected 3D seismic reflection data for shallow or medium penetration subbottom profiler data (although not for pipeline pre-installation surveys). A typical HRG operation for an oil and gas exploration site consists of a ship towing an airgun about 25 m (82 ft) behind the ship and a 600-m (1,969-ft) streamer cable with a tail buoy. The ship travels at 3-3.5 kn (5.6-6.5 km/hr), and the airgun is fired every 7-8 s (or about every 12.5 m [41 ft]). The other acoustic sources typically are operated concurrently with the airgun array. Typical surveys cover one lease block, which is usually 4.8 km (3 mi or 2.6 nmi) on a side. The BOEM has identified all blocks in the Atlantic OCS as having a high probability for the presence of historic archaeological resources (i.e., shipwrecks) and requires surveys using a 30-m (98-ft) line spacing. Including line turns, the time to survey one block is about 36 hr; however, streamer and airgun deployment and other operations add to the total survey time.

3D high-resolution surveys using ships towing multiple streamer cables have become commonplace. Since multiple streamers are towed, the ships tend to be slightly larger (47 m vs. 37 m [154 ft vs. 121 ft]). Up to six streamers 100-200 m (328-656 ft) long are used with a tri-cluster of airguns. With this system, 66 lines are necessary per block, which take about 5 days to collect.

For postlease engineering studies involving the placement of production facilities and pipelines in deep water, HRG surveys are often conducted with autonomous underwater vehicles (AUVs) equipped with a multibeam depth sounder, side-scan sonar, and a chirp subbottom profiler. Geophysical contractors have been using AUVs since about 2000 to make detailed maps of the seafloor before they start building subsea infrastructure.

3.2.2.3. Electromagnetic Surveys

Electromagnetic surveys are often used in conjunction with seismic surveys to help delineate potential oil and gas reservoirs. Many geological processes in the crust and upper mantle of the seafloor involve the interaction of fluid phases with surrounding rock. The conductivities of hydrothermal phases are different from those of host rock, and collectively they offer distinct profiles of electrical conductivity/resistivity, depending on the specific geological process involved. There are two practical electromagnetic techniques applicable to oil and gas exploration: CSEM surveys and magnetotelluric (MT) surveys. Both have been used mainly in the last decade, with the CSEM method more widely used in deepwater environments (Constable, 2010).

3.2.2.3.1. Controlled Source Electromagnetic Surveys

The CSEM methods have been applied worldwide to help distinguish "economic" hydrocarbon accumulations from other scenarios (Constable, 2010; Darnet et al., 2010). The CSEM technique, sometimes referred to as seabed logging, induces very low frequency (typically less than 2 Hz) electromagnetic signals into the upper layers of the seafloor via a towed dipole. The signals are propagated laterally to an array of receivers kilometers away. The variations in the electromagnetic field relative to the geometry of the receiver arrays and distance provide a conductivity/resistivity profile of the seafloor. From the profile, hydrocarbon reservoirs can be differentiated from water reservoirs and surrounding rock. In this technique, two cables (one a few hundred feet longer than the other) are joined together and towed by a ship. Attached to the end of each cable is a metal cylinder about 3 m (10 ft) long and 0.3 m (1 ft) in diameter. At regular intervals, an electrical signal is input through the cables and into the seafloor. These electrical signals are detected by previously deployed receivers 2-10 km (1.1-5.4 nmi) away from the source and arranged in a line or profile. The receiver boxes are attached to degradable concrete blocks like those used in the MT technique. Inside the receiver boxes are recording devices that allow for recording for a few days. When the recording is finished, an acoustic pinger releases the recording box from the anchor, and the recording box floats to the surface for retrieval.

3.2.2.3.2. Magnetotelluric Surveys

Magnetotelluric surveys are passive measurement of the earth's electromagnetic fields. In this technique, no electrical currents are induced into the earth, but the receiver device detects the natural electrical and magnetic fields present in the earth. Ships are used to deploy and retrieve the recording devices. These devices are about 1.5 m (5 ft) high by 1 m (3 ft) on a side and are attached to a degradable concrete anchor about 60 centimeters (cm) (24 inches [in]) on a side, 15 cm (6 in) high, and weighing about 136 kg (300 lb). Also attached to the recording device are four arms sticking out from each side of the box with an electrode on each end. These arms are about 20 m (66 ft) long and made of polyvinyl chloride (PVC) pipe. Inside the recording box is a magnetometer and a long-term recording device, that allows the box to remain on the water bottom for days at a time. The recording box is retrieved by using an acoustic pinger that releases the anchor from the recording box, which then floats to the surface.

3.2.2.4. Deep Stratigraphic and Shallow Test Drilling

Drilling of deep stratigraphic (COST) and shallow test wells are typically off-lease activities, especially in frontier areas, or they can be carried out on a leased block if it does not interfere with the leaseholder's activities. These activities may occur infrequently in the AOI during the time period of this Programmatic EIS. As defined by 30 CFR 551.1, a deep stratigraphic test well must penetrate at least 152 m (500 ft) into the seafloor; otherwise, it is classified as shallow test drilling.

The COST wells typically are drilled to obtain information about regional stratigraphy, reservoir beds, and hydrocarbon potential. The COST wells are drilled away from any potential petroleum-bearing feature to minimize the chance of encountering oil or gas. The data are used to evaluate structural interpretations from geophysical surveys, determine the age of sediments drilled, and estimate the potential for hydrocarbon accumulation and for determining the presence, absence, or quality of gas hydrate deposits. Drilling would be done by conventional, rotary drilling equipment from a drilling rig; the selection of a moored vs. dynamically positioned drilling rig would depend on water depth, site-specific seafloor conditions, and rig availability. Under BOEM regulations, an EA is automatically required for drilling of a COST well.

Five COST wells were drilled by industry offshore the U.S. Atlantic Coast between 1975 and 1979. Water depths of these wells ranged from 41 to 819 m (136 to 2,686 ft), and total depth (penetration) ranged from 4,040 to 6,667 m (13,254 to 21,874 ft) (USDOI, BOEM, 2011a).

Shallow test wells can be drilled postlease to allow operators to place wireline testing equipment into a borehole to evaluate subsurface properties such as the presence of gas hydrates. Drilling would be done by conventional, rotary drilling equipment from a drilling barge or boat.

It is likely that there would be some interest in a test program for gas hydrates within the proposed action scenario period, at least in the South Atlantic Planning Area in the Blake Plateau region. These wells could be considered either COST wells or shallow test drilling, depending on the penetration depth. Gas hydrate wells typically penetrate from 152 m (500 ft) to a few thousand feet below the seafloor, where gas hydrates are found because of the physico-chemical requirements for their stability. In the Gulf of Mexico, test programs for gas hydrates were fielded in 2005 (Birchwood et al., 2008) and 2009 (Boswell et al., 2009). The deepest well for the 2009 test program was 1,122 m (3,680 ft) below the seafloor.

3.2.2.5. Bottom Sampling

Coring or grab sampling methods typically are used to obtain sediment samples for geological and/or geotechnical analyses. Geotechnical sampling and testing are used in engineering studies for placement of structures such as platforms and pipelines. Usually, a program of bottom sampling and shallow coring is conducted simultaneously using a small marine drilling vessel.

“Deep” geologic cores are obtained by standard rotary coring. Rotary corers are designed as double or triple tube devices where the innermost tube acts as a core liner; the middle tube, if present, acts as a holder; and the rotating outer tube carries the hollow drill bit. As the bit cuts down through the soils and rock, the core created passes into the liner in a relatively undisturbed state (Fugro, 2003; International Society for Soil Mechanics and Geotechnical Engineering [ISSMGE], 2005). The cores obtained by this method vary in diameter from 3 to 20 cm (1 to 8 in) and can penetrate several hundred meters beneath the seafloor.

Other methods used during geotechnical surveys include vibracorers, gravity corers, piston corers, box corers, and jet probes (Fugro, 2003; ISSMGE, 2005). Bottom sampling involves devices that penetrate only a few centimeters to several meters below the seafloor. Samples of surficial sediments are typically obtained by dropping a piston core or gravity core (“dart”), essentially a weighted tube, to the ocean floor and recovering it with an attached wire line. Grab samplers are one of the most common methods of retrieving sediment samples or biological samples from the seabed. A grab sampler is a device that collects a sample of the topmost layers of the seabed by bringing two steel clamshells together and cutting a bite from the soil.

3.2.2.6. Passive Remote-Sensing Surveys

Remote-sensing surveys use passive detection methods that do not involve an active acoustic sound source. Gravity, gravity gradiometry, and marine magnetic surveys are remote-sensing surveys typically conducted from ships. Radar imaging is done by satellite and used to detect oil slicks on the sea surface. Aeromagnetic surveys are conducted by fixed-wing aircraft and look for deep crustal structure, salt-related structure, and intra-sedimentary anomalies.

3.2.2.6.1. Gravity Surveys

Marine gravity data can be collected with instruments on the seafloor, in boreholes, or in helicopters, but usually on ships. In some cases, the data are collected during a seismic survey. However, the preferred method has been to use dedicated ships (about 50 m [164 ft] long) in order to acquire more precise data. With the advent of GPS navigation and larger, more stable seismic ships, it is now possible to achieve the same order of accuracy with meters placed in seismic ships as in dedicated ships. Data grids for gravity surveys range from 1.6 x 8 km to 9.7 x 32 km (0.9 x 4.3 nmi to 5.2 x 17 nmi). Helicopters also may be used to collect gravity data, but such surveys are rare because of the logistics required to keep the craft in the air for extended periods far from shore.

3.2.2.6.2. Gravity Gradiometry

Measuring the earth's gravity gradient is now possible with the release of Department of Defense (DOD) technology. The instrument is housed in a box located on a 60-m (197-ft) survey ship or fixed-wing aircraft. In shallow water, ships survey a 0.25- by 1-km (0.13- by 0.54-nmi) grid, and in deep water, a 1- by 2-km (0.54- by 1.08-nmi) grid is used. Typically, a 20-block area is selected for survey, and a ship traveling at 11 kn (20 km/hr) can complete a survey in about 2 days. Gravity gradiometry surveys are also conducted with fixed-wing aircraft that fly at a speed of about 100 kn (185 km/hr) and altitudes of 80-100 m (262-328 ft) (DiFrancesco et al., 2009).

3.2.2.6.3. Marine Magnetic Surveys

Marine magnetic surveys measure the earth's magnetic field for the purpose of determining structure and sedimentary properties of subsurface horizons. Magnetic surveys are also conducted to detect shipwrecks. These surveys are usually conducted in conjunction with a seismic survey, allowing the navigation information to be used for both surveys. The development of low-power digital sensors has allowed the sensor package to be towed behind the seismic source array, which has greatly improved operational efficiency of magnetic surveys. The sensor is housed in a cylindrical package measuring approximately 1 m (3 ft) long and 15-20 cm (6-8 in) in diameter and weighing about 14 kg (31 lb). The electronics package inside the case contains about 1 liter (L) (0.3 gallons [gal]) of chemically inert nontoxic fluid. The sensor is towed behind one of the subarrays of the seismic source array at distances of 50, 100, or 150 m (164, 328, or 492 ft) behind the array, although the 100-m distance is the most common. The sensor is typically towed at a depth of 3 m (10 ft) and makes use of depth devices mounted on the cable to maintain a constant depth. In magnetic surveys for archaeological resources, the instrument is towed 6 m (20 ft) above the seafloor.

3.2.2.6.4. Radar Imaging

Radar imaging by satellite can be used to detect oil slicks on the sea surface because oil molecules reaching the sea surface form a thin layer that dampens the ocean surface capillary waves. The detection of oil slicks requires quiet water conditions and consequently is limited by sea state as well as satellite position and frequency of coverage. The resolution of the radar images ranges from 8 to 100 m (26 to 328 ft), with a swath width range of 50-500 km (27-270 nmi). The radar satellite is in a near polar orbit at an altitude of 800 km (432 nmi). The cycle time for a duplicate orbit is 24 days, but a common spot on the earth can be revisited every 5 days and surveyed with different viewing parameters. BOEM does not permit nor approve radar imaging surveys.

3.2.2.6.5. Aeromagnetic Surveys

Aeromagnetic surveys are conducted to look for deep crustal structure, salt-related structure, and intra-sedimentary anomalies. The surveys are flown by fixed-wing aircraft flying at speeds of about 250 km/hr (135 kn) (Reeves, 2005). Based on aeromagnetic datasets posted by Fugro Gravity and Magnetic Services (2012) for the northern Gulf of Mexico, most offshore aeromagnetic surveys are flown at altitudes between 61-152 m (200-500 ft) and collect 15,000-60,000 line km (9,320-37,282 line mi) of data. Line spacing varies depending on the objectives, but typical grids are 0.5 x 1.0 mi or 1.0 x 1.0 mi. A broad scale survey may be flown at higher altitudes (e.g., 305 m [1,000 ft]) and use wider line spacing (e.g., 4 x 12 mi or 8 x 24 mi). The magnetic field is measured by either a proton precision or cesium vapor magnetometer mounted in a "stinger" projection from the tail of the aircraft (Reeves, 2005). On occasion, two magnetometers are used to measure not only the total magnetic field but also the vertical gradient of the field.

3.2.3. Proposed Action Scenario

3.2.3.1. Areas Considered for Oil and Gas Exploration

The G&G activities for oil and gas exploration could occur anywhere within the Mid- and South Atlantic Planning Areas, from the Federal/State boundary (3 nmi from shore) to the limits of this Agency's jurisdiction at the EEZ (200 nmi from shore). The potential geographic scope is indicated by the nine applications for seismic surveying in the Atlantic that have been received and posted to BOEM's website at http://www.boem.gov/Oil-and-Gas-Energy-Program/GOMR/GandG.aspx. The proposed survey areas collectively encompass most of the AOI, with considerable overlap. Although some G&G applications extend into State waters and beyond the EEZ (out to 350 nmi from shore), jurisdiction beyond the EEZ is not currently within this Agency's permitting authority. Surveys in State waters would be under the permitting authority of the COE through their NWP Program as described in **Chapter 1**. All seismic surveys including those conducted in State waters or beyond the EEZ would be within the jurisdiction of NMFS with respect to authorization of incidental take of marine mammals under the MMPA.

3.2.3.2. Projected Activity Levels

Projected activity levels over the time period analyzed in this Programmatic EIS are shown in **Tables 3-3** and **3-4**. To construct a scenario for oil and gas exploration, BOEM had to make some assumptions for how the Mid- and South Atlantic Planning Areas would be administered as Federal lands, and if oil and gas exploration is to be allowed. The current applications for seismic surveying in the Atlantic were reviewed to separate those portions of proposed surveys that cover the Mid- and South Atlantic Planning Areas. Seismic operators were contacted to determine if they still wished to pursue seismic surveying if restricted to only the Mid- and South Atlantic Planning Areas. The BOEM assumes that there will be no lease sale in these planning areas until at least 2018, according to the 2012-2017 Proposed 5-Year Program, which was released for public comment in November 2011 (USDOI, BOEM, 2011c).

Prelease seismic surveys could take place as soon as BOEM completes the NEPA evaluation and publishes a ROD in early 2013. Whereupon, BOEM would expect to evaluate the site-specific attributes for G&G permit applications that include the environmental consultations required by law. Processing of permit applications is typically carried out within approximately 45-60 days. The 3D estimates shown in **Table 3-3** include ocean bottom cable and nodal surveys, vertical cable surveys, and 4D nodal projects, and the WAZ estimates also include coil shooting (exclusive to WesternGeco).

Table 3-4 provides general activity levels for MT surveys; gravity, gravity gradient, and magnetic surveys; aeromagnetic surveys; COST wells; shallow test drilling; and bottom sampling, but with no breakdown by year or planning area. Activity estimates were not developed for satellite radar imaging as BOEM does not permit or approve these surveys.

3.3. Renewable Energy G&G Surveys for Site Assessment and Characterization

3.3.1. Background and Jurisdiction

The G&G surveys are expected to be conducted in support of renewable energy development in the Mid- and South Atlantic Planning Areas within the 2012-2020 time period covered by this Programmatic EIS. Under the renewable energy program (30 CFR 585), the need for G&G surveys in support of site characterization and foundation studies are part of a developer's planning to secure a commercial competitive or non-competitive lease on the OCS for renewable energy facilities. Thus, the decision to offer an OCS lease is an actualizing step for G&G activities. The competitive lease process is set forth at

30 CFR 585.210 through 585.225, and the non-competitive process is set forth at 30 CFR 585.230 through 585.232, and was slightly modified by a recent rulemaking on May 16, 2011 (*Federal Register*, 2011c). Most wind energy facilities on the Atlantic OCS will probably track the competitive process.

There are several OCS plans that are part of the renewable energy program, the approval of any of which could result in G&G activities (**Table 3-2**). A staged decision-making process takes place for a commercial development, such as a wind energy facility: (1) BOEM's planning and analysis; (2) lease issuance; (3) approval of a Site Assessment Plan (SAP); and, (4) approval of a Construction and Operations Plan (COP). A General Activities Plan (GAP) is processed to issue grants for rights-of way on unleased OCS land or across land leased to a third party (**Table 3-2**). Under a GAP a similar staged approval process takes place. Typically a GAP would be used to approve installation of electrical cable in the sea bed or substations supporting an OCS wind energy facility.

A NEPA evaluation is part of the approval process for OCS plans under the renewable energy program. A proposed action at a specific location, tool type, and intensity of G&G activity are subjected to evaluation, which may be an EA or an EIS. The consultations required under environmental law for protected species are part of the NEPA evaluation.

A commercial lease gives the lessee the exclusive right to subsequently seek BOEM approval for the development of the leasehold. A lease does not grant the lessee the right to construct any facilities; rather, the lease grants the right to use the leased area to actualize plans that must be approved by BOEM before the lessee can move on to the next stage of the process (30 CFR 585.600 and 585.601). With the submission of a SAP the lessee proposes characterizing activities for the wind resource by constructing a meteorological tower or installing meteorological buoys on the leasehold (30 CFR 585.605 through 585.618). The lessee's SAP must be approved by BOEM before it conducts these "site assessment" activities on the lease. The BOEM may approve, approve with modification, or disapprove a lessee's SAP (30 CFR 585.613). A lessee may proceed directly to the fourth stage, COP submittal, if no site assessment activities are needed to support a COP submittal. In the current operating environment, this scenario is anticipated to occur in only a few exceptional cases. With the submission of a COP, which is a detailed plan for constructing and operating a wind energy facility on the lease, the lessee must also submit information characterizing the areal extent of the site and the sea bed foundation conditions that includes the detailed plan for constructing and operating a wind energy facility on the lease (30 CFR 585.620 through 585.638). The BOEM approval of a COP is a precondition to the construction of any wind energy facility on the OCS (30 CFR 585.628). The BOEM may approve, approve with modification, or disapprove a lessee's COP (30 CFR 585.628).

The regulations also require that a lessee provide the results of G&G surveys with its COP, including a shallow hazards survey (30 CFR 585.626 (a)(1)), geological survey (30 CFR 585.616(a)(2)), geotechnical survey (30 CFR 585.626(a)(4)), and an archaeological resource survey (30 CFR 585.626(a)(5)). Although BOEM does not issue permits or approvals for these site characterization activities, BOEM will not consider approving a lessee's COP if the required survey information is not included. Guidance packages report acceptable instrumentation, survey design parameters, and the report outputs that allow BOEM decisions to be made (USDOI, BOEM, 2011d).

The distance from shore for a wind facility is generally defined at the outward limit of its economic viability, currently about 46 km (25 nmi) from shore or 100 m (328 ft) water depth. Wind energy facilities are currently the only type of renewable energy facility contemplated in the Mid- and South Atlantic Planning Areas. Specific locations of G&G surveys for renewable energy sites are not known at this time. However, for this programmatic analysis, the general areas for renewable energy projects in the Mid- and South Atlantic Planning Areas from 2012-2020 have been estimated in terms of numbers of OCS lease blocks offshore the States of Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida.

The BOEM has published Requests for Interest for specific wind energy areas (WEAs) offshore Delaware, Maryland, and Virginia. In May 2011, North Carolina completed a screening exercise to yield candidate areas of OCS lease blocks meeting their criteria for wind facility development. The BOEM has not published Requests for Interest for the states adjacent to the South Atlantic Planning Area (South Carolina, Georgia, and Florida), but activity levels have been estimated for this analysis. Also, the scenario takes into account the Atlantic Wind Connection, a submarine electricity transmission cable proposed to be installed offshore the Atlantic Coast from New Jersey, offshore New York City, to Virginia, offshore Norfolk, to facilitate wind energy development. The BOEM has received only one indication of interest for a marine hydrokinetic (MHK) project proposal in the Atlantic, but it is located in the Straits of Florida Planning Area, outside the scope of this Programmatic EIS.

3.3.2. Types of Surveys

Two general types of G&G site characterization surveys are expected to be conducted in support of renewable energy development: HRG surveys and geotechnical surveys. The HRG surveys are conducted to obtain information about subseafloor conditions, shallow hazards, archaeological resources, and sensitive benthic habitats. Typical equipment used in HRG surveys includes single beam or multibeam depth sounders, magnetometers, side-scan sonars, and shallow and medium penetration subbottom profilers. Geotechnical surveys, which involve seafloor-disturbing activities such as cone penetrometer tests (CPTs), geologic coring, and grab sampling, are conducted to obtain information about surface and subsurface geological and geotechnical properties. Information from both survey types is taken into consideration during siting, design, construction, and operation of renewable energy facilities.

Another activity conducted as part of site characterization is the deployment of bottom-founded monitoring buoys in a lease area. The buoys typically would include current meters and other equipment to monitor oceanographic conditions and marine life. The information collected can be used to evaluate the potential for sediment erosion, aid in the design of renewable energy facilities, and provide baseline environmental information for the lease area.

Under certain conditions, BOEM may encourage the use of additional instrumentations and methods such as divers, remote or manned submersibles, video cameras on ROVs, and additional geophysical survey lines. Once an operator submits a SAP, GAP, or COP, BOEM will review the geophysical survey and any other information available to determine the possible presence of sensitive benthic habitats or archaeological resources. These include areas where information suggests the presence of exposed hard bottoms of high, moderate, or low relief; hard bottoms covered by thin, ephemeral sand layers; seagrass patches; or algal beds. A survey that includes benthic grab samples and photodocumentation to delineate areas of sensitive benthic habitats may be recommended by BOEM where such features are known to occur or are suspected from previously conducted studies or surveys, or in areas where data are inadequate. Biological surveys are not part of the analysis in this Programmatic EIS.

The renewable energy scenario includes the possibility that a deep penetration (2D or 3D) seismic survey would be conducted to evaluate formation suitability for carbon sequestration. However, given the much greater number and extent of seismic surveys included in the oil and gas scenario, a single seismic survey for carbon sequestration is not analyzed separately.

3.3.2.1. High-Resolution Geophysical Surveys

Lessees must submit the results of site characterization surveys with their SAP (30 CFR 585.610 and 585.611) and COP (30 CFR 585.626 and 585.627). The purpose of the HRG survey would be to acquire geophysical shallow hazards data and information pertaining to the presence or absence of archaeological resources, and to conduct bathymetric charting. The HRG data are collected by lessees to provide information on subseafloor conditions, shallow hazards, archaeological resources, and sensitive benthic habitats in a lease area and along transmission cable corridors. The scope of investigation should be sufficient to reliably cover any portion of the site that would be affected by the renewable energy installation including the maximum area of potential effect encompassing all seafloor/bottom-disturbing activities. The maximum area includes, but is not limited to, the footprint of all seafloor/bottom-disturbing activities (including the areas in which installation vessels, barge anchorages, and/or appurtenances may be placed) associated with construction, installation, inspection, maintenance, or removal of structures and/or transmission cables.

Equipment typically used in HRG surveys for renewable energy includes single beam or multibeam depth sounders, magnetometers, side-scan sonars, and shallow or medium penetration subbottom profilers. The BOEM does not anticipate that airguns would be necessary for renewable energy site assessment activities. Typical equipment is summarized below; see **Chapter 3.5** for additional information, including sound source levels.

- *Depth Sounders:* The depth sounder system should record with a sweep appropriate to the range of water depths expected in the survey area. The BOEM encourages use of a multibeam bathymetry system, particularly in areas characterized by complex topography or fragile habitats.

- *Magnetometers:* Magnetometer survey techniques should be capable of detecting and aiding the identification of ferrous, ferric, or other objects having a distinct magnetic signature. The magnetometer sensor should be towed as near as possible to the seafloor but should not exceed an altitude of greater than 6 m (20 ft) above the seafloor. The sensor should be towed in a manner that minimizes interference from the vessel hull and other survey instruments. The magnetometer sensitivity should be 1 gamma or less, and the background noise level should not exceed a total of 3 gammas peak to peak.
- *Side-Scan Sonars:* Recording should be of optimal quality (good resolution, minimal distortion) resulting in displays automatically corrected for slant range, lay-back, and vessel speed. The operator should use a digital dual-frequency side-scan sonar system with preferred frequencies of 445 and 900 kHz and no less than 100 and 500 kHz to record continuous planimetric images of the seafloor. The recorded data should be used to construct a mosaic to provide a true plan view that provides 100 percent coverage of the area of potential effect. The side-scan sonar sensor should be towed at a distance above the seafloor that is 10-20 percent of the range of the instrument.
- *Shallow and Medium Penetration Subbottom Profilers:* A high-resolution chirp subbottom profiler is typically used to delineate near-surface geologic strata and features. The BOEM recommends that the subbottom profiler system be capable of achieving a vertical bed separation resolution of at least 0.3 m (1 ft) in the uppermost 15 m (49 ft) below the seafloor. The medium-penetration boomer profiler system must be capable of penetrating greater than 10 m (33 ft) beyond any potential foundation depth, and the vertical resolution must be less than 6 m (20 ft).

The HRG surveys are conducted from specialized survey vessels fitted with equipment for deploying and handling geophysical systems. In nearshore waters, the surveys would be conducted by a single, small (<23-30 m [75-98 ft]) vessel moving at <5 kn (9.3 km/hr). Typically, a survey would be completed in 3-5 days, and depending on the location, the vessel may return to its shore base daily. Sites in deeper water may require larger vessels that operate 24 hr per day and can remain at sea for weeks. Survey vessels follow precise, pre-plotted lines so that the desired coverage of the seafloor is achieved. An integrated navigational system keeps track of the position and depth of the towed survey equipment.

The BOEM recommends that the geophysical survey grid(s) for project structures and surrounding area for bathymetric charting, shallow hazards assessments, and archaeological resources assessments be oriented with respect to bathymetry, shallow geologic structure, and renewable energy structure locations whenever possible. The grid pattern for each survey should cover the maximum area of potential effect for all anticipated physical disturbances. Specific grid requirements are as follows:

- line spacing for all geophysical data for shallow hazards assessments (on side-scan sonar/all subbottom profilers) should not exceed 150 m (492 ft) throughout the area.
- line spacing for all geophysical data for archaeological resources assessments (on magnetometer, side-scan sonar, chirp subbottom profiler) should not exceed 30 m (98 ft) throughout the area. The BOEM may require higher resolution surveys where necessary to ensure that site-specific actions comply with the NHPA.
- line spacing for bathymetric charting using multibeam technique or side-scan sonar mosaic construction should be suitable for the water depths encountered and provide both full coverage of the seabed plus suitable overlap and resolution of small discrete targets of 0.5-1.0 m (1.5-3 ft) in diameter.
- all track lines should run generally parallel to each other. Tie-lines running perpendicular to the track lines should not exceed a line spacing of 150 m (492 ft) throughout the survey area.

In addition, the geophysical survey grid for proposed transmission cable route(s) should include a minimum 300-m (984-ft) wide corridor centered on the transmission cable location(s). Line spacing should be identical to that noted above.

3.3.2.2. Geotechnical Surveys

Geotechnical surveys are conducted to obtain information about surface and subsurface geological and geotechnical properties. This information is used to aid in siting, design, construction, and operation of renewable energy facilities. Geotechnical surveys involve seafloor-disturbing activities such as CPTs, geologic coring, and grab sampling. Sediment sampling and testing locations for geotechnical surveys are guided by the geophysical data and maps generated during HRG surveys.

The principal purposes of geotechnical surveys are to (1) assess the suitability of shallow foundation soils to support renewable energy structure(s) or associated transmission cable(s) under extreme operational and environmental conditions that might be encountered; and (2) document soil characteristics necessary for design and installation of all structures and transmission cables. The results reveal the stratigraphic and geoengineering properties of the sediment that may affect the foundations or anchoring systems for the project. Specific uses of geotechnical data are to

- analyze *in situ* and laboratory soil test data to estimate foundation soil response to maximum anticipated static and dynamic loads;
- determine embedment depth and predict susceptibility of the foundation to liquefaction and scour phenomena;
- characterize liquefaction potential, specifically in the context of regional seismicity;
- evaluate the potential for seafloor erosion and scour in the context of empirically derived current velocity data for the project area; and
- integrate the results of the geotechnical and shallow hazards investigations to provide a comprehensive analysis of foundation stability for the site.

The BOEM recommends that the results of *in situ* testing, boring, and/or sampling be analyzed at each foundation location and at every kilometer of the transmission cable route to shore to examine all important sediment and rock strata to determine its strength classification, deformation properties, and dynamic characteristics. Sampling should include a minimum of one "deep" geologic coring (with soil sampling and testing) at each edge of the project area and within the project area as needed to determine the vertical and lateral variation in seabed conditions and to provide the relevant geotechnical data required for design. To be considered a "geologic coring," the core depth should be at least 10 m (33 ft) deeper than the design penetration of the foundation piles. For areas with highly variable subsea soil conditions, it may be appropriate to obtain a much higher number of deep borings than the minimum described in 30 CFR 585.626(a)(4)(iii), and it may be necessary to obtain one at each turbine foundation location to adequately characterize the stratigraphic and geoengineering properties for each foundation design.

Geotechnical surveys for renewable energy sites are expected to be conducted from a small barge or ship approximately 20 m (65 ft) in length. The duration of a typical survey would be 3 days or less. The spatial scale of sampling and testing activities would range from a minimum of 1/16 of a lease block (approximately 260 hectares [ha] or 640 ac) to multiple lease blocks and is assumed to include cable route(s) to shore. The area of seabed disturbed by individual sampling events (e.g., collection of a core or grab sample) is estimated to range from 1 to 10 m^2 (11 to 108 ft^2). Some operational platforms require anchoring for brief periods using small anchors; however, approximately 50 percent of deployments for this sampling work could involve a boat having dynamic positioning capability. Consequently, not all geological sampling necessarily includes bottom disturbance by anchoring. Jack-up barges and spudded work barges are seldom used.

3.3.2.2.1. Cone Penetrometer Tests

The CPT is a widely used *in situ* test for marine engineering applications (Fugro, 2003; ISSMGE, 2005). It is used to obtain information on soil type and stratification as well as shear strength in clays and relative density and friction angles in sand. The CPT provides an empirical assessment of seabed soils based on the resistance of the soil to a cone-tipped probe, or penetrometer, as it is pushed into the seabed at a constant rate of penetration (about 2 cm/s [0.8 in/s]). Standard cones have a tip angle of 60° and a cross-sectional area between 5 and 20 cm^2 (0.8 and 3 in^2). Electrical strain gauges within the cone assembly measure the resistance on the cone tip and friction on a sleeve behind the tip. In a piezocone penetration test (PCPT), an additional parameter, soil pore water pressure, is measured via a porous element in the cone face or at the shoulder between cone tip and friction sleeve. Data are transmitted in realtime to the surface support vessel for recording and analysis.

3.3.2.2.2. Geologic Coring

During geotechnical surveys for renewable energy facilities, core samples are collected to characterize the geotechnical properties of surface and subsurface sediments. The BOEM requires that this sampling include a minimum of one "deep" geologic coring (with soil sampling and testing) at each edge of a project area and within a project area as needed to determine the vertical and lateral variation in seabed conditions and to provide the relevant geotechnical data required for design of renewable energy facilities. To be considered a geologic coring, the core depth should be at least 10 m (33 ft) deeper than the design penetration of the foundation piles. Geologic cores are obtained by standard rotary coring. Rotary corers are designed as double or triple tube devices where the innermost tube acts as a core liner, the middle tube, if present, acts as a holder, and the rotating outer tube carries the hollow drill bit. As the bit cuts down through the soils and rock, the core created passes into the liner in a relatively undisturbed state (Fugro, 2003; ISSMGE, 2005). The cores obtained by this method vary in diameter from 3 to 20 cm (1 to 8 in) and can penetrate several hundred meters beneath the seafloor.

Other methods may be used during geotechnical surveys, including vibracorers, gravity corers, piston corers, box corers, and jet probes (Fugro, 2003; ISSMGE, 2005). These methods are not specifically analyzed here, but the extent of seafloor disturbance would be similar to that for geologic coring.

3.3.2.2.3. Grab Sampling

Grab samplers are one of the most common methods of retrieving sediment samples from the seabed. A grab sampler is a device that collects a sample of the topmost layers of the seabed and benthic biota by bringing two steel clamshells together and cutting a bite from the soil. The grab sampler consists of two steel clamshells on a single or double pivot. The shells are brought together either by a powerful spring or powered hydraulic rams operated from the support vessel. The grab is lowered to the seabed and activated, either automatically or by remote control. The shells swivel together in a cutting action and by so doing remove a section of seabed. The sample is recovered to the ship for examination. Geotechnical investigations normally require large samples and favor the bigger hydraulic clamshell grab. These systems can retrieve samples of 0.35 m^3 (12.4 ft^3) or 700 kg (1,543 lb). A typical hydraulic grab sampler will weigh about half a tonne and can operate in water depths down to 200 m (656 ft). Typical sampling rates are between three and four grabs per hour.

3.3.2.3. Bottom-Founded Monitoring Buoy Deployments

While a meteorological tower has been the traditional device for characterizing wind conditions, several companies have expressed interest in installing meteorological buoys instead (USDOI, BOEM, 2011b). This Programmatic EIS assumes that lessees would choose to install buoys instead of meteorological towers. These meteorological buoys would be anchored at fixed locations and regularly collect observations from many different atmospheric and oceanographic sensors. The scenario does not preclude the use of meteorological towers. Rather, it recognizes that experience to date has shown that operators facing the costs of installing, operating, and decommissioning a meteorological tower have selected against this method for buoys that have near-equivalent capability for obtaining the same data as towers.

A meteorological buoy can vary in height, hull type, and anchoring method. The NOAA has successfully used discus-shaped and boat-shaped hull buoys for weather data collection for many years; these are the buoy types that would most likely be adapted for offshore wind data collection. A large discus buoy has a circular hull that ranges between 10 and 12 m (33 and 39 ft) in diameter and is designed for many years of service (USDOC, National Data Buoy Center [NDBC], 2011). The boat-shaped hull buoy (known as the "NOMAD") is an aluminum-hulled, boat-shaped buoy that provides long-term survivability in severe seas (USDOC, NDBC, 2011). The largest meteorological buoys anticipated in this scenario would be similar to one proposed offshore New Jersey by Garden State Offshore Energy, which was a 30-m (100-ft) long spar-type buoy just over 2 m (6 ft) in diameter (USDOI, BOEM, 2011e).

See **Chapter 3.5** for the estimated extent of seafloor disturbance associated with bottom-founded monitoring buoys.

3.3.3. Proposed Action Scenario

To estimate the survey activity that could reasonably result from renewable energy lease issuance and approval of site assessment activities, BOEM's Office of Renewable Energy Programs (OREP) developed the following activity scenario based on applications and other proposals for commercial wind facilities and data collection activities on the Atlantic OCS. Offshore wind facilities are currently the only type of renewable energy facility contemplated in the Mid- and South Atlantic Planning Areas. BOEM has only received one expression of interest for an MHK project proposal in the Atlantic, but it is located in the Straits of Florida Planning Area, outside the scope of this Programmatic EIS. The size or scale of this facility, and whether it will be staged for demonstration before commercial operation is not known at this time.

3.3.3.1. Areas Considered for Renewable Energy Projects

The general area proposed for site assessment activities for renewable energy projects in the Mid- and South Atlantic Planning Areas between 2012 and 2020 would be a portion of the OCS offshore Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. Estimated areal extent of the OCS blocks where renewable energy activities may occur offshore each state are summarized in **Table 3-5**. The distance from shore for a wind facility is generally defined at the outward limit of its economic viability, currently about 25 nmi (46.3 km) from shore or 100 m (328 ft) water depth. This is generally far enough offshore to minimize interactions with birds and visibility from shore.

3.3.3.1.1. Mid-Atlantic Planning Area

In the Mid-Atlantic Planning Area, BOEM published Requests for Interest for WEAs offshore Delaware (*Federal Register*, 2010d), Maryland (*Federal Register*, 2010e), and Virginia (*Federal Register*, 2011d). In July 2011, BOEM issued a draft EA for these areas that included changes to the extent of the Maryland and Virginia WEAs (USDOI, BOEM, 2011e). The revised WEAs are the ones included in this Programmatic EIS.

The proposed Delaware WEA rests between the incoming and outgoing shipping routes for Delaware Bay and is made up of 11 whole OCS blocks and 16 partial blocks. The closest point to shore is 18.5 km (10 nmi) due east from Rehoboth Beach, Delaware. The area is approximately 122 nmi^2 (103,323 ac or 41,813 ha).

The Maryland WEA is defined as 9 whole OCS blocks and 11 partial blocks. The western and eastern boundaries of the WEA are located approximately 18.5 and 50 km (10 and 27 nmi), respectively, from Ocean City, Maryland. The area is approximately 94 nmi^2 (79,706 ac or 32,256 ha).

The Virginia WEA consists of 22 whole OCS blocks and 4 partial blocks. The western and eastern boundaries of the area are approximately 33.4 and 68.5 km (18 and 37 nmi), respectively, from Virginia Beach, Virginia. The area is approximately 164 nmi^2 (138,788 ac or 56,165 ha).

In May 2011, North Carolina completed a screening exercise to yield a candidate area of 500 OCS lease blocks meeting their criteria for wind facility development (Thrive in North Carolina, 2011). The screening exercise was to determine potential environmental suitability, and the area is not proposed for wind development at this time. The best judgment of BOEM staff is that all 500 blocks would not be proposed for leasing or actually leased to begin site assessment activities within the period covered by this Programmatic EIS. Based upon continuing conversations between the State and Federal partners, a more likely number is 75 blocks that will eventually be assessed beginning in late 2012 or early 2013. Based on this assumption, the area would be approximately 510 nmi^2 (432,002 ac or 174,825 ha).

3.3.3.1.2. South Atlantic Planning Area

For the states adjacent to the South Atlantic Planning Area (South Carolina, Georgia, and Florida), BOEM has not published Requests for Interest, and there is no other specific information to estimate the activity level in these areas. For this analysis, the activity level has been estimated at 30 lease blocks offshore each of these states. The BOEM has received one plan for an MHK project proposal in the Atlantic, but it is located in the Straits of Florida Planning Area, outside the scope of this Programmatic EIS. It is difficult at this time to estimate the quantity and placement of MHK devices on a commercial scale within a lease block there.

3.3.3.1.3. Atlantic Wind Connection Transmission Cable

Atlantic Grid Holdings LLC has proposed to develop a high-voltage direct current transmission cable offshore the Atlantic Coast running from northern New Jersey to Virginia in five phases (Atlantic Wind Connection, 2011a,b). The company has requested a right-of-way that is approximately 1,320 km (820 mi) in length, with as many as a dozen offshore platforms (substations). Under BOEM's regulations, a right-of-way is 61 m (200 ft) in width, though the developer may elect to perform surveys on a somewhat wider area to facilitate rerouting should obstructions in the right-of-way be discovered. About 90 percent of the right-of-way is in Federal waters. Although some of the right-of-way is outside the AOI, for the analysis in this Programmatic EIS the entire length is included.

3.3.3.2. Projected Activity Levels

Table 3-6 summarizes the projected activity levels for G&G activities associated with renewable energy development from 2012-2020.

To estimate HRG activity levels, BOEM assumed that geophysical surveys for shallow hazards and archaeological resources would be conducted at the same time using the finer line spacing required for archaeological resource assessment (30 m [98 ft]). Tie-lines would be run perpendicular to the track lines at a line spacing of 150 m (492 ft), which would result in 925 km (575 mi [500 nmi]) of HRG surveys per OCS block. It would take approximately 150 hr to survey one OCS block. In addition, a 16-km (10 mi) cable route to shore was assumed for each state, with a 300-m (984-ft) wide survey corridor requiring about 8 km (5 mi) or 1 hr of surveys per mile of cable. This assumption (1 hr per mile of cable) is also used for the Atlantic Wind Connection submarine transmission cable. In order to survey an entire renewable energy area and potential cable route, HRG surveys would have to be conducted by multiple vessels and/or over multiple years and potential cable routes.

The number of bottom sampling/testing locations for geotechnical surveys was estimated by assuming that a sample would be collected at every potential turbine location. Spacing between wind turbines is typically determined on a case-by-case basis to minimize wake effect and is based on turbine size and rotor diameter. Offshore Denmark, a spacing of seven rotor diameters between units has been used. In the U.S., the Cape Wind project proposed a spacing of 6 by 9 rotor diameters. In some land-based settings, turbines are separated by as much as 10 rotor diameters from each other. Based on this range in spacing for a 3.6-megawatt (MW) (110-m rotor diameter) turbine and a 5-MW (130-m rotor diameter) turbine, it would be possible to place 14-45 turbines in one OCS block. The sampling numbers in **Table 3-6** are based on the assumption that a bottom sample would be collected at every potential turbine location in a WEA, at a density of 14-45 turbines per block. In addition, the Atlantic Wind Connection has proposed up to 12 transmission substations along the transmission line, and it is estimated that one or two bottom samples would be collected at each substation.

3.4. MARINE MINERALS G&G SURVEYS

The suite of survey and tool types deployed for the renewable energy and marine minerals programs are very similar.

3.4.1. Background and Jurisdiction

The Marine Minerals Program is responsible for managing the exploration for and use of marine minerals, in particular sand and gravel, on the OCS. The OCS sand resources are frequently identified for and used in shore protection, coastal and wetlands restoration, and other federally-authorized construction projects. The BOEM has historically implemented the combined authorities for sand and gravel exploration and use through four principal functions:

- authorizing G&G prospecting for OCS sand resources;
- undertaking environmental evaluation and studies in support of G&G authorizations and leasing OCS sand resources;
- preparing non-competitive leases and MOAs authorizing use of OCS sand resources in beach nourishment and coastal restoration projects; and
- managing and coordinating cooperative agreements, task forces, and working groups with State and Federal partners in management of OCS sand resources.

The G&G surveys may occur during three distinct phases of a project, which, in order of occurrence, could include the following: (1) initial sand resource exploration; (2) pre-authorization or pre-leasing environmental review; and (3) borrow area monitoring before and after dredging and construction.

The typical project requiring use of OCS sand first involves resource identification. In this phase, reconnaissance G&G surveys are performed to map and characterize OCS sand resources and/or identify any sensitive environmental resources that could be affected by surveys. The G&G surveys may also be performed in support of regional or strategic sediment management planning without a particular end use or user in mind. The G&G surveys may be performed by other Federal agencies, State or local governments, contractors working on the behalf of a government, and/or academia.

These surveys activities fall under two types, prospecting and scientific research. Under Section 11 of the OCSLA, BOEM may authorize G&G prospecting for non-energy marine minerals, except in the case that another Federal agency is performing the survey on the OCS. Before authorizing any proposed prospecting, BOEM undertakes the necessary environmental review, including preparation of a NEPA document. Scientific research only requires notification and is not authorized by BOEM.

After OCS sand resources are identified and smaller-scale borrow area(s) are proposed, under Section 8(k) of the OCSLA, BOEM may authorize use of those minerals through a negotiated non-competitive leasing process for qualified projects. Qualified projects include: shore protection; beach or coastal restoration; or a federally-authorized construction project undertaken by a Federal agency, State, or local government.

A separate process and regulatory framework (30 CFR 581-582) is in place for competitive leasing of OCS non-energy minerals, a process similar to oil and gas leasing where interested parties bid on specific OCS blocks proposed for leasing. However, BOEM has never conducted a competitive leasing process for sand or gravel and does not expect to do so within the period 2012-2020.

In advance of entering into a negotiated agreement for the non-competitive use of OCS sand resources, BOEM undertakes a detailed environmental and technical review of the proposed project. The BOEM may prepare its own NEPA document, which typically is an EA but can be an EIS (**Table 3-2**), collaborate with another lead Federal agency, or have a contractor prepare the NEPA document. As with all NEPA evaluations, any coordination or consultations required by environmental law are also carried out. To provide relevant information for the environmental review, additional G&G surveys are typically conducted by the applicant in the proposed borrow area to identify sensitive environmental and cultural resources and avoid to the extent possible adverse effects to those resources during dredging through appropriate mitigation. Geophysical surveys are most frequently used to identify archaeological/cultural resources and/or map benthic and hard-bottom habitat near the proposed borrow area. The BOEM cannot currently authorize these surveys under its authority, unless the surveys are being used to further delineate the mineral resource.

Finally, additional geophysical surveys may be conducted at the borrow area prior to and at regular intervals after dredging. These surveys are performed as conditions of BOEM's authorization. Previous environmental review would have considered, analyzed, and established the need for such monitoring surveys. Typical surveys include pre- and post-construction bathymetric surveys in the borrow area and are used to document bottom changes, determine volumes used, and validate environmental analyses.

The G&G surveys for the marine minerals program have historically occurred: (1) under cooperative agreements where State or academic researchers, funded by this Agency, regionally identified and assessed potential offshore sand resources (USDOI, MMS, 1999, 2000); and (2) under prospecting authorizations and/or in support of non-competitive leasing in advance of and following dredging operations. Until 2009, this Agency managed cooperative agreements with six coastal states along the Mid- and South Atlantic Planning Areas: Delaware, Maryland, Virginia, North Carolina, South Carolina, and Florida (USDOI, BOEM, 2011f). Currently, BOEM has only one such agreement in the Atlantic, with Florida. Between 1995 and 2011, this Agency issued more than 20 negotiated agreements along the Mid- and South Atlantic Planning Areas authorizing use of OCS sand resources from borrow areas offshore of Maryland, Virginia, South Carolina, and Florida in recreational beach, storm and hurricane damage protection, and infrastructure protection projects (USDOI, BOEM, 2011a). Much of the OCS sand used in these projects was previously identified through the cooperative agreement program that has since largely been discontinued because of budget constraints.

The G&G activities in support of marine mineral uses are expected to occur in both Federal and State waters of the AOI during the time period from 2012-2020. It should be noted that prospecting for and use of sand or gravel in State waters is under jurisdiction of the COE, and G&G surveys are permitted under their NWP Program. Exact G&G survey locations and durations are not known at this time. However, sand source areas (borrow areas) are typically located in water depths between 10 and 30 m (33 and 98 ft). The cost for transporting sand to shore for beach nourishment or coastal restoration is relatively expensive, so coastal planners first use resources in areas closest to shore. Much of the G&G survey activity is expected to occur within existing borrow sites offshore the Mid-Atlantic and South Atlantic states (see **Chapter 4.2.12.3** for locations).

3.4.2. Types of Surveys

Two general types of G&G surveys are expected to be conducted in support of marine mineral uses: HRG surveys and geotechnical surveys. The HRG surveys are conducted to obtain information about subseafloor conditions, shallow hazards, archaeological resources, and sensitive benthic habitats. Typical equipment used in HRG surveys includes single beam or multibeam depth sounders, magnetometers, side-scan sonars, and shallow or medium penetration subbottom profilers. Geotechnical surveys involve seafloor-disturbing activities such as vibracoring, geologic coring, and grab sampling, which are conducted to evaluate the quality of mineral resources for their intended use.

3.4.2.1. High Resolution Geophysical Surveys

3.4.2.1.1. Prospecting and Prelease Geophysical Surveys

The HRG surveys are undertaken to identify OCS sand resources and any environmental resources, cultural resources, and shallow hazards that may exist in potential borrow areas. These surveys are comparable to those undertaken for renewable energy site characterization. Typical survey deployments may involve single beam or multibeam depth sounders; side-scan sonar; a magnetometer; and subbottom profilers (chirp or boomer). Rarely, marine resistivity systems (involving a towed current emitter and an array of receivers) may also be deployed. Geophysical survey equipment is typically deployed from a single relatively small (<20-30 m [65-98 ft]) vessel moving at <5 kn (9.3 km/hr). Since survey areas over prospective borrow sites (3-10 km^2 [300-1,000 ha or 741-2,471 ac]) or reconnaissance areas (on the order of 1-3 OCS blocks) are small in comparison to areas for oil and gas and renewable energy site characterization, these surveys are generally completed in 1-5 operational days.

Prospecting HRG surveys are reconnaissance in nature and generally performed over larger areas to identify sand bodies and characterize the shallow geological framework and surficial geology of potential sand resources. These initial surveys are used to ascertain if sand or gravel resources are of a certain quality (sediment type) and quantity to warrant further exploration and may be conducted at line spacing between 150 and 600 m (492 and 1,969 ft). During the reconnaissance phase, limited geotechnical sampling often occurs along seismic lines and is used to validate geophysical data interpretations.

In comparison, prelease (or design-level) HRG surveys are often performed once a relatively smaller area (or areas) is (are) identified as promising borrow area target(s). Prelease/design HRG surveys provide information on seafloor/subseafloor conditions, shallow hazards, archaeological resources, and sensitive benthic habitats. These HRG data may be used to prepare a dredging plan to efficiently and economically obtain the needed sand volumes while minimizing adverse environmental impacts. Depending on the quality of the initial reconnaissance geophysical data, these data may also be used to refine the borrow area and/or determine horizontal and vertical continuity of sedimentary units (in which case, the survey may be subject to BOEM authorization). These surveys may be conducted at 15-50 m (49-164 ft) line spacing.

3.4.2.1.2. On-Lease Geophysical Surveys

On-lease HRG surveys are typically performed at the borrow area, or a sub-area of the borrow area, prior to and at specified intervals after dredging. A typical area for these surveys would be 1 mi^2 (259 ha or 640 ac). These surveys are used by BOEM to monitor the location and volumes of sand dredging, ensure observance of exclusion zones, and monitor the morphologic evolution of sand bodies and borrow pits. The most frequent geophysical surveys are bathymetric surveys; if sensitive cultural or benthic resources are in the immediate vicinity of dredging and cannot be avoided, side-scan sonar may also be deployed. Since survey areas are relatively small, on-lease geophysical surveys are generally completed in 1-2 days.

3.4.2.2. Geotechnical Surveys

Geological sampling, most commonly by means of vibracoring, geologic (rotary) coring, and/or grab sampling, is carried out to characterize the volume (footprint and thickness) and quality of a prospective sand body or lens. Geotechnical sampling is most frequently done in connection with reconnaissance geophysical surveying. Of these techniques, vibracoring is the most likely technique used to define the thickness and lateral extent of OCS sand bodies. Other sampling methods such as piston or box coring and jet probes are also used as part of geotechnical surveys but are not specifically analyzed here; the extent of seafloor disturbance would be similar to that of the other sediment sampling methods.

Vibracoring generally uses a 7-cm (2.8-in) diameter core barrel mounted on a platform or tripod support assembly and can penetrate sediments in the upper 15 m (50 ft). To penetrate dense sands and gravels, or to reach deeper into stiff clays, the corer's barrel is vibrated, facilitating its penetration into the soil (Fugro, 2003; ISSMGE, 2005). A typical vibracore survey will obtain 15-25 cores, approximately 6 m (20 ft) deep in a 1 mi^2 (640-ac or 259-ha) area.

Geologic coring (standard rotary coring) varies in diameter from 3 to 20 cm (1.2 to 7.9 in) and can penetrate several hundred meters beneath the seafloor. Because of the significantly greater expense, only 1-2 geologic cores would typically be drilled in a 1-mi^2 (640-ac or 259-ha) area. Methods have been described previously in **Chapter 3.3.2.2**.

Grab sampling penetrates from a few inches to a few feet below the seafloor and typically involves 30-40 grabs in the area of interest. Methods have been described previously in **Chapter 3.3.2.2**.

Nearly all geotechnical sampling occurs from either relatively small- to medium-sized stationed vessels approximately 20 m (65 ft) in length or from work barges towed into place. The duration of a typical survey would be 3 days or less. The area of seabed disturbed by individual sampling events (e.g., collection of a core or grab sample) is estimated to range between 1 and 10 m^2 (11 and 108 ft^2). Some operational platforms require anchoring for brief periods with small anchors; however, approximately 50 percent of deployments for this sampling work could involve a boat having dynamic positioning capability. Consequently, not all geological sampling necessarily includes bottom disturbance by anchoring. Jack-up barges and spudded work barges are seldom used.

3.4.3. Proposed Action Scenario

3.4.3.1. Areas Considered for Marine Minerals Projects

The general area where prospecting, prelease site assessment, and on-lease G&G surveys in the Mid- and South Atlantic Planning Areas will likely occur between 2012 and 2020 is in water depths between 10 and 30 m (33 and 98 ft) offshore Delaware south to Florida. Georgia is excluded because the State has never had an agreement with BOEM for joint study of OCS marine minerals resources and has never requested a non-competitive lease to use them onshore. Current technology in the U.S. hopper and cutterhead dredging fleet effectively limits dredging to less than 30-m (98-ft) water depths. Moreover, the cost for transporting sand located in offshore sand shoals and banks to shore is relatively expensive, ensuring coastal planners first use resources in areas closest to shore.

Many OCS usable sand bodies are already known and have been surveyed (USDOI, BOEM, 2011g) and/or used previously. (See **Chapter 4.2.12.1.3** for a map of existing borrow sites.) When existing sites are reused in the future, additional G&G surveying usually is not required, but may be conducted on a case-by-case basis if needed to detect archaeological resources and other bottom obstructions and to sample the area to see if it can provide the quantity and quality of sand required. Some projects are likely to draw from existing borrow sites over and over again, whereas others may use new areas yet to be drawn from. For this analysis, specific G&G survey locations are not identified. However, based on past usage, a few existing borrow sites such as Sandbridge Shoal offshore Virginia and the Canaveral Shoals and Jacksonville borrow sites offshore Florida are likely to be reused, perhaps accounting for 40-50 percent of future projects.

3.4.3.2. Projected Activity Levels

The Marine Minerals Program has identified beach nourishment and coastal restoration projects that are most likely to require use of OCS sand resources over the next 10 years. Estimated survey levels are summarized in **Table 3-7** (for HRG surveys) and **Table 3-8** (for geotechnical surveys). The proposed activity scenario is based on an examination of past trends in OCS G&G and leasing activity and anticipated OCS leasing requests, as well as projections of other possible uses as existing borrow areas are nearing depletion. Note that most of G&G prospecting and prelease/design surveys have already been completed for most projects.

3.4.3.2.1. High-Resolution Geophysical Surveys

The HRG scenario (**Table 3-7**) is based on the following assumptions for three different survey types:

1. Prospecting HRG survey – 200-m (656-ft) line spacing. Assuming an average borrow area of 1 mi2 (640 ac or 259 ha), the corresponding HRG prospecting survey would be conservatively estimated at 29 km (18 mi) of line.
2. Prelease/design HRG survey – 30-m (98-ft) line spacing. Assuming the same average borrow area, the corresponding HRG prelease survey would be conservatively estimated at 177 km (110 mi) of line.
3. On-lease HRG survey – 50-m (164-ft) line spacing. Assuming the same average borrow area, the corresponding HRG on-lease survey would be conservatively estimated at 106 km (66 mi) of line.

The number and size of borrow areas across known sand resources vary substantially. In some cases, the presence of a sand resource is already known, but specific borrow areas have yet to be identified that have the specific grain-size characteristics or other geoengineering attributes for a specific project. Nourishment volumes and frequency are comparatively well-defined for the relevant time frame. Given a projected fill volume and assuming a typical cut depth (2 m [6.6 ft] in this case), the length of HRG survey lines can be estimated for each project. For each HRG survey, a lower bound is estimated from the best available volume projections. Projections were verified by comparing historical prospecting, prelease, and postlease survey kilometers of line with what would have been estimated strictly from anticipated volumes. An upper bound is estimated by applying a multiplier to the lower bound. It was determined that a multiplier of up to 25 times for prospecting surveys and 5 times for prelease and postlease surveys adequately represented the upper bound.

The HRG scenario for the Mid- and South Atlantic Planning Areas projected through 2020 includes approximately 100-3,200 km (62-1,988 mi) of prospecting surveys, 850-4,300 km (528-2,672 mi) of prelease/design surveys, and 900-4,600 km (559-2,858 mi) of on-lease surveys. Across all geophysical survey activities, the maximum activity level is estimated at 12,100 km (7,519 mi); this is the equivalent of approximately 1,450 hr of surveying across 180 8-hr operational survey days. Note that this scenario does not include similar activities that may occur in State waters or in adjacent OCS Planning Areas (north of Delaware Bay and south of Brevard County, Florida). Similarly, G&G activities associated with connected actions, such as monitoring of nearshore environmental resources or beach fill performance, are not included.

3.4.3.2.2. Geotechnical Surveys

Projected activity levels for geotechnical sampling in the marine minerals program are summarized in **Table 3-8**. Approximately 6-24 on-lease deployments for pneumatic vibracoring, 1-4 deployments for geologic coring, and 2-8 deployments for grab sampling are expected to occur in the Mid- and South Atlantic Planning Areas. Each deployment is assumed to involve 15-25 vibracores, 1-2 standard (geologic or rotary) cores, and 30-40 grabs, as discussed above. It is estimated that 40-50 percent of the sampling will occur at existing borrow sites such as Sandbridge Shoal, Canaveral Shoals, and Jacksonville.

3.5. Proposed Action Scenario Summary and Impact-Producing Factors

Table 3-9 summarizes scenario elements for the three program areas (oil and gas exploration, renewable energy, and marine minerals). Based on the scenario, the following IPFs have been identified for the proposed action:

- IPFs for Routine Activities
  - active acoustic sound sources
  - vessel and equipment noise
  - vessel traffic
  - aircraft traffic and noise
  - vessel exclusion zones
  - vessel wastes
  - trash and debris
  - seafloor disturbance
  - drilling discharges
  - onshore support activities
- IPFs for Accidental Events
  - fuel spills

Table 3-10 summarizes the IPFs with respect to the associated survey types and program areas.

3.5.1. Impact-Producing Factors for Routine Activities

3.5.1.1. Active Acoustic Sound Sources

Active acoustic sound sources included in the proposed action include airguns, boomer and chirp subbottom profilers, side-scan sonars, and multibeam depth sounders. **Table 3-11** summarizes characteristics of these sources. Detailed characteristics and assumptions for representative sources are discussed in **Appendix D**.

3.5.1.1.1. Airguns

Airguns would be used as seismic sources during deep penetration seismic surveys for oil and gas exploration and for postlease HRG surveys of oil and gas leases. BOEM does not anticipate that airguns would be used for renewable energy site assessment activities or for HRG surveys of marine mineral sites. The renewable energy scenario includes the possibility that a deep penetration (2D or 3D) seismic survey would be conducted to evaluate formation suitability for carbon sequestration. However, given the much greater number and extent of seismic surveys included in the oil and gas scenario, a single seismic survey for carbon sequestration is not analyzed separately.

An airgun is a stainless steel cylinder charged with high-pressure air. The acoustic signal is generated when the air is released nearly instantaneously into the surrounding water column. Seismic pulses are typically emitted at intervals of 5-60 s, and occasionally at shorter or longer intervals.

Detailed acoustic characteristics of airguns are discussed in **Appendix D**. Although airguns have a frequency range from about 10 to 2,000 Hz, most of the acoustic energy is radiated at frequencies below 200 Hz. The amplitude of the acoustic wave emitted from the source is equal in all directions, but airgun arrays do possess some directionality due to different phase delays between guns in different directions.

Individual airguns are available with a wide range of chamber volumes, from under 5 in^3 to over 2,000 in^3, depending on the survey requirements. Airgun sources can range from a single airgun (for HRG surveys) to a large array of airguns (for deep penetration seismic surveys). The volume of airgun arrays used for seismic surveys can vary from about 45 to 8,000 in^3. For this Programmatic EIS, two sizes of airgun arrays were modeled, based on current usage in the Gulf of Mexico, and considered representative for potential Atlantic G&G seismic surveys:

- large airgun array (5,400 in^3). This array was used to represent sound sources for deep penetration seismic surveys, including 2D, 3D, WAZ, and other variations.
- small airgun array (90 in^3). This array was used to represent sound sources for HRG surveys for oil and gas exploration sites.

As described in **Appendix D**, the large airgun array has dimensions of 16 by 15 m (52.5 by 49.2 ft) and consists of 18 airguns placed in three identical strings of six airguns each. The volume of individual airguns ranges from 105 to 660 in^3. The depth below the sea surface for the array was set at 6.5 m (21.3 ft). The small airgun array consists of two airguns of 45 in^3 each, placed with 1 m (3.3 ft) separation from each other at a depth of 6.5 m (21.3 ft).

Broadband source levels are 230.7 dB re 1µPa for the large airgun array and 210.3 dB re 1µPa for the small array (**Table 3-11**). The two arrays differ in both their total source level and the frequency spectrum; large arrays have more low frequencies due to the presence of large volume airguns.

3.5.1.1.2. Electromechanical Sources

In HRG surveys for renewable energy development and sand source evaluation, a high-resolution boomer or chirp subbottom profiler is typically used to delineate near-surface geologic strata and features. Typical survey deployments also include single beam or multibeam depth sounders and side-scan sonar. AUV surveys for oil and gas leases include a similar equipment suite. These electromechanical sources may also be operated simultaneously with the airguns during deep penetration seismic surveys.

Boomers are electromechanical sound sources that generate short, broadband acoustic pulses that are useful for high-resolution, shallow penetration sediment profiling. This system is commonly mounted on a sled and towed off the stern or alongside the ship. The reflected signal is received by a towed hydrophone streamer. Chirp systems are used for high-resolution mapping of relatively shallow deposits and in general have less penetration than boomers; however, newer chirp systems are able to penetrate to levels comparable to the boomer yet yield extraordinary detail or resolution of the substrate (National Science Foundation [NSF] and USGS, 2011). Multibeam depth sounders emit brief pings of medium- or high-frequency sound in a fan-shaped beam extending downward and to the sides of the ship, allowing bathymetric mapping of swaths of the seafloor. Single beam depth sounders may also be used for seafloor mapping, but the multibeam depth sounder was selected as a representative source for this Programmatic EIS and is conservative from the standpoint of acoustic impacts.

Detailed acoustic characteristics of electromechanical sources are discussed in **Appendix D**. Electromechanical sources are considered mid- or high-frequency sources. They usually have one or two (sometimes three) main operating frequencies (**Table 3-11**). The frequency ranges for representative sources are 200 Hz–16 kHz for the boomer; 100 kHz and 400 kHz for the side-scan sonar; 3.5 kHz, 12 kHz, and 200 kHz for the chirp subbottom profiler; and 240 kHz for the multibeam depth sounder. For all of these sources, the acoustic energy emitted outside the main operating frequency band is negligible, therefore these can be considered narrow-band sources. High-frequency electromechanical sources can be highly directive, with beam widths as narrow as few degrees or less. Broadband source levels for the representative electromechanical sources analyzed in this Programmatic EIS range from 212 to 226 dB re 1μPa at 1 m (**Table 3-11**).

3.5.1.2. Vessel and Equipment Noise

3.5.1.2.1. Vessel Noise

Most of the G&G activities in the proposed action scenario would be conducted from ships. The exception would be remote sensing methods from aircraft and satellites. The most extensive vessel activities are 2D and 3D seismic surveys, which could occur anywhere in the AOI. Vessels conducting G&G surveys or sampling for renewable energy would be operating mainly at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Vessels conducting G&G surveys or sampling for marine minerals would be operating mainly at specific borrow sites in water depths less than 30 m (100 ft).

Vessel noise is one of the main contributors to overall noise in the sea (National Research Council [NRC], 2003a; Jasny et al., 2005). The G&G survey vessels would contribute to the overall noise environment by transmitting noise through both air and water. Vessel noise is a combination of narrow-band (tonal) and broadband sound (Richardson et al., 1995). Tones typically dominate up to about 50 Hz, whereas broadband sounds may extend to 100 kHz. The primary sources of vessel noise are propeller cavitation, propeller singing, and propulsion; other sources include auxiliaries, flow noise from water dragging along the hull, and bubbles breaking in the wake (Richardson et al., 1995). Propeller cavitation is usually the dominant noise source. The intensity of noise from service vessels is roughly related to ship size and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladen vessels. For a given vessel, relative noise also tends to increase with increased speed. Broadband source levels for most small ships (a category that would include seismic survey vessels and support vessels for drilling of COST wells or shallow test wells) are anticipated to be in the range of 170-180 dB re 1 μPa at 1 m (Richardson et al., 1995). Broadband source levels for smaller boats (a category that would include survey vessels for renewable energy and marine minerals sites) are in the range of 150-170 dB re 1 μPa at 1 m (Richardson et al., 1995). Noise levels would dissipate quickly with distance from the source.

3.5.1.2.2. Equipment Noise Including Drilling Noise

Drilling of COST and shallow test wells would introduce additional underwater noise into the AOI from engines, generators, and other drilling rig equipment. The oil and gas scenario assumes that up to three COST wells and up to five shallow test wells would be drilled in the Mid- or South Atlantic Planning Areas during the time period of this Programmatic EIS. Neither the well locations nor the types of drilling rig are known at this programmatic stage. Jack-up rigs typically are used in water depths less than 100 m (328 ft) (USDOI, MMS, 2007c). Semisubmersibles are floating rigs that are used in depths ranging from 100 to 3,000 ft (328 to 9,843 ft) and can be either moored or dynamically positioned. Drillships are used in water depths greater than about 600 m (1,968 ft) and can also be moored or dynamically positioned (usually the latter).

Noise from drilling operations includes strong tonal components at low frequencies (<500 Hz), including infrasonic frequencies in at least some cases (Richardson et al., 1995). Machinery noise can be continuous or transient, and variable in intensity. Noise levels vary with the type of drilling rig and the water depth. Drillships produce the highest levels of underwater noise because the hull containing the rig generators and drilling machinery is well coupled to the water. In addition, dynamically positioned drillships use thrusters to maintain position and are constantly emitting engine and propeller noise.

Jack-up rigs are at the other end of the spectrum because they are supported by metal legs with only a small surface area in contact with the water, the drilling machinery is located on decks well above the water, and there is no propulsion noise. Semisubmersibles are intermediate in noise level because the machinery is located well above the water but the pontoons supporting the structure have a large surface area in contact with the water. Richardson et al. (1995) noted that broadband source levels for semisubmersible rigs have been reported to be about 154 dB re 1 μPa. Source levels for drillships have been reported to be as high as 191 re 1 μPa during drilling.

Drilling operations would be supported by crew boats, supply vessels, and helicopters traveling between the drilling rig and the onshore support base. Support vessels usually make a few round trips per week, and helicopters typically make one round-trip daily. The characteristics of vessel noise have been described in **Chapter 3.5.1.2.1**, and aircraft noise is discussed in **Chapter 3.5.1.4**.

3.5.1.3. Vessel Traffic

The G&G activities in all three program areas involve vessel traffic. Vessels conducting 2D and 3D seismic airgun surveys are the largest vessels and would account for most of the line miles traveled. Based on the permit applications received by BOEM, these surveys could occur anywhere within the AOI. Vessels conducting G&G surveys or sampling for renewable energy would be smaller and would operate mainly at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Similarly, vessels conducting G&G surveys or sampling for marine minerals would be operating mainly at specific borrow sites in water depths less than 30 m (98 ft). Survey vessels for renewable energy and marine minerals projects are expected to make daily round trips to their shore base, whereas the larger seismic vessels can remain offshore for weeks or months.

The G&G vessel traffic in the AOI would be subject to the Right Whale Ship Strike Reduction Rule (50 CFR 224.105), a Federal regulation that limits vessel speed to 10 kn (18.5 km/hr) in the Mid-Atlantic and Southeast U.S. SMAs for North Atlantic right whales during migration. The Southeast U.S. SMA, with seasonal restrictions in effect from November 15 to April 15 of each year, is a continuous area that extends from St. Augustine, Florida, to Brunswick, Georgia, extending 37 km (20 nmi) from shore. The Mid-Atlantic U.S. SMA, with seasonal restrictions extending from November 1 through April 30, is a combination of both continuous areas and half circles drawn with 37-km (20-nmi) radii around the entrances to certain bays and ports. Within the AOI, the Mid-Atlantic U.S. SMA includes a continuous zone extending between Wilmington, North Carolina, and Brunswick, Georgia, as well as the Ports of Delaware Bay (Wilmington, Philadelphia), the entrance to the Chesapeake Bay (Ports of Hampton Roads and Baltimore), and the Ports of Morehead City and Beaufort, North Carolina.

3.5.1.3.1. Seismic Surveys for Oil and Gas Exploration

Seismic survey vessels typically are 60-90 m (200-300 ft) long for 2D surveys and 80-90 m (262-300 ft) long for 3D surveys. The 3D surveys usually require larger vessels because there is more equipment to be towed. A typical towing speed is 4.5 kn (8.3 km/hr). These surveys could occur anywhere within the AOI, with 24-hr operations that may continue for weeks or months, depending upon the size of the survey.

The proposed action scenario includes 617,775 line km of 2D streamer surveys, 2,500 blocks of 3D streamer surveys (or 120,000 line km, assuming 48 line km [30 line mi] per block), and 900 line km of 3D WAZ surveys. Assuming a vessel speed of 4.5 kn (8.3 km/hr), these surveys would represent about 90,000 hr (3,750 days) of vessel activity.

Seismic survey vessels are likely to remain offshore for most of the survey duration. They may be supported by supply vessels operating from ports along the Atlantic Coast, but service vessel support is not a requirement. For this analysis, five potential support bases were identified: Norfolk, Virginia; Wilmington, North Carolina; Charleston, South Carolina; Savannah, Georgia; and Jacksonville, Florida. The ports were selected based on their geographic proximity to the AOI, locations named in permit applications for G&G activities, and the availability of adequate support facilities that could be used by G&G survey and support vessels.

3.5.1.3.2. Renewable Energy Surveys

Vessels conducting G&G surveys or sampling for renewable energy would operate mainly at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Typically, the vessel would return to its shore base daily.

In nearshore waters, HRG surveys would be conducted by a single, small (<23-30 m or 75-98 ft) vessel moving at <5 kn (<9.3 km/hr). Geotechnical surveys for renewable energy sites are expected to be conducted from a small barge or ship of a similar size. A typical duration for an individual survey would be 3 days or less.

The renewable energy scenario includes 34,040 hr of HRG surveys (**Table 3-6**). Assuming that HRG survey vessels would operate on 8-hr working days, the scenario would require 4,255 days and the same number of vessel round trips.

Also included in the renewable energy scenario are 3,106-9,969 geotechnical sampling locations where CPT testing, geologic coring, and grab sampling would be conducted. Assuming that one sampling location could be completed per work day, there would be approximately 3,106-9,969 vessel round trips associated with these surveys.

Vessel trips associated with renewable energy areas would use existing ports in Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. Depending on the location of the renewable energy area, the surveys could operate from one of the five larger ports analyzed in this Programmatic EIS (Norfolk, Wilmington, Charleston, Savannah, or Jacksonville) or any of numerous smaller ports along the coast, depending on whatever is convenient.

3.5.1.3.3. Marine Minerals Surveys

For HRG surveys of sand source areas, geophysical survey equipment is typically deployed from a single vessel, <20-30 m (65-98 ft) long, moving at about 4.5 kn (8.3 km/hr). Surveys are likely to focus on prospective borrow sites (3-10 km^2) or reconnaissance areas (on the order of 1-3 OCS blocks), and each survey is assumed to require 1-5 operational days for completion. Vessels are assumed to operate on site for 8 hr per day and return to the shore base at the end of each day.

The marine minerals scenario includes approximately 100-3,200 km of HRG prospecting surveys, 850-4,300 km of HRG prelease/design surveys, and 900-4,600 km of on-lease HRG surveys (**Table 3-7**). Across all geophysical survey activities, the maximum activity level is estimated at 12,100 km; this is the equivalent of approximately 1,450 hr of surveying across 180 8-hr operational survey days. The scenario would require 180 vessel round trips.

Nearly all geotechnical sampling occurs from either relatively small vessels approximately 20 m (65 ft) in length, or from work barges towed into place. The duration of a typical survey would be 3 days or less. The marine minerals scenario includes 6-24 deployments for pneumatic vibracoring, 1-4 deployments for geologic coring, and 2-8 deployments for grab sampling (**Table 3-8**). Each deployment is assumed to involve 15-25 vibracores, 1-2 standard (geologic or rotary) cores, and 30-40 grab samples, as discussed above. Total sample numbers are estimated to include 90-600 vibracores, 1-8 geologic cores, and 60-320 grab samples. Assuming that one vibracore, one geologic core, or 25 grab samples can be collected per work day, there would be approximately 95-615 vessel round trips associated with these surveys.

Vessel trips associated for marine minerals activities would be divided among several existing ports in Delaware, Maryland, Virginia, North Carolina, South Carolina, and Florida. Georgia is excluded because the State has never had an agreement with BOEM for joint study of OCS marine minerals resources and has never requested a non-competitive lease to use them onshore. Depending on the location of the renewable energy area, the surveys could operate from one of the larger ports analyzed in this Programmatic EIS (Norfolk, Wilmington, Charleston, Savannah, or Jacksonville) or any of numerous smaller ports along the coast, depending on whatever is convenient.

3.5.1.4. Aircraft Traffic and Noise

The BOEM anticipates that one or two aeromagnetic surveys may be conducted in the AOI during the time period covered by this Programmatic EIS. The surveys would be conducted by fixed-wing aircraft flying at speeds of about 250 km/hr (135 kn) (Reeves, 2005). Based on aeromagnetic datasets posted by

Fugro Gravity and Magnetic Services (2012) for the northern Gulf of Mexico, most offshore aeromagnetic surveys are flown at altitudes between 61-152 m (200-500 ft) and collect 15,000-60,000 line km (9,320-37,282 line mi) of data. Line spacing varies depending on the objectives, but typical grids are 0.5 x 1.0 mi or 1.0 x 1.0 mi. A broad scale survey may be flown at higher altitudes (e.g., 305 m [1,000 ft]) and use wider line spacing (e.g., 4 x 12 mi or 8 x 24 mi). A fixed-wing aircraft typically acquires 20,000 line km (12,427 line mi) of useful data per month (Reeves, 2005). Therefore, it is expected that a typical aeromagnetic survey may require 1-3 months to complete. Based on the scale of aeromagnetic surveys that have been conducted in the northern Gulf of Mexico, an individual survey probably would cover less than 10 percent of the AOI.

Helicopters are a potential source of aircraft noise during drilling of COST wells and shallow test wells. The oil and gas scenario assumes that up to three COST wells and up to five shallow test wells would be drilled in the Mid- or South Atlantic Planning Areas during the time period of this Programmatic EIS. It is expected that drilling activities would be supported by a helicopter making one round-trip daily between the drilling rig and onshore support base. Neither the well locations nor the location of potential helicopter support bases are known at this programmatic stage.

Both helicopters and fixed-wing aircraft generate noise from their engines, airframe, and propellers. The dominant tones for both types of aircraft are generally below 500 Hz (Richardson et al., 1995). Richardson et al. (1995) reported received sound pressure levels (SPLs) (in water) from aircraft flying at altitudes of 152 m (500 ft) were 109 dB re 1 μPa for a Bell 212 helicopter and 101 dB re 1 μPa for a small, fixed-wing aircraft (B-N Islander). Helicopters are about 10 dB louder than fixed-wing aircraft of similar size (Richardson et al., 1995). Penetration of aircraft noise into the water is greatest directly below the aircraft; at angles greater than 13º from the vertical, much of the sound is reflected and does not penetrate into the water (Richardson et al., 1995). The duration of underwater sound from passing aircraft is much shorter in water than air; for example, a helicopter passing at an altitude of 152 m (500 ft) that is audible in air for 4 min may be detectable underwater for only 38 s at 3 m (10 ft) depth and for 11 s at 18 m (59 ft) depth (Richardson et al., 1995).

All aircraft would be expected to follow U.S. Department of Transportation, Federal Aviation Administration (USDOT, FAA 2004) guidance, which recommends a minimum altitude of 610 m (2,000 ft) when flying over noise-sensitive areas such as parks, wildlife refuges, and wilderness areas. When flying in transit offshore, helicopters typically maintain a minimum altitude of 213 m (700 ft).

3.5.1.5. Vessel Exclusion Zones

The proposed action includes extensive 2D and 3D surveys involving towed streamer arrays. The scenario includes 617,775 line km of 2D streamer surveys, 2,500 blocks of 3D streamer surveys, and 900 line km of 3D WAZ surveys. These surveys could occur anywhere within the AOI.

Vessels towing streamers during 2D and 3D seismic surveys follow pre-plotted track lines and have limited maneuverability during data acquisition. Accordingly, seismic vessels typically are accompanied by an escort vessel, which is used to scout the route ahead; identify hazards, such as adverse currents, vessel traffic, or fishing equipment; and ensure that other vessels do not cross over or interfere with the equipment being towed.

For safety reasons, survey operators attempt to keep a zone around the source vessel and its towed streamer arrays clear of other vessel traffic. The size of the vessel exclusion zone that would be maintained around a source vessel and its towed streamer arrays varies depending on the array configuration. A typical vessel exclusion zone would be approximately 8.5 km (4.6 nmi) long and 1.2 km (0.6 nmi) wide, covering a total of 1,021 ha (2,520 ac) of the sea surface. With the source vessel moving at speeds of about 4.5 kn (8.3 km/hr), the length of time that any particular point would be within the vessel exclusion zone would be about 1 hr.

The vessel exclusion zone is simply an area monitored by a seismic survey operator and has no formal status or designation by USCG. Prior to conducting a seismic survey, operators would submit information to the local USCG office and the local harbormaster for issuance of a Local Notice to Mariners. The Local Notice to Mariners would specify the survey dates and locations and the recommended avoidance requirements. The wording of these notices is general (e.g., "a wide berth is urged"). All vessels operating with restricted maneuverability are required to carry the lights and signals described in Rule 27 of International Regulations for Preventing Collisions at Sea (COLREGS). Towed streamers are marked with an orange buoy equipped with a quick flashing light and radar reflector.

3.5.1.6. Vessel Wastes

Operational waste generated from all vessels associated with the proposed action includes bilge and ballast waters, trash and debris, and sanitary and domestic wastes. Bilge water is water that collects in the lower part of a ship. The bilge water may be contaminated by oil that leaks from the machinery within the vessel. The discharge of any oil or oily mixtures of greater than 15 parts per million (ppm) into the territorial sea is prohibited under 33 CFR 151.10. However, discharge is not prohibited in waters farther than 22 km (12 nmi) from shore if the oil concentration is less than 100 ppm. As a result, to the extent that bilge water is expelled at sea, BOEM anticipates that the discharge would be more likely to occur beyond 22 km (12 nmi) from shore.

Ballast water is used to maintain the stability of the vessel and may be pumped from coastal or marine waters. Generally, the ballast water is pumped into and out of separate compartments and is not usually contaminated with oil. However, the same discharge criteria apply to ballast water as to bilge water (33 CFR 151.10). The USCG has proposed a Ballast Water Discharge Standard, which is currently in review (U.S. Department of Homeland Security [USDHS], USCG, 2011a).

All vessels with toilet facilities must have a Type II or Type III marine sanitation device (MSD) that complies with 40 CFR 140 and 33 CFR 149. A Type II MSD macerates waste solids so that the discharge contains no suspended particles and has a bacteria count below 200 per 100 milliliters (ml). Type III MSDs are holding tanks and are the most common type of MSD found on boats. These systems are designed to retain or treat the waste until it can be disposed of at the proper shoreside facilities. State and local governments regulate domestic or gray water discharges. However, a State may prohibit the discharge of all sewage within any or all of its waters. Domestic waste consists of all types of wastes generated in the living spaces on board a ship, including gray water that is generated from dishwasher, shower, laundry, bath, and washbasin drains. Gray water from vessels is not regulated outside the State's territory and may be disposed of overboard. Gray water should not be processed through the MSD, which is specifically designed to handle sewage. BOEM assumes that vessel operators would discharge gray water overboard outside of State waters or store it aboard ship until they are able to dispose of it at a shoreside facility.

3.5.1.7. Trash and Debris

Survey operations generate trash made of paper, plastic, wood, glass, and metal. Most of this trash is associated with galley and offshore food service operations. Occasionally, some personal items such as hardhats and personal flotation devices are accidentally lost overboard.

The discharge of trash and debris is prohibited (33 CFR 151.51-77) unless it is passed through a comminutor (a machine that breaks up solids) and can pass through a 25-mm mesh screen. Discharge of plastic is prohibited regardless of size. All other trash and debris must be returned to shore for proper disposal with municipal and solid waste. BOEM/BSEE assumes vessel operators would discharge trash and debris only after it has passed through a comminutor and that all other trash and debris would be returned to shore.

The USCG and USEPA regulations require operators to become proactive in avoiding accidental loss of solid waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. In addition, over the last several years, companies operating offshore have developed and implemented trash and debris reduction and improved handling practices to reduce the amount of offshore trash that could potentially be lost into the marine environment. These trash management practices include substituting paper and ceramic cups and dishes for those made of styrofoam, recycling offshore trash, and transporting and storing supplies and materials in bulk containers when feasible and have resulted in a reduction of accidental loss of trash and debris.

Under the proposed action, all authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012). All vessel operators, employees, and contractors actively engaged in G&G surveys must be briefed on marine trash and debris awareness elimination as described in the NTL except that BOEM will not require applicants to undergo formal training or post placards. The applicant would be required to ensure that its employees and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment where it could affect protected species.

3.5.1.8. Seafloor Disturbance

Sources of seafloor disturbance in the proposed action include

- bottom sampling activities in all three program areas;
- placement of anchors, nodes, cables, sensors, or other equipment on or in the seafloor for various activities in the oil and gas program;
- COST well and shallow test drilling in the oil and gas program; and
- placement of bottom-founded monitoring buoys in the renewable energy program.

The BOEM will require site-specific information regarding potential archaeological resources and sensitive benthic communities (including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. The BOEM will use this information to ensure that physical impacts to archaeological resources or sensitive benthic communities are avoided.

The BOEM has not designated specific benthic locations for avoidance in the AOI. However, likely areas for avoidance would include known hard/live bottom areas, known deepwater coral locations including *Lophelia* and *Oculina* coral sites, deepwater coral HAPCs, deepwater MPAs, Gray's Reef NMS, the Charleston Bump area, and the walls of submarine canyons. These benthic features are discussed in **Chapter 4.2.1.1.2**. All authorizations for G&G surveys proposed within or near these areas would be subject to the review noted above to facilitate avoidance. The BOEM has not developed specific buffer zones for sensitive benthic communities in the Atlantic, but it is expected that they would be similar to those that BOEM uses in the Gulf of Mexico. The BOEM would not authorize seafloor-disturbing activities in marine sanctuaries in the AOI except in consultation with NOAA under the NMSA. Setbacks of 152 m (500 ft) for seafloor-disturbing activities would be expected that could be modified by consultations with NOAA under the NMSA for specific activities in proximity to an NMS.

For the renewable energy program, BOEM has issued *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 585* (USDOI, BOEM, 2011d). The guidelines specify that a site characterization survey must reliably cover any portion of the site that would be affected by seafloor-disturbing activities. The guidelines recommend avoidance as a primary mitigation strategy for objects of historical or archaeological significance. The applicant has the option to demonstrate through additional investigations that an archaeological resource either does not exist or would not be adversely affected by the seafloor/bottom-disturbing activities. While site characterization activities covered by these guidelines could identify other resource types (e.g., benthic communities), recommendations for conducting and reporting the results of other baseline collection studies (e.g., biological) would be provided by BOEM in separate guidelines.

3.5.1.8.1. Bottom Sampling Activities

The proposed action scenario includes bottom sampling activities in all three program areas. These include

- 50-300 core or grab samples in the oil and gas program;
- 3,106-9,969 core or grab samples in the renewable energy program; and
- 1-8 geologic cores, 60-320 grab samples, and 90-600 vibracores in the marine minerals program.

Collection of each sample is estimated to disturb an area of approximate 10 m^2 (108 ft^2), although the actual area of the core or grab extracted may be much smaller. If all of the samples in the proposed action scenario were collected, the total seafloor disturbance would be about 11 ha (27 ac), which represents 0.00001 percent of the AOI.

Sampling for oil and gas exploration would be conducted at specific lease blocks where structures such as drilling rigs, platforms, or pipelines may be installed. The blocks could be anywhere within the Mid- or South Atlantic Planning Areas and cannot be predicted as there are currently no active oil and gas leases in the Atlantic OCS.

Sampling for renewable energy projects would occur at specific sites consisting of one or more OCS blocks in water depths less than 100 m (328 ft) and along potential cable routes to shore. Offshore Delaware, Maryland, and Virginia, the likely sampling locations would be within designated WEAs (USDOI, BOEM, 2011e). North Carolina has identified 500 OCS blocks of interest, but it is likely that sampling would occur within only a small subset of these blocks. Specific AOIs have not been identified for the South Atlantic states.

Sampling activities for marine minerals would be conducted at specific borrow sites in water depths less than 30 m (98 ft). Much of the marine minerals activity is expected to occur within existing borrow sites offshore the Mid-Atlantic and South Atlantic states (see **Chapter 4.2.12.3** for locations). By design, the sampling locations are expected to be almost exclusively sand bottom.

3.5.1.8.2. Placement of Anchors, Nodes, Cables, and Sensors

Certain surveys in oil and gas exploration require placement of anchors, nodes, cables, sensors, or other equipment on or in the seafloor. Ocean bottom cable and nodal surveys, vertical cable surveys, CSEM surveys, and MT surveys involve placement of sensors and/or anchors on the seafloor. In VSP surveys, receivers are placed in boreholes in the seafloor. Each of these activities would temporarily affect a small area of seafloor. After a survey is completed, the sensors are removed; anchors are either removed or left in place (if biodegradable). The blocks where these surveys would be conducted could be anywhere within the Mid- or South Atlantic Planning Areas and cannot be predicted as there are currently no active oil and gas leases in the Atlantic OCS. The total area of seafloor disturbed has not been calculated.

3.5.1.8.3. COST Wells and Shallow Test Drilling

The oil and gas scenario assumes that up to three COST wells and up to five shallow test wells would be drilled in the Mid- or South Atlantic Planning Areas during the time period of this Programmatic EIS. Locations for COST wells and shallow test wells are unknown. However, it is likely that there would be some interest in a test program for gas hydrates within the proposed action scenario period, at least in the South Atlantic Planning Area in the Blake Plateau region. These wells could be considered either COST wells or shallow test drilling, depending on the penetration depth.

COST wells and shallow test wells would be drilled using conventional rotary drilling techniques. Seafloor disturbance would result from anchoring (if a moored drilling rig was used), placing a well template on the seafloor, and jetting the well. The area of seafloor disturbance varies with the type of rig chosen to drill a well, which depends primarily on water depth (USDOI, MMS, 2007c). Jack-up rigs are used in shallow water and disturb approximately 1 ha (2.5 ac) for each location. Semisubmersibles can be operated in a wide range of water depths and disturb about 2-3 ha (5-7 ac), depending on their mooring configurations. In water depths >600 m (>1,969 ft), dynamically positioned drillships could be used; these drillships disturb only a very small area where the bottom template and wellbore are located, approximately 0.25 ha (0.62 ac).

For this impact analysis, the area of seafloor disturbance is assumed to average about 2 ha (5 ac) per well. If all of the COST wells and shallow test wells in the proposed action scenario were drilled, the total seafloor disturbance would be about 16 ha (40 ac), or about 0.00002 percent of the AOI.

3.5.1.8.4. Bottom-Founded Meteorological Buoys

As part of the renewable energy program, lessees may install bottom-founded meteorological buoys. The Programmatic EIS assumes that lessees would choose to install buoys instead of meteorological towers. These buoys would be anchored at fixed locations and regularly collect observations from many different atmospheric and oceanographic sensors.

Meteorological buoys would typically be towed or carried aboard a vessel to the installation location. Once at the location site, the buoy would be either lowered to the surface from the deck of the transport vessel or placed over the final location and then the mooring anchor dropped. A boat-shaped buoy in shallower waters of the AOI may be moored with an all-chain mooring, while a larger discus-type buoy would use a combination of chain, nylon, and buoyant polypropylene materials (USDOC, NDBC, 2011). After installation, the transport vessel would remain in the area for several hours while technicians configure proper operation of all systems. Buoys would typically take 1 day to install. Transport and installation vessel anchoring for 1 day is anticipated for these types of buoys. Decommissioning of buoys is essentially the reverse of the installation process.

The proposed action scenario includes 7-38 buoys that may be installed within the AOI during the time period of this Programmatic EIS. Anchors for boat-shaped and discus-shaped buoys would have a footprint of about 0.55 m^2 (6 ft^2) and an anchor sweep of about 3.4 ha (8.5 ac) (USDOI, BOEM, 2011e). The larger anchor sweep area is used to estimate seafloor disturbance. If all of the monitoring buoys in the proposed action scenario were installed, the total seafloor disturbance would be about 129 ha (319 ac), or about 0.0002 percent of the AOI.

3.5.1.9. Drilling Discharges

The oil and gas scenario assumes that up to three COST wells would be drilled in the AOI during the time period of this Programmatic EIS. COST wells are drilled using conventional rotary drilling techniques, the same as those routinely used for drilling oil and gas exploration and development wells. During the process, drilling fluid and cuttings are discharged, disperse in the water column, and accumulate on the seafloor (NRC, 1983; Neff, 1987; Neff et al., 2000).

During the initial stage of drilling, a large diameter surface hole is jetted a few hundred meters into the seafloor. An NPDES permit must be obtained from USEPA in order to discharge drilling fluids and cuttings. At this stage, the cuttings and seawater used as drilling fluid are discharged onto the seafloor. A continuous steel pipe known as a surface casing is lowered into the hole and cemented in place. A blowout preventer (BOP) is installed on the top of the surface casing to prevent water or hydrocarbons from escaping into the environment. Once the BOP is fully pressure tested, the next section of the well is drilled.

The marine riser is a pipe with special fittings that establishes a seal between the top of the wellbore and the drilling rig. After it is set, all drilling fluid and cuttings are returned to the drilling rig and passed through a solids control system designed to remove cuttings and silt so that the drilling fluids may be recirculated downhole. The drill cuttings, typically sand or gravel-sized with any residual drilling mud attached, are then discharged via the shale chute.

The only drilling fluids in widespread use on the OCS are either water-based fluids (WBFs) or synthetic-based fluids (SBFs). Typically, the upper portion of exploration wells are drilled with WBF to a depth in the range of 800-2,000 m (2,625-6,562 ft) and, following “switchover,” the remainder is drilled with SBF (USDOI, MMS, 2007c).

During well intervals when WBF systems are used, cuttings and adsorbed WBF solids are discharged to the ocean at a rate of 0.2-2.0 m^3/hr (Neff, 1987). Overboard discharge of WBF results in increased turbidity in the water column, alteration of sediment characteristics because of coarse material in cuttings, and elevated concentrations of some trace metals (NRC, 1983; Neff, 1987). In shallow environments, WBFs are rapidly dispersed in the water column immediately after discharge and quickly descend to the seafloor, whereas in deeper water, fluids discharged at the sea surface are dispersed over a wider area (Neff, 1987).

The SBFs are manufactured hydrocarbons without aromatic hydrocarbons and polycyclic aromatic hydrocarbons (PAHs) characteristic of oil-based fluids, which are not used on the United States OCS. When SBF systems are used, the SBF is returned to shore for recycling, and the only discharge consists of SBF adhering to cuttings. Retention on cuttings is subject to regulatory limits; for example, under the current NPDES permit for USEPA Region IV in the Gulf of Mexico, the limits are 6.9 percent for internal olefins and 9.4 percent for esters (USEPA, 2010). SBF-wetted cuttings typically settle close to the discharge point and affect the local sediments and any benthic invertebrates in proximity (Neff et al., 2000; Continental Shelf Associates, Inc., 2006).

The average exploration well in the Gulf of Mexico is approximately 3,674 m (12,055 ft) below mudline (USDOI, MMS, 2007c) and is equivalent to an Atlantic COST well in depth. Each well discharges about 7,000-9,700 bbl of WBF and 1,500-2,500 bbl of cuttings (USEPA, 1993, 2000). Assuming an average of 2,000 bbl of cuttings and 8,350 bbl of drilling fluid discharged per well, the total volumes for 1-3 COST wells would range from 2,000 to 6,000 bbl of cuttings and from 8,350 to 25,050 bbl of drilling fluid.

Shallow test wells for gas hydrate will also result in drilling fluid and cuttings discharges. The oil and gas exploration scenario estimates up to five shallow test wells in the AOI. It is likely that, at the least, there would be some interest within the proposed action scenario period in a test program for gas hydrates in the South Atlantic Planning Area in the Blake Plateau region. Gas hydrate wells are from 152 m (500 ft) to a few thousand feet deep because gas hydrates are found in shallow depths within the sediment due to the physico-chemical requirements for their stability. In the Gulf of Mexico, test programs for gas hydrates were fielded in 2005 (Birchwood et al., 2008) and 2009 (Boswell et al., 2009). The deepest well for the 2009 test program was 1,122 m (3,680 ft) below mudline. Wells this shallow would yield a few hundred barrels of drilling fluid and cuttings each.

3.5.1.10. Onshore Support Activities

All of the vessels involved in G&G activities would operate out of onshore support bases. Ports and service bases serve as launching points for the structures, equipment, supplies, and crew that serve the offshore G&G industry. In addition to providing berthing space, fuel, and supplies, these bases may provide products and services such as engine repair, electric generators, chains, gears, tools, pumps, compressors, and a variety of other tools and equipment.

Seismic surveys for oil and gas exploration are conducted by large ships that are likely to remain offshore for most of their survey duration. These typically are foreign-flagged vessels that may mobilize from ports outside the AOI, but they may travel periodically (e.g., about every 30 days) to an onshore support base in the AOI for fuel, supplies, equipment repairs, and crew changes. Based on the estimate of about 3,750 days of seismic survey vessel activity as indicated in **Chapter 3.5.1.3**, and assuming a port visit every 30 days, the total number of port visits for the proposed action scenario would be 125. For this analysis, five ports were identified as potential support bases: Port of Virginia (Norfolk, Virginia), Wilmington (North Carolina), Charleston (South Carolina), Savannah (Georgia), and Jacksonville (Florida). The ports were selected based on their geographic proximity to the AOI, locations named in permit applications for G&G activities, and the availability of adequate support facilities that could be used by G&G survey and support vessels. The surveys would likely be conducted by existing geophysical firms with a crew size of about 40 per vessel. Due to the specialized expertise required for these surveys, little or no local employment would be expected.

Survey vessels for renewable energy or marine minerals would be relatively small and are expected to make daily round trips to their shore base. Depending on the location of the survey area, these vessels could operate from one of the five ports analyzed in this Programmatic EIS, or any of numerous smaller ports along the coast, depending on whatever is convenient. Surveys would likely be conducted by existing engineering or oceanographic/environmental firms with little or no new employment. The crew size for these smaller vessels could range from 10 to 20 people. The vessels would be expected to purchase fuel, supplies, and services locally. As estimated in **Chapter 3.5.1.3**, the renewable energy scenario would require 4,255 vessel round trips for HRG surveys and 3,106-9,969 vessel round trips for geotechnical surveys. The marine minerals scenario would require 180 vessel round trips for HRG surveys and 93-615 vessel round trips for geotechnical surveys.

3.5.2. Impact-Producing Factors for Accidental Events

3.5.2.1. Accidental Fuel Spills

Vessel fuel capacities generally depend on vessel size, which varies according to the nature of the survey (for example, 3D surveys use larger vessels than 2D surveys). A large seismic survey vessel may carry between 100,000-1.1 million gal (2,380-27,000 bbl) of fuel, including diesel and fuel oil (CGGVeritas, 2011; Geophysical Service, Inc., 2011a,b). Smaller coastal vessels may carry several thousand gallons.

Vessels involved in G&G activities off the Mid-Atlantic and South Atlantic Coasts could be involved in collisions or other accidents that result in a fuel spill. Spill size would depend on the type of vessel, the severity of the event, and whether the fuel storage is compartmentalized.

All G&G vessels are required to comply with USCG requirements relating to prevention and control of oil spills. Nevertheless, for the purposes of this analysis, a spill scenario was evaluated – a release of 1.2-7.1 bbl of diesel fuel caused by either a vessel collision or an accident during fuel transfer. The volume is based on spill statistics for the period 2000-2009 developed by the USDHS, CG (2011b). During this period, there were 1,521-5,220 spills per year from vessels other than tankers and tank barges. Total annual spill volumes from these vessels ranged from 92,388 to 453,901 gal, resulting in average spill sizes ranging between 49.6 and 297.3 gal, or 1.2-7.1 bbl.

The likelihood of a fuel spill during seismic surveys or other G&G activities is expected to be remote. For example, in their programmatic analysis of impacts associated with seismic research, NSF and USGS (2011) note that there has never been a recorded oil/fuel spill during more than 54,000 nmi (100,000 km) of previous NSF-funded seismic surveys.

The potential for impacts from a 1.2- to 7.1-bbl diesel fuel spill would depend greatly on the location of the spill, meteorological conditions at the time, and the speed with which cleanup plans and equipment could be employed. Diesel fuel is a refined petroleum product that is lighter than water. It may float on the water's surface or be dispersed into the water column by waves. It is assumed that spilled fuel would rapidly spread to a layer of varying thickness and break up into narrow bands or windrows parallel to the wind direction. Diesel is a distillate of crude oil and does not contain the heavier components that contribute to crude oil's longer persistence in the environment. Small diesel spills (500-5,000 gal) will usually evaporate and disperse within a day or less, even in cold water (USDOC, NOAA, 2006); thus, seldom is there any oil on the surface for responders to recover. However, what is commonly referred to as "marine diesel" is often a heavier intermediate fuel oil that will persist longer when spilled. When spilled on water, diesel oil spreads very quickly to a thin film of rainbow and silver sheens, except for marine diesel, which may form a thicker film of dull or dark colors (USDOC, NOAA, 2006). There is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink. Particulate matter contaminated with diesel fuel could eventually reach the benthos either within or outside the AOI, depending upon spill location, water depth, ambient currents, and sinking rate.

3.6. CUMULATIVE ACTIVITIES SCENARIO

The CEQ regulations for implementing NEPA define cumulative effects as the impact on the environment that 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 (40 CFR 1508.7). The Programmatic EIS addresses G&G activities within the 2012-2020 time frame, and a cumulative activity scenario has been developed for the same period as recommended by the CEQ (1997) guidelines. The reasonably foreseeable future activities described below are part of the cumulative scenario.

3.6.1. Oil and Gas Exploration and Development

There are currently no active oil and gas leases or oil and gas exploration, development, or production activities on the Atlantic OCS. Ten oil and gas lease sales were held in the Atlantic between 1976 and 1983. Fifty-one wells were drilled on the Atlantic OCS between 1975 and 1984, including one well in the Mid-Atlantic Planning Area and seven wells in the South Atlantic Planning Area (**Chapter 4.2.12.1.6**).

Leasing in these planning areas is not proposed for the 2012-2017 5-Year Program (USDOI, BOEM, 2011c). Oil and gas exploration and development activities that could occur before 2018 would be limited to the prelease G&G activities that are analyzed in this Programmatic EIS. Surveys could take place as soon as BOEM completes the NEPA evaluation and publishes a ROD in early 2013. Whereupon, BOEM would expect to evaluate the site-specific attributes for G&G permit applications that include the environmental consultations required by law. Processing of permit applications is typically carried out within approximately 45-60 days.

If a lease sale were held in 2018, oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020 (the end of the time period analyzed in this Programmatic EIS) would be prelease and postlease G&G surveys and possibly drilling of an exploration well(s). It is possible, but unlikely, that 1-3 exploration wells could begin before the end of the cumulative activities scenario in 2020. For that to happen, however, the necessary OCSLA steps and NEPA evaluations that are required to authorize a lease sale would have to proceed at a pace that is generally contrary to BOEM's experience. Under these circumstances, exploration well locations cannot be predicted because they would depend on the results of a lease sale. Impacts of exploration drilling have been studied extensively and are summarized in recent lease sale EISs for the Gulf of Mexico (USDOI, MMS, 2007c; USDOI, BOEM, 2011h). Reasonably foreseeable IPFs for exploration drilling include

- seafloor disturbance and turbidity due to placement of a well template on the seafloor, jetting of the well, and anchoring of drilling rigs (if a moored drilling unit is used);
- discharges of drilling fluid, drill cuttings, and other effluents from drilling rigs;
- presence of drilling rigs, including underwater and airborne noise and lights;
- support vessel and helicopter traffic;
- air emissions from drilling rigs, as well as support vessels and helicopters;
- onshore waste disposal;
- accidental releases of trash and marine debris;
- a risk of fuel spills from drilling rigs or support vessels; and
- a risk of a crude oil spill from a well blowout.

3.6.2. Renewable Energy Development

Offshore wind facilities are currently the most likely type of renewable energy development in the Mid- and South Atlantic Planning Areas. BOEM has received only one plan for an MHK project proposal in the Atlantic, but it is located in the Straits of Florida Planning Area, outside the scope of this Programmatic EIS.

Geographically, wind facility development could occur offshore any of the states in the AOI. The distance from shore for a wind facility is generally defined at the outward limit of its economic viability, currently about 46 km (25 nmi) from shore or 100 m (328 ft) water depth.

In the Mid-Atlantic Planning Area, BOEM published Requests for Interest for WEAs offshore Delaware, Maryland, and Virginia. In July 2011, BOEM issued a Draft EA for these areas that included changes to the extent of the Maryland and Virginia WEAs (USDOI, BOEM, 2011e). More information about these locations is provided in **Chapter 4.2.12.1.4**.

In May 2011, North Carolina completed a screening exercise to yield a candidate area of 500 OCS lease blocks meeting their criteria for wind facility development (Thrive in North Carolina, 2011). The screening exercise was to evaluate for potential environmental suitability, and the area is not proposed for wind development at this time. It is the expert judgment of BOEM staff that all 500 blocks would not be proposed for leasing or actually leased to begin site assessment activities within the period covered by this Programmatic EIS. Based on continuing conversations between the State and Federal partners, a more likely number is 75 blocks that will eventually be assessed, beginning in late 2012 or early 2013.

For the states adjacent to the South Atlantic Planning Area (South Carolina, Georgia, and Florida), BOEM has not published Requests for Interest, and there is no other specific information to estimate the activity level in these areas. For the analysis of G&G activities in this Programmatic EIS, the activity level has been estimated at 30 lease blocks offshore each of these states.

Atlantic Grid Holdings LLC has proposed to develop a high-voltage direct current transmission cable offshore the Atlantic Coast running from northern New Jersey to Virginia in five phases (Atlantic Wind Connection, 2011a,b). The company has requested a right-of-way that is approximately 1,320 km (820 mi) in length, with as many as a dozen offshore platforms (substations). About 90 percent of the right-of-way is in Federal waters.

Within the 2012-2020 time period covered by this Programmatic EIS, it is likely that site characterization and site assessment activities would be conducted for WEAs, and these would include the types of G&G surveys analyzed in this Programmatic EIS. The level and timing of actual wind facility construction is difficult to predict. The BOEM's experience with the Cape Wind Project offshore Massachusetts, as well as its understanding of the evolution of the wind industry offshore northern Europe, has demonstrated that rapidly changing technology, different wind resources and wave conditions, various seabed characteristics, different project economics, and the variety of possible project designs can affect whether, to what extent, and how a lease is ultimately developed. Additionally, project design and the resulting environmental impacts are often geographically and design specific, and therefore it would be premature to project activity levels for wind facility development at this time.

Potential impacts of wind facility development have been analyzed at a programmatic level by USDOI, MMS (2007a). Reasonably foreseeable IPFs include

- seafloor disturbance and turbidity due to installation of wind turbines and cables;
- presence of structures (including risk of avian collisions with turbine blades);
- construction vessel traffic and associated effluent discharges, air emissions, and noise;
- underwater noise from pile driving during turbine installation, and from routine turbine operations;
- onshore waste disposal;
- accidental releases of trash and marine debris; and
- a risk of fuel spills from construction vessels.

3.6.3. Marine Minerals Use

Chapter 4.2.12.1.3 describes previous usage of OCS sand for beach restoration and shoreline protection projects in the coastal states adjacent to the AOI. Between 1995 and 2011, BOEM issued more than 20 negotiated agreements along the Mid- and South Atlantic Planning Areas authorizing use of OCS sand resources from borrow areas offshore of Maryland, Virginia, South Carolina, and Florida in recreational beach, storm and hurricane damage protection, and infrastructure protection projects (USDOI, BOEM, 2011a).

Over the time frame of this Programmatic EIS (2012-2020), BOEM anticipates that OCS sand resources will continue to be used for beach restoration and shoreline protection projects. Most OCS usable sand bodies are already known and have been surveyed (USDOI, BOEM, 2011g) and/or used previously. Previously used OCS sand and gravel borrow areas within the AOI are as follows:

- Great Gull Bank Borrow Area (offshore Ocean City, Maryland);
- Sandbridge Shoal Borrow Area (offshore Virginia Beach, Virginia);
- Little River Borrow Area (offshore North Myrtle Beach, South Carolina);
- Cane South Borrow Area (offshore Myrtle Beach, South Carolina);
- Surfside Borrow Area (offshore Garden City, South Carolina);
- Jacksonville Borrow Area (offshore Jacksonville, Florida); and
- Canaveral Shoals Borrow Area (offshore Brevard County, Florida).

A map of the existing borrow sites is presented in **Chapter 4.2.12.1.3**. The general area where sand mining will likely occur between 2012 and 2020 is in water depths between 10 and 30 m (33 and 98 ft) offshore Delaware south to Florida. Georgia is excluded because the State has never had an agreement with BOEM for joint study of OCS marine minerals resources and has never requested a non-competitive lease to use them onshore. Current technology in the U.S. hopper and cutterhead dredging fleet effectively limits dredging to less than 30-m (98-ft) water depths. Moreover, the cost for transporting sand located in offshore sand shoals and banks to shore is relatively expensive, ensuring coastal planners first use resources in areas closest to shore.

The Marine Minerals Program has identified beach nourishment and coastal restoration projects that are most likely to require use of OCS sand resources over the next 10 years (**Table 3-7**). The proposed activity scenario is based on an examination of past trends in OCS G&G and leasing activity and anticipated OCS leasing requests, as well as projections of other possible uses as existing borrow areas are nearing depletion. Based on past usage, a few existing borrow sites such as Sandbridge Shoal offshore Virginia and the Canaveral Shoals and Jacksonville borrow sites offshore Florida are likely to be reused, perhaps accounting for 40-50 percent of future projects.

Impacts of sand and gravel mining along the Atlantic Coast have been evaluated in several studies (Louis Berger Group, Inc., 1999; Byrnes et al., 2003; Hammer et al., 2005). Reasonably foreseeable IPFs for OCS sand mining include

- seafloor disturbance, turbidity, and benthic habitat alterations due to dredging;
- a risk of direct physical impacts to sea turtles (e.g., by hopper dredges);
- vessel traffic and associated effluent discharges, air emissions, and noise;
- accidental releases of trash and marine debris; and
- a risk of fuel spills from dredging vessels.

3.6.4. Geosequestration

Geosequestration is the process of removing carbon from the atmosphere and depositing it in a deep reservoir beneath the earth's surface. An example of one such potential project is PURGeN One, an onshore 400-MW coal-fueled integrated gasification combined cycle electric-generating and manufacturing facility that has been proposed for construction in Linden, New Jersey (PurGen, 2011). The carbon dioxide (CO_2) emissions from the new plant and potentially neighboring industrial operations, totaling up to approximately 6 million tons annually, would be captured and transported via a submarine pipeline to injection wells 113 km (70 mi) off the Atlantic Coast for sequestration approximately 2,438 m (8,000 ft) beneath the seabed (PurGen, 2011). Although the proposed location is outside the AOI, the project provides an example of the type of geosequestration project that could occur within the AOI during the time period of this Programmatic EIS.

The OCSLA, as amended by the EPAct of 2005, gave BOEM the authority to issue leases, easements, and rights-of-way for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas." In certain circumstances, subseabed CO_2 sequestration falls under this authority, including CO_2 produced as by-product of the production of electricity from a coal-fired power plant. The BOEM is developing regulations to implement its authority, conducting a worldwide literature synthesis, and developing Best Management Practices for CO_2 transport and sequestration projects on the OCS (USDOI, BOEM, 2011i).

Geosequestration projects would require G&G activities to evaluate the suitability of subsea formations, drilling of CO_2 injection wells, and construction of a pipeline to shore. Reasonably foreseeable IPFs would be similar to those for oil and gas exploration and development and would include

- seafloor disturbance due to placement of a well template on the seafloor, jetting of wells, and anchoring of drilling rigs (if a moored drilling unit is used);
- seafloor disturbance due to pipeline installation, including anchoring of pipelaying vessels (if moored pipelaying barges are used);
- discharges of drilling fluid, drill cuttings, and other effluents from drilling rigs;
- presence of drilling rigs, including underwater and airborne noise and lights;
- support vessel and helicopter traffic;
- air emissions from drilling rigs, as well as support vessels and helicopters;
- onshore waste disposal;
- accidental releases of trash and marine debris; and
- a risk of fuel spills from drilling rigs, support vessels, or pipelaying vessels.

3.6.5. Liquefied Natural Gas Import Terminals

Liquefied natural gas (LNG) is a form of natural gas that is used mainly for transport to markets, where the liquid is regasified and distributed via pipeline networks. LNG is imported to the U.S. through both offshore and onshore terminals. Licensing of offshore LNG terminals (deepwater ports) is under the jurisdiction of USCG and the Maritime Administration (MARAD). Onshore LNG terminals are licensed by the Federal Energy Regulatory Commission (FERC). There are two USCG/MARAD licensed deepwater ports offshore the Atlantic Coast – Neptune and Northeast Gateway, both located offshore Massachusetts. There are no active, pending applications for deepwater ports on the Atlantic Coast (USDHS, CG, 2010). There are three FERC-licensed LNG terminals in Atlantic states – Everett, Massachusetts; Cove Point, Maryland; and Elba Island, Georgia (FERC, 2011).

Because there are no active, pending deepwater port applications, the cumulative scenario assumes that no deepwater LNG port construction will occur within the AOI during the 2012-2020 period. The development of shale gas in Appalachian Basin black shales has created a significant new source of onshore gas in proximity to major use areas along Atlantic Coast States. Planning for LNG facilities, in general, has been complicated by this development, making it difficult to predict the level of future LNG port construction. However, over the 2012-2020 time period, it is reasonable to assume that no additional deepwater LNG port construction will occur. The main, reasonably foreseeable IPFs associated with routine operations of the existing LNG terminals are vessel traffic, along with the associated discharges, air emissions, and noise.

3.6.6. Commercial and Recreational Fishing

Chapters 4.2.7 and **4.2.8** describe commercial and recreational fishing activities in the AOI. Although there are interannual and seasonal variations in both types of activities, as well as geographic differences among states, there are no apparent long-term temporal trends in the level of these activities. Over the 2012-2020 time period of this Programmatic EIS, it is assumed that these activities will continue at about the present level. Reasonably foreseeable IPFs associated with commercial and recreational fishing include

- direct taking of fish and shellfish resources, including targeted species and bycatch;
- incidental taking of protected species;
- seafloor disturbance and turbidity due to trawling and dredging;
- vessel traffic, including the associated effluent discharges, air emissions, and noise;
- accidental releases of trash and marine debris (e.g., discarded fishing line); and
- a risk of fuel spills from commercial and recreational vessels.

3.6.7. Military Range Complexes and Civilian Space Program Use

Most of the AOI is within Military Use Areas, as discussed in **Chapter 4.2.12.1.2**. Military activities can include various air-to-air, air-to-surface, and surface-to-surface naval fleet training, submarine and antisubmarine training, and Air Force exercises. Where naval vessels and aircraft conduct operations that are not compatible with commercial or recreational transportation, they are confined to Operating Areas (OPAREAs) away from commercially used waterways and inside Special Use Airspace (U.S. Fleet Forces, 2009). Hazardous operations are communicated to all vessels and operators by use of Notices-to-Mariners issued by USCG and Notices-to-Airmen issued by the FAA.

The National Aeronautics and Space Administration (NASA) also has designated downrange danger zones and has identified patterns for recent debris cones from rocket tests that represent hazards for surface activities after such tests. There are also restricted areas for rocket testing, satellite launches, and other range mission activities. The NASA restricted areas within the AOI include areas offshore the Goddard Space Flight Center's (GSFC's) Wallops Island Flight Facility (WFF) in Virginia and offshore of the Kennedy Space Center at Cape Canaveral.

The National Aeronautics and Space Administration's GSFC owns and operates the launch range at the WFF, which is located on Virginia's eastern shore. The National Aeronautics and Space Administration is expected to continue to conduct science, technology, and educational flight projects from WFF aboard rockets, balloons, and uninhabited aerial vehicles (UAVs), using Atlantic waters for operations on almost a daily basis. Since 2006, launches from WFF have grown in number and importance to the Nation's space and national defense priorities and programs. The WFF is one of the Nation's few launch ranges to support medium to large vehicle class satellite launches. Orbital Sciences Corporation (OSC) of Virginia selected WFF, including the Mid-Atlantic Regional Spaceport (MARS), as its preferred site to develop and launch its *Taurus II* rocket. MARS is a Virginia and Maryland sponsored spaceport whose mission is to foster regional economic development through aerospace projects and commercial space launch operations conducted from their property on the WFF Research Range. According to NASA, OSC foresees an average of five MARS-associated launches a year beginning in 2011 using the *Taurus II* rocket. In addition, OSC has been selected by NASA to conduct launches from WFF for ongoing commercial cargo re-supply services for the International Space Station. The National Aeronautics and Space Administration will depend on commercial re-supply for reliable, safe and cost effective cargo delivery services to the station. The contract is for launch services, orbital rendezvous and berthing with a crewed spacecraft, delivery of internal and/or external cargo, unberthing and de-orbit, and disposal or return of internal cargo for 2011 through 2016. Future planned flights from WFF also include NASA scientific satellites with a lunar reconnaissance mission in 2012, Lunar Atmospheric and Dust Experiment Explorer, as the first planned Expendable Launch Vehicle mission from WFF to support the Nation's scientific program goals. The WFF tenants such as the Navy's Surface Combat System Center and Naval Air Warfare Center-Aircraft Division also rely on the WFF Research Range for aircraft and shipboard system development testing and training. The U.S. Air Force also relies on launches from WFF to support two critical programs: Operationally Responsive Space and the Tactical Satellite Program. Future missions in this program are on schedule for launch from WFF in 2011 and beyond. The Missile Defense Agency also relies on launches from WFF for suborbital targets to train the Navy fleet, and orbital technology development programs including Near Field Infrared Experiment.

Over the 2012-2020 time period of this Programmatic EIS, it is assumed that military and civilian space program uses of the AOI will increase above the present level due to the ongoing and planned programs discussed in the preceding paragraphs. Reasonably foreseeable IPFs associated with military uses include

- vessel traffic, including associated effluent discharges, air emissions, and noise;
- aircraft traffic, including associated air emissions and noise;
- underwater noise from sonars, explosives, and other active acoustic sound sources;
- seafloor disturbance due to bottom-founded buoys, towers, or other equipment;
- accidental releases of trash and marine debris (including debris from rocket launches); and
- a risk of fuel spills from military and civilian vessels.

3.6.8. Shipping and Marine Transportation

Shipping and marine transportation in the AOI are discussed in **Chapter 4.2.12.1.1**. Deepwater commercial ports located along the coast adjacent to the AOI include Norfolk, Virginia (Port of Virginia); Wilmington, North Carolina; Charleston, South Carolina; Savannah, Georgia; Brunswick, Georgia; and Jacksonville, Florida. In addition, Delaware Bay provides access to Delaware River ports and terminals in the Wilmington, Delaware, and Philadelphia, Pennsylvania, area. Chesapeake Bay provides access to the Port of Baltimore and numerous smaller ports in Maryland and Virginia.

Large commercial vessels (cargo ships, tankers, and container ships) use these ports to access overland rail and road routes to transport goods throughout the U.S. Other vessels using these ports include military vessels, commercial business craft (tug boats, fishing vessels, and ferries), commercial recreational craft (cruise ships and fishing/sight-seeing/diving charters), research vessels, and personal craft (fishing boats, houseboats, yachts and sailboats, and other pleasure craft).

Over the 2012-2020 time period of this Programmatic EIS, it is assumed that shipping and marine transportation activities in the AOI will increase above the present level, due in part to the expansion of the Panama Canal, which is expected to be complete in 2014 and which will double its capacity (Canal de Panamá, 2012). Reasonably foreseeable IPFs associated with these activities include

- vessel traffic, including associated effluent discharges, air emissions, and noise;
- accidental releases of trash and marine debris; and
- a risk of fuel spills from commercial vessels.

3.6.9. Dredged Material Disposal

Dredged material disposal sites in the AOI are discussed in **Chapter 4.2.12.1.5**. There are 13 designated dredged material disposal sites on the Atlantic OCS ranging from Dam Neck, Virginia, to Canaveral Harbor, Florida. The disposal sites are used mainly for the disposal of dredged material from the maintenance dredging of commercial ports. Typically, sites are permitted for continuing use, and the activity level varies depending on the dredging requirements for particular ports. Over the 2012-2020 time period of this Programmatic EIS, it is assumed that usage of dredged material disposal sites in the AOI will continue at about the present level. Reasonably foreseeable IPFs associated with this usage include

- seafloor disturbance, turbidity, and benthic habitat alterations due to dredging (at the port or channel location) and dumping of dredged material (at the disposal site);
- a risk of direct physical impacts to sea turtles (e.g., by hopper dredges);
- vessel traffic and associated effluent discharges, air emissions, and noise;
- accidental releases of trash and marine debris; and
- a risk of fuel spills from dredging vessels.

3.6.10. Climate Change

Warming of the earth's climate system is occurring, and most of the observed increases in global average temperatures since the mid-20th century are very likely due to the observed increase in anthropogenic greenhouse gas concentrations (Intergovernmental Panel on Climate Change [IPCC], 2007; U.S. Global Change Research Program, 2009). Globally, many environmental effects have been documented, including widespread changes in snow melt and ice extent; spatial changes in precipitation patterns; changes in the frequency of extreme weather events; changes in stream flow and runoff patterns in snow-fed rivers; warming of lakes and rivers, with effects on thermal structure and water quality; changes in the timing of spring events such as bird migration and egg-laying; poleward shifts in ranges of plant and animal species; and acidification of marine environments (IPCC, 2007; Orr et al., 2005; Nye et al., 2009). Documented changes in marine and freshwater biological systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. These include shifts in ranges and changes in algal, plankton, and fish abundance in high-latitude oceans; increases in algal and zooplankton abundance in high-latitude and high-altitude lakes; and range changes and earlier fish migrations in rivers (IPCC, 2007).

The U.S. Global Change Research Program (2009) has summarized regional climate changes for the southeastern U.S. (including most of the states in the AOI). Since 1970, average annual temperature has risen approximately 2°F (1.1°C) and the number of freezing days has declined by 4-7 days per year. Average autumn precipitation has increased 30 percent since 1901. There has been an increase in heavy downpours in many parts of the region, while the percentage of the region experiencing moderate to severe drought increased over the past three decades. The area of moderate to severe spring and summer drought has increased by 12 percent and 14 percent, respectively, since the mid-1970's. Continuing changes in precipitation could affect the water quality and marine ecology of the AOI by altering the quantity and quality of runoff into estuaries.

Over the next century, the IPCC (2007) projects that global temperature increases will cause significant global environmental changes, including reductions in snow cover and sea ice; more frequent extreme heat waves and heavy precipitation events; an increase in the intensity of tropical cyclones (hurricanes and typhoons); and numerous hydrological, ecological, social, and health effects. Regionally, the U.S. Global Change Research Program (2009) predicts similar long-term changes for the southeastern U.S., including increased shoreline erosion due to sea level rise and increases in hurricane intensity; a precipitous decline in wetland-dependent fish and shellfish populations due to loss of coastal marshes; heat-related stresses for people, plants, and animals; and decreased water availability due to increased temperature and longer time between rainfall events. The resilience of many ecosystems is likely to be exceeded by an unprecedented combination of climate change, associated disturbances, and other global change drivers. There are projected to be major changes in ecosystem structure and function, species' ecological interactions, and shifts in species' geographical ranges, with predominantly negative consequences for biodiversity and ecosystem function (IPCC, 2007).

Reasonably foreseeable marine environmental changes in the AOI that could result from climate change over the next century include altered migratory routes and timing (e.g., for marine mammals and migratory birds); changes in shoreline configuration that could adversely affect sea turtle and shorebird and seabird nesting beaches and prompt increased levels of beach restoration activity (and increased use of OCS sand sources); changes in estuaries and coastal habitats due to interactive effects of climate change along with development and pollution; and impacts on calcification in plankton, corals, crustaceans, and other marine organisms due to ocean acidification (The Royal Society, 2005).

Over the next two decades, the IPCC (2007) projected a warming of about 0.2 °C per decade. During the 10-year time period of this Programmatic EIS (2012-2020), environmental changes in the AOI due to climate change are likely to be small, incremental, and difficult to discern from effects of other natural and anthropogenic factors.

3.6.11. Cumulative Noise in the Sea

Various activities and processes, both natural and anthropogenic, combine to form the sound profile within the ocean, generally referred to as ambient ocean noise (Richardson et al., 1995; Hildebrand, 2009). Most ambient noise is broadband (composed of a spectrum of numerous frequencies without a differentiating pitch) and encompasses virtually the entire frequency spectrum. For purposes of understanding the sources and characteristics of ocean ambient noise, it can be divided into three frequency bands: low (10-500 Hz), medium (500 Hz-25 kHz) and high (>25 kHz) (Hildebrand, 2009). Shipping noise is the main contributor to ambient ocean noise in the low-frequency band (NRC, 2003a; Hildebrand, 2009). Noise in the low-frequency band has a broad maximum around 10-80 Hz, with a steep negative slope above 80 Hz. According to ambient noise spectra presented by Hildebrand (2009), spectrum levels of ambient noise from shipping are 60-90 dB re 1 μPa^2 Hz^{-1}. Sea surface agitation correlated with wind and sea state is the major contributions to ambient noise in the medium frequency band. In the high-frequency band, "thermal noise" caused by the random motion of water molecules is the primary source (Hildebrand, 2009). Ambient noise sources, especially noise from wave and tidal action, can cause coastal environments to have particularly high ambient noise levels.

A large portion of the noise from vessel traffic comes from vessel engines and propellers, and those sounds occupy the low frequencies used by most large whales (Richardson et al., 1995). In the open water, ship traffic can influence ambient background noise at distances of thousands of kilometers; however, the effects of ship traffic sounds in shallow coastal waters are much less far reaching, most likely because a large portion of the sound's intensity is absorbed by soft, nonreflective, unconsolidated materials (sands and mud) on the seafloor. Other anthropogenic sources include dredging, oil and gas operations, nearshore construction activities, and sonar signals (especially those used by the military).

Behavioral responses of cetaceans to underwater noise and the population consequences of those responses are subjects of recent and ongoing research (NRC, 2005; Southall et al., 2007; Ellison et al., 2011). However, the increased noise may be steadily eroding marine mammals' abilities to communicate. Acousticians have estimated that the chance of two whales hearing each other today has been reduced to 10 percent of what it was 100 years ago due to the masking of communication sounds by the ambient ocean noise created by multiple industrial activities (Parks and Clark, 2007). At some point this acoustic smog (Clark et al., 2007) could affect the abilities of whales to find food and mates. Because the bulk of human industrial sounds in the oceans are low frequency, it is likely that the large mysticete whales would be affected first. Fish can also use and communicate by sound, and increased noise could interfere with their foraging and reproductive behaviors (Vasconcelos et al., 2007; Codarin et al., 2009).

Long-term data analyzed by McDonald et al. (2006) offshore California show an increase in ambient noise of approximately 10-12 dB in the frequency range 30-50 Hz over a 40-year period, suggesting an average noise increase rate of 2.5-3 dB per decade. The authors attributed the change to increased levels of shipping traffic. While comparable long-term data for the AOI have not been published, it is assumed that underwater noise from vessel traffic and other anthropogenic sources is increasing and will continue to increase incrementally over the time period of this Programmatic EIS (2012-2020).

CHAPTER 4

DESCRIPTION OF THE AFFECTED RESOURCES AND IMPACT ANALYSIS

4. DESCRIPTION OF THE AFFECTED RESOURCES AND IMPACT ANALYSIS

4.1. INTRODUCTION

Within the AOI, various types of G&G activities may be conducted in support of three broad categories of offshore energy and minerals development under BOEM jurisdiction:

- *Oil and Gas Exploration*: The G&G surveys are conducted to locate and evaluate oil and gas resources, primarily through broad scale 2D and 3D seismic exploration surveys. In addition, high-resolution site surveys of individual lease blocks are conducted to detect geohazards, shipwrecks and other archaeological resources, and certain types of benthic communities.
- *Renewable Energy Development*: The G&G surveys in support of renewable energy development are likely to include high-resolution surveys of wind facility locations as well as cable routes to shore. The surveys are conducted to aid in siting facilities as well as to detect geohazards, shipwrecks and other archaeological resources, and certain types of benthic communities.
- *Marine Minerals*: The G&G surveys are used to locate and evaluate marine mineral deposits, including sand for beach nourishment.

A detailed summary of G&G activities, including the projected activity scenario (for each of the three offshore programs; e.g., number of line miles of seismic airgun surveys, including airgun and electromechanical sources; number of core samples) is presented in **Chapter 3**.

4.1.1. Preliminary Screening of Activities and Affected Resources

Earlier environmental analyses were reviewed to determine the physical, chemical, biological, and socioeconomic resources that should be considered in the current programmatic baseline characterization and impact analysis covering Atlantic G&G activities during the 2012-2020 time period. Previous environmental assessments included the Programmatic EA for G&G activities in the Gulf of Mexico (USDOI, MMS, 2004) and the draft EA of wind energy on the Atlantic OCS (USDOI, BOEM, 2011e), as well as a series of applicable EISs covering both oil and gas and renewable energy activities (e.g., USDOI, MMS, 2007c, 2008b; USDOI, BOEM, 2012b; NSF and USDOI, USGS, 2011). The following 17 resource categories were identified for consideration within the current impact analysis:

- benthic communities;
- marine mammals;
- sea turtles;
- marine and coastal birds;
- fisheries resources and EFH;
- threatened and endangered fishes;
- commercial fisheries;
- recreational fisheries;
- recreational resources;
- archaeological resources;
- marine protected areas (MPAs);
- other marine uses;
- human resources and land use;
- geology/sediments;
- air and water quality;

- physical oceanography; and
- meteorology.

Preliminary screening was conducted to identify those resources at risk of impact from the suite of proposed or anticipated G&G activities. Screening allows for the elimination from a detailed impact analysis of those resources with no potential for adverse or significant impact, and focuses the analysis on those resources at greatest impact risk.

The initial step in the preliminary screening was to briefly identify and characterize G&G activities expected to occur in the AOI (i.e., including activities expected under the oil and gas, renewable energy, and marine minerals programs), focusing on activity-specific IPFs. The IPFs identified in this analysis included (1) active acoustic sound sources (i.e., airguns, subbottom profilers, side-scan sonar, etc.); (2) vessel and equipment noise; (3) vessel traffic; (4) aircraft traffic and noise; (5) vessel exclusion zones; (6) vessel wastes; (7) trash and debris; (8) seafloor disturbance; (9) drilling discharges; and (10) onshore support activities. Potential accidents were also integrated into the preliminary screening in the form of a diesel fuel spill resulting from a vessel collision.

The G&G activity types and IPFs were formulated into a matrix (**Table 4-1**). A second matrix, the Leopold Matrix, was subsequently developed to identify resources potentially affected by each type of G&G activity (**Table 4-2**). In this preliminary analysis, the level of impact associated with each interaction was categorized as *potential impact for analysis* (e.g., a measurable impact to a resource is predicted), or *no impact expected* (i.e., no measurable impact to a resource evident).

4.1.1.1. Activity Screening

Based on the preliminary screening of G&G activities and identifiable IPFs (**Table 4-2**), no activities were eliminated from detailed impact analysis under Alternative A with the exception of radar imaging using satellites, which does not require BOEM permit review and issuance. During the preliminary screening, the vessel waste IPF was determined to result in *no impact expected*, and therefore was not carried forward to the impact analysis. All G&G activities evaluated under Alternative A were expected to produce some level of impact to AOI resources, although more than 60 percent of the possible impacts fell within the "no impact" category (**Table 4-2**).

Alternatives B and C were also evaluated in the impact analysis, although a comprehensive activity screening was not conducted for these alternatives because these alternatives constitute a reduced level of G&G activity compared to Alternative A. Alternative B reflects additional activity restrictions on G&G activities, as described in **Chapter 2.2**. Alternative C reflects the no action for oil and gas and status quo for renewable energy and marine minerals G&G activity, as described in **Chapter 2.3**.

4.1.1.2. Resource Screening

Several resource areas were identified as having no expected impacts from G&G activities, including the following:

- *Geology/Sediments*: Those G&G activities that have the potential to affect sediments include deep stratigraphic and shallow test drilling and bottom sampling. Because of the nature of these sampling activities, only very minor impacts to ambient sediments are expected as a result of well drilling, coring, grab sampling, and penetrometer tests, including the creation of small areas of surficial sediment disturbance, localized sediment resuspension and redeposition, and creation of minor surficial discontinuities. Further, deep stratigraphic and shallow test drilling and bottom sampling would have no effect on local or regional geology.
- *Air and Water Quality*: Survey vessels and aircraft involved in G&G activities would emit a variety of air pollutants including nitrogen oxides (NO_x), sulphur oxides (SO_x), particulate matter, volatile organic compounds (VOCs), carbon monoxide (CO), and greenhouse gas emissions (e.g., CO_2). Survey vessels would also discharge treated sanitary and domestic wastes from USCG-approved marine sanitation units.

Potential impacts from emissions and discharges on water and air quality are expected to be negligible.

- *Physical Oceanography*: The G&G activities to be conducted from a survey vessel or floating platform would necessarily account for local and regional physical oceanographic conditions. Ocean current characteristics, water column density stratification, and vertical current structure, among other factors, would be considered during planning, operation, and data post-processing of G&G survey or sampling efforts. Physical oceanographic resources would not be affected by G&G activities and associated discharges; no impacts to physical oceanography are expected.
- *Meteorology*: Meteorological parameters (e.g., temperature, humidity, wind speed and direction, and seasonal storm activity) would be taken into consideration during planning and operation of G&G activities, including both vessel-based and aircraft survey operations. Meteorological resources would not be affected by G&G activities; no impacts to meteorology are expected.

A total of 13 resource categories was carried forward for detailed baseline environment characterization and impact analysis, including benthic communities (soft bottom, hard/live bottom/coral/chemosynthetic), marine mammals, sea turtles, marine and coastal birds, fish resources and EFH, endangered and threatened fishes, commercial fisheries, recreational fisheries, recreational resources, archaeological resources, MPAs, other marine uses, and human resources and land use.

4.1.2. Impact Levels and Impact Significance Criteria

Broad significance criteria were developed for each of the biological and socioeconomic resources present in the AOI, based on the results of the resource screening (**Chapter 4.1.1.2**) and in consideration of recent environmental impact analyses and their respective impact descriptions. Criteria reflect consideration of both the context and intensity of impact (40 CFR 1508.27), based on four parameters – detectability (i.e., measurable or detectable impact), duration (i.e., short-term, long-term), spatial extent (i.e., localized, extensive), and severity (i.e., severe, less than severe). While the impact descriptions developed for this analysis are unique, the impact thresholds employed and impacts determined in earlier EISs, including the Alternative Energy Programmatic EIS (USDOI, MMS, 2007a) and the NSF-USGS Marine Seismic Research Programmatic EIS/OEIS (NSF and USDOI, USGS, 2011), have been considered. For the purposes of this analysis, negative impacts have been classified into one of four levels – negligible, minor, moderate, or major. For both biological and socioeconomic resources, the significance criteria have been broadly defined as follows:

- *Negligible*: Little or no measurable/detectable impact.
- *Minor*: Impacts are detectable, short-term, extensive or localized, but less than severe;
- *Moderate*: Impacts are detectable, short-term, extensive, and severe; ***or*** impacts are detectable, short-term or long-lasting, localized, and severe; ***or*** impacts are detectable, long-lasting, extensive or localized, but less than severe.
- *Major*: Impacts are detectable, long-lasting, extensive, and severe.

While broad significance criteria are outlined above, each impact parameter was evaluated on a resource-specific basis to determine the appropriate impact level for each IPF. These evaluations considered the unique attributes of the resource being evaluated. For biological resources, attributes such as distribution/range, life history, and susceptibility to impact of individual and populations were considered, among other factors. For socioeconomic resources, attributes such as archaeological or socioeconomic characteristics and susceptibility to impact were evaluated, among other factors.

The evaluation process to determine significance considered potential impacts by context (e.g., short- vs. long-term) and intensity (e.g., severity) following the NEPA regulations as guidance (40 CFR 1508.27). Each type of IPF was evaluated not only according to context and intensity but also for duration and likelihood. Context was defined as the extent of the effect (geographic extent or extent within a species, ecosystem, or region) and any special circumstances (e.g., endangered species or legal status), while intensity of an impact was defined as its magnitude and duration. Moreover, the potential effect was evaluated in terms of duration or frequency (short-term, long-term, and intermittent). The evaluation process also consisted of evaluating the likelihood (likely or not likely) of an effect to occur, i.e., whether it was plausible or just speculative.

4.1.3. Impact-Producing Factors

Table 4-3 outlines the IPFs identified in association with G&G activities. **Chapter 3** outlined the specific details of each IPF.

Overall, the impact analyses considered direct effects, indirect effects, and cumulative effects. Direct effects were defined as effects that may be caused by the proposed action and occur at the identical location and time of the action (40 CFR 1508.8). Indirect effects were defined as effects that may be caused by the proposed action at a later time or farther removed from the location of the action but are still reasonably foreseeable to occur (40 CFR 1508.8). Cumulative effects were defined as additive or interactive effects that would result from the incremental impact of the proposed action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR 1508.7). Cumulative impacts, or the accumulation of effects, can result from one or more processes. These processes, as outlined by NRC (2003b), include (1) frequent and repeated impacts on a single environmental resource (i.e., time crowding); (2) high density impacts on a single environmental resource (i.e., space crowding); (3) synergistic impacts attributable to multiple sources on a single environmental resource (i.e., compounding impacts); (4) impacts that become qualitatively different once a resource-specific threshold of disturbance has been reached or surpassed (i.e., thresholds); and (5) the progressive loss of habitat resulting from a sequence of activities, each of which has relatively innocuous consequences, however, the environmental consequences accumulate (i.e., "nibbling").

4.1.4. Other Considerations

4.1.4.1. Analysis and Incomplete or Unavailable Information

The analyses of potential effects on the wide variety of biological and socioeconomic resources in the vast area of the Mid- and South Atlantic and adjacent coastal areas are very complex. Specialized education, experience, and technical knowledge are required, as well as familiarity with the numerous IPFs associated with G&G activities at sea that can cause cumulative impacts in the area. Knowledge and practical working experience with major environmental laws and regulations such as NEPA, the CWA, CAA, CZMA, ESA, MMPA, Magnuson-Stevens FCMA, and others is also required.

When an agency is evaluating reasonably foreseeable significant adverse effects on the environment in an EIS and there is incomplete or unavailable information, the agency reports that such information is lacking. Under NEPA regulations at 40 CFR 1502.22, the agency is required to report what relevant information is incomplete and why it is unavailable; either there is no relevant agency or public domain information at hand, cost or time limitations would be exhorbitant to produce it, or a means to acquire it is not known. Complex environmental evaluations are always to some degree a documentation exercise in the face of imperfect information.

This chapter has thoroughly examined the existing, credible scientific evidence that is relevant to evaluating the reasonably foreseeable, significant adverse impacts of the proposed G&G activities. The subject-matter experts that prepared this Programmatic EIS conducted a diligent search for pertinent information with which to assess impacts. All reasonably foreseeable impacts have been considered, and the characterization of impact magnitude and duration is supported by credible scientific evidence. The BOEM's assessment of impacts is not based on conjecture, media reports, or public perception, rather it is based on theoretical approaches, research methods, and modeling applications generally accepted in the scientific community and that are even in the vanguard for assessing these types of impacts.

4.1.4.2. Space-Use Conflicts

Marine space-use issues are a continuing problem and are an important element in marine spatial planning (Crowder and Norse, 2008; Douvere and Ehler, 2009). Whenever activities take place on the

OCS, there is the potential for space-use conflict that must be evaluated prior to conducting regulated activities. The cumulative impacts scenario discussed in detail in **Chapter 3.6** includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. Most of the activities are competing for very small footprints on the OCS; only a few of them permanently or temporarily compete directly for large areas of OCS on a semi-continuous basis. These exceptions include (1) military range complexes and civilian space program use; (2) commercial fishing; and less importantly (3) shipping and marine transportation. All of these activities spatially coexist with other activities on the OCS, but differ in their potential for space-use conflict by their degree of permanence or frequency.

Military and NASA activities have the potential for creating temporary space-use conflicts on the OCS. The AOI includes all or parts of five major DOD range complexes that include periodic vessel access restrictions to portions each range complex. NASA also has designated downrange danger zones and restricted areas for rocket testing, satellite launches, and other range mission activities. NASA restricted areas within the AOI include Wallops Island in Virginia and offshore of the Kennedy Space Center at Cape Canaveral. In the Gulf of Mexico, an area heavily leased for oil and gas activity, a Military Areas Stipulation is required for leased OCS lands that specify points of contact between industry operators and DOD facility operators to reduce potential impacts, particularly in regards to safety. Military and all other Gulf of Mexico activities essentially coexist except under prearranged circumstances. The reduction in potential impacts resulting from this stipulation makes multiple-use conflicts most unlikely, but without it some potential conflict with respect to safety issues is likely. The best indicator of the overall effectiveness of the stipulation may be that there has never been an accident involving a conflict between military operations and oil and gas activities in the Gulf of Mexico. Similar stipulations would be included in leased OCS lands within the AOI to reduce the potential for conflicts. In addition, military coordination mitigation measures would be a condition of G&G activities permit approval (i.e., similar to NTL 2009-G06, the military coordination lease stipulation in effect in the Gulf of Mexico) (**Chapter 2.1.2.8**). Mitigation of this type would require the G&G operator to contact designated DOD or NASA personnel identified for the purpose to be notified of the nature and schedule for any pending G&G activity planned within military range complexes or NASA's use areas.

Commercial fishing has the potential to cause semi-permanent, space-use conflicts on the OCS. Marine space conflicts are already an issue between many competing fisheries in some portions of the AOI (e.g., pelagic longline fisheries; deepwater crab fisheries). On a space use basis, commercial fishing can potentially occur anywhere in favored areas where it is not temporarily or permanently excluded (i.e., in areas where there are no surface or bottom obstructions). Virtually all commercial trawl fishing is performed in water depths less than 200 m (656 ft). Almost no OCS surface area is now obstructed, the exception being the South Atlantic Bight Synoptic Offshore Observational Network (SABSOON) tower network offshore of the Georgia coast and small patches of sea bottom area obstructed by artificial reefs, aids to navigation, and known obstructions in NOAA's Automated Wreck and Obstruction Information System (AWOIS) database. Together, a very small fraction of 1 percent of total OCS area in the AOI is now unavailable for trawl or longline fishing, and the introduction of surface and bottom obstructions from oil and gas or renewable energy structures from the cumulative impacts scenario would not be greater than 1 percent of the available surface or bottom area in the AOI in water <200 m deep.

Marine transportation presents a transitory but persistent potential for space-use conflicts over the OCS. Commercial vessels can range across the entire OCS, but higher traffic areas are generally self-restricted to transit corridors as discussed further in **Chapter 4.2.12**.

Marine spatial planning is a key factor in reducing space-use conflicts. Coastal and Marine Spatial Planning (CMSP) is "a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process, based on sound science for analyzing current and anticipated uses of ocean, coastal, and Great Lakes areas" (EO No. 13547; *Federal Register*, 2010b). CMSP aims to reduce conflict among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services. The BOEM is implementing CMSP as the planning tool to achieve National Ocean Policy objectives. CMSP will provide a framework for the coordinated application of existing laws and agency authorities. The BOEM is using a phased implementation approach to CMSP that includes engaging State, Tribal, Federal, and public stakeholders and technical experts; consultation with regional Fisheries Management Councils (FMCs); drafting of Strategic Action Plans; and development of a data portal for all applicable Federal data access and sharing. Space-use conflicts for each applicable resource category have been addressed within individual impact discussions, identified within those IPFs associated with the presence of structures, vessel traffic, and vessel exclusion zones. The analyses include direct, indirect, and cumulative impacts to each resource category.

4.2. ALTERNATIVE A – THE PROPOSED ACTION

The AOI for the proposed action (**Figure 4-1**) includes U.S. Atlantic waters from the mouth of Delaware Bay to just south of Cape Canaveral, Florida, and from the shoreline (excluding estuaries) to 350 nmi (648 km) from shore. It includes a portion of the Mid-Atlantic Bight (MAB), which extends from Cape Cod to Cape Hatteras, North Carolina, and all of the South Atlantic Bight (SAB), which extends from Cape Hatteras to Cape Canaveral, Florida.

The northern (38°51' N) and southern (28° N) limits are based on the boundaries of the Mid- and South Atlantic Planning Areas. The seaward limit of 350 nmi (648 km) from shore is based on the maximum constraint line for the U.S. ECS under Article 76 of the UNCLOS (U.S. Extended Continental Shelf Task Force, 2010). Along most of the Atlantic coast where the shoreline consists of barrier islands and beaches, the shoreward boundary is the MHW line. A straight line was drawn across inlets and the mouths of estuaries and embayments. Water depth within the AOI ranges from 0 to 5,629 m (0 to 18,468 ft).

The total size of the AOI is 854,779 km^2 (330,032 mi^2). The two largest components are the Mid-Atlantic Planning Area (456,818 km^2 or 176,378 mi^2) and the South Atlantic Planning Area (219,890 km^2 or 84,900 mi^2). Together these account for 79 percent of the AOI. State jurisdiction on the Atlantic coast extends from the shoreline to 3 nmi (5.6 km) from shore. State waters constitute an area of 9,174 km^2 (3,452 mi^2), or about 1 percent of the AOI. Waters beyond the outer boundaries of the two planning areas represent an area of 168,898 km^2 (65,211 mi^2), or 20 percent of the AOI.

Potentially affected resources vary to some extent for different G&G program areas. The G&G activities in support of oil and gas exploration and development are expected to occur only in the two planning areas under USDOI jurisdiction; as noted above, these account for 79 percent of the AOI. The G&G activities in support of renewable energy development are expected to occur within both Federal and State waters less than 100 m (328 ft) deep (USDOI, MMS, 2007a). This represents an area of 132,167 km^2 (51,029 mi^2), or about 15 percent of the AOI. The G&G activities in support of marine minerals use (e.g., sand and gravel mining) are expected to occur in both Federal and State waters less than 30 m (98 ft) deep, which represents an area of 76,330 km^2 (29,471 mi^2), or about 9 percent of the AOI. The G&G activities beyond the outer boundary of the planning areas have not been determined but could include geophysical surveys in support of the U.S. Extended Continental Shelf Project.

Although the MHW line is the shoreward boundary, there are no G&G activities planned in the intertidal zone under this program. The intertidal zone is relevant only to the extent that resources within the AOI use it (e.g., sea turtle nesting beaches). A similar approach applies to estuaries, embayments, and coastal habitats in general, which are not within the AOI but are relevant to the ecology of many marine species. Where needed to evaluate the resource and potential impacts, the description of affected resources includes migration pathways and life stages that extend beyond the AOI boundaries.

In addition to the marine environment of the AOI, the analysis includes the human resources and land use in and around five ports identified as likely shore bases for G&G activities. These are Norfolk, Virginia (Port of Virginia); Wilmington, North Carolina; Charleston, South Carolina; Savannah, Georgia; and Jacksonville, Florida (**Figure 4-1**). The ports were selected based on their geographic proximity to the AOI, locations named in permit applications for G&G activities, and the availability of adequate support facilities that could be used by G&G survey vessels. Many smaller ports exist along the coast from Delaware to Florida that could be used as support bases for G&G activities associated with individual renewable energy or marine minerals projects. (See **Chapter 3.5.1.3** for a discussion of onshore support activities.)

The following chapters describe the environmental and socioeconomic resources in the AOI and analyze potential impacts of the proposed action, as described in detail in **Chapter 2.1.1**, on them. **Appendix F** provides an overview of the physical-chemical environment, including geology, meteorology, oceanography, water quality, and acoustics. Additional information is provided in recent publications from the Environmental Studies Program conducted by BOEM, as listed in **Appendix D**.

4.2.1. Benthic Communities

4.2.1.1. Description of the Affected Environment

The benthic environment of the AOI straddles two broad eco-regions: (1) the MAB, which extends from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina; and (2) the SAB, which extends from Cape Hatteras, North Carolina, to Cape Canaveral, Florida. The continental margins in these two areas differ topographically. The MAB has a classic shelf-slope-rise sequence, while the SAB has a terrace-like sequence with several prominent features (**Figure 4-2**). The MAB and SAB coincide with two biogeographic regions, the North Atlantic Temperate Region and the North Atlantic Subtropical Region, which are divided by the northern edge of the Gulf Stream as it is deflected eastward at Cape Hatteras (Wiebe et al., 1987).

The seafloor in the MAB consists predominantly of soft sediments, mostly sands but grading to silt and clay in deeper areas (Boesch, 1979; Wigley and Theroux, 1981). Hard bottom habitats are sparsely distributed over the MAB shelf and are composed of bare rock, gravel, shell hash, and artificial reefs (Steimle and Zetlin, 2000). In contrast, there are extensive areas of hard/live bottom on the SAB shelf (**Figure 4-3**) (Van Dolah et al., 1994). In deeper water, hard bottom habitats are associated with canyon walls in the MAB and with deepwater coral bioherms along the Blake Plateau and Florida-Hatteras slope in the SAB. Locations of canyons and some hard bottom features are well known (e.g., Gray's Reef). In other areas where the presence of deepwater corals is known but the distribution of coral sites is not well documented, broad areas have been designated as Habitat Areas of Particular Concern (HAPCs) by the South Atlantic Fishery Management Council (SAFMC) to protect these communities from physical damage by fishing gear. Although the SAFMC does not regulate activities unrelated to fishing, the designation highlights the ecological importance of these areas and their sensitivity to seafloor-disturbing activities.

The following discussion provides an overview of benthic communities in the MAB, SAB, and Hatteras middle slope (an area with unique benthic characteristics). The overview is followed by a discussion of sensitive benthic communities.

4.2.1.1.1. Regional Overview

Mid-Atlantic Bight

The MAB has a classic shelf-slope-rise sequence. The continental shelf extends to a water depth of approximately 100 m (328 ft). The change in gradual to steep topographic relief between the continental shelf and the slope is the shelf break, occurring in water depths between 40 and 160 m (131 and 525 ft) (Tucholke, 1987). The continental slope, occurring between 200- and 2,000-m (656- and 6,562-ft) water depths, is characterized by a steep depth gradient varying from 4° to 11° (Tucholke, 1987). The continental rise, at water depths of 2,000-4,000 m (6,562-13,123 ft), is a narrow transition zone that parallels the continental margin from the bathyal to the abyssal plain (Rex et al., 2005).

The continental shelf in the MAB is a heterogeneous region dominated by a ridge-and-swale (hill-and-valley) topography resulting in a patchy distribution of sediments and varying benthic communities (Boesch, 1979). The shelf is characterized by a sandy bottom consisting of medium-grained sand inshore, grading to muddy finer sands at the shelf break (Boesch, 1979). Coarser surficial sediments are often found on ridges and shoals, while generally finer sediments with higher organic carbon content are found in swales, along with greater biomass and species diversity (Boesch, 1979). Polychaetes, bivalves, and amphipods are common in sand habitats of the continental shelf (Schaffner and Boesch, 1982; Brooks et al., 2006). Large burrowers and surface tube dweller are found in the fine, stable sediments of swales.

In the MAB, the continental shelf can be divided into four faunal zones related to depth (Boesch, 1979): the inner shelf (18-30 m [59-98 ft]), open or mid-shelf (30-50 m [98-164 ft]), outer shelf (50-100 m [164-328 ft]), and shelf break or ridge (100-200 m [328-656 ft]) zones. Medium to medium-coarse sand with a trace of silt and clay are found on the inner shelf and are colonized predominantly by small infauna or large motile predators (Boesch, 1979). A silty sand consisting of greater silt, clay, and organic material is characteristic of the open or mid-shelf faunal zone and is colonized by a greater number of tube-dwelling organisms and suspension and deposit feeders than the inner shelf zone (Boesch, 1979). The OCS is colonized by a silt-clay fauna dominated by deposit feeding polychaetes, bivalves, and echinoderms (Boesch, 1979). The shelf break is a transitional zone from the sandy sediments on the shelf to the finer, silt- and clay-dominated sediments on the slope. Polychaetes, brittle stars, galatheid crabs, and worm tubes colonize the muddy sediments of the shelf break (Boesch, 1979).

Density and biomass of macrofauna are greater in finer shelf sediments found on the outer shelf compared to the coarser sediments found on the inner shelf (Boesch, 1979). Boesch (1979) found that small polychaetes, peracarid crustaceans, mollusks, and echinoid and ophiuroid echinoderms were the dominant macrofauna along the MAB shelf.

The continental slope, occurring in water depths of 200-2,000 m (656-6,562 ft), is characterized by a steep depth gradient varying from 4° to 11° (Tucholke, 1987). Sediments are predominantly silt and clay (Boesch, 1979). Macrofaunal density generally decreases with depth, which corresponds to changes in sediment grain size (Boesch, 1979; Wigley and Theroux, 1981).

The continental rise (water depths of 2,000-~4,000 m [6,562-13,124 ft]) is a narrow transition zone that parallels the continental margin from the bathyal to the abyssal zone (Rex et al., 2005). Deposit feeders are the dominant epifaunal group present below 2,000 m (6,562 ft) (Rex et al., 2005). Density and diversity of the macrofaunal community in the abyss continue to decrease with both depth and distance from land; macrofaunal abundance is two to three orders of magnitude lower than on the continental margin (Rex et al., 2005). Macro- and megafaunal diversity decrease from the mid-bathyal depths to the abyssal plain (Stuart and Rex, 2009).

Hatteras Middle Slope

The continental shelf and slope offshore Cape Hatteras represents a transition between the MAB and SAB (Cerame-Vivas and Gray, 1966). The Hatteras middle slope area is characterized by high densities of benthic infauna, unusual communities of benthic fishes and invertebrates, and a relatively high rate of flux of labile organic carbon to the bottom (Diaz et al., 1993; Blake and Grassle, 1994; Blake and Hilbig, 1994; Sulak and Ross, 1996; Aller et al., 2002; Green et al., 2002). A portion of this area has long been known as "The Point" and is an important fishing area (Ross et al., 2001; Currin and Ross, 2002). "The Point" is designated by the SAFMC as an Essential Fish Habitat-Habitat Area of Particular Concern (EFH-HAPC).

Polychaetes and oligochaetes numerically dominate the macrobenthos, and nematodes dominate the meiofauna. There are variations in sediment depth, species, densities, and size classes noted across the shelf and slope (Diaz et al., 1993; Aller et al., 2002). High rates of bioturbation have been documented in this area, infauna have been collected in cores to at least 20 cm (8 inches [in]), and direct visual observations revealed large crustacean burrow galleries providing evidence of a deep-burrowing benthos (Diaz et al., 1993; Aller et al., 2002; Green et al., 2002). Sulak and Ross (1996) reported that the demersal fish fauna in this area is remarkable for the diminutive size of individuals within and across species.

The Hatteras middle slope is one of the steepest slope environments along the U.S. east coast and is influenced by the complex hydrographic structure of the water column off Cape Hatteras resulting from the interactions of circulation patterns of major currents, position of ocean fronts, Gulf Stream eddies and meanders, water column stratification, and upwellings. The unique nature of the bottom fauna is closely linked to the biological and physical interactions that are regulated by these currents (Diaz et al., 1993; Blake and Grassle, 1994).

South Atlantic Bight

The continental margin of the SAB is characterized by a terrace-like sequence with several prominent features: Blake Plateau, Charleston Bump, Blake Ridge, and Blake Escarpment (Popenoe and Manheim, 2001) (**Figure 4-2**). Soft bottom habitats in the SAB are primarily sand habitats of varying grain size. Hard bottom habitats are interspersed throughout the SAB and range from areas of flat hard bottom with a sand veneer sparsely colonized by sponges and soft corals to dense coral thickets on shelf-edge coral banks (Parker et al., 1983; Van Dolah et al., 1994; Schobernd and Sedberry, 2009).

Soft bottom macroinfaunal communities on the continental shelf of the SAB have high species diversity but low densities because of unstable sediments, wide temperature fluctuation, and low nutrient and organic carbon inputs (Tenore, 1979, 1985). The benthic community structure of the shelf varies with physical factors (temperature, depth, sediment texture) as well as with population factors (natality, mortality, recruitment, migration) but generally has a north-south homogeneity with a cross-shelf zonation (Tenore, 1979). Many of the fauna are surface deposit feeders or filter feeders with quick generation times that can respond quickly to intermittent and patchy nutrient inputs (Tenore, 1985). The inner shelf assemblage, dominated by magelonid, prionospid, and nereid polychaetes, and both burrowing and surface brittle stars, differs from the central and outer shelf zones, which are more similar to each other (Tenore, 1985).

The nearshore area of the SAB is a relatively narrow band (~20 km [12 mi]) that receives the continental organic and inorganic nutrient outfall, resulting in relatively high silt/clay fractions and nutrient conditions favorable to biological activity (Tenore, 1979). The shallow, wide shelf of the SAB is characterized by a sandy bottom interspersed with isolated areas of live bottom of varying relief.

The Blake Plateau is a broad, terrace-like feature seaward of the southern Atlantic shelf off of Georgia and South Carolina in water depths ranging from 500 to 1,100 m (1,640 to 3,609 ft) (Popenoe and Manheim, 2001). South of the Charleston Bump, surficial sediments consist primarily of poorly sorted carbonates with a significant clay fraction, while relatively thick accumulations of well sorted carbonate sand increase in thickness north of the Charleston Bump (Popenoe and Manheim, 2001).

4.2.1.1.2. Sensitive Benthic Communities

Live Bottom Areas

Hard bottom habitats occur widely on the continental shelf in the AOI, particularly in the SAB (**Figure 4-3**), where they are often referred to as "live bottom." The term was coined by Cummins et al. (1962) to describe highly productive trawling areas of hard bottom from North Carolina to Florida. Struhsaker (1969) subsequently defined live bottom habitat as islands of broken relief on the shelf consisting of rock outcrops heavily encrusted with sessile invertebrates such as sponges and sea fans and harboring subtropical and tropical fishes. Large sponges and corals may be important components of these habitats because they enhance structural complexity of the environment and therefore contribute shelter and hiding places attractive to fishes (Fraser and Sedberry, 2008). Additionally, these large sessile organisms provide microhabitats for various smaller invertebrate species that may provide food for a variety of reef and pelagic fishes. Several specific live bottom areas in the SAB are designated by the SAFMC as EFH-HAPCs, including Big Rocks, Outer Hurl Rocks, 10 Fathom Ledge, and Gray's Reef.

The distribution and ecology of live bottom areas in the SAB have been studied extensively. These studies include general habitat descriptions (Barans and Henry, 1984), surveys and mapping (USDOI, Bureau of Land Management [BLM], 1981; Van Dolah et al., 1994), fish assemblages (Miller and Richards, 1980; Sedberry and Van Dolah, 1984), fish spawning habitats and behavior (Sedberry et al., 2006), seasonality (Wenner et al., 1983, 1984), and evaluation of damage to sessile biota from trawling (Van Dolah et al., 1987).

Live bottom is distributed across the SAB shelf from shallow, nearshore waters to the shelf edge and upper slope (Van Dolah et al., 1994). The locations of hard bottom and "probable" hard bottom habitat in the region have been mapped and are available on the SAFMC map server at http://ocean.floridamarine.org/efh_coral/ims/viewer.htm. Parker et al. (1983) estimated that 24 percent of the SAB shelf area between 27 and 101 m (89 and 331 ft) is hard bottom habitat. Van Dolah et al. (1994) mapped hard bottom habitats throughout the SAB based on various data sources but did not cite a percentage.

The SAFMC (2009) cautions that the exact size and location of live-bottom habitat in the SAB is not well defined. By its nature, this habitat type is discontinuous and patchy. The BOEM has determined that incomplete or unavailable data or information about the location of sensitive benthic habitat in the AOI is not relevant to reasonably foreseeable significant adverse impacts and is not essential to a reasoned choice among the alternatives, including the No Action alternative (40 CFR 1502.22). The G&G activities that are being evaluated in the proposed action are undertaken precisely to address this condition before bottom-disturbing activity takes place. The G&G activity includes the types of surveys that are able to locate these habitats or allow their presence to be inferred on the basis of geophysical evidence so that this Agency may mitigate by avoiding significant adverse impacts on live bottom habitat.

Nearshore hard bottom habitats are patchily distributed throughout the nearshore area in water depths of 4-25 m (13-82 ft) primarily located between Jacksonville, Florida, and Charleston, South Carolina (Continental Shelf Associates, Inc., 1979; Powles and Barans, 1980) and in Onslow Bay, North Carolina (MacIntyre, 2003). These nearshore hard bottom habitats primarily consist of low relief rock outcrops, often referred to as sponge-coral habitats, colonized by decapods, mollusks, polychaetes, sponges, octocorals, ascidians, echinoderms, bryozoans, and algae (Continental Shelf Associates, Inc., 1979; Wenner et al., 1983). Flat rock outcrops in Onslow Bay, North Carolina, are colonized by two species of zooxanthellate corals, *Solenastrea hyades* and *Siderastrea siderea,* in water depths of 20-40 m (66-131 ft) (MacIntyre, 2003).

Hard bottom outcrops on the SAB shelf range from a fairly level seafloor covered by a thin veneer of sand to high-relief outcrops (Miller and Richards, 1980; Sedberry and Van Dolah, 1984). High-relief ridges occur along the shelf edge (Barans and Henry, 1984; Schobernd and Sedberry, 2009). The shelf edge reef varies from a narrow steep scarp of nearly-vertical relief and faulted blocks of hard substrate located in 50-60 m (164-197 ft) depths off of Florida to a partially buried and broader reef, sometimes consisting of a double-ridge system as one moves progressively northward to South Carolina (Sedberry et al., 2004). A moderate-to-heavy growth of epifauna consisting of a variety of sponges (*Aplysina archeri, Chondrilla* sp., and *Iricina campana*), antipatharian corals (*Stichopathes* sp.), octocorals, algae, bryozoans, and hard corals can be found in this habitat (Barans and Henry, 1984; Sedberry et al., 2004). Dense assemblages of large invertebrates occur off Florida, while larger species are replaced by smaller tunicates, encrusting sponges, and hydrozoans off South Carolina (Sedberry et al., 2004). Polychaetes and crustaceans are common infaunal components on shelf edge reefs (Sedberry et al., 2004).

A conspicuous hard/live bottom feature on the SAB shelf is Gray's Reef NMS offshore Georgia; this site supports up to 150 fish species and is a popular site for recreational fishing and boating (Kendall et al., 2007; Gray's Reef National Marine Sanctuary, 2011). Gray's Reef NMS encompasses approximately 57 km^2 (22 mi^2) and is a submerged hard bottom (limestone) area that, when compared to surrounding areas, contains extensive but scattered rock outcroppings interspersed with sand bottom. The hard bottom ranges from areas with little or no vertical relief to areas of irregular, high-relief rocky ledges (>2 m [6.6 ft]) where invertebrate growth is abundant. Most of the hard bottom areas at Gray's Reef are flat, with a thin veneer of sand overlying sandstone or limestone rock, and are sparsely colonized by sessile invertebrates (Kendall et al., 2007). Further information on Gray's Reef NMS is provided in **Chapter 4.2.11.1**.

At the southern edge of the AOI (offshore east-central Florida), there are unusual nearshore hard bottom formations that consist of shore-parallel rocky outcrops in water depths ranging from 0 to 4 m (0 to 13 ft) (CSA International, Inc., 2009). These outcrops are composed of sediment and mollusk shells that accumulated during the last interglacial period. They support assemblages of algae, invertebrates, and (primarily juvenile) fishes and sea turtles (Gilmore et al., 1981; CSA International, Inc., 2009). These nearshore *Phragmatopoma* "reefs" are created by the tube worm *Phragmatopoma lapidosa* and are designated by the SAFMC as an EFH-HAPC.

Deepwater Corals and Chemosynthetic Communities

Deepwater coral systems can be found in almost all the world's oceans and seas, but only recently have these systems become of the focus of scientific research (Freiwald et al., 2004). They have been cited as important fish habitat and hotspots of biodiversity (Partyka et al., 2007).

Studies of Mid-Atlantic and northeastern U.S. canyons in the 1970's and 1980's showed that canyons supported deepwater coral communities and other sessile benthic fauna. Research in the last decade has documented the occurrence of deepwater coral features in the SAB (Reed and Ross, 2005; Reed et al., 2006; Ross, 2006). Several features including *Lophelia* coral mounds on the Blake Plateau and the *Oculina* Bank offshore east-central Florida have been mapped. These features have been designated as Deepwater Coral HAPCs by the SAFMC (**Chapter 4.2.5**). In addition, one chemosynthetic community site has been reported on the Blake Ridge (Van Dover et al., 2003) and is also designated as a Deepwater Coral HAPC.

Submarine Canyons

Submarine canyons are important features of the MAB shelf edge and slope. There are three major canyons in the AOI (Baltimore, Washington, and Norfolk) and several minor canyons (Warr, Accomac, Hull, Keller, Hatteras, and Pamlico) (**Figure 4-2**). The New England Fishery Management Council (NEFMC) (2007) has designated Baltimore, Washington, and Norfolk Canyons as HAPCs.

Canyons vary in size, shape, and morphological complexity; some have a riverine origin, but most formed via other erosional processes such as slides, debris flows, and turbidity currents (Uchupi, 1968; Malahoff et al., 1980; Tucholke, 1987). Through the National Oceanographic Partnership Program (NOPP), the BOEM is currently co-sponsoring a study of deepwater coral communities associated with Mid-Atlantic canyons (NOPP, 2011).

Exposed hard substrata are present in most MAB canyons, including steep-sided walls, exposed ridges, talus fields, and isolated rocks and boulders (Tucholke, 1987). Hard bottoms have been identified from submersible dives (Hecker et al., 1980). Deepwater corals have been documented in several canyons bisecting the shelf edge and slope in the MAB (Packer et al., 2007). The black coral *Cirrhipathes* sp. was documented at 262 m (860 ft) off Virginia (Packer et al., 2007). Dense localized patches of solitary stony corals and massive colonies of gorgonians are documented in Baltimore and Norfolk Canyons (Packer et al., 2007). Available information indicates that the MAB canyon corals are dominated by octocorals, solitary scleractinia, and anemones (Packer et al., 2007) rather than by the large concentrations of reef-forming stony corals (*Lophelia pertusa*, *Enallopsammia profunda*) that dominate the southeastern U.S. or Gulf of Mexico (Ross and Nizinski, 2007).

Lophelia ***Coral Areas***

Deepwater coral areas have been mapped and studied from North Carolina to the Florida Straits (Reed and Ross, 2005; Reed et al., 2006; Ross, 2006). The SAFMC has designated Deepwater Coral HAPCs encompassing the known areas (**Figure 4-4**). The SAFMC has recently discovered *Lophelia* reefs in 200 m water depth off the coast of Florida and is reviewing potential modifications to existing HAPCs to include the 200-m depth contour; **Figure 4-4** illustrates the designated areas as of January 2012.

North Carolina (Cape Lookout and Cape Fear HAPCs): The northernmost coral banks in the southeastern U.S. occur off of North Carolina and appear to be formed by successive coral growth, collapse, and sediment entrapment (Reed and Ross, 2005; Ross, 2006; Ross and Quattrini, 2007). The tops and sides of these mounds are mostly covered by dense monotypic thickets of *L. pertusa,* but other colonial corals (*Madrepora oculata* and *Enallopsammia* spp.) and various solitary corals also contribute to the overall complexity of the habitat (Reed and Ross, 2005; Ross, 2006). The *Lophelia* reefs off North Carolina also have a well developed and abundant invertebrate fauna visually dominated by the brittle star *Ophiacantha bidenata*, galatheid crabs (especially *Eumunida picta*), and the basket star *Novodinia antillensis* (Ross, 2006).

Stetson Reef/Savannah and East Florida Lithoherms/Miami Terrace: This HAPC encompasses several *Lophelia* sites (Stetson Reef, Savannah, East Florida Lithoherms, and Miami Terrace). Stetson Reef is a very large region of extremely diverse, rugged topography and bottom types on the eastern edge of the Blake Plateau southeast of Charleston, South Carolina, within the region of the Charleston Bump (640-869 m [2,100-2,851 ft]) (Stetson et al., 1962; Reed and Ross, 2005; Reed et al., 2006; Ross, 2006). *L. pertusa*, primarily located on top of the mounds, and *Enallopsammia profunda* are the dominant scleractinian coral species, but sponges, gorgonians, octocorals, and black coral are also present (Reed and Ross, 2005; Reed et al., 2006; Ross and Nizinski, 2007; Ross and Quattrini, 2007). Dominant groups of mobile benthic invertebrates observed in this habitat include squat lobsters *Eumunida picta*, the portunid crabs *Bathynectes longispina* and *Chaceon fenneri* (Geryonidae), echinoderms (*Sylocidaris* spp. and an unidentified white urchin), and dense populations of Ophiuroidea (Reed et al., 2006).

The Savannah site is an area along the western Blake Plateau at the base of the Florida-Hatteras Slope composed of tall (30-60 m [98-197 ft]) mounds covered with thickets of corals, sponges, and gorgonians known as the Savannah Lithoherms (Reed and Ross, 2005; Reed et al., 2006). These high-relief (61-m [200-ft]) *Lophelia* mounds with rock ledges, sharp ridges, and scarps occur at depths of 490-550 m (1,608-1,804 ft) (Reed et al., 2006). While deep corals occur there, they are often scattered in and concentrated on patches of exposed hard bottom (Reed et al., 2006; Ross, 2006). Dominant sessile biota consists of sponges (*Phakellia* spp., *Geodia* spp. Pachastrellidae, and Hexactinellida), Scleractinia (*L. pertusa* and *M. oculata*), stylasterid hydrocorals, octocorals, and black coral (*Antipathes* spp.) (Reed et al., 2006). Motile fauna consist primarily of echinoderms (cidaroid and *Hygrosoma* spp. urchins) and large decapods crustaceans (*C. fenneri* and large Galatheidae) (Reed et al., 2006).

The East Florida Lithoherms/Miami Terrace area consists of a 222-km (138-mi) stretch of nearly 300 coral bioherms and lithoherms from Jacksonville and southern Georgia south to Jupiter, Florida, at depths of 670-866 m (2,198-2,841 ft) (Reed and Ross, 2005; Reed et al., 2006). The northern sites are primarily rocky pinnacles capped with coral debris and live coral thickets, and the features from St. Augustine south are predominantly mud mounds capped with dense, 1-m (3.3-ft) tall thickets of *L. pertusa* and coral rubble (Reed and Ross, 2005; Reed et al., 2006). Dominant sessile fauna consists of *L. pertusa,* Isididae, Antipatharia, small octocorals and gorgonians, and sponges (Reed et al., 2006).

Oculina *Bank*

The *Oculina* Bank is located near the continental shelf edge off east-central Florida, near the southern boundary of the AOI (**Figure 4-4**). It is a 150-km (90-mi) strip of deepwater coral reefs named for the presence of banks, thickets, and rubble zones of a stony coral that occurs there (*Oculina varicosa*) (Reed and Ross, 2005; Ross and Nizinski, 2007). Depths of the *Oculina* Bank range from about 60-120 m (197-394 ft). The substrate is mostly sandy, silty, and muddy sediments with limestone ridges and pinnacles. The pinnacles vary in size and shape but can rapidly rise as much as 18 m (60 ft) or more from the seabed. They are capped on the slopes and crest with living and dead colonies of *Oculina varicosa* (Reed and Ross, 2005; Reed et al., 2005). Invertebrate diversity on *Oculina* reefs is equivalent to many shallow-water tropical reefs with many species of mollusks, decapods, amphipods, echinoderms, and pycnogonids, but larger sessile invertebrates such as massive sponges and gorgonians are not common (Reed, 2002a; Ross and Nizinski, 2007).

The *Oculina* Bank has suffered extensive habitat damage from mobile fishing gear (trawls and dredges) and anchoring activities (Reed et al., 2007). In 1984, the SAFMC recognized the special significance of the *Oculina* Bank habitat and designated it as a Deepwater Coral HAPC. This action closed the area to trawling, dredging, longlining, and trapping. Additional restrictions apply to anchoring and possession of rock shrimp and *Oculina* while in this area. In 1994, the SAFMC created the *Oculina* Experimental Closed Area (OECA), which closed the area to all bottom fishing indefinitely.

Charleston Bump

The Charleston Bump is a feature located on the northern portion of the Blake Plateau (**Figure 4-2**) (Popenoe and Manheim, 2001; Sedberry et al., 2001). It rises abruptly from 700 to 300 m (2,300 to 980 ft) in depth over a distance of about 20 km (12 mi). The topography of the Charleston Bump deflects the Gulf Stream offshore, causing eddies, gyres, and upwelling that concentrate plankton, fishes, and other organisms and leads to localized increases in overall productivity. Areas containing the highest relief are the only documented spawning locations for wreckfish (*Polyprion americanus*) (USDOC, NMFS, 2011d). Hard bottom habitats on the Charleston Bump vary from flat pavements with a thin sand veneer to a high relief ridge and trough feature (300-m [984-ft] relief) with various levels of coral coverage (Popenoe and Manheim, 2001; Sedberry et al., 2001; Ross and Quattrini, 2007). While the seafloor is primarily hard bottom, Wenner and Barans (1990) described both mud and sand habitats on the Charleston Bump, and Popenoe and Manheim (2001) noted extensive ripple areas and large sand-wave fields composed of carbonate sands that accumulated in low areas. The Charleston Bump is designated by the SAFMC as an EFH-HAPC.

Chemosynthetic Communities

Van Dover et al. (2003) documented a soft-sediment, chemosynthetically based ecosystem associated with a methane hydrate site on the Blake Ridge (**Figure 4-5**). The site is located in a water depth of 2,155 m (7,071 ft) at 32°29.623' N, 76°11.467' W. The SAFMC has designated this area as the Blake Ridge Diapir Deepwater Coral HAPC.

At the Blake Ridge diapir site, gas-rich plumes rising up to 320 m (1,050 ft) in the water column have been detected where the fault system intersects the seafloor (Van Dover et al., 2003). The terrain observed from the submersible ranged from flat to rugged, hummocky surfaces draped by fine, readily suspended silt-clay sediments that varied in color from yellow to gray. The prominent morphologic feature on the ridge crest is a circular depression (50–m [164-ft] diameter, 4 m [13 ft] deep) whose floor is covered by beds of densely packed, live and dead large mussels and by fields of vesicomyid clams.

According to Van Dover et al. (2003), the Blake Ridge area is among the most extensively mapped gas hydrate provinces in the world's oceans. In this area, a line of about, 20 salt diapirs begins near the intersection of the Blake Ridge with the Carolina Rise and extends northward on the eastern side of the Carolina Trough. Although only one site has been documented in this area to date, it is likely that others are present.

4.2.1.1.3. Artificial Reefs

In addition to natural hard bottom habitats, artificial reefs provide suitable substrate for the proliferation of live bottom communities (SAFMC, 2009). **Figure 4-6** shows locations of artificial reefs in the AOI. These artificial habitats are an integral part of the coastal and shelf ecosystem in the region that support a diverse and special biological community (Steimle and Zetlin, 2000). Hard surfaces such as metal, wood, and concrete can support algae, barnacles, sponge, tube worms, hydroids, anemones, encrusting bryozoans, oysters, blue mussels, tunicates, and caprellid amphipods (Steimle and Figley, 1996; Steimle and Zetlin, 2000). The communities are often similar to those occurring on natural hard bottoms, though the size, composition, location, and age affect the structure and habitat value of these reefs (Steimle and Zetlin, 2000). In the SAB, the combined area of artificial substrates is much smaller than the total area of natural, exposed hard bottom (SAFMC, 2009), but in the MAB artificial reefs represent a more significant contribution to the available hard substrate (Steimle and Zetlin, 2000).

4.2.1.2. Impacts of Routine Events

This section discusses the potential impacts of routine events associated with Alternative A on benthic communities. As discussed in **Chapter 4.1.1**, through preliminary screening of the activities and affected resources, the IPFs for benthic communities were determined to include (1) active acoustic sound sources (e.g., airgun noise); (2) trash and debris; (3) seafloor disturbance; and (4) drilling discharges (**Table 4-2**). Active acoustic sound sources have the potential to produce impacts to benthic invertebrates present in the AOI via sound exposure. Several types of G&G survey activities (e.g., bottom sampling, deep stratigraphic, and shallow test wells) could disrupt the seafloor and result in localized burial or crushing of benthic communities. In addition, drilling discharges from the installation of stratigraphic and shallow test wells could result in localized smothering and burial of benthic communities. Most G&G survey activities are transient; therefore, the accidental release of trash and debris is not a major impact concern for benthic communities. However, during the installation of stratigraphic and shallow test wells, a drilling rig would be located on station for a longer period of time; therefore, the potential for accidental release of trash and debris could be a concern for benthic communities. These potential IPFs and their associated impacts are discussed below.

4.2.1.2.1. Significance Criteria

Negligible impacts to benthic communities would include impacts to soft bottom benthic organisms that might produce extremely small changes in abundance of individual species but no overall changes in species composition, community structure, and/or ecological functioning of soft bottom communities.

Minor impacts to benthic communities would include those that are detectable but are not severe. Soft bottom benthic communities showing a minor impact are expected to realize limited changes in species composition, community structure, and/or ecological functioning beyond that of normal variability.

Moderate impacts would include measurable, extensive, but not severe damage to sensitive benthic resources, including live bottom and hard bottom (hard/live bottom) communities, deepwater corals, or chemosynthetic communities. For soft bottom communities, moderate impacts would include changes in species composition, community structure, and/or ecological functioning that are either locally or spatially extensive, but not severe. Under the moderate impact category, some impacts may be irreversible.

Major impacts to benthic communities would include localized short-term or long lasting and severe damage or spatially extensive and severe damage to sensitive benthic resources, including live bottom and hard bottom (hard/live bottom) communities, deepwater corals, or chemosynthetic communities. Major impacts would also encompass extensive and severe changes in species composition, community structure, and/or ecological functioning of soft bottom communities, with measurable change in species composition or abundance beyond that of normal variability, or ecological function within a species range.

Benthic communities of greatest concern within the AOI include extensive hard/live bottom areas in the SAB, and deepwater corals and chemosynthetic communities, including the one found on the Blake Ridge. Many of these sensitive benthic communities are found on the continental shelf and shelf edge (hard/live bottom habitats) or within various submarine canyons. No listed endangered or threatened species are found within benthic communities of the AOI, although several endangered species may rely upon the benthos (e.g., hawksbill and Kemp's ridley turtles [**Chapter 4.2.3**], smalltooth sawfish feeding on benthic invertebrates [**Chapter 4.2.6**]).

4.2.1.2.2. Evaluation

Active Acoustic Sound Sources

The proposed action includes extensive 2D and 3D surveys involving several airgun sources, including a large airgun array (5,400 in^3) and a small airgun array (90 in^3). The scenario for the 2012-2020 timeframe includes 617,775 line km of 2D streamer surveys, 2,500 blocks of 3D streamer surveys, and 900 line km of 3D WAZ surveys. These surveys could occur anywhere within the AOI, including over continental shelf, slope, and canyon areas containing benthic communities of interest.

The acoustic energy of airguns is directed towards the seafloor. Sound pressure from the full airgun array would be produced from a moving source, with periodic firing of the airguns every 16 s for 2D and 3D surveys. In the interim between firings, the vessel and its array would cover approximately 37.5 m (123 ft). Consequently, the seafloor and benthic communities beneath an active airgun array would be exposed to a limited number of airgun firings with variable sound pressure intensity (i.e., increasing levels as the array approaches; decreasing levels as the array departs; attenuation of sound pressure with increasing water depth).

The impacts to benthic communities from active acoustic sound sources (e.g., airguns) are not well documented and there are no known systematic studies of the effects of sonar sound on invertebrates. Most marine invertebrates do not have sensory organs that can perceive sound pressure, but many have tactile hairs or sensory organs that are sensitive to disturbances such as those caused by hydroacoustic equipment. Most studies performed have dealt with only one or a few species.

However, there are three potential types of impacts to marine invertebrates from exposure to seismic survey noise (e.g., airguns): pathological, physiological, and behavioral. Pathological effects include lethal or permanent sublethal injury to organisms. Physiological effects include temporary and permanent primary and secondary stress responses (e.g., changes in levels of enzymes and proteins). Behavioral effects include temporary or permanent changes in behavior (e.g., startle and avoidance behavior). Very few specific data are available regarding seismic sound impacts that may cause pathological or physiological effects on invertebrates, and these data are limited to a small number of invertebrate species and life stages. Studies on behavioral responses make up the predominant available data.

Pathological effects resulting in acute injury or death of organisms result from exposure to sound and are suspected to be dependent on two features of the sound source: the received peak pressure and the time required for the pressure to rise and decay. In general, the higher the pressure and the quicker the pressure rises and decays, the higher the potential for acute pathological effects. However, taking into account the peak pressure and rise/decay time of commonly used seismic airguns, the pathological zone for invertebrates is anticipated to be small (i.e., within a few meters of the seismic source). Payne et al. (2007), in their analysis of feeding and serum biochemistry in the lobster *Homarus americanus*, observed a series of sublethal effects; effects were sometimes observed weeks to months after exposure. However, this species is not present in the AOI, and these results may not necessarily apply to other invertebrates. The stress responses to marine invertebrates could potentially affect populations by reducing reproductive capacity and adult abundance.

The limited available data (e.g., Payne et al., 2007) assessing physiological effects or biochemical responses of marine invertebrates to acoustic noise indicates the absence of serious pathological and physiological effects. The BOEM has determined that incomplete or unavailable data or information on the physiological effects or biochemical response of marine invertebrates in the AOI that results from acoustic noise is not relevant to reasonably foreseeable significant adverse impacts or essential to a reasoned choice among the alternatives (40 CFR 1502.22). With the exception of live bottom and chemosynthetic communities (Chapter 4.2.1.1) this Agency does not place any special protections on soft-bottom epi- or infauna prior to the deployment of active acoustic sources or bottom-disturbing activities. Foreknowledge of the presence of soft-bottom epi- or infauna would not initiate any mitigation by avoidance.

Studies that have addressed the behavior of marine invertebrates exposed to sound, including airguns, indicate that most are not seriously affected by far-field sounds, although many do respond to low frequency stimulation (McCauley, 1994). For example, the alarm response (e.g., closing of siphons in sponges) only occurs at very close range to a sound source, including airguns, and is considered negligible (McCauley, 1994). Research summarized by Froglia et al. (1998) indicated that there was no evidence of induced mortality on commercial clams and on macrobenthic invertebrates from the execution of a 3D airgun seismic survey with similar operating frequencies and pressure to those anticipated from G&G activities carried out on a shallow (<10 m [33 ft]) sandy bottom in the central Adriatic Sea. McCauley (1994) also indicated that the eggs and larvae of marine invertebrates may be affected in close proximity to a seismic array; however, the total number of potentially impacted eggs and larvae would be very small when compared to the overall numbers in an area.

Results from applicable studies indicate that there could be an insignificant number of invertebrate species or developmental stages of individual invertebrates potentially injured if they are present in very close proximity to an operating airgun. However, the number of potentially injured individuals would be limited because of the water depths at which most seismic operations would occur (i.e., sound pressure exposure levels sufficient to cause injury would be attenuated with depth) or the nature of the sound source (i.e., narrow beam for depth sounders). Based on results of studys of invertebrate communities following airgun exposure, detectable impacts on hard/live bottom, coral, or chemosynthetic communities are not expected from active acoustic sound sources. Further, only limited impacts to soft bottom benthic organisms are expected to be detectable, and no overall changes in species composition, community structure, and/or ecological functioning of soft bottom communities are expected. Therefore, impacts to benthic communities from active acoustic sound sources would be **negligible**.

Trash and Debris

The oil and gas scenario assumes that up to three COST wells would be drilled in the AOI during the time period of the Programmatic EIS. COST wells are drilled using conventional rotary drilling techniques, the same as routinely used for drilling oil and gas exploration and development wells. Because a drilling rig could be on location for a few weeks to a couple of months, there is the potential for accidental releases of trash and debris. The effects of debris lost overboard from offshore drilling operations in the U.S. Gulf of Mexico have been addressed by several authors (e.g., Shinn et al., 1989, 1993; Dustan et al., 1991; Shinn and Lidz, 1992). These assessments have evaluated operations in variable water depths (i.e., 21-149 m [69-489 ft]), over different substrates, and at variable times following the completion of drilling. Time elapsed is the most important factor determining habitat recovery. The loss of debris during exploratory drilling results in minimal impact to the benthic environment. In areas of extensive soft bottom, the debris has provided artificial hard substrate and produced epifaunal colonization and attracted fishes.

Survey, sampling, and COST and shallow well drilling operations generate trash comprising paper, plastic, wood, glass, and metal. Most trash is associated with galley and offshore food service operations. In addition, over the last several years, companies operating offshore have developed and implemented trash and debris reduction and improved handling practices to reduce the amount of offshore trash that could potentially be lost into the marine environment. These trash management practices include substituting paper and ceramic cups and dishes for those made of styrofoam, recycling offshore trash, and transporting and storing supplies and materials in bulk containers when feasible and have resulted in a reduction of accidental loss of trash and debris.

All survey vessels performing work within U.S. jurisdictional waters are expected to comply with Federal regulations that implement the International Convention for the Prevention of Pollution from Ships (MARPOL) as amended by the 1978 Protocol (MARPOL 73/78). Within MARPOL Annex V, Regulations for the Control of Pollution by Garbage from Ships, as implemented by 33 CFR 151, are requirements designed to protect the marine environment from various types of garbage generated on board vessels. In addition, all authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012). Because operators must comply with Federal regulations and would be expected to follow the guidance provided by BOEM, the amount of trash and debris dumped offshore would be minimal as only accidental loss of trash and debris is anticipated, some of which could sink to the seafloor. Therefore, impacts from trash and debris on benthic communities, as generated by seismic survey vessels, sampling, shallow or COST well drilling, and other G&G related activities, would be **negligible**.

Seafloor Disturbance

There are several G&G activities that could cause seafloor disturbance, including geological and geochemical samplings (e.g., bottom sampling, shallow coring), placement and removal of equipment on the seafloor (e.g., ocean bottom cables, anchors), and the installation of up to three COST wells and up to five shallow test wells. Both soft and hard/live bottom communities would potentially be affected by these G&G activities.

Proposed activities under Alternative A include bottom sampling in all three program areas. These include 50-300 core or grab samples in the oil and gas program; 3,106-9,969 core or grab samples in the renewable energy program; and 1-8 geologic cores, 60-320 grab samples, and 90-600 vibracores in the marine minerals program. Collection of each sample is estimated to disturb an area of approximately 10 m^2, although the actual area of the core or grab extracted may be much smaller. The maximum total area disturbed by core or grab sampling is expected to be about 11 ha (27.7 ac), which represents 0.00001 percent of the AOI.

Sampling for renewable energy projects would occur at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Offshore Delaware, Maryland, and Virginia, the likely sampling locations would be within designated WEAs (USDOI, BOEM, 2011e) (**Chapter 4.2.12.1.4**). North Carolina has identified 506 OCS blocks of interest, but it is likely that sampling would occur within only a small subset of these blocks. Specific AOIs have not been identified for the South Atlantic states. Given the water depths of anticipated bottom sampling for renewable energy projects, deepwater coral systems and the chemosynthetic community would not be at risk. However, shallow water hard/live bottom habitats may fall within the area of proposed bottom sampling activities. As discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information regarding potential sensitive benthic communities (including hard/livebottom ares, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. In addition, as discussed in **Chapter 2.1.2.6.2**, setbacks from sensitive bottom communities similar to those currently required for the Gulf of Mexico would be applied to activities within the AOI. The BOEM would use this information and setbacks to ensure that physical impacts to sensitive benthic communities are avoided; therefore, hard/live bottom habitats would be protected from impacts from proposed bottom sampling activities and impacts would be **negligible**.

Sampling activities for marine minerals would be conducted at specific borrow sites in water depths less than 30 m (98 ft). Much of the marine minerals activity is expected to occur within existing borrow sites offshore the Mid-Atlantic and South Atlantic States (**Chapter 4.2.12.2**); therefore, deepwater coral systems and chemosynthetic communities would not be at risk. As discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information regarding potential sensitive benthic communities prior to approving any G&G activities involving seafloor-disturbing activities in the AOI and would implement setbacks from any sensitive bottom communities (**Chapter 2.1.2.6.2**). The BOEM would use this information to ensure that physical impacts to sensitive benthic communities are avoided. Therefore, hard/live bottom habitats would be protected from impacts from proposed bottom sampling activities and the impacts would be **negligible**.

Sampling for oil and gas exploration would be conducted at specific lease blocks where structures (e.g., drilling rigs, platforms, floating production structures, or pipelines) may be installed. The blocks could be anywhere within the Mid- or South Atlantic Planning Areas and cannot be predicted as there are currently no active oil and gas leases in the Atlantic OCS. However, requirements for mapping and avoidance, as well as pre-deployment photographic surveys of areas where bottom-founded instrumentation and appurtenances are to be deployed, would be required for all surveys. In addition, as discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information regarding potential sensitive benthic communities (including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. In addition, as discussed in **Chapter 2.1.2.6.2**, setbacks from sensitive bottom communities similar to those currently required for the Gulf of Mexico would be applied to activities within the AOI. The BOEM would use this information and these setbacks to ensure that physical impacts to sensitive benthic communities are avoided; deepwater coral systems, the chemosynthetic community at Blake Ridge, and hard/live bottom habitats within the AOI would be protected from proposed bottom sampling activities. Therefore, potential impacts to hard/live bottom, chemosynthetic communities, and deepwater coral systems from seafloor sampling under this alternative would be **negligible**.

Bottom sampling activities would primarily take place in soft bottom areas as most bottom sampling equipment cannot penetrate hard bottom substrate. The direct environmental consequences of piston/gravity cores are approximately 8-cm (3-in) diameter holes in the seafloor, and depending upon the firmness of the seafloor, the core or probe weight stand (30-45 cm [12-18 in] diameter footprint) may also impact the seafloor and crush seafloor animals if the core penetrates to the maximum depth. Grab sampling is performed to identify the benthic fauna and penetrates from a few inches to a few feet below the seafloor and typically involves 30-40 grabs within an area of interest. Piezocone penetrometer testing is performed to determine the sediment engineering properties and uses a probe typically 10-1,500 mm^2 in diameter that is mounted on a frame and lowered to the seafloor. A vibracore survey generally uses a 7-cm (2.8-in) diameter core barrel mounted on a 2- to 4-m^2 platform and penetrates sediments between 10-15 m (33-50 ft) below the seafloor and would obtain 15-25 cores in a 1 mi^2 (259 ha) area of interest. All combined, the total area of seafloor disturbed by bottom sampling and shallow coring activities is estimated to be a very small area (0.000003 percent of the AOI) when compared to the overall seafloor area included in the AOI. Although several thousand cores may be collected under the renewable energy program, sampling in soft bottom areas would produce only localized impacts to soft bottom benthos. Sampling under the oil and gas programs and marine minerals would be very limited, resulting in localized impacts to soft bottom benthos. Potential impacts to soft bottom benthic communities from seafloor sampling under this alternative would not be detectable and therefore would be **negligible**.

The installation of COST wells and shallow test wells has the potential to impact benthic resources. For this impact analysis, the area of seafloor disturbance is assumed to average about 2 ha (5 ac) per well. If all of the COST wells and shallow test wells in the proposed action scenario were drilled, the total seafloor disturbance would be about 16 ha (40 ac), or about 0.00002 percent of the AOI. Requirements for mapping and avoidance, as well as pre-deployment photographic surveys of areas where bottom-founded appurtenances are to be deployed, would be required. In addition, as discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information regarding potential sensitive benthic communities (including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. In addition, as discussed in **Chapter 2.1.2.6.2**, setbacks from sensitive bottom communities similar to those currently required for the Gulf of Mexico would be applied to activities within the AOI. These setbacks would include a 500-ft (152-m) setback for bottom-disturbing activities near an NMS. The BOEM would use this information to ensure that physical impacts to sensitive benthic communities are avoided, and therefore the deepwater coral systems, the Blake Ridge chemosynthetic community, and hard/live bottom habitats would be protected from proposed bottom sampling activities. Potential impacts to sensitive benthic communities under this alternative would be **negligible**.

Up to 16 ha (40 ac) of soft bottom communities could be impacted from the installation of COST wells and shallow test wells. Although this is only 0.00002 percent of the AOI, each well could impact up to 2 ha (5 ac) of contiguous soft bottom community, which could result in changes in species composition, community structure, and/or ecological functioning of soft bottom communities beyond that of normal variability, or ecological function within a species range. Therefore, the installation of COST wells and shallow test wells would result in **minor** impacts to soft bottom communities.

The BOEM would implement requirements to ensure protection of sensitive benthic resources, including setbacks from sensitive bottom communities similar to those currently required for the Gulf of Mexico for activities within the AOI. Given that BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures (including requiring site-specific information), sensitive benthic resources would be avoided. Therefore, impacts to sensitive benthic resources would be **negligible**.

There is also the potential for the installation of 7-38 bottom-founded monitoring buoys as part of the renewable energy program. Similarly, the placement and removal of bottom cables and anchors would produce localized sediment disturbance to soft bottom communities. Anchors for either boat-shaped or discus-shaped buoys are expected to produce a footprint of about 0.55 m^2 (6 ft^2) and an anchor sweep of about 3.4 ha (8.5 ac) (USDOI, BOEM, 2011e). Total footprint area would range from 3.8 to 20.9 m^2 (42 to 228 ft^2) for the anchors, while the sweep area would range from 23.8 to 129.2 ha (59.5 to 323 ac). If all of the monitoring buoys in the proposed action scenario were installed, the total seafloor disturbance would be about 129 ha (319 ac), or about 0.0002 percent of the AOI and 0.047 percent of the identified WEAs. The impact from anchoring and anchor sweep would be spread out over the identified WEAs, as typically only one to two buoys are installed per lease, which averages approximately 10 lease blocks. Each individual area of impact from a buoy anchor would be small (approximately 0.55 m^2 [6 ft^2] each), and the anchor sweep area (3.4 ha [8.5 ac] per buoy) comprises 0.015 percent of an average lease area. In addition, the anchor sweep impacts are caused by the anchor chains or lines sweeping the soft bottom substrate; sediments are not removed, and only the surficial sediments and associated soft bottom community are impacted, not the soft bottom community present beneath the surficial sediments. No overall changes in species composition, community structure, and/or ecological functioning of soft bottom communities are expected (Grannis, 2005). Therefore, potential impacts to soft bottom communities under this alternative would be **negligible**.

Considering all seafloor-disturbing G&G activities, impacts to sensitive benthic resources (i.e., hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) are expected to be **negligible**. Impacts to soft bottom benthic communities would range from **negligible** to **minor**.

Drilling Discharges

The oil and gas scenario assumes that up to three COST wells would be drilled in the AOI during the time period of the Programmatic EIS. The COST wells are drilled using conventional rotary drilling techniques, the same as routinely used for drilling oil and gas exploration and development wells. During the process, drilling fluid and cuttings would be discharged, disperse in the water column, and accumulate on the seafloor (NRC, 1983; Neff, 1987; Neff et al., 2000). Impacts to the benthic environment would include changes in sediment grain size and benthic community effects because of burial and smothering, anoxia, and sediment toxicity.

It is likely that both WBFs and SBFs would be used during drilling. WBFs are routinely discharged along with cuttings, while SBFs are recycled and only cuttings (along with small amounts of adhering SBF) are discharged. Assuming an average of 2,000 bbl of cuttings and 8,350 bbl of drilling fluid discharged per well, the total volume for one to three COST wells would range from 2,000 to 6,000 bbl of cuttings and 8,350 to 25,050 bbl of drilling fluid.

During the initial stage of drilling, a large-diameter surface hole is jetted a few hundred meters into the seafloor. At this stage, the cuttings and seawater used as drilling fluid would be discharged onto the seafloor. Excess cement slurry would also be released at the seafloor during casing installation for this portion of the drilling operations. Cement slurry components typically include cement mix and some of the same chemicals used in water-based drilling muds (Boehm et al., 2001). The main impacts would be burial and smothering of benthic organisms within several meters to tens of meters around the wellbore. Soft bottom sediments disturbed by cuttings, drilling fluids, and cement slurry would eventually be recolonized through larval settlement and migration from adjacent areas.

After the marine riser is set, allowing the return of all drilling fluid and cuttings to the drilling rig for processing, all discharges would occur from the drilling rig. Discharges of WBF and SBF along with cuttings from the rig may affect benthic communities, primarily within several hundred meters of each wellsite. The fate and effects of WBF discharges have been reviewed by NRC (1983) and Neff (1987); impacts of SBF cuttings discharges have been synthesized by Neff et al. (2000). In general, cuttings with adhering SBFs tend to clump together and form cuttings piles close to the drillsite. Areas of SBF cuttings deposition may develop elevated organic carbon concentrations and anoxic conditions (Continental Shelf Associates, Inc., 2006). Where SBF cuttings have been discharged from a series of wells, and cuttings tend to accumulate and concentrations have exceeded approximately 1,000 mg/kg, benthic infaunal communities have been adversely affected by both the toxicity of the base fluid and organic enrichment (with resulting anoxia) (Neff et al., 2000). In these instances, infaunal numbers may increase and diversity may decrease as opportunistic species that tolerate low oxygen and high hydrogen sulfide (H_2S) predominate (Continental Shelf Associates, Inc., 2006). The localized and limited drilling activity proposed under the G&G activity scenario strongly suggests that sizable cuttings accumulations and associated impacts would not occur.

Geophysically detectable drilling fluid and cuttings deposits may persist for 5 years or more around wellsites, particularly in areas where multiple wells have been drilled (Continental Shelf Associates, Inc., 2006). Recovery of affected benthic communities must rely on either recruitment of new fauna from planktonic larvae or immigration into disturbed areas from adjacent undisturbed sediments. Recovery typically begins as soon as a discharge ceases (Neff, 2005). The precise timing of recovery is dependent upon a series of factors – the nature of the benthic community (e.g., species composition, reproductive triggers, larval mode), the physical characteristics of the benthic environment, and its chemical characteristics (Neff, 2005). Neff et al. (2000) indicate that within 3-5 years of the cessation of SBF cuttings discharges, a complete recovery of the benthic community is possible; such recovery requires that the concentrations of SBF components (e.g., organics) in the sediments decrease to sufficiently low levels and that sediment oxygen concentrations increase to levels that can support benthic infauna.

The areal extent of impacts from drilling discharges during the proposed action would be small. Assuming a typical effect radius of 500 m (1,640 ft), the affected area around each wellsite would represent about 3 percent of the seafloor within an OCS lease block. Soft bottom communities are ubiquitous regionally, and the impact on soft bottom communities would be **negligible** on a regional basis. Given the BOEM requirement for site-specific information regarding potential sensitive benthic communities and the application of setbacks from these resources, impacts from drilling discharges on hard/live bottom areas, deepwater coral communities, and chemosynthetic communities of the AOI are expected to be **negligible**.

4.2.1.3. Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. Spills occurring at the ocean surface would disperse and weather. Volatile components of the fuel would evaporate. Fuel and diesel used for operation of survey vessels is light and would float on the ocean surface. There is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink. Particulate matter contaminated with diesel fuel would eventually reach the benthos either within or outside the AOI, depending upon spill location, water depth, ambient currents, and sinking rate. However, given the relatively small size of the spill and the loss of most spilled fuel through evaporation and dispersion, a small diesel fuel spill at the surface would be expected to have no effect on benthic communities. An accidental diesel fuel spill would be expected to result in **negligible** impacts to benthic communities.

4.2.1.4. Cumulative Impacts

The cumulative impacts scenario is discussed in detail in **Chapter 3.6** and includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The potential IPFs for these cumulative activities that have the potential to affect benthic communities include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, and other active sound sources; (2) seafloor disturbance and turbidity; (3) discharges of drilling fluid, drill cuttings, and other effluents from drilling rigs; (4) presence of structures; (5) accidental releases of trash and marine debris; (6) changes in coastal habitats because of interactive effects of climate change along with impacts on calcification in plankton, corals, crustaceans, and other marine organisms because of ocean acidification; and (7) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Among the IPFs identified above for the cumulative impacts scenario, only five sources of potential impact to benthic communities have been identified in association with proposed G&G activities:

- noise sources (i.e., active acoustic sound sources);
- trash and debris;
- seafloor disturbances;
- drilling discharges; and
- accidental fuel spills.

Impact analyses presented in **Chapters 4.2.1.2** and **4.2.1.3** determined that activities projected to occur under Alternative A would result in **negligible** or **minor** impacts to benthic communities depending on the IPF. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Underwater Noise Including Active Acoustic Sound Sources

Long-term noise data for the AOI have not been published. For the purposes of this analysis, and in consideration of the documented increases in marine transportation volumes along the U.S. Atlantic coast, it is assumed that underwater noise from vessel traffic and other anthropogenic sources within the AOI is increasing. Most ambient noise is broadband and encompasses virtually the entire frequency spectrum, with vessel traffic recognized as a major contributor to ocean noise in the low-frequency bands between 5 and 500 Hz. Modeled sound source measurements of 195 dB re 1 μPa^2/Hz at 1 m at 30 Hz have been documented for fast moving, large supertankers, with smaller fishing vessels characteristically producing sound source levels down to 140 dB re 1 μPa^2/Hz or less at 1 m (NRC, 2003). Naturally occurring noise is typically generated from biological or physical processes (e.g., spray and bubbles from breaking waves) and is also a major contributor to ambient noise in the 500-100,000-Hz range. Wind typically produces noise associated with wave action and spray and is typically between ~100 Hz and 30 kHz, while wave generated noise typically is in the 1-20 Hz range. The associated sound levels for 5 kn wind noise would differ with water depth but would typically be between 51 and 56 dB re 1 μPa^2/Hz (Simmonds et al., 2004).

Underwater noise from proposed G&G activities (i.e., active acoustic sound sources) has been shown to cause a negligible impact to benthic communities (**Chapter 4.2.1.2**). Active acoustic sound sources, including both airguns and electromechanical sources, and vessel and equipment noise from the proposed action would contribute to ambient noise levels within the AOI. Noise from G&G operations would be survey- or activity-based, occurring on a transient and intermittent basis over the period of interest. Because the type of underwater noise associated with the proposed action would be similar to the existing underwater noise under the cumulative scenario (e.g., vessel and equipment noise, sonars, active sound sources), there would be minor increases in ambient noise levels within specific portions of the AOI during G&G operations. Because there are no overt noise impacts evident from the cumulative activities scenario, and there is little evidence that benthic communities are impacted by sound sources, the impacts associated with the proposed action would result in a minor incremental increase in ambient noise levels under the cumulative scenario.

Trash and Debris

The accidental release of trash and debris can potentially occur from any of the nine activities identified in the cumulative impacts scenario. Vessel operators are expected to comply with Federal laws and regulations, which implement the requirements of MARPOL 73/78, including Annex V. In addition, companies operating offshore have developed and implemented trash and debris reduction and improved handling practices over the last several years to reduce the amount of offshore trash that could potentially be lost to the marine environment. With compliance with existing Federal laws and regulations, the amount of trash and debris intentionally dumped offshore would be very limited, with only accidental loss of trash and debris expected. Some of the trash and debris accidentally lost could sink to the seafloor and have the potential to become entangled in or smother sessile benthic organisms. There is a remote possibility that the lost trash and debris would to sink to an area of the seafloor that included benthic resources; therefore, the impacts from cumulative activities within the AOI are expected to be negligible.

G&G vessel operations would similarly operate under Federal regulations, which implement MARPOL and Annex V dumping restrictions. In addition, BOEM would develop guidance similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012), which would include guidance for marine debris awareness (**Appendix C**). Only negligible impacts to benthic communities associated with the accidental release of trash and debris are expected under the cumulative activities scenario; the proposed action would potentially add a very small amount of accidentally released trash and debris. Therefore, cumulative impacts associated with the proposed action are expected to be a negligible incremental increase in benthic community impacts.

Seafloor Disturbance

The BOEM would require site-specific information regarding benthic communities prior to approving most of the cumulative scenario activities (e.g., oil and gas development, renewable energy development, marine minerals use, geosequestration), while other agencies have responsibility over approval and licensing/permitting of LNG import terminals and dredged material disposal. All of these activities involve seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. For those activities under their purview, BOEM would use this information and established setbacks from sensitive benthic communities to ensure that physical impacts to benthic communities are avoided; therefore, sensitive benthic communities would be protected from impacts associated with these activities. Consequently, cumulative impacts from oil and gas development, renewable energy development, marine minerals use, geosequestration, LNG import terminals, and dredged material disposal and their associated impacts are expected to be negligible. However, BOEM requirements do not protect the resources from activities outside of BOEM jurisdiction (i.e., commercial and recreational fishing, dredged material disposal).

The areal extent of benthic communities that would potentially be affected by G&G activities under the proposed action is extremely small when compared to the total area of the AOI (0.00025%). Sensitive benthic communities are already protected via existing mitigation measures including the implementation of setbacks from these resources for bottom-disturbing activities. In addition, MPAs and NMSs (discussed in detail in **Chapter 4.2.11**) provide protection from impacts to benthic communities from commercial fishing operations. Alternative A would not contribute significantly to the impacts to benthic communities already caused by commercial and recreational fishing activities, the latter of which have been estimated to affect approximately 53 percent of the world's continental shelf (Watling and Norse, 1998). Therefore, the impacts associated with Alternative A would result in a negligible incremental increase in seafloor disturbance under the cumulative scenario.

Drilling Discharges

Cumulative scenario activities that would include discharges of drilling fluids, drill cuttings, and other effluents from drilling rigs (e.g., oil and gas development, geosequestration) would require the submittal and agency review of site-specific information regarding benthic communities prior to activity approval. In addition, setbacks from sensitive benthic communities would be implemented for all bottom-disturbing activities. Information regarding water intake and discharges related to drilling operations would be required to be submitted to the USEPA to obtain an NPDES permit prior to beginning drilling operations.

These measures would ensure that physical impacts to sensitive benthic communities are avoided and that benthic resources are protected from impacts from cumulative scenario activities.

Drilling activities associated with the cumulative scenario would occur within soft bottom communities. Soft bottom communities are ubiquitous regionally, and the impact on soft bottom communities would be anticipated to be negligible on a regional basis. Therefore, impacts to all benthic communities from discharges of drilling fluid, drill cuttings, and other effluents from drilling rigs under the cumulative scenario are expected to be negligible.

Drilling discharges from proposed G&G activities (i.e., COST and shallow test wells) have been shown to cause a negligible impact to benthic communities (**Chapter 4.2.1.2**). Because impacts to benthic communities associated with drilling discharges from the cumulative activities scenario are expected to be negligible, the proposed action would add an extremely small area of seafloor disturbance to the cumulative area affected. Therefore, the impacts associated with Alternative A would result in a negligible incremental increase in seafloor impacts associated with drilling discharges.

Accidental Fuel Spills

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to benthic communities would depend on the location and size of the spill. However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prior to the drilling of any wells. In addition, a project-specific EA would require an analysis of site-specific information regarding benthic communities and mitigation measures taken to minimize impacts from drilling activities and potential accidental crude oil spills. With the required mitigation measures in place and with oversight of these activities by the BSEE, as included in CFR Title 30 Chapter II, Part 250, an accidental crude oil spill from an exploratory well is not anticipated; however, a spill still could occur. However, with these mitigation measures in place, the impacts to benthic communities from exploratory drilling operations would be negligible.

A significant amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations, research vessels, and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The impacts of accidental fuel spills arising from a vessel collision under the cumulative scenario are expected to range from negligible to minor.

The likelihood of a fuel spill during survey operations or other G&G activities is considered to be remote and the associated impacts to the benthos are expected to be negligible (**Chapter 4.2.1.3**), even when considering that a small proportion of the heavier fuel components of a spill may adhere to particulate matter in the upper portion of the water column and sink to the seafloor. It is also reasonable that the potential for fuel spills from vessels involved in the cumulative activities scenario would be considerably higher than that expected under the proposed action because of the magnitude of vessel activity in the AOI and the high number of vessel transits. Therefore, the incremental increase in potential for accidental fuel spills arising from vessel collision during G&G activities would be considered extremely small. The impacts associated with the proposed action and the low probability of a G&G activity-related fuel spill would result in a minor incremental increase in benthic community impacts under the cumulative scenario.

4.2.2. Marine Mammals

4.2.2.1. Description of the Affected Environment

In the western North Atlantic Ocean, including the waters of the AOI, there are 38 species of marine mammals representing three taxonomic orders: Cetacea (baleen whales, toothed whales, dolphins, and porpoises), Sirenia (manatee), and Carnivora (true seals) (Waring et al., 2010). A listing of species, including current status, occurrence, and auditory range, is provided in **Table 4-4**.

All marine mammals are protected under the MMPA of 1972. Some species are further protected under the ESA of 1973. Under the ESA, a species is considered endangered if it is "in danger of extinction throughout all or a significant portion of its range." A species is considered threatened if it "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

The MMPA prohibits, with certain exceptions, the 'take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. Some marine mammal species or specific stocks (defined as a group of nonspecific individuals that are managed separately [Wang, 2002]) may be designated as *strategic* under the MMPA, which requires the jurisdictional agency (NMFS or FWS) to impose additional protection measures. A stock is considered strategic if

- direct human-caused mortality exceeds its Potential Biological Removal (PBR) level (defined as the maximum number of animals, not including natural mortality, that can be removed from the stock while allowing the stock to reach or maintain its optimum sustainable population level);
- it is listed under the ESA;
- it is declining and likely to be listed under the ESA; or
- it is designated as depleted under the MMPA.

The following chapters provide a brief description of each marine mammal species or species group (where appropriate), including current status, distribution, and behavior. Species that are listed as endangered or threatened under the ESA are discussed within a separate chapter from nonlisted species.

4.2.2.1.1. Threatened and Endangered Species

Seven marine mammal species that occur in the AOI are federally listed as endangered species (USDOC, NMFS, 2011e). These include five baleen whales (North Atlantic right whale, blue whale, fin whale, sei whale, and humpback whale), one toothed whale (sperm whale), and the Florida subspecies of the West Indian manatee (Waring et al., 2010; USDOC, NMFS, 2011e).

North Atlantic Right Whale (*Eubalaena glacialis*)

The North Atlantic right whale is the only member of the baleen whale family Balaenidae found in north Atlantic waters. It is medium in size when compared to other baleen whale species, with adult size ranging from 14 to 17 m (46-56 ft) (USDOC, NMFS, 2005).

Status

The North Atlantic right whale is considered one of the most critically endangered whales (Jefferson et al., 2008). It is listed as endangered under the ESA, and the western Atlantic stock is classified as strategic because the average annual human-related mortality and serious injury exceeds PBR (Waring et al., 2010). Today, the minimum population size is approximately 361 individuals (Waring et al., 2010). Continued threats to the North Atlantic right whale population include commercial fishing interactions, vessel strikes, underwater noise, habitat degradation, and predators (USDOC, NMFS, 2005; Waring et al., 2010).

In 1994, three critical habitats for the North Atlantic right whale were designated by NMFS along the eastern coast of the U.S. (*Federal Register*, 1994). These include Cape Cod Bay/Massachusetts Bay, Great South Channel, and selected areas off the southeastern U.S. (**Figure 4-7**). In 2009, NMFS received a petition to expand the critical habitat, and the agency is continuing its ongoing rulemaking process. NMFS initially had the expectation that a proposed critical habitat rule would be submitted for publication in the *Federal Register* in the second half of 2011 (*Federal Register*, 2010f); as of January 2012, expansion of the North Atlantic right whale critical habitat remains under review.

In addition to the critical habitat, SMAs for reducing ship strikes of right whales have been designated in the U.S. and Canada (**Figure 4-7**). All vessels greater than 19.8 m (65 ft) in overall length must operate at speeds of 10 kn or less within these areas during specific time periods (**Table 4-5**).

Distribution

The North Atlantic right whale is a migratory species that is usually found within waters of the western North Atlantic between 20° and 60° N latitude. Generally, individual right whales undergo seasonal coastal migrations from summer feeding grounds off eastern Canada and the U.S. northeast coast to winter calving grounds off the U.S. southeast coast (**Figure 4-8**).

Recent sightings data also report a few North Atlantic right whales as far as Newfoundland, the Labrador Basin, and southeast of Greenland (Waring et al., 2010). Research results suggest the existence of six major congregation areas for North Atlantic right whales: the coastal waters of the southeastern U.S.; 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., 2010). Movements of individuals within and between these congregation areas are extensive, and data show distant excursions, including into deep water off the continental shelf (Mate et al., 1997; Baumgartner and Mate, 2005). The groupings of individual right whales within these congregation areas is likely to be a function of acceptable prey distribution, since right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx, 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitats (Kenney et al., 1986, 1995).

Behavior

North Atlantic right whales are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs. Larger groups may be observed in feeding or breeding areas (Jefferson et al., 2008). Right whales feed on zooplankton (e.g., calanoid copepods) generally by skimming through concentrated patches of prey at or below the sea surface. The typical reproductive cycle in mature female right whales is 3 years between births. The age at sexual maturity is estimated at 9 or 10, and gestation length is about 12 months; calves nurse for almost 12 months.

Auditory Range

Right whale vocalizations are primarily low-frequency (below 500 Hz), with some sounds up to 1,500-2,000 Hz (Kenney, 2002). Right whales are classified within the low-frequency cetacean functional marine mammal hearing group (7 Hz-22 kHz) (Southall et al., 2007).

Blue Whale (*Balaenoptera musculus*)

The blue whale is the largest cetacean, although its size range overlaps with that of fin and sei whales. The northern hemisphere subspecies (*B.m. musculus*) is known to occur within the AOI. Most adults of this subspecies are 23-27 m (75-90 ft) in length.

Status

The northern hemisphere subspecies of the blue whale is listed as an endangered species. There are insufficient data to determine the status of this stock and population within the U.S. Currently, the number of blue whales in the North Atlantic Ocean is estimated at around 1,000 individuals (International Whaling Commission [IWC], 2011a). This stock of the blue whale is listed as strategic because the species is listed as endangered under the ESA (Waring et al., 2010). There is no designated critical habitat for this species within the AOI.

Distribution

The blue whale is considered by NMFS as an occasional visitor in U.S. Atlantic EEZ waters, which may represent the current southern limit of its feeding range (Waring et al., 2010). In the western North Atlantic Ocean, the blue whale's range extends from the Arctic to Cape Cod, Massachusetts, although it is frequently sighted off eastern Canada (e.g., Newfoundland) (Waring et al., 2010). Yochem and Leatherwood (1985) suggested an occurrence of this species south to Florida and the Gulf of Mexico. In general, the blue whale's range and seasonal distribution is governed by the availability of prey (USDOC, NMFS, 1998a).

Behavior

Blue whales are usually observed alone or in pairs (Jefferson et al., 2008). Scattered aggregations may develop on prime feeding grounds. Their diet consists primarily of krill (euphausiids), and their depth distribution is usually associated with feeding (Sears, 2002). Blue whales reach sexual maturity at 5-15 years, and mating in the northern hemisphere occurs in late fall and throughout the winter, although no specific breeding ground has been discovered (Sears, 2002).

Auditory Range

Most blue whale vocalizations are low frequency, ranging from 17 to 20 Hz. Sound intensity of blue whale vocalizations are the loudest of any animal (188 dB) (Sears, 2002). It is classified within the low-frequency cetacean functional marine mammal hearing group (7 Hz-22 kHz) (Southall et al., 2007).

Fin Whale (*Balaenoptera physalus*)

The fin whale is the second largest species of whale (USDOC, NMFS, 2010a). Some authors recognize separate northern and southern hemisphere subspecies, although this designation is not widely accepted (Jefferson et al., 2008). Adult fin whales in the northern hemisphere may reach a length of approximately 24 m (80 ft).

Status

Fin whales off the eastern U.S. and eastern Canada are believed to constitute a single stock (Western North Atlantic stock) (Waring et al., 2010). The species is currently listed as endangered under the ESA. The Western North Atlantic stock is classified as strategic because of its listing under the ESA. There is no designated critical habitat for the fin whale (USDOC, NMFS, 2010a).

Distribution

The fin whale is found primarily within temperate and polar latitudes (**Figure 4-9**). Seasonal migration patterns within its range remain undetermined (2010). The fin whale is the most common whale sighted in northwest Atlantic waters from Cape Hatteras, North Carolina, to Maine during surveys conducted from 1978 through 1982, with fin whales representing 46 percent of all sightings (Waring et al., 2010; USDOC, NMFS, 2010a).

Behavior

Fin whales are observed singly or in groups of two to seven individuals. In the North Atlantic, fin whales are often seen in large mixed-species feeding aggregations including humpback whales, minke whales, and Atlantic white-sided dolphins (Jefferson et al., 2008). Fin whales feed on zooplankton (euphausiids and copepods); small schooling fishes such as capelin, herring, mackerel, sandlance, and blue whiting; and squids (Jefferson et al., 2008). USDOC, NMFS (2010a) reports summer feeding grounds mostly between 41°20' and 51°00' N latitude (shore to 1,829 m [6,000 ft]). Fin whale mating and births occur in the winter (November-March), with reproductive activity peaking in December and January.

Auditory Range

Fin whale vocalizations are low frequency, generally below 70 Hz but ranging up to 750 Hz (Clark et al., 2002; Department of the Navy, 2007). Estimated source levels are as high as 180-190 dB re 1 μPa @ 1 m (Patterson and Hamilton, 1964; Watkins et al., 1987; Thompson et al., 1992; McDonald et al., 1995; Charif et al., 2002; Croll et al., 2002). Fin whales are classified within the low-frequency cetacean functional marine mammal hearing group (7 Hz-22 kHz) (Southall et al., 2007).

Humpback Whale (*Megaptera novaeangliae*)

The humpback whale is medium in size, and adults range from 15 to 18 m (50 to 60 ft). The body is more robust than other rorqual whales (*Balaenoptera* spp.), and humpbacks are distinguished from all other large whale species by their long flippers, which are approximately one-third the length of the body.

Status

Distinct geographic forms of humpback whales are not widely recognized, though genetic evidence suggests there are several subspecies (e.g., North Atlantic, Southern Hemisphere, and North Pacific subspecies) (USDOC, NMFS, 1991; Waring et al., 2010). In 2000, NMFS Atlantic Stock Assessment Team reclassified the western North Atlantic humpback whale as a separate and discrete management stock (Gulf of Maine stock) (Waring et al., 2010).

The humpback whale is currently listed as endangered under the ESA. The Gulf of Maine stock is classified as strategic because of its listing under the ESA. The NMFS has recently estimated the humpback population in the western North Atlantic as 7,698 individuals (4,894 males and 2,804 females) (Waring et al., 2010). No critical habitat has been designated for the humpback whale.

Distribution

The humpback whale is a cosmopolitan species that may be found from the equator to subpolar latitudes, less commonly in the Arctic. Some individuals are found year-around at certain locations (e.g., Gulf of Maine), while others display highly migratory patterns. Humpback whales are generally found within continental shelf areas and oceanic islands. Most humpback whales in the western North Atlantic Ocean migrate to the West Indies to mate (e.g., Dominican Republic); however, some whales do not make the annual winter migration (Waring et al., 2010). Sightings data show that humpback whales traverse through coastal waters of the southeastern U.S., including the AOI (Waring et al., 2010) (**Figure 4-10**).

Swingle et al. (1993) and Barco et al. (2002) reported humpback sightings off Delaware Bay and Chesapeake Bay during the winter, which suggests the Mid-Atlantic region may also serve as wintering grounds for some Atlantic humpback whales. This region has also been suggested as important area for juvenile humpbacks (Wiley et al., 1995).

Behavior

Humpback whales feed on krill and small schooling fishes (Jefferson et al., 2008). In New England waters, humpback whales prey upon herring, sand lance, and euphausiids (Paquet et al., 1997). Humpback whales use unique behaviors such as bubble nets, bubble clouds, and flickering their flukes and flippers, to herd and capture prey (USDOC, NMFS, 1991). They are also one of the few species of baleen whales to utilize cooperative feeding techniques. The age at sexual maturity is between 4 and 6 years (USDOC, NMFS, 1991), and gestation length is 11 months; calves are nursed for 6-10 months.

Auditory Range

Humpback vocalizations are complex, ranging from low-frequency sounds from 40 to 5,000 Hz to higher frequency sounds from 2 to 14 kHz (Winn and Reichley, 1985). Humpback whales are classified within the low-frequency cetacean functional marine mammal hearing group (7 Hz-22 kHz) (Southall et al., 2007).

Sei Whale (*Balaenoptera borealis*)

The sei whale is the third largest whale (following the blue and fin whales), with adult length ranging from 16 to 20 m (52 to 66 ft). It is very similar in appearance to fin and Bryde's whales.

Status

There are two classified sei whale stocks within the Atlantic: the Nova Scotia stock and the Labrador Sea stock. The range of the Nova Scotia stock includes the continental shelf waters of the northeastern U.S. and extends northeastward to south of Newfoundland.

The sei whale is currently listed as endangered under the ESA. The Nova Scotia stock is classified as strategic because of its listing under the ESA. There is no current population estimate of sei whales in the western North Atlantic Ocean, though survey data suggest that the Nova Scotia stock size is around 386 individuals (Waring et al., 2010). There is no designated critical habitat for this species.

Distribution

The sei whale is a cosmopolitan and highly migratory species that is found from temperature to subpolar regions, but it appears to be more restricted to mid-latitude temperate zones than other rorquals (*Balaenoptera* sp. and *Megaptera novaeangliae*) (Reeves et al., 2002; Shirihai and Jarrett, 2006; Jefferson et al., 2008). Sei whales are commonly sighted off Nova Scotia, the Gulf of Maine, and Georges Bank in spring and summer (Waring et al., 2010). Data suggest a major portion of the Nova Scotia stock is centered in waters north of the AOI, at least during the feeding season (Waring et al., 2010). Within this range, the sei whale is often found near the continental shelf edge region. This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters (**Figure 4-11**).

Behavior

Sei whales are largely planktivorous, feeding primarily on euphausiids and copepods, but they will feed on small schooling fishes as well (Jefferson et al., 2008; Waring et al., 2010). Similar to right whales, they generally skim copepods, though they will lunge and gulp on occasion like other rorqual species. Groups of two to five individuals are most commonly seen. Calving occurs in midwinter within the low latitude portions of the species' range (Jefferson et al., 2008).

Auditory Range

Recorded vocalizations of sei whales range from 432 Hz to 3.5 kHz (Thompson et al., 1979; Knowlton et al., 1991; McDonald et al., 2005). Sei whales are classified within the low-frequency cetacean functional marine mammal hearing group (7 Hz-22 kHz) (Southall et al., 2007).

Sperm Whale (*Physeter macrocephalus*)

The sperm whale is the largest toothed cetacean, with adult length ranging from 12 to 18 m (40 to 60 ft). They are also the most sexually dimorphic whale in body length and weight (Whitehead, 2002). The most distinctive feature of the sperm whale is a massive and specialized nasal complex.

Status

Sperm whales within the northern Atlantic are classified in one stock (North Atlantic). It remains unresolved whether the northwestern Atlantic population is discrete from the northeastern Atlantic population (Waring et al., 2010).

The sperm whale is currently listed as endangered under the ESA. The Northern Atlantic stock is classified as strategic because of its listing under the ESA. According to Waring et al. (2010), the current population estimate for the western North Atlantic (U.S East Coast) is 4,804 individuals, including 2,607 individuals in the northern U.S. Atlantic and 2,197 individuals in the southern U.S. Atlantic. There is no critical habitat for this stock (USDOC, NMFS, 2010b).

Distribution

Sperm whales are cosmopolitan in their distribution, ranging from tropical latitudes to pack ice edges in both hemispheres (Jefferson et al., 2008). Generally, only male sperm whales venture to the extreme low latitudes. In the U.S. Atlantic EEZ waters, there appears to be a distinct seasonal cycle (Waring et al., 2010). In winter, sperm whales concentrate east and northeast of Cape Hatteras. In spring, the distribution center moves northward to waters east of Delaware and Virginia but spreads throughout the central portion of the MAB to the southern portion of Georges Bank. In summer, the distribution also includes continental slope and shelf waters as far as southern New England (**Figure 4-12**). In the fall, sperm whale occurrence on the continental shelf and shelf edge is highest in the MAB.

Behavior

Sperm whales are usually found in medium to large "family unit" groups of 20-30 females and their young. Young males leave their natal unit group at an age of 4-21 years and form loose aggregations called "bachelor schools" with other males of approximately the same age. Older males are usually solitary (Whitehead, 2002). Sperm whales feed primarily on cephalopods (squids and octopuses) and demersal and mesopelagic fishes (Whitehead, 2002; Jefferson et al., 2008; USDOC, NMFS, 2010b). The age at sexual maturity (between 7 and 13 years for females and in the twenties for males) is much older than for most whales (USDOC, NMFS, 2010b). Gestation length is between 12 and 15 months, and lactation extends almost 2 years. The lifespan has been estimated to be 60 years or more (Rice, 1989).

Auditory Range

Sperm whale vocalizations range from 2.5 to 60 kHz, with best hearing sensitivity between 5 and 20 kHz (Ridgway and Carder, 2001). Sperm whales are classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

West Indian Manatee (Florida subspecies) (*Trichechus manatus latirostris*)

The Florida subspecies of the West Indian manatee is the only sirenian that occurs along the eastern coast of the U.S. The average adult West Indian manatee ranges from 3 to 4 m (10 to 13 ft) in length and between 362 and 544 kg (800 and 1,200 lb) in weight (USDOI, FWS, 2001, 2007).

Status

The Florida manatee is currently listed as endangered under the ESA, a "strategic stock" under the MMPA, and vulnerable under the International Union for the Conservation of Nature (IUCN). The species is also protected under the Florida Manatee Sanctuary Act. The majority of the Atlantic population of the Florida manatee is located in eastern Florida and southern Georgia (Waring et al., 2010) and managed within four distinct regional management units: Atlantic Coast (northeast Florida to the Florida Keys), Upper St. Johns River (St. Johns River, south of Palakta), Northwest (Florida Panhandle to Hernando County), and Southwest (Pasco County to Monroe County) (USDOI, FWS, 2001, 2007). The Atlantic Coast unit is the most relevant to the AOI. Critical habitat was designated for the Florida manatee on September 24, 1976 (*Federal Register*, 1976) and includes inland waterways in four northeastern Florida coastal counties (Brevard, Duval, St. Johns, and Nassau) that are adjacent to the AOI (**Figure 4-13**).

Distribution

Within the northwestern Atlantic, manatees occur in coastal marine, brackish, and freshwater areas from Florida to Virginia, with occasional extralimital sightings as far north as Rhode Island (Jefferson et al., 2008). Because they have little tolerance for cold, they are generally restricted to the inland and coastal waters of peninsular Florida during the winter, where they shelter in or near sources of warm water (springs, industrial effluents, and other warm water sites) (USDOI, FWS, 2001, 2007).

Behavior

Manatees are herbivorous, feeding on a wide array of aquatic (freshwater and marine) plants such as water hyacinths and marine seagrasses. They generally prefer shallow seagrass beds, especially areas with access to deep channels. Preferred coastal and riverine habitats (e.g., near the mouths of coastal rivers) are also used for resting, mating, and calving (USDOI, FWS, 2001, 2007).

Auditory Range

Recent studies estimate the maximum hearing range for the manatee to be from 0.4 to 46 kHz, but primarily within the 3-5 kHz range (Steel and Morris, 1982; Thomson and Richardson, 1995; Gerstein et al., 1999; Reynolds and Powell, 2002; Niezrecki et al., 2003; O'Shea and Poche, 2006; Department of the Navy, 2007).

4.2.2.1.2. Nonlisted Marine Mammals

There are 31 marine mammal species that may occur in Atlantic OCS waters that are not classified as endangered or threatened under the ESA (**Table 4-4**), comprising two mysticete whales, 26 toothed whales and dolphins, and three seals. A brief discussion of each species or species group (where appropriate) is provided below.

Bryde's Whale (*Balaenoptera brydei*)

The Bryde's whale is a large rorqual that may reach a length of 16.5 m (54 ft). It is similar in size and appearance to the sei whale.

Status

Bryde's whales within the northwest Atlantic are not classified within a management stock. The species is not listed as threatened or endangered under the ESA.

Distribution

Bryde's whales have a circumglobal distribution in tropical and subtropical waters. In the western Atlantic Ocean, Bryde's whales are reported from off the southeastern U.S. (Virginia to Florida) and through the southern West Indies to Cabo Frio, Brazil (Cummings, 1985; Waring et al., 2010). The southeastern U.S., including the AOI, is considered to be a "secondary range" for this species (Jefferson et al., 2008).

Behavior

Bryde's whales are generally observed alone or in pairs, although they do aggregate into groups of 10-20 individuals on feeding grounds (Jefferson et al., 2008). They primarily feed on schooling fishes, though they may also feed on squids, krill, and other invertebrates. The Bryde's whale does not have a well-defined breeding season in most areas, and births can take place throughout the year (Jefferson et al., 2008).

Auditory Range

Bryde's whale vocalizations are low frequency, ranging from 20 to 900 Hz (Cummings, 1985; Oleson et al., 2003). The species is classified within the low-frequency cetacean functional marine mammal hearing group (7 Hz-22 kHz) (Southall et al., 2007).

Common Minke Whale (*Balaenoptera acutorostrata acutorostrata*)

The minke whale is a small mysticete that is divided into two species: the common minke whale and the Antarctic minke whale. The common minke whale is further divided into three subspecies. The subspecies *B. a. acutorostrata* occurs within the North Atlantic. Adult common minke whales reach a length of 8.8 m (29 ft).

Status

Minke whales off the eastern coast of the U.S. are included within the Canadian East Coast stock, which ranges from the Davis Strait, Canada (45º W), to the Gulf of Mexico (Waring et al., 2010). There are insufficient data to determine the status of minke whales in the U.S. Atlantic EEZ. It is not listed as endangered under the ESA, and the stock is not classified as strategic.

Distribution

The minke whale has a cosmopolitan distribution and occurs in polar, temperate, and tropical waters. Minke whales are generally found within waters of the continental shelf. It is considered common within the U.S. Atlantic EEZ during summer months and largely absent during winter, although sightings data suggest its distribution within this area is largely centered in New England and Canadian waters north of the AOI.

Behavior

Group sizes of mike whales are generally small (one to three individuals), but larger groups are observed on feeding grounds. They feed on small invertebrates and small schooling fishes and larger fish species. Calving occurs in low latitude areas during the winter.

Auditory Range

Minke whale vocalizations are low frequency, ranging from 80 Hz to 20 kHz range (Winn and Perkins, 1976; Frankel, 2002). It is classified within the low-frequency cetacean functional marine mammal hearing group (7 Hz-22 kHz) (Southall et al., 2007).

Beaked Whales

Five species of whales of the family Ziphiidae may occur within the AOI. These include one species of the genus *Ziphius* (Cuvier's beaked whale [*Z. cavirostris*]), and four species of the genus *Mesoplodon* (Blainville's beaked whale [*M. densirostris*], Gervais' beaked whale [*M. europaeus*], Sowerby's beaked whale [*M. bidens*], and True's beaked whale [*M. mirus*]). Beaked whales are medium-sized cetaceans with body lengths of 4.6-10 m (15-33 ft) characterized by reduced dentition, elongated rostrum, and accentuated cranial vertex (associated with sound production and modification) (Jefferson et al., 2008). *Mesoplodon* beaked whales are difficult to identify to the species level at sea, and much of the available characterization for them is to genus level only (Waring et al., 2010).

Status

All beaked whale species known to occur within the northwest Atlantic are not listed as threatened or endangered under the ESA or classified as strategic stocks (Waring et al., 2010).

Distribution

Cuvier's and *Mesoplodon* spp. beaked whale sightings within the northwest Atlantic during shipboard and aerial surveys have usually been along the continental shelf edge in the Mid-Atlantic region between Nova Scotia and central Florida, primarily in late spring and summer (Waring et al., 2010). Along the Atlantic coast of the U.S., beaked whales may be associated with the Gulf Stream and warm-core eddies (Waring et al., 1992).

Behavior

Beaked whales are usually observed singly or in small groups. As a group they are poorly known but are thought to be deep-diving animals. They feed at depth on deepwater squids and fishes (Mead, 2002).

Auditory Range

Very little information on the sound production of beaked whales is available; existing data suggest their range may be between 1 and 48 kHz (Caldwell and Caldwell, 1971; Johnson et al., 2004). Beaked whales as a group are classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

***Stenella* Dolphins**

Five species of oceanic dolphins of the genus *Stenella* occur within the northwestern Atlantic. These include the pantropical spotted dolphin (*S. attenuata*), striped dolphin (*S. coeruleoalba*), Clymene dolphin (*S. clymene*), Atlantic spotted dolphin (*S. frontalis*), and spinner dolphin (*S. longirostris*). *Stenella* body length ranges between 1.7 and 2.6 m (5.6 and 8.5 ft) (Jefferson et al., 2008).

Status

Each western Atlantic *Stenella* species is managed as a separate Western North Atlantic stock. None of these species are listed as threatened or endangered under the ESA, and none of the management stocks are classified as strategic (Waring et al., 2010).

Distribution

The five species of western Atlantic *Stenella* occur within both coastal and oceanic waters from 40° S to 40° N (Perrin and Gilpatrick, 1994; Perrin and Hohn, 1994). Atlantic spotted, pantropical spotted, Clymene, and spinner dolphins are distributed primarily in tropical and subtropical waters, whereas the distribution of striped dolphins extends from tropical to temperate waters (Jefferson et al., 2008). Generally, *Stenella* occur along the continental shelf edge and slope within their range. The Atlantic spotted dolphin, however, may also occur on the continental shelf in some areas, including the AOI (Jefferson et al., 2008; Waring et al., 2010).

Behavior

Atlantic spotted dolphins are often observed in small groups of generally less than 50 individuals. They feed on a wide variety of mesopelagic fishes and squids, as well as on benthic invertebrates (Perrin, 2002a; Jefferson et al., 2008). Little is known about their life history, though tropical populations are thought to have protracted breeding seasons.

Pantropical spotted dolphins are gregarious and commonly form aggregations ranging from less than 100 to thousands of individuals. Offshore individuals feed on small epi- and mesopelagic fishes, squids, and crustaceans. Individuals on the continental shelf are thought to feed on larger pelagic and demersal fishes (Perrin, 2002b; Jefferson et al., 2008).

Clymene dolphins are found in groups of less than 200 individuals, generally segregated by age and sex (Jefferson et al., 2008). They are thought to feed on small fishes and squids, primarily at night (Jefferson, 2002).

Spinner dolphins are highly gregarious and form large groups ranging in size from a few individuals to several thousand (Perrin, 2002c; Jefferson et al., 2008). They commonly school together with other cetacean species (Perrin, 2002c). Spinner dolphins feed on small midwater fishes, squids, and crustaceans, usually at night.

Striped dolphins feed on small fishes and cephalopods (Perrin et al., 1994). They are somewhat gregarious, often forming pods of 20 or more individuals, and are active at the surface (Whitehead et al., 1998; Archer, 2002). Baird et al. (1997) reported that striped dolphins can be found in groups of 100-500 individuals and are sometimes associated with other species of marine mammals and seabirds. The pod composition of striped dolphins may vary and can include adult males and females as well as juveniles (Perrin et al., 1994). They feed primarily on a wide variety of small midwater and demersal fishes and squids (Jefferson et al., 2008).

Auditory Range

Stenella species produce sounds that range from 0.1 to 160 kHz (Richardson et al., 1995). As a group, *Stenella* dolphins are classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Pygmy and Dwarf Sperm Whales (*Kogia breviceps* and *K. sima*)

Pygmy (*Kogia breviceps*) and dwarf (*K. sima*) sperm whales are small cetaceans with blunt squarish heads and underslung lower jaws, similar to the sperm whale. Pygmy sperm whales attain body lengths of approximately 4 m (13 ft), whereas dwarf sperm whales reach lengths of approximately 3 m (10 ft) (Jefferson et al., 2008).

Status

Pygmy and dwarf sperm whales are difficult to differentiate at sea (Caldwell and Caldwell, 1989; Würsig et al., 2000b), and sightings of either species are often categorized as *Kogia* sp. There are insufficient data to determine the population status of *Kogia* sp. in the western U.S. Atlantic EEZ. These species are not listed as endangered or threatened under the ESA, and there is insufficient information with which to assess population trends. Pygmy and dwarf sperm whales within the western North Atlantic are placed within separate Western North Atlantic stocks. They are not classified as strategic stocks.

Distribution

Dwarf and pygmy sperm whales appear to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell, 1989; McAlpine, 2002). Sightings of these animals in the western North Atlantic occur in oceanic waters between Maine and central Florida (Waring et al., 2010).

Behavior

Group sizes of pygmy and dwarf sperm whales tend to be small, generally less than six individuals. Very little is known about the species except from studies on stranded individuals. Studies on stranded animals suggest that these species feed on cephalopods, deep-sea fishes, and shrimps (Jefferson et al., 2008).

Auditory Range

A study on a pygmy sperm whale suggests an underwater hearing range between 90 and 150 kHz (Carder et al., 1995; Ridgway and Carder, 2001). No information is available on sound production in dwarf sperm whales. They are classified within the high-frequency cetacean functional marine mammal hearing group (200 Hz-180 kHz) (Southall et al., 2007).

Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise is the only porpoise species found in the Atlantic. It is a small, stocky cetacean with a blunt, short-beaked head. There are four subspecies, with *P. p. phocoena* in the North Atlantic. This subspecies reaches a body length of 1.9 m (6 ft) (Jefferson et al., 2008).

Status

The Gulf of Maine/Bay of Fundy stock of harbor porpoise is found in U.S. and Canadian Atlantic waters. There are insufficient data to determine the status of this stock in the U.S. Atlantic EEZ. It is not listed as threatened or endangered under the ESA; however, it is classified as a strategic stock (Waring et al., 2010).

Distribution

The harbor porpoise is usually found in shallow waters of the continental shelf, although they occasionally travel over deeper offshore waters. Waring et al. (2010) reports that harbor porpoises are generally concentrated along the continental shelf within the northern Gulf of Maine and southern Bay of Fundy region during summer months (July-September). During fall (October-December) and spring (April-June), they are widely dispersed from New Jersey to Maine. During winter (January-March), they range from New Brunswick, Canada, to North Carolina.

Behavior

Most harbor porpoise groups are small, usually between five and six individuals, although they aggregate into large groups for feeding or migration (Jefferson et al., 2008). They eat a wide variety of fishes and cephalopods.

Auditory range

An auditory study of harbor porpoise underwater hearing sensitivity found hearing sensitivity between 2 and 180 kHz (Kastelein et al., 2002). Harbor porpoise is classified within the high-frequency cetacean functional marine mammal hearing group (200 Hz-180 kHz) (Southall et al., 2007).

Bottlenose Dolphin (*Tursiops truncatus*)

Adult bottlenose dolphins range in length from 1.8 to 3.8 m (5.9 to 12.5 ft). Within the western North Atlantic, including the AOI, there are two distinct bottlenose dolphin forms, or ecotypes: coastal and offshore. The two forms are genetically and morphologically distinct, though regionally variable (Jefferson et al., 2008).

Status

The offshore and coastal forms of the bottlenose dolphin are classified as separate stocks: the Western North Atlantic Offshore and the Western North Atlantic Coastal morphotype stocks (Waring et al., 2010). Based on genetic differences, coastal form bottlenose dolphins in the AOI are divided into a complex mosaic of separate stocks (Waring et al., 2010) that include the following:

- Western North Atlantic Northern Migratory Coastal stock;
- Western North Atlantic Southern Migratory Coastal stock;
- Western North Atlantic South Carolina/Georgia Coastal stock;
- Western North Atlantic Northern Florida Coastal stock;
- Western North Atlantic Central Florida Coastal stock;
- Northern North Carolina Estuarine System stock;
- Southern North Carolina Estuarine System stock;
- Charleston Estuarine System stock;
- Northern Georgia/Southern South Carolina Estuarine System stock;
- Southern Georgia Estuarine System stock;
- Jacksonville Estuarine System stock; and
- Indian River Lagoon Estuarine System stock.

There are insufficient data to determine the status of the Western North Atlantic Offshore stock in the U.S. Atlantic EEZ, and it is not listed as threatened or endangered under the ESA. All coastal form stocks have been designated as “depleted” under the MMPA but not listed as threatened or endangered under the ESA. Consequently, all of the coastal form stocks are classified as strategicbecause of their depleted listing (Waring et al., 2010).

Distribution

The bottlenose dolphin is widely distributed throughout the western North Atlantic. The offshore form is distributed primarily along the OCS and continental slope in the northwest Atlantic Ocean from Nova Scotia to the southern Florida peninsula but has been documented to occur relatively close to shore within areas from south of Cape Hatteras, North Carolina. The coastal form is continuously distributed along the Atlantic coast from south of New York to around the Florida peninsula and may overlap with the offshore from off the southeastern U.S. Generally, population density appears to be higher within inner shelf areas (Jefferson et al., 2008).

Behavior

Group size of bottlenose dolphins is commonly less than 20 individuals, although larger groups are occasionally observed. They are considered as generalist feeders and use a wide variety of prey species, including fishes, squids, shrimps, and other crustaceans (Jefferson et al., 2008). Sexual maturity ranges from 5 to 13 years for females and 9 to 14 years for males (USDOC, NMFS, 2011f). Gestation length is around 12 months, and calves are weaned at around 18-20 months; births occur in late spring to early summer (Thayer et al., 2003). Bottlenose dolphins are long-lived; life expectancy is around 25 years, with some living longer (Duffield and Wells, 1990).

Auditory Range

The auditory range of bottlenose dolphins is between 150 Hz and 135 kHz (Ljungblad et al., 1982). The species is classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Killer Whale (*Orcinus orca*)

Killer whales within the western North Atlantic are included within the Western North Atlantic stock. They are considered uncommon or rare in waters of the U.S. Atlantic EEZ (Katona et al., 1988). Adults reach a body length of 9.8 m (32 ft) (Jefferson et al., 2008).

Status

There are insufficient data to determine the population status of killer whales in U.S. Atlantic EEZ. The species is not listed as threatened or endangered under the ESA, and the Western North Atlantic stock is not classified as a strategic stock.

Distribution

The killer whale's distribution is cosmopolitan. Within the North Atlantic, its range extends from the Arctic ice-edge to the West Indies. While their occurrence is unpredictable, in the U.S. Atlantic EEZ, they do occur in fishing areas, perhaps coincident with tuna, in warm seasons (Katona et al., 1988; USDOC, NMFS, 1995). In an extensive analysis of historical whaling records, Reeves and Mitchell (1988) plotted the distribution of killer whales in offshore and mid-ocean areas. Their results suggest that the offshore areas need to be considered in present-day distribution, movements, and stock relationships. Stock definition is unknown. Results from other areas (e.g., the Pacific Northwest and Norway) suggest that social structure and territoriality may be important.

Behavior

Killer whales are usually observed alone or in groups of up to 50 individuals (Ford, 2002). Three types of killer whale societies (resident, transient, and offshore), based on differences in ecology, coloration, and external morphology, are reported in certain areas (Jefferson et al., 2008). Killer whales feed on mammals, fishes, and cephalopods and use cooperative techniques to herd fish and attack large prey (Ford, 2002; Jefferson et al., 2008).

Auditory Range

The auditory range of killer whales is from <500 Hz-120 kHz (Bain et al., 1993; Szymanski et al., 1999). It is classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Pygmy Killer Whale (*Feresa attenuata*)

Pygmy killer whales within the western North Atlantic are included within the Western North Atlantic stock. They are considered uncommon or rare in waters of the U.S. Atlantic EEZ (Waring et al., 2010). Adults attain a body length of up to 2.6 m (8.5 ft) (Jefferson et al., 2008).

Status

There are insufficient data to determine the status of pygmy killer whales in the U.S. Atlantic EEZ. The species is not listed as threatened or endangered under the ESA, and the Western North Atlantic stock is not a classified as strategic stock (Waring et al., 2010).

Distribution

The pygmy killer whale is distributed worldwide in tropical to subtropical waters (Jefferson et al., 2008). There are insufficient data to determine the numbers of pygmy killer whales off the U.S. or Canadian Atlantic coast, and it is rarely observed within these waters during dedicated surveys. A group of six individuals was sighted during a 1992 vessel survey off of Cape Hatteras, North Carolina, in waters greater than 4,920 ft (1,500 m) deep (Hansen et al., 1994), but the whales were not encountered again during subsequent surveys (USDOC, NMFS, 1999, 2002; Mullin and Fulling, 2003).

Behavior

There is little known about the biology of the pygmy killer whale. Groups generally contain approximately 12-50 individuals. They feed on fishes and squids, though they have been known to attack dolphins (Jefferson et al., 2008).

Auditory Range

Little is known of the auditory range and sound production of the pygmy killer whale. Data show pygmy killer whale clicks between 70 and 85 kHz (Madsen et al., 2004). The species is classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

False Killer Whale (*Pseudorca crassidens*)

The false killer whale is a large, dark gray to black dolphin that has a long, slender body form with a small conical head. Adults may reach a body length of up to 6 m (20 ft) (Jefferson et al., 2008).

Status

The false killer whale is not included within a separate management stock. There are insufficient data to determine its status within the AOI.

Distribution

False killer whales are distributed worldwide within tropical to warm temperate waters. Generally, they are found in deep oceanic areas, though they are known to also occur on the continental shelf and shelf edge (Baird, 2002; Jefferson et al., 2008).

Behavior

False killer whales are highly social and commonly observed in groups of 10-60 individuals, although larger groups have been documented. They primarily feed on fishes and cephalopods, although they are known to attack other cetaceans. The calving interval for one group was reported as almost 7 years, and calving may occur year-round (Baird, 2002).

Auditory Range

The auditory range of false killer whales is <1-115 kHz (Johnson, 1967; Awbrey et al., 1988; Au, 1993). The species is classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Risso's Dolphin (*Grampus griseus*)

Risso's dolphins are large dolphins with characteristic blunt head and light coloration, often with extensive scarring. Adults reach body lengths of over 3.8 m (12.5 ft).

Status

The status of the Western North Atlantic stock of the Risso's dolphin in the U.S. Atlantic EEZ is not well documented. The species is not listed as threatened or endangered under the ESA, and there are insufficient data to determine population trends for this species. The stock is not classified as strategic.

Distribution

Risso's dolphins are widely distributed in tropical and temperate seas. In the Northwest Atlantic they occur from Florida to eastern Newfoundland (Leatherwood et al., 1976; Baird and Stacey, 1990). Risso's dolphins occur along the continental shelf edge from Cape Hatteras to Georges Bank during spring, summer, and autumn. In winter, they occur in oceanic (slope) waters within the MAB (Waring et al., 2010).

Behavior

Risso's dolphins are often observed in small to moderate-sized groups of 10-100 individuals, though larger aggregations have been reported. They commonly associate with other cetacean species. They feed on crustaceans and cephalopods (primarily squids). Data suggest a summer calving peak within the North Atlantic.

Auditory Range

The auditory range of Risso's dolphins is between 4 and 80 kHz (Au et al., 1997). The species is classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Pilot Whales (*Globicephala macrorhynchus* and *G. melas*)

Two species of pilot whales occur within the western North Atlantic: the short-finned pilot whale (*Globicephala macrorhynchus)* and the long-finned pilot whale (*G. melas*). These species are difficult to differentiate at sea and so they are often reported as *Globicephala* sp. Pilot whales attain a body length of 7.2 m (24 ft) (short-finned pilot whale) and 6.7 m (22 ft) (long-finned pilot whale) (Jefferson et al., 2008).

Status

There are insufficient data to determine the status of short-finned and long-finned pilot whales in the U.S. Atlantic EEZ. Each species within this area is categorized into the Western North Atlantic stock. Neither species is listed under the ESA, nor are their Western North Atlantic stocks classified as strategic.

Distribution

Pilot whales in the U.S. Atlantic EEZ occur in oceanic waters. Short-finned pilot whales are found within warm temperate to tropical waters and, within the North Atlantic, generally do not range farther north than 50° N latitude. Long-finned pilot whales occur in temperate and subpolar waters, though there is some distributional overlap in their southern range with short-finned pilot whales. Within the western North Atlantic, short-finned pilot whale strandings have been reported as far north as Nova Scotia (1990) and Block Island, Rhode Island (2001), though the majority of the strandings occurred from North Carolina southward. Long-finned pilot whales (*Globicephala melas*) have been reported stranded as far south as Florida.

Behavior

Pilot whales are generally found in large aggregations. Studies suggest that these aggregations are relatively stable and maternally based. Aggregations of short-finned pilot whales are commonly associated with other cetacean species. Pilot whales feed primarily on squids, although they also take small to medium-sized fishes when available. Pilot whales are one of the species most often associated with mass strandings. Breeding peaks occur during summer.

Auditory Range

Short-finned pilot whales produce vocalizations from 280 Hz to 100 kHz (Scheer et al., 1998). Recent studies indicate that the region of best hearing in long-finned pilot whales is between 11.2 and 50 kHz (Pacini et al., 2010). They are classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Short-beaked Common Dolphin (*Delphinus delphis*)

The common dolphin may be one of the most widely distributed species of cetaceans, as it is found worldwide in temperate, tropical, and subtropical seas. Two species have been recognized: the long-beaked common dolphin (*Delphinus capensis*) and the short-beaked common dolphin (which includes individuals within the northern Atlantic). Common dolphins attain a body length of 2.5 m (8.2 ft) (Jefferson et al., 2008).

Status

Short-beaked common dolphins within the northwestern Atlantic are classified within one stock (Western North Atlantic stock). Their status in the U.S. Atlantic EEZ is not well documented. The species is not listed as threatened or endangered under the ESA, and there are insufficient data to determine the population trends for this species. It is not classified as a strategic stock.

Distribution

Common dolphins are distributed in waters off the northeastern U.S. coast (Cetacean and Turtle Assessment Program [CETAP], 1982; Selzer and Payne, 1988; Waring et al., 1992; Hamazaki, 2002). They regularly occur along the continental shelf and slope (100-2,000 m [328-6,562 ft]) from 50º N to Cape Hatteras, North Carolina, although aggregations have been reported as far south as eastern Florida (Gaskin, 1992). They occur from Cape Hatteras northeast to Georges Bank (35°-42° N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to autumn (Selzer and Payne, 1988).

Behavior

Common dolphins are often observed in groups ranging in size from 10 to 10,000 individuals. These groups are often segregated by age and sex. The prey of common dolphins consists of small schooling fishes and squids. Their calving interval is 1-3 years, with peak calving in summer months.

Auditory Range

The auditory range of common dolphins is between 60 and 128 kHz (Popov and Klishin, 1998). The species is classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Melon-headed Whale (*Peponocephala electra*)

The melon-headed whale is a small, robust whale that reaches a maximum length of about 2.8 m (9 ft).

Status

The western North Atlantic population of melon-headed whales is considered a separate stock. There are insufficient data to determine the population status of the stock in the western North Atlantic EEZ, and it is not classified as a strategic stock nor is it listed as threatened or endangered under the ESA.

Distribution

The melon-headed whale is distributed worldwide in tropical to subtropical waters and is assumed to be part of the cetacean fauna of the tropical western North Atlantic (Jefferson et al., 1994). The numbers of melon-headed whales off the northwest Atlantic coast are unknown, and seasonal abundance estimates are not available (Waring et al., 2010). The paucity of sightings is probably because of a naturally low number of groups compared to other cetacean species.

Behavior

Melon-headed whales are social and usually occur in large aggregations of 100-500 individuals. They are often observed in mixed species groups. They feed on squids and small schooling fishes. Little is known of this species' life history or reproductive biology.

Acoustic Range

There is no direct measurement of auditory threshold for the hearing sensitivity of melon-headed whales (Ketten, 2000). They are known to produce sounds between 8 and 40 kHz (Watkins et al., 1997) and are classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*)

The Atlantic white-sided dolphin is robust and attains a body length of approximately 2.8 m (9 ft) (Jefferson et al., 2008). It is characterized with a strongly "keeled" tail stock and distinctive color pattern.

Status

Atlantic white-sided dolphins observed off the eastern U.S. coast are classified within the Western North Atlantic stock. The distribution of sightings, strandings, and incidental takes suggest the possible existence of three stock units within this region: Gulf of Maine, Gulf of St. Lawrence, and Labrador Sea stocks (Waring et al., 2010). There are insufficient data to determine seasonal abundance estimates of Atlantic white-sided dolphins off the eastern U.S. coast and their status in the U.S. Atlantic EEZ. The species is not listed as threatened or endangered under the ESA, and the stock is not classified as strategic.

Distribution

Atlantic white-sided dolphins are found in cold temperate and subpolar waters of the North Atlantic (Cipriano, 2002). Their preferred habitat appears to be waters of the outer continental shelf and slope, although there are regular sightings of this species within the western North Atlantic waters along the mid-shelf to the 100-m (328-ft) depth contour (Waring et al., 2010). The Western North Atlantic stock inhabits waters from central West Greenland to North Carolina (about 35˚ N) (Waring et al., 2010).

Behavior

Atlantic white-sided dolphins form groups of varying size, ranging from less than 100 to over 1,000 individuals. Data suggest that there may be age and/or sex segregation of these groups, with evidence of stable subgroups within the large groups. They are often observed feeding in mixed-species groups with pilot whales and other dolphin species. Atlantic white-sided dolphins feed mostly on small schooling fishes, shrimps, and squids (Cipriano, 2002; Jefferson et al., 2008).

Auditory Range

The hearing sensitivity of the Pacific white-sided dolphin, a congener of the Atlantic species, is 75 Hz-150 kHz (Tremel et al., 1998). They are classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Fraser's Dolphin (*Lagenodelphis hosei*)

Fraser's dolphins are characterized by an extremely robust body and small appendages. Maximum length is approximately 2.7 m (9 ft).

Status

Fraser's dolphins are distributed worldwide in tropical waters (Perrin et al., 1994) and are assumed to be part of the cetacean fauna of the tropical western North Atlantic. The species is considered uncommon within the AOI. There are insufficient data to determine the status of the Western North Atlantic stock of Fraser's dolphins in the U.S. Atlantic EEZ or population trends for this species. The species is not listed as threatened or endangered under the ESA. It is not classified as a strategic stock.

Distribution

Fraser's dolphins are distributed within tropical, oceanic waters between 30° N and 30° S. They may also occur closer to shore in areas where deep water approaches the coast (Dolar, 2002; Jefferson et al., 2008).

Behavior

Very little is known about the life history of Fraser's dolphin. They are commonly observed in large aggregations consisting of hundreds or thousands of individuals (Dolar, 2002). Fraser's dolphin aggregations are often mixed with other cetacean species. Data show that Fraser's dolphins feed on midwater fishes (such as myctophids), squids, and crustaceans.

Auditory Range

Fraser's dolphins produce vocalizations ranging from 4.3 to over 40 kHz (Watkins et al., 1994). The species is classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Rough-Toothed Dolphin (*Steno bredanensis*)

The rough-toothed dolphin is a relatively robust dolphin that attains a body length of 2.8 m (9 ft) (Jefferson et al., 2008). It is characterized by a long, conical head with no demarcation between the melon and beak.

Status

Rough-toothed dolphins observed off the eastern U.S. coast are classified within the Western North Atlantic stock. There are insufficient data to determine seasonal abundance estimates of rough-toothed dolphins off the eastern U.S. coast or their status in the U.S. Atlantic EEZ. The species is not listed as threatened or endangered under the ESA, and the stock is not classified as strategic.

Distribution

Rough-toothed dolphins are distributed within tropical and subtropical waters between 40° N and 35° S. They generally inhabit deep, oceanic waters. Records from the Atlantic are mostly from between the southeastern U.S. and southern Brazil (Jefferson, 2002).

Behavior

The rough-toothed dolphin is commonly observed in groups of 10-20 individuals, although aggregations of over 100 individuals have been reported. They frequently associate with other cetacean species. Rough-toothed dolphins feed on cephalopods and fishes, including large pelagic fishes.

Auditory Range

Rough-toothed dolphins produce vocalizations ranging from 0.1 to 200 kHz (Yu et al., 2003). The species are classified within the mid-frequency cetacean functional marine mammal hearing group (150 Hz-160 kHz) (Southall et al., 2007).

Seals

Three species of true seals (Family Phocidae) may occur within the AOI. These include the harbor seal (*Phoca vitulina*), gray seal (*Halichoerus grypus)*, and hooded seal (*Cystophora cristata*). Generally, the normal range of all three species is north of the AOI; however, there are sightings records of harbor seal, gray seal, and hooded seal within the AOI that are considered to be extralimital sightings.

Status

Harbor, gray, and hooded seals within the western North Atlantic are classified within separate Western North Atlantic stocks. There are insufficient data to determine the status of these seal stocks in the U.S. Atlantic EEZ. The species are not listed as threatened or endangered under the ESA, and none of the stocks are classified as strategic.

Distribution

The harbor seal is found in all nearshore waters of the Atlantic Ocean and adjoining seas north of 30º N (Katona et al., 1993). In the western North Atlantic, they are distributed from eastern Canada to southern New England and New York, and occasionally to the Carolinas (Mansfield, 1967; Boulva and McLaren, 1979; Katona et al., 1993; Gilbert and Guldager, 1998; Baird, 2001). The gray seal ranges from Canada to New York; however, there are strandings records as far south as Cape Hatteras (Davies, 1957; Mansfield, 1966; Katona et al., 1993; Lesage and Hammill, 2001). The hooded seal occurs throughout much of the North Atlantic and Arctic Oceans (King, 1983), preferring deeper water and occurring farther offshore than harbor seals (Sergeant, 1976; Campbell, 1987; Lavigne and Kovacs, 1988; Stenson et al., 1996). Individuals may wander widely, with sightings records as far south as Puerto Rico (Mignucci-Giannoni and Odell, 2001). There are increased occurrences of hooded seals from Maine to Florida in summer and autumn (McAlpine et al., 1999; Harris et al., 2001; Mignucci-Giannoni and Odell, 2001).

Behavior

Harbor seals and gray seals feed on a variety of benthic and demersal prey in coastal areas, as well as on schooling fishes. Hooded seals are deep divers and feed primarily on fishes, squids, and crustaceans (Jefferson et al., 2008).

Acoustic Range

The auditory range of harbor, gray, and hooded seals is generally from <1-150 kHz (Richardson et al., 1995). Southall et al. (2007) classified pinnipeds within separate functional marine mammal hearing groups ("pinnipeds in water" [75 Hz-75 kHz] and "pinnipeds in air" [75 Hz-30 kHz]), since they communicate acoustically in air and water and have significantly different hearing capabilities in the two media.

Incomplete and Unavailable Information on Marine Mammal Populations and Physiology

The BOEM concludes that there is incomplete or unavailable information (40 CFR 1502.22) for all marine mammals with respect to: (1) seasonal abundances; (2) stock or population size; (3) population trends, whether they are increasing, stable, or decreasing; (4) the hearing range for mysticetes; and (5) the basic biology of specific species and their physiology for underwater hearing. All of these species-specific and population variables may be relevant to reasonably foreseeable adverse impacts on marine mammals that are subject to active acoustic sound sources, i.e., airguns. However, what is known about the biology and hearing physiology of representative species, in combination with observations of behavioral response to stimuli, allows inferences and conclusions about reasonably foreseeable adverse impacts on marine mammals to be understood with an adequate degree of certainty. The BOEM has therefore determined that the data or information on marine mammal biology, hearing physiology, seasonal abundances, and population stock in the AOI identified as incomplete or unavailable is not essential to a reasoned choice among the alternatives, including the No Action alternative.

Moreover, a more complete knowledge base for all types of marine mammals that use the AOI and that bear on the factors listed above is not available and the acquisition of such information cannot be acquired without exorbitant cost. Such information certainly cannot be acquired in a time frame to make it available for this evaluation. While there will never be complete scientific information on marine mammals that live in OCS waters, a body of biological and physiological data and information about the underwater hearing of representative marine mammals is available to us. These data are sufficient to draw inferrences and conclusions about types of marine mammals that are less well understood. Thus, while we report where limited data and insufficient knowledge challenge our ability to understand how and when specific types of marine mammal species use the AOI and that bear on the factors listed above, incomplete or unavailable information does not affect our ability to understand and assign impacts or design mitigation strategies. We are able to draw basic conclusions despite incomplete or unavailable information, discuss results using available scientifically credible information, and apply that information using accepted scientific methodologies.

4.2.2.2. Impacts of Routine Events

This section discusses potential impacts of routine events associated with Alternative A on marine mammals. Federally listed endangered and threatened species are included in the discussion with nonlisted species because the potential impact mechanisms are the same. However, any impacts on managed species are of particular concern since they could affect key populations of these species. As discussed in **Chapter 4.1.1** and highlighted in **Table 4-2**, the IPFs from routine events that may impact marine mammals within the AOI include (1) active acoustic sound sources (i.e., airguns; electromechanical sources including boomer and chirp subbottom profilers, multibeam depth sounders, and side-scan sonars); (2) vessel and equipment noise; (3) vessel traffic (i.e., physical disturbance to and risk of collisions with marine mammals); (4) aircraft traffic and noise; and (5) trash and debris (i.e., potential for entanglement and ingestion). These potential IPFs and their associated impacts are discussed below.

4.2.2.2.1. Significance Criteria

Negligible impacts to marine mammals would include those where little to no measurable impacts are observed or expected. No mortality or injury (i.e., life threatening or debilitating injury) to any individual marine mammal would occur, and no disruption of behavioral patterns would be expected.

Minor impacts to marine mammals would include those that are detectable but are neither extensive nor severe. Minor impacts to marine mammals would include minor auditory discomfort, temporary disruption of communication and/or echolocation from auditory masking, behavior disruptions of individual or localized groups of marine mammals, and limited, localized, and short-term displacement of individuals of any species, including strategic stocks, from the area of impact.

Moderate impacts to marine mammals would be detectable and extensive but not severe. Moderate impacts to marine mammals would include injury or mortality, but in low enough numbers such that the continued viability of the local population or stock is not threatened and the annual rates of recruitment or survival of the local population or stock are not seriously affected. Moderate impacts would also include temporary displacement of individuals from preferred or critical habitats. Under the moderate impact category, the viability or continued existence of marine mammal population(s) or stock(s) affected would not be threatened, although some of the impacts to individual mammals or local groups of mammals may be irreversible.

Major impacts to marine mammals would be detectable, extensive, and severe. Major impacts to marine mammals would include extensive levels of life-threatening or debilitating injury or mortality in sufficiently high numbers that the continued viability of the population is seriously threatened, including serious diminishment of annual rates of recruitment or survival. Major impacts would also include long-term disruption of behavioral patterns that would adversely affect a listed or nonlisted species or stock through its effects on annual rates of recruitment or survival, as well aspermanent or long-term displacement of individuals from either preferred or critical habitat.

Background: Potential Effects of Noise on Marine Mammals

A review of marine mammal hearing and sensitivity to acoustic impacts is presented in **Appendix H**. Underwater noise sources in the proposed action include active acoustic sound sources such as airguns and electromechanical sources, as well as continuous (non-pulsed) vessel and equipment noise. Past studies on the reactions of animals to noise have shown widely varied responses, depending on the individual, age, gender, and the activity in which the animals were engaged (Simmonds et al., 2003). Where there is an overlap between noise sources and the frequencies of sound used by marine life, there is the potential for sound to interfere with important biological functions. Noise, either natural or anthropogenic, can adversely affect marine life in various ways. Four zones of influence from noise are offered by Richardson et al. (1995) and summarized by Gordon et al. (2004), including (1) zone of audibility – the area within which the sound is both above the animal's hearing threshold and detectable above background noise; (2) zone of responsiveness – the region within which behavioral reactions in response to the sound occur; (3) zone of masking – the area within which the sound may mask biologically significant sounds; and (4) zone of hearing loss, discomfort, or injury – the area within which the sound level is sufficient to cause threshold shifts or hearing damage.

The range of potential effects from noise, in order of decreasing severity and modified slightly from the four zones initially outlined by Richardson et al. (1995) above, includes death, non-auditory physiological effects, auditory injury–hearing threshold shift, masking, and stress and disturbance, including behavioral response (Richardson et al., 1995; NRC, 2003, 2005; Nowacek et al., 2004; Southall et al., 2007). There is a high likelihood of these potential effects when exposure is close to a sound source; however, the magnitude and probability of an effect decrease with increasing distance from a source. The following discussion addresses the range of potential effects noted above, with the exception of death and physiological effects, which have been combined.

Death and Non-Auditory Physiological Effects

Direct physical injury, which might result in death, may occur from exposure to high levels of sound or, more commonly, to shock wave pulses associated with high intensity events such as explosions. These pulses are typically short, with peak pressures that may damage internal organs or air-filled body cavities (e.g., lungs) (Yelverton et al., 1973; Goertner, 1982; Young, 1991). Data on direct physical injury are limited to anecdotal or forensic investigations after accidental events because ethical considerations prevent direct empirical methods to measure such impacts in marine mammals. However, such observations (e.g., Todd et al., 1996) and modeling based on impact data for the human vestibular system as well as other organs (e.g., lungs) for underwater sound exposures (Cudahy and Ellison, 2002) suggest that marine mammals can be susceptible to direct physical injury to particular organ systems and tissues following intense exposure, particularly where high particle motion events occur. Possible types of non-auditory physiological effects or injuries that might occur include stress, neurological effects, bubble formation (which is a highly debated effect), resonance effects, and other types of organ or tissue damage. Based on some stranding observations coincidental to certain naval exercises, it is possible that some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strongly pulsed sounds, particularly at higher frequencies. Given the predominant low frequency sound sources, limited sound pressure levels (SPLs) and durations, and directionality of higher frequency sound sources associated with Alternative A, it is not likely that G&G activities would generate sounds loud enough to cause mortality (DNV Energy, 2007). However, low frequency sounds from G&G activities do have the potential to affect marine mammals through behavioral modification.

Although airguns produce high intensity, intermittent sound pulses, there have been no observations of direct physical injury or death to marine mammals from exposure to these active acoustic sound sources, and it is not anticipated that G&G activities expected under Alternative A would have the potential for either effect in any marine mammal. In addition, seismic survey protocols and mitigation procedures (**Appendix C**, **Section 3.2**) would be implemented to decrease the potential for any marine mammal to be within the exclusion zone of an operating airgun array, thereby avoiding the highest SPLs and minimizing their exposure to these sound sources.

Auditory Injuries – Hearing Threshold Shift

The minimum sound level an animal can hear at a specific frequency is called the hearing threshold at that frequency. Sounds above a hearing threshold are accommodated until a certain level of sound intensity or duration is reached. Too much exposure at a certain level might cause a shift in the animal's hearing thresholds within a certain frequency range. Following exposure, the magnitude of the hearing impairment, or threshold shift (TS), normally decreases over time following cessation of noise exposure. Threshold shifts can be temporary (TTS) or permanent (PTS), can consist of both temporary and permanent components, and are defined as follows, as adapted from Southall et al. (2007) and Finneran et al. (2005):

- TTS – the mildest form of hearing impairment; exposure to strong sound results in a non-permanent (reversible) elevation in hearing threshold, making it more difficult to hear sounds; TTS can last from minutes or hours to days; the magnitude of the TTS depends on the level and duration of the noise exposure, among other considerations.
- PTS – permanent elevation in hearing threshold; no data are currently available regarding noise levels that might induce PTS in marine mammals; PTS is attributed to exposure to very high peak pressures and short rise times, or very prolonged or repeated exposures to noise strong enough to elicit TTS.

Several important factors relate to the type and magnitude of hearing loss, including exposure level, frequency content, duration, and temporal pattern of exposure. A range of mechanical effects (e.g., stress or damage to supporting cell structure, fatigue) and metabolic processes (e.g., inner ear hair cell metabolism such as energy production, protein synthesis, and ion transport) within the auditory system underlie both TTS and PTS. Additional discussion of TTS and PTS is presented in **Appendix H**.

Auditory impairment (TTS or PTS) is a possibility when marine mammals are exposed to very loud sounds. The minimum SPL (or sound exposure level, SEL) necessary to cause permanent hearing impairment is higher than the level that induces TTS, although there are insufficient data to determine the precise differential.

The pool of available data on hearing and noise impacts has expanded rapidly in recent years. Southall et al. (2007) published a paper summarizing noise exposure results (i.e., SELs) and offering a series of new approaches to noise impact determinations for marine mammals. First, the marine mammals were segregated into the functional hearing groups (**Table 4-7**). Second, sound sources were categorized into functional categories, based on their acoustic and repetitive properties. Three sound types were characterized, including single and multiple pulses and nonpulses, with separation of sound types based on understanding of sound exposure, auditory fatigue, and acoustic trauma in terrestrial mammals and applicable damage risk criteria in humans. The review indicated that the lowest received levels of impulsive sounds (e.g., airgun pulses) that might elicit slight auditory injury (TTS) are 198 dB re 1 μPa^2-s in cetaceans and 186 dB re 1 μPa^2-s in pinnipeds. Odontocetes exposed to impulsive sounds developed TTS with exposures as low as ~183 dB re 1 μPa^2 s. It should be noted that these received sound levels are expressed in SEL terms. Southall et al. (2007) also concluded that receipt of an instantaneous flat-weighted peak pressure exceeding 230 dB re 1 μPa (peak) for cetaceans or 218 dB re 1 μPa (peak) for pinnipeds might also lead to auditory injury even if the aforementioned cumulative energy-based criterion was not exceeded.

The following determinations regarding TTS and PTS are noteworthy (NSF and USGS, 2011):

- recently acquired data indicate that TTS onset in marine mammals is more closely correlated with the received SEL than with sound pressure (root mean square [rms]) levels and that received sound energy over time should be considered a primary measure of potential impact, not just the single strongest pulse; and
- TTS values for pinnipeds are not well defined; while there are published data on levels of non-impulse sound (see Kastak et al., 1999), data are not available regarding impulse sound and TTS in pinnipeds. Based on the results for non-impulse sound, the TTS for pinnipeds exposed to impulse sound may be as low as 171 dB re 1 μPa2 s in the more sensitive species such as the harbor seal.

The primary measure of sound used in the proposed new criteria is the received sound energy, not just in the single strongest pulse, but accumulated over time. Received sound energy over a period of time or, in this case, a series of pulsed sounds over a period of time, is the fundamental basis for the SEL metric. Southall et al. (2007) define SEL as "the dB level of the time integral of the squared-instantaneous sound pressure normalized to a 1-s period." The use of an SEL is advantageous because it can account for (1) cumulative sound exposure, (2) sounds of differing duration, and (3) multiple sound exposures. It also allows comparison between different sound exposures based on total energy (i.e., calculation of a single exposure "equivalent" value; Southall et al., 2007). This approach also assumes no recovery of hearing between repeated exposures. The most appropriate interval over which the received airgun pulse energy should be accumulated is not well defined. However, pending the availability of additional relevant information, recommendations suggest considering noise exposure over 24-hr periods (Southall et al., 2007). The NMFS continues to evaluate the SEL metric for marine mammal injury (i.e., TTS, PTS), however, the current regulatory thresholds remain based on SPLs (i.e., 180/190 dB re 1 μPa [rms] for injury; 160 dB re 1 μPa [rms] for behavioral modification); further discussion of the current noise exposure thresholds is provided in a subsequent section (***Acoustic Impact Criteria***).

Sound sources used during G&G activities have the potential to produce TTS or PTS in marine mammals present within range of operational sound sources, with range to exposure thresholds dependent upon the size of the sound source and other factors; detailed analysis of active acoustic sound source impacts is provided later in this chapter. Seismic survey protocols and mitigation procedures (**Appendix C**, **Section 3.2**) would be implemented to decrease the potential for any marine mammal to be within the exclusion zone of an operating airgun array, thereby avoiding the highest sound levels.

Masking

Noise can affect hearing and partially or completely reduce an individual's ability to effectively communicate; detect important predator, prey, and/or conspecific signals; and/or detect important environmental features associated with spatial orientation (Clark et al., 2009). Masking is defined as the obscuring of weaker sounds of interest by other, stronger, more intense sounds, often at similar frequencies. Spectral, temporal, and spatial overlap between the masking noise and the sender/receiver determines the extent of interference; the greater the spectral and temporal overlap, the greater the potential for masking.

Naturally occurring ambient noise is produced from various sources, including wind, waves, precipitation, other animals, and (at frequencies above 30 kHz) thermal noise resulting from molecular agitation (Richardson et al., 1995). Background noise can also include sounds from distant human activities (e.g., shipping), particularly in areas where heavy levels of shipping traffic are located. Ambient noise can produce masking, effectively interfering with the ability of an animal to detect a sound signal that it otherwise would hear. Under normal circumstances, in the absence of high ambient noise levels, an animal would hear a sound signal because it is above its absolute hearing threshold. Natural masking prevents a portion or all of that sound signal from being heard. Further masking of natural sounds can result when human activities produce high levels of background noise. Ambient noise is highly variable on continental shelves (e.g., see Desharnais et al., 1999), effectively creating a high degree of variability in the range at which marine mammals can detect anthropogenic sounds.

Masking is a natural phenomenon to which marine mammals have adapted through various mechanisms (e.g., dominant frequency shift; increasing source levels). However, the production of strong sounds at frequencies that are important to marine mammals necessarily increases the severity and frequency of masking. In the cases of high-frequency hearing by the bottlenose dolphin (*Tursiops truncatus*), beluga whale (*Delphinapterus leucas*), and killer whale (*Orcinus orca*), empirical evidence confirms that masking depends strongly on the relative directions of arrival of sound signals and the characteristics of the masking noise (Penner et al., 1986; Dubrovskiy, 1990; Bain et al., 1993; Bain and Dahlheim, 1994).

Toothed whales have the ability to facilitate the detection of sounds in the presence of background noise. There is evidence that some toothed whales (e.g., bottlenose dolphin: Au et al., 1974, Moore and Pawloski, 1990, Romanenko and Kitain, 1992; beluga whale: Au et al., 1985, Lesage et al., 1999; false killer whale: Thomas and Turl, 1990) can shift the dominant frequencies of their echolocation signals from a frequency range containing excessive ambient noise toward frequencies with less noise. Several marine mammal species are also known to increase the source levels of their calls in the presence of elevated sound levels (Dahlheim, 1987; Au, 1993; Lesage et al., 1999; Terhune, 1999). While data exist that demonstrate adaptation among odontocetes to reduce the effects of masking at high frequencies, there are fewer data sources available regarding corresponding mechanisms at moderate or low frequencies, or in other marine mammal groups (i.e., mysticetes). Recent work by Clark et al. (2009) summarizes the potential for acoustic masking on baleen whales from anthropogenic sounds, including shipping. Castellote et al. (2010), studying fin whales in the eastern Atlantic and western Mediterranean, documented the shortening of low frequency (20 Hz) pulse duration, decreasing bandwidth, and decreasing center and peak frequencies as a result of masking from shipping (and seismic) activity. Directional hearing has been demonstrated at frequencies as low as 0.5-2 kHz in several marine mammals, including killer whales (see Richardson et al., 1995). This ability may be useful in reducing masking at these frequencies.

Sound sources used during G&G activities have the potential to mask marine mammal communication and monitoring of environmental cues if an individual is present within range of operational sound sources. Seismic survey protocols and mitigation procedures (**Appendix C**, **Section 3.2**) would be implemented to decrease the potential for any marine mammal to be within the exclusion zone of an operating airgun array, thereby reducing the potential for masking. While a determination of the full extent of the zone of masking is problematic, it is expected that the exclusion zone encompasses a portion of the ensonification area where masking may occur.

Stress, Disturbance, and Behavioral Responses

Stress in marine mammals resulting from noise exposure typically involves the sympathetic nervous system. Stress response in marine mammals is immediate, acute, and characterized by the release of the neurohormones norepinephrine and epinephrine (i.e., catecholamines; U.S. Navy, Office of Naval Research, 2009). Various researchers (e.g., Romano et al., 2004) have summarized available evidence for profound activity during stressors such as stranding or predation (Cowan and Curry, 2008; Mashburn and Atkinson, 2008; Eskesen et al., 2009). Romano et al. (2004) note that no quantitative approach to estimating changes in mortality or fecundity because of stress has been identified and that qualitative effects may include increased susceptibility to disease and early termination of pregnancy.

Disturbance can induce a variety of effects including subtle changes in behavior, more conspicuous dramatic changes in activities, and displacement. Disturbance is one of the main concerns of the potential impacts of manmade noise on marine mammals. Richardson et al. (1995) noted that most small and medium-sized toothed whales exposed to prolonged or repeated underwater sounds are unlikely to be displaced unless the overall received level is at least 140 dB re 1 μPa. While a prediction of behavioral responses resulting from received SPLs is problematic, several study results are available. Limited available data indicate that sperm whales (*Physeter macrocephalus*) are sometimes, though not always, more responsive to anthropogenic noise than other toothed whales. Baleen whales probably have better hearing sensitivities at lower sound frequencies, and in several studies have been shown to react at received sound levels of approximately 120 dB re 1 μPa (e.g., 0.5 probability of avoidance by gray whales of a continuous noise source; Malme et al., 1988; also see Southall et al., 2007).

Behavioral reactions of marine mammals to sound are difficult to predict because reactions are dependent on numerous factors, including the species being evaluated; the animal's state of maturity, prior experience and exposure to anthropogenic sounds, current activity patterns, and reproductive state; time of day; and weather state (Wartzok et al., 2004). If a marine mammal reacts to an underwater sound by changing its behavior or moving to avoid a sound source, the impacts of that change may not be important to the individual, the stock, or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on both individuals and the population could be important.

There is a very wide range of possible behavioral responses to sound exposure, given that the sound is audible to the particular animal, including, in approximate order of increasing severity but decreasing likelihood, the following:

- none observable – animals can become less sensitive over repeated exposures;
- looking at the sound source or increased alertness;
- minor behavioral responses such as vocal modifications associated with masking;
- cessation of feeding or social interactions;
- temporary avoidance behavior (emerging as one of the more common responses);
- modification of group structure or activity state; and/or
- habitat abandonment.

Assessing the severity of behavioral effects of anthropogenic sound exposure on marine mammals presents unique challenges associated with the inherent complexity of behavioral responses and the contextual factors affecting them, both within and between individuals and species. Severity of responses can vary depending on characteristics of the sound source (e.g., moving or stationary, number and spatial distribution of sound source[s], similarity to predator sounds, and other relevant factors) (Richardson et al., 1995; NRC, 2005; Southall et al., 2007; Wirsing et al., 2008; Bejder et al., 2009; Barber et al., 2010; Ellison et al., 2011).

There is considerable available literature on the effects of noise on marine mammal hearing (see Southall et al., 2007 and **Appendix H** for an extensive review). Traveling blue and fin whales exposed to seismic noise from airguns have been reported to stop emitting redundant songs (McDonald et al., 1995; Clark and Gagnon, 2006). By contrast, Di Iorio and Clark (2010) found increased production of transient, non-redundant calls during seismic sparker operations, suggesting that blue whales respond to noise interference according to the context and the signal produced. They further postulated that animals engaged in near-term, proximate communication are probably afforded an advantage in acoustic behaviors that maintain the immediate social link; for animals engaged in long-term singing directed to a distant audience, information loss is minor if singing is temporarily interrupted. Di Iorio and Clark (2010) determined that blue whales changed their calling behavior in response to a low frequency, low output sound source that was previously presumed to have minor environmental impact (Duchesne et al., 2007). The mean sound pressure was relatively low, 131 dB re 1 μPa (peak to peak) (30-500 Hz) with a mean SEL of 114 dB re 1 μPa^2 s (90 percent energy approach for duration estimate; Madsen, 2005). There are insufficient data to determine the relevance of the observed vocal adjustment to an individual whale's well-being. However, their observations were conducted in an important feeding area where blue whales acquire energy and where this wide-roaming, highly dispersed population congregates to engage in social interactions. Reducing an individual's ability to detect socially relevant signals could therefore affect biologically important processes. This study suggests careful reconsideration of the potential behavioral impacts of even low source level seismic survey sounds on large whales. This is particularly relevant when the species is at high risk of extinction, as is the blue whale.

Bain and Dahlheim (1994) observed behavioral changes in a captive killer whale exposed to 135 dB (in a band below 5 kHz), and Bain (1995) effectively used noise with a received level of around 135 dB (with a predominant frequency at 300 Hz) as a deterrent. Olesiuk et al. (2002) found noise from acoustic harassment devices with a source level of 195 dB excluded harbor porpoises within a radius of 3 km (1.9 km), a distance at which received levels were estimated to drop to ~135 dB. Individual harbor porpoises may have been kept farther away, as there were sighting limitations beyond 3 km (1.9 km). Morton and Symonds (2002) also found that the same type of acoustic harassment devices as studied by Olesiuk et al. (2002) excluded killer whales from the area around the devices. North Atlantic right whales exhibited changes in diving behavior when exposed to noise below 135 dB (Nowacek et al., 2004). Blue whales responded to noise from seismic sparker operations by increasing call production. Acoustic reactions of cetaceans to airgun activity include reduced vocalization rates (e.g., Goold, 1996) but no vocal changes (e.g., Madsen et al., 2002) or cessation of singing (e.g., McDonald et al., 1995). Other short-term vocal adjustments observed across taxa exposed to elevated ambient noise levels include shifting call frequency, increasing call amplitude or duration, and ceasing to call (Nowacek et al., 2007). In baleen whales, North Atlantic right whales (*Eubalaena glacialis*) exposed to high shipping noise increased call frequency (Parks et al., 2007), while some humpback whales (*Megaptera novaeangliae*) responded to low frequency active sonar playbacks by increasing song length (Miller et al., 2000). Porpoises avoid pingers with source levels of about 130 dB at distances of from 100 to 1,000 m (328-3,280 ft), depending on experience and environmental context (Gearin et al., 1996, 2000; Kraus et al., 1997; Laake et al., 1997,, 1998; Barlow and Cameron, 1999; Cameron, 1999; Cox et al., 2001; Bain, 2002); Kastelein et al. (1997, 2001) found behavioral responses at lower levels. Williams et al. (2002a,b, 2009) found killer whales exhibited behavioral changes in the presence of a single vessel producing a received level of approximately 105-110 dB re 1 μPa. Toothed whales appear to exhibit a greater variety of reactions to manmade underwater noise than do baleen whales. Toothed whale reactions can vary from approaching vessels (e.g., to bow ride) to strong avoidance.

It is apparent that there is significant species-specific variability in the behavioral responses of marine mammals to noise exposure, including several different active acoustic sound sources. It is also evident that there is a broad spectrum of behavioral responses, each of which has varying importance to the individual. Recognizing these issues, Southall et al. (2007) concluded (1) that there are many more published accounts of behavioral responses to noise by marine mammals than of direct auditory or physiological effects; (2) available data on behavioral responses do not converge on specific exposure conditions resulting in particular reactions, nor do they point to a common behavioral mechanism; (3) study data obtained with substantial controls, precision, and standardized metrics indicate high variance both in behavioral responses and in exposure conditions required to elicit a given response; and (4) distinguishing a significant behavioral response from an insignificant, momentary alteration in behavior is problematic.

Sound sources used during G&G activities have the potential to produce stress, disturbance, and behavioral responses in marine mammals if they are present within range of the operational airgun array. In summary, seismic survey protocols and mitigation procedures (**Appendix C**, **Section 3.2**) would be implemented to decrease the potential for any marine mammal to be within the exclusion zone of an operating sound source, thereby reducing the potential for behavioral responses in close proximity to the sound source. However, beyond the exclusion zone, some behavioral responses may occur.

Acoustic Impact Criteria

Since the mid-1990's, NMFS has specified that marine mammals should not be exposed to pulsed sounds with received SPLs exceeding 180 or 190 dB re 1 μPa (rms), depending upon whether the marine mammal is a cetacean or a pinniped (USDOC, NMFS, 2003). The lower threshold, 180 dB re 1 μPa (rms), has been used as the Level A harassment threshold for cetaceans. The upper threshold, 190 dB re 1 μPa (rms), has been used as the Level A harassment threshold for pinnipeds in water. The

NMFS also considers that cetaceans and pinnipeds exposed to pulsed sound levels ≥160 dB re 1 μPa (rms) are subject to Level B harassment (**Table 4-6**).

In June 1997, the High Energy Seismic Survey (HESS) team convened a panel of experts to assess existing data on marine mammals exposed to seismic pulses and to predict exposures at which physical injury could occur (HESS, 1999). With the limited available data at that time, exposure to airgun pulses with received levels above 180 dB re 1 μPa (rms) was determined to have a high potential for "serious behavioral, physiological, and hearing effects."

Based on the HESS (1999) panel conclusions, NMFS established threshold levels for both injury (Level A harassment) and behavioral (Level B harassment) response. The NMFS considers behavioral response criteria as a step-function (all-or-none) threshold based solely on the rms value of received levels. For injury associated with sound exposure from impulsive sound, NMFS established a 180-dB (rms, received level) threshold criterion for cetaceans and a 190-dB (rms, underwater, not including in-air anthropogenic sources) threshold criterion for pinnipeds (*Federal Register*, 2003a), based on HESS recommendations that "exposure to levels above 180 dB are likely to have the potential to cause serious behavioral, physiological, and hearing effects." The sub-injurious threshold (that likely to cause TTS and associated behavioral disruption for impulsive sounds [Level B harassment]) is 160 dB re 1 μPa (rms). For non-impulsive sound sources, such as those associated with drilling and dredging activities, the sub-injurious threshold is 120 dB re 1 μPa (rms). Level A and Level B harassment levels correspond to **moderate** and **minor** impact categories, respectively, the latter of which have been previously described in Significance Criteria, **Chapter 4.2.2.2**. Distinctions between **moderate** and **major** impacts are based on the respective definitions of each. **Moderate** impacts to marine mammals would include injury or mortality, but in low enough numbers such that the continued viability of the local population or stock is not threatened and the annual rates of recruitment or survival of the local population or stock are not seriously affected. **Major** impacts to marine mammals would include extensive levels of life-threatening or debilitating injury or mortality in sufficiently high numbers that the continued viability of the population is seriously threatened, including serious diminishment of annual rates of recruitment or survival.

The NMFS thresholds have been based on the "rms sound pressure" metric; however, recent scientific evidence suggests that auditory effects of transient sounds on marine mammals are better correlated with the amount of received energy than with the level of the strongest pulse. Therefore, the present analysis considers both the current regulatory thresholds of sound pressure as well as the SEL metric. The importance of the SEL metric lies, in part, with the concept of cumulative sound exposure and is particularly relevant when considering active acoustic, pulsed sounds such as seismic sounds and their potential injurious effects on marine mammals.

Since development and application of the 180- and 190-dB re 1 μPa (rms) criteria, additional scientific research has been completed that further clarifies the received levels of underwater sound that cause TTS or PTS in marine mammals (e.g., see Kastak et al., 1999; 2005; Finneran et al., 2002, 2005). Additional discussion of TTS and PTS study results are presented in **Appendix H**. New criteria have been developed based on further advances in the understanding of the impacts of noise on marine mammals, as noted previously. The proposed energy (or SEL) criterion considers multiple, cumulative exposures across pulses (Southall et al., 2007). Energy criteria refer to cumulative energy from a series of impulsive sounds.

4.2.2.2.2. Evaluation

Active Acoustic Sound Sources

Active acoustic sound sources included in the proposed action include airguns, boomer and chirp subbottom profilers, side-scan sonars, and multibeam depth sounders, as discussed in **Chapter 3.5**. These active acoustic sound sources are divided into two types, airguns and electromechanical sources (**Appendix D**). Both airguns and electromechanical sources are expected to be used in seismic airgun surveys for oil and gas exploration, whereas HRG surveys associated with the renewable energy and minerals management programs are expected to use only electromechanical sound sources (i.e., no airguns). Additional information on these types of equipment is provided in **Chapter 3** and **Appendix D**. Calculated radial distances to any of the isopleths (i.e., NMFS SPL thresholds) from a source such as an airgun array are dependent upon the size and orientation of the sound source and the physical characteristics of the marine environment and sediments (e.g., water column stratification, water depth, and nature of the seafloor). Calculations of radial distance for each G&G equipment type via modeling provide a metric for evaluating noise-related impacts to marine mammals and can account for differences in environmental parameters that may affect sound propagation and attenuation. Results of sound propagation modeling from sound sources associated with the proposed action are shown in **Appendix D, Tables D-21** and **D-22**. **Appendix D** also presents details of the acoustic modeling that generated these results.

Most marine mammal species that are likely to occur within the AOI are cetaceans, with few pinnipeds (possibly present in the northern extent of the AOI) and manatees (potentially present in southern, near-coastal waters of the AOI). The vast majority of these species fall within the low- or mid-frequency hearing category (**Table 4-7**). While low-frequency cetaceans would be expected to hear airguns, the mid-frequency cetacean species have auditory bandwidths that overlap only slightly with the frequencies of maximum airgun output. For most of the mid-frequency cetacean species, including the endangered sperm whale, the injury criteria proposed by Southall et al. (2007) and general conclusions on behavioral response would be expected to be applicable; direct recent information on behavioral responses in sperm whales to seismic airguns is available (e.g., Miller et al., 2009). For the endangered mysticetes that occur in the area (North Atlantic right whale, blue whale, fin whale, humpback whale, and sei whale), as is the case for all low-frequency cetaceans, no direct information regarding hearing is available. As described above, the Southall et al. (2007) exposure criteria for injury are based on assumptions and extrapolations from mid-frequency cetacean data that may need to be reassessed to some degree based on the subsequent measurements of lower onset TTS levels in bottlenose dolphins within their range of best hearing sensitivity (Finneran and Schlundt, 2010; Finneran et al., 2010a,b).

In terms of behavioral response, substantial effort has been made and data are available for impulse noise (seismic airguns specifically) for mysticetes, though not for all of the species present in the AOI. Nowacek et al. (2004) showed that North Atlantic right whales may be particularly responsive to alarm-like non-impulsive noise in controlled exposure studies. Similarly and more recently, Southall et al. (2011) demonstrated behavioral responses, and an apparent context-dependence in response based on behavioral state, in some blue and fin whales exposed to simulated sonar sounds off the coast of California. The fact that many of the mysticetes in the AOI may be engaged in migratory behavior during the course of operations (**Chapter 4.2.2.1**), the increased sensitivity of some other mysticetes (e.g., bowhead and gray whales, neither of which occur in the AOI) during migrations should be considered in assessing potential responses of species where no direct data on responses to certain sound types (airguns) are available (e.g., blue, fin, and sei whales).

Radial distances to the regulatory thresholds for each of the modeled equipment types are outlined in **Table 4-8**. On an instantaneous, single pulse basis, the radii to the 180-dB (rms) isopleth ranges from 799 to 2,109 m (2,622 to 6,920 ft) for the large airgun array, from 76 to 186 m (249 to 610 ft) for the small airgun array, and from 27 to 192 m (89 to 630 ft) for the electromechanical sources. The 160-dB radius ranges from 5,184 to 15,305 m (17,009 to 50,216 ft) for the large airgun array and from 1,294 to 3,056 m (4,246 to 10,027 ft) for the small airgun array, and from 147 to 2,138 m (482 to 7,015 ft). The variability evident in these calculations is attributed to site-specific differences in water depth, water column stratification, and seafloor type. Additional discussion regarding modeling results is provided in **Appendix D**.

The proposed action includes extensive seismic airgun surveys during the 2012-2020 time period. These include 617,775 line km of 2D surveys, 2,500 blocks of 3D surveys, 900 line km of 3D WAZ and FAZ coil surveys, 1,280 line km of VSP surveys, and 175,465 line km of HRG surveys (**Table 3-3**). All of these surveys are within the oil and gas exploration program, as airguns are not expected to be used for HRG surveys in either renewable energy or marine minerals programs. However, the HRG surveys for these two programs would use electromechanical sound sources (e.g., boomer and chirp subbottom profilers, side-scan sonars, and multibeam depth sounders). The renewable energy scenario includes the possibility that a deep penetration (2D or 3D) seismic survey would be conducted to evaluate formation suitability for carbon sequestration. However, given the much greater number and extent of seismic airgun surveys included in the oil and gas scenario, a single seismic survey for carbon sequestration is not analyzed separately.

Appendix C, **Section 3.0** discusses the operational seismic and HRG survey protocols and mitigation measures that would be implemented during surveys, including ramp-up of airgun arrays, visual monitoring of an exclusion zone by protected species observers, and startup and shutdown requirements. The purpose of these operational measures is to prevent serious injury to marine mammals (and sea turtles) by ensuring that they are not present within an exclusion zone defined by a received SPL of 180 dB re 1 µPa. As shown in **Table 4-8**, this zone could extend up to 2,109 m (6,920 ft) from a large airgun array (5,400 in^3) and up to 186 m (610 ft) from a small airgun array (90 in^3). For electromechanical sound sources, the 180-dB isopleths could extend up to 192 m (630 ft) for an instantaneous, single pulse basis.

The initial 180-dB calculations for electromechanical sources as listed in **Table 4-8** were based on nominal source levels and did not take into account the pulse duration. However, the pulses produced by all of the electromechanical sources are much shorter than 1 s. As summarized by Au and Hastings (2008), when receiving tone pulses, the mammalian ear behaves like an integrator with an "integration time constant." Energy is summed over the duration of a pulse until the pulse is longer than the integration time constant. Studies of bottlenose dolphins by Johnson (1968) indicate an integration time constant of approximately 100 ms. A 10-ms pulse with a received SPL of 180 dB would be integrated over a 100-ms period, resulting in a 10-fold (10 dB) reduction. Using the assumption of a 100-ms integration time, the 180-dB radii were recalculated as explained in **Appendix D** to account for short pulse duration. For the boomer and multibeam depth sounder, the recalculated 180-dB radius was <5 m (16 ft) under all scenarios. The recalculated 180-dB radius ranged from 65 to 96 m (213 to 315 ft) for the side-scan sonar and from 26 to 35 m (85 to 115 ft) for chirp subbottom profiler.

The Level A harassment (injury) criterion is based on the potential for onset of TTS; this criterion is conservative because, as discussed above, available data indicate that injury may occur only at higher thresholds (see Southall et al., 2007 and **Appendix H**). If the operational survey protocols and mitigation measures were 100 percent successful in practice, then by definition all Level A harassment of marine mammals would be avoided because no marine mammals would be present within the exclusion zone. However, BOEM expects that operational survey protocols and mitigation measures would not be 100 percent effective, and so the potential exists to expose some individual marine mammals to sound levels exceeding the 180-dB criterion, which could result in temporary or permanent loss of hearing (i.e., TTS or PTS, or injury, representing Level A harassment). In this analysis, no lethal takes are expected in any case.

By definition, operational survey protocols and mitigation measures implemented during seismic airgun surveys would not completely prevent Level B harassment, which is currently defined by a received SPL of 160 dB re 1 µPa for impulse sources. As shown in **Table 4-8**, this zone could extend up to 15.3 km from a large airgun array (5,400 in^3). For the small airgun array (90 in^3), this zone could extend up to 2.5 or 3.1 km, depending on the geographic location and season modeled.

Calculations of incidental take to marine mammals from both seismic and non-seismic sound sources associated with the proposed action (Alternative A) scenario are presented in **Appendix E**. Incidental take calculations were made using the AIM©, which is a 4D, individual-based, Monte Carlo statistical model designed to predict the exposure of receivers to any stimulus propagating through space and time. The modeling used both the current NMFS criteria for Level A and Level B harassment, as well as the Southall et al. (2007) criterion for Level A harassment. The results of these analyses are summarized below. *Note: It is important to note that the results of the take estimate calculation process considered only sound source activity (i.e., sound source output, survey location and duration) and seasonal presence of marine mammals; operational survey protocols and mitigation measures* have not *been integrated into the take calculations outlined below.*

Activities associated with proposed G&G activitivities that involve the use of airguns to characterize the shallow and deep structure of the shelf, slope, and deepwater ocean environments are discussed in **Chapter 3**. These include both oil and gas exploration and development surveys and postlease HRG surveys of oil and gas leases. This analysis of potential impacts of seismic airgun surveys associated with these proposed activities to marine mammals within the AOI are based on estimates of total Level A and Level B incidental take from each of these seismic activities. Methods for the estimation of incidental take are provided in **Appendix E**, and the results are provided in the following tables:

- **Table 4-9**: Level A incidental take using Southall criteria;
- **Table 4-10**: Level A incidental take using historic NMFS criterion (180 dB SPL); and
- **Table 4-11**: Level B incidental take using historic NMFS criterion (160 dB SPL).

Level A Incidental Take Estimates

This analysis of potential Level A impacts to marine mammals from seismic airgun survey activities was based on the examination of combined seismic airgun survey activities is presented in **Tables 4-9** and **4-10**. It should be noted that oil and gas seismic airgun surveys would use other equipment, including subbottom profilers, side-scan sonars, and depth sounders; because these sources would be operating concurrently with the airguns, and airguns represent the highest energy source, it is reasonable to assume that there would be no additional take from the electromechanical sources operating concurrently.

Total incidental take estimates for proposed airgun seismic surveys using 180-dB criterion (Level A take) are presented in **Table 4-10**. These estimates of take do not factor in effects of mitigation methods associated with the Alternative A scenario. Level A take for all airgun seismic survey types has been predicted for all listed marine mammal species except the West Indian manatee and includes the following:

- sperm whale (30-310 individuals per [survey] year; total: 979 individuals for the project duration);
- humpback whale (1-11 individuals per year; total: 39 individuals for the project duration); and
- all other listed cetacean species (less than 9 individuals taken per year).

Level A take from airgun surveys are predicted for all nonlisted marine mammal species except the three pinnipeds (hooded seal, gray seal, and harbor seal). Because of the relative distributions and densities of nonlisted species within the AOI, Level A take estimates of nonlisted cetacean species are less than six individuals per survey year during the project period, except for the bottlenose dolphin (1,314-11,748 individuals), short-beaked common dolphin (707-6,146 individuals), and Atlantic spotted dolphin (641-5,848 individuals).

Level A incidental take estimates for airgun seismic surveys using the Southall et al. (2007) criterion are presented in **Table 4-9**. Incidental take is predicted for all listed species except the fin whale. Estimated take is less than one individual per survey year (beginning in 2013) except for the humpback whale (0-5.9 individuals), blue whale (0-1.6 individuals), and Bryde's whale (0-1.2 individuals). Level A take is predicted for all nonlisted cetacean species. Species with the highest estimates of take (>50 individuals per survey year) include the following outer continental shelf and slope species:

- Atlantic spotted dolphin (154-1,496 individuals per year);
- striped dolphin (86-1,020 individuals per year);
- Risso's dolphin (8-731 individuals per year);
- pantropical spotted dolphin (28-263 individuals per year);
- short-beaked common dolphin (1-225 individuals per year);
- short-finned pilot whale (2-151 individuals per year);
- Clymene dolphin (13-126 individuals per year); and
- long-finned pilot whale (1-117 individuals per year).

Level B Incidental Take Estimates

Table 4-11 presents estimates of total Level B (160-dB criterion) incidental take for all seismic airgun surveys. As noted previously, oil and gas seismic airgun surveys would use other equipment, including subbottom profilers, side-scan sonars, and depth sounders; because these sources would be operating concurrently with the airguns, and airguns represent the highest energy source, take calculations were not provided for other sources operating at the same time.

For listed species, total Level B take for all airgun seismic survey types has been predicted at levels of over 100 individuals per survey year (2013-2020) for all listed marine mammal species except the West Indian manatee. The sperm whale had the highest number of estimated annual Level B takes, ranging from 2,926 to 30,356 individuals during the survey period. Estimated annual Level B take of the North Atlantic right whale during this period ranges from 26 to 184 individuals.

Annual Level B take was predicted for all nonlisted marine mammal species except the three pinnipeds. Cetacean species with annual Level B take estimates over 100 individuals include both shelf and shelf edge-slope species, including dolphins, beaked whales, "blackfish" whales (a grouping composed of killer, pilot, false killer, and melon-headed whales and Risso's dolphin), and the harbor porpoise. Highest annual Level B take estimates are predicted for the following marine mammals:

- bottlenose dolphin (1,151,442 individuals);
- short-beaked common dolphin (602,424 individuals);
- Atlantic spotted dolphin (573,121 individuals);
- short-finned pilot whale (453,897 individuals);
- striped dolphin (391,376 individuals); and
- Risso's dolphin (311,717 individuals).

Conclusions

In review, from incidental take estimates associated with proposed seismic survey activities, it is likely that seismic airgun survey-related noise from G&G activities may impact individual and groups of marine mammals within the AOI, including listed and nonlisted cetacean species on the continental shelf, shelf edge, and slope. This analysis of impacts from seismic airgun surveys used a conservative estimation of take (i.e., under conditions where no survey protocols or mitigation measures are used) and predicted that no lethal impacts to either listed or nonlisted mammals would occur.

Incidental take calculations presented in **Tables 4-10** and **4-11** for seismic airgun survey-related noise may be conservatively overestimated. Level A and Level B take numbers that were calculated utilizing only 180-dB and 160-dB criteria, respectively, do not consider functional hearing sensitivity ranges for the various species and so assume that all of the species are equally sensitive to received sound frequencies and levels. As noted previously, baleen whales are believed to be low frequency specialists with best hearing sensitivity below 3 kHz (Ketten, 2000). Smaller odontocetes are most sensitive in the 30-120 kHz range (Au, 1993) and relatively insensitive to low frequency sounds (Au et al., 1997). It is assumed that baleen whales, in general, are more susceptible to low frequency anthropogenic sounds than are odontocetes (Ketten, 2000). Marine mammal species with the highest take estimates are the odontocetes (e.g., dephinids), all of which are mid- to high-frequency specialists and are relatively insensitive to low frequency sounds. Mid- and high-frequency specialists (e.g., delphinids) would be more susceptible to electromechanical sources than seismic sources.

Differences also exist between take calculations developed using SPL and SEL metrics. For example, AIM modeling results using Southall et al. (2007) criterion for Level A take estimated levels of less than one individual sperm whale per year. By comparison, using the 180-dB criterion, estimates of Level A sperm whale take were the highest of all the listed cetacean species. Furthermore, operational survey protocols (**Appendix C**, **Section 3.2**) that would be implemented to ensure that marine mammals are not present within the 180-dB exclusion zone around the sound source are not considered in either analysis (180-dB or Southall et al.). Although these measures are not assumed to be 100 percent effective, they are expected to significantly reduce the risk of Level A harassment to marine mammals.

Among the listed species, Level A take estimated using the 180 dB criterion would be highest (in decreasing order and without mitigation) for sperm, humpback, fin, blue, and sei whales, although individual annual takes would generally be <9 individuals except for sperm and humpback whales. North Atlantic right whale take estimates ranged from 1 to 2 individuals per year. The potential consequences of Level A harassment would be expected to include injury onset, specifically the onset of TTS. Physical injuries from seismic noise are assumed in this analysis to be limited to TTS or (in the worst case) PTS impairment of individuals or small groups of cetaceans. The onset of TTS may result in one or more impacts to an individual or small group. For example, decreased foraging success may be realized for those species that use sound in this capacity (i.e., sperm whales). The TTS also has the potential to decrease the range over which socially significant communication takes place (e.g., communication between competing males, between males and females during mating season, between mothers and offspring). It is generally recognized that the potential effects of TTS on the relative importance of these impacts are problematic only when exposures and resulting TTS are prolonged.

Level B take estimates suggest large numbers of cetaceans may experience non-injurious impacts from seismic airgun surveys during the project period. For example, Level B take of bottlenose dolphins are estimated at levels between 128,771 individuals (during 2015) to over one million individuals (during 2014). Given the estimated stock size of these populations (**Table 4-4**) and frequency of surveys outlined in Alternative A, it is likely that individual animals would experience multiple exposures over the course of the study period. It is presumed that these impacts would largely consist of harassment and, in the worst case, would elicit behavioral alterations such as avoidance or temporary displacement from areas of ensonification. The behavioral responses of marine mammals to acoustic stimuli vary widely, depending on the species, the context, the properties of the stimuli, and prior exposure of the animals (Wartzok et al., 2004). Species variability in the response to anthropogenic noise is also a factor, as distinctions need to be made between taxonomic groups that have widely different hearing and sensitivity frequencies (NRC, 2005). Seismic airgun surveys associated with the proposed activity are planned to occur in open ocean areas where these highly motile cetaceans may move freely to avoid the relatively slow-moving sound source and so would avoid exposure to injurious sound levels. The surveys would be performed in a systematic fashion along preplotted transects, so it is presumed that exposure to elevated sound would be somewhat localized and temporary in duration, but would affect a large number of individuals. Therefore, based on the results of this analysis and proposed mitigation measures, the effects of project-related seismic airgun survey noise on marine mammals within the AOI would be **moderate**. Most impacts would be limited to short-term disruption of behavioral patterns or displacement of individual marine mammals from discrete areas within the AOI, including both critical and preferred habitats.

Impacts of Non-Airgun HRG Surveys for Renewable Energy and Marine Minerals Sites

The HRG surveys for renewable energy and marine minerals sites are discussed in **Chapter 3**. Non-airgun equipment typically used in HRG surveys for renewable energy includes single beam and/or multibeam depth sounders, magnetometers, side-scan sonars, and shallow- or medium-penetration subbottom profilers (electromechanical sources). Detailed acoustic characteristics of electromechanical sources are discussed in **Appendix D**. Electromechanical sources are adjustable in terms of main operating frequency bands. The electromechanical sources can be considered narrow-band sources, as the acoustic energy emitted outside the main operating frequency band is negligible. Electromechanical sources can be highly directive, with beam widths as narrow as few degrees or less. Several electromechanical sound sources, including the 400-kHz side-scan sonar, 200-kHz chirp subbottom profiler, and 240-kHz multibeam depth sounder, would operate within a frequency range that is inaudible to cetacean species within the AOI. Other frequency outputs from several electromechanical sources would be audible to marine mammals in the AOI, including the 0.2-16-kHz boomer, 100-kHz side-scan sonar, and 3.5- and 12-kHz chirp subbottom profilers.

This analysis of potential impacts of non-airgun HRG surveys associated with proposed activities to marine mammals within the AOI are based on estimates of total Level A and Level B incidental take from each activity. Methods for the estimation of incidental take are provided in **Appendix E**, and the results are provided in the following Tables:

- **Table 4-12**: Level A incidental take using Southall criteria;
- **Table 4-13**: Level A incidental take using historic NMFS criterion (180 dB SPL); and
- **Table 4-14**: Level B incidental take using historic NMFS criterion (160 dB SPL).

Level A Incidental Take Estimates

Incidental take estimates for proposed non-airgun HRG surveys using 180-dB criterion (Level A take) are listed in **Table 4-13**. Level A take was predicted for all listed marine mammal species except the West Indian manatee at levels of less than one individual per year. Modeling results also predict Level A harassment for all nonlisted species except the three pinnipeds. Take estimates for non-listed cetacean species are less than one individual per survey year except for the following species:

- bottlenose dolphin (<1-6 individuals);
- Atlantic spotted dolphin (<1-5 individuals);
- short-beaked common dolphin (<1-4 individuals); and
- short-finned pilot whale, Risso's dolphin, and striped dolphin (<1-2 individuals).

Level A incidental take estimates for non-airgun HRG surveys using the Southall et al. (2007) criterion are listed in **Table 4-12**. Level A take is predicted for all listed species except the humpback whale and the manatee, and estimated at levels of less than one individual per year. Level A take using the Southall et al. (2007) criterion is predicted for all nonlisted marine mammal species except the long-finned pilot whale, northern bottlenose whale, Atlantic white-sided dolphin, and the three pinniped species. Estimated take levels were less than one individual per year except for rough-toothed dolphin (<1-26 individuals), Atlantic spotted dolphin (<1-7 individuals), short-beaked common dolphin (<1-5 individuals), and Risso's dolphin and bottlenose dolphin (<1-2 individuals).

Differences in Level A incidental take estimates using 180-dB and Southall et al. (2007) criteria are because of both individual species density differences within modeled sites within the AOI and their functional hearing groups. As discussed above, all take estimates do not take into account the efficiency of operational mitigation measures designed to ensure that listed marine mammals are not present within the 180-dB radius exclusion zone around the sound source (**Appendix C**, **Section 3.0**). Therefore, it is expected that values for Level A incidental take presented in **Appendix E** are overestimated.

Level B Incidental Take Estimates

From **Table 4-14**, AIM modeling estimated non-airgun HRG survey Level B take estimates for all listed marine mammal species except the manatee at levels of less than one individual per year for all species except the sperm whale. The sperm whale was predicted to have Level B harassment takes ranging from less than one individual during the proposed activities from 2012-2017 to levels of 4-12 individuals from 2018-2020. Level B take was estimated for all nonlisted marine mammal species, except the pinniped species. Highest annual Level B take estimates (above 50 individuals per survey year) are predicted for the bottlenose dolphin (631 individuals), Atlantic spotted dolphin (490 individuals), short-beaked common dolphin (379 individuals), short-finned pilot whale (227 individuals), Risso's dolphin (170 individuals), and striped dolphin (155 individuals).

Conclusions

In conclusion, it is possible that noise from non-airgun HRG surveys for renewable energy and marine minerals sites may impact individual marine mammals within the AOI, primarily because of the location of surveys (i.e., renewable energy and marine minerals surveys in water depths <100 m [328 ft] and <30 m [98 ft], respectively), the high densities of delphinids in nearshore waters, and the overlap in source frequencies and hearing thresholds. In this analysis, there are no lethal impacts predicted and Level A incidental take estimates of most species are less than one individual per year. The highest level of annual Level A take from non-airgun HRG surveys (using the 180-dB criterion) includes six individual bottlenose dolphins. As in the case of seismic airgun–related take estimates, Level A incidental take calculations presented in **Tables 4-12** and **4-13** for non-airgun HRG survey-related noise may be conservatively overestimated. Level A take estimates that were calculated utilizing only the 180-dB criterion do not consider functional hearing sensitivity ranges for the various species and so assume that all of the species are equally sensitive to received sound frequencies and levels. Operational mitigation measures would also be implemented during HRG surveys to ensure that marine mammals are not present within an exclusion zone around the sound source, both prior to and during its operation (**Appendix C**). These mitigative measures are also expected to significantly reduce Level B incidental take, assuming selective avoidance of the sound source by individual animals and operations within an open ocean environment. Other mitigation measures provided within the proposed action scenario include time-area closures for all G&G-related activities using airguns within the North Atlantic right whale critical habitat and SMAs and case-by-case review of other (non-airgun) surveys for renewable energy and marine minerals within critical habitat area and U.S. SMAs. The closure of these areas from G&G activities using airguns is designed to further protect the critically endangered North Atlantic right whale, both during seasonal migrations and its winter calving period.

Based on the results of this analysis and proposed mitigation measures, the effects of project-related non-airgun HRG survey noise on marine mammals within the AOI are expected to be **minor**. Physical injuries from HRG-related seismic noise are assumed in this analysis to be limited to TTS or (in the worst case) PTS impairment of individuals or small groups of cetaceans. Most impacts would be limited to short-term disruption of behavioral patterns or displacement of individual marine mammals from discrete areas within the AOI, including both critical and preferred habitats.

Vessel and Equipment Noise

The G&G activities in all three program areas would generate vessel and equipment noise that could disturb marine mammals. The types of sound produced by these sources are nonpulsed, or continuous. The current acoustic sub-injurious threshold established by NMFS for continuous sounds is 120 dB_{rms} re 1 μPa. This threshold was based on avoidance responses observed in whales, specifically from research on migrating gray whales and bowhead whales (Malme et al., 1983, 1984, 1988; Richardson et al., 1986, 1990; Richardson and Malme, 1993; Dahlheim and Ljunblad, 1990).

As discussed in **Chapter 3.5.1.2**, vessel noise is a combination of narrow-band (tonal) and broadband sound (Richardson et al., 1995). Tones typically dominate up to about 50 Hz, whereas broadband sounds may extend to 100 kHz. The dominant source of noise from vessels is from the propeller operation, including cavitation, singing, and propulsion, and the intensity of this noise is largely related to ship size and speed. Vessel and equipment noise from G&G vessels, including survey and support vessels associated with activities described in the proposed action, would produce low levels of noise. Broadband source levels for most small ships (a category that would include seismic survey vessels and support vessels for drilling of COST wells or shallow test wells) are anticipated to be in the range of 170-180 dB re 1 μPa at 1 m and source levels for smaller boats (a category that would include survey vessels for renewable energy and marine minerals sites) are in the range of 150-170 dB re 1 μPa at 1 m (Richardson et al., 1995). These noise levels are within the audible range for all cetacean and pinniped species and, near the source, exceed NMFS threshold for Level B harassment by continuous sound sources. As discussed in **Chapter 3.5.1.3.1**, seismic survey vessels conducting 2D and 3D seismic airgun surveys are large in size and would account for most of the line miles traveled, and these surveys could occur anywhere within the AOI. Vessels conducting G&G surveys or sampling for renewable energy would be smaller and operate mainly at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Similarly, vessels conducting G&G surveys or sampling for marine minerals would be operating mainly at specific borrow sites in water depths less than 30 m (98 ft). Survey vessels for renewable energy and marine minerals projects are expected to make daily round trips to their shore base, whereas the larger seismic vessels can remain offshore for weeks or months. It is anticipated that one to three diesel-powered survey and support vessels would be associated with any specific G&G activity. For this analysis, it is expected that the proposed additional volume of vessel traffic would not constitute a significant increase to existing vessel traffic within the AOI.

The effects of noise produced by moving geophysical survey and support vessels on marine mammals are difficult to assess because of the wide array of reports of their observed behavioral responses, both between and among species. Several species of small toothed cetaceans have been observed to avoid boats when they are approached to within 0.5-1.5 km (0.3-0.9 mi), with occasional reports of avoidance at greater distances (Richardson et al., 1995). Reports of responses of cetacean species to moving power vessels are variable, both between species and temporally. Most beaked whales tend to avoid approaching vessels (e.g., Würsig et al., 1998) and may dive for an extended period when approached by a vessel (e.g., Kasuya, 1986). Northern bottlenose whales (*Hyperoodon ampullatus*), on the other hand, are sometimes quite tolerant of slow-moving vessels (Reeves et al., 1993; Hooker et al., 2001). Dolphins may tolerate boats of all sizes, often approaching and riding the bow and stern waves (Shane et al., 1986). At other times, dolphin species that are known to be attracted to boats will avoid them. Such avoidance is often linked to previous boat-based harassment of the animals (Richardson et al., 1995). Coastal bottlenose dolphins that are the object of whale watching activities have been observed to swim erratically (Acevedo, 1991), remain submerged for longer periods of time (Janik and Thompson, 1996; Nowacek et al., 2001), display less cohesiveness among group members (Cope et al., 1999), whistle more frequently (Scarpaci et al., 2000), and be restless often (Constantine et al., 2004) when boats were nearby. Pantropical spotted dolphins (*Stenella attenuata*) and spinner dolphins (*S. longirostris*) in the eastern tropical Pacific, where they have been targeted by the tuna fishing industry because of their association with these fish, show avoidance of survey vessels up to 11 km (6 nmi) away (Au and Perryman, 1982; Hewitt, 1985), whereas spinner dolphins in the Gulf of Mexico were observed bowriding the survey vessel in all 14 sightings of this species during one survey (Würsig et al., 1998). Harbor porpoises tend to avoid boats. In the Bay of Fundy, Polacheck and Thorpe (1990) found harbor porpoises to be more likely to be swimming away from the transect line of their survey vessel than swimming toward it and more likely to be heading away from the vessel when they were within 400 m (1,312 ft) of it. Similarly, off the west coast of North America, Polacheck and Thorpe (1990) observed harbor porpoises avoiding a survey vessel by moving rapidly out of its path within 1 km (0.6 mi) of that vessel.

From these reports, it is conservative to assume that noise associated with geophysical survey vessels may, in some cases, elicit behavioral changes in individual marine mammals that are in close proximity to these vessels. These behavioral changes may include evasive maneuvers such as diving or changes in swimming direction and/or speed. Vessel and equipment noise is transitory and generally does not propagate at great distances from the vessel. For a majority of the time that seismic vessels are underway, they would be operating their airguns or other active acoustic sound sources; under these conditions, Level B take numbers have already been accounted for. During those periods when non-seismic vessels are operating, or when seismic vessels have shut down their airguns, the potential for behavioral impacts from vessel and equipment noise remains. Under the proposed action, all authorizations for shipboard surveys would include guidance for maintaining safe distances between G&G vessels and protected species to minimize potential impacts from vessel and equipment noise and the avoidance of vessel collisions with these protected species. The guidance would be similar to Joint BOEM-BSEE NTL 2012-G01 ("Vessel Strike Avoidance and Injured/Dead Protected Species Reporting"), which incorporates NMFS "Vessel Strike Avoidance Measures and Reporting for Mariners" addressing protected species identification, vessel strike avoidance, and injured/dead protected species reporting (USDOI, BOEM and BSEE, 2012a). For the proposed activities, is is assumed that this guidance should avoid or minimize potential negative impacts to marine mammals from both the presence of vessels and the noise they produce. The proposed action also includes a time-area closure for all G&G surveys using airguns in the right whale critical habitat area and in the Mid-Atlantic and Southeast SMAs for the North Atlantic right whale from November 15 through April 15. Authorization for HRG (non-airgun) surveys for renewable energy and marine minerals in critical habitat area and SMAs may include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. These measures are expected to reduce vessel-related noise impacts to this species during its seasonal migration and calving/nursing periods. Based on the proposed volume of vessel traffic associated with project activities within the AOI and the presumption that marine mammals within the AOI are familiar with various and common vessel-related noises, the effects of project-related vessel and equipment noise on marine mammals within the AOI would be **negligible** to **minor**.

Other sound sources associated with the proposed activity include drilling-related noises during the completion of up to three COST wells and up to five shallow test wells in the Mid- or South Atlantic Planning Areas during the time period of the Programmatic EIS. As discussed in **Chapter 3.5.1.2**, noise from drilling operations includes strong tonal components at low frequencies (<500 Hz), including infrasonic frequencies in at least some cases (Richardson et al., 1995). Machinery noise can be continuous or transient, and variable in intensity. Noise levels vary with the type of drilling rig and the water depth. Drilling-related noise from jack-up platforms is continuous and generally of very low frequencies (near 5 Hz), and therefore expected to be within the audible range of only baleen whales. Sound source levels of drilling from jack-up platforms may range from 119 to 127 dB re 1 μPa at nearfield locations. Drilling-related noises from semi-submersible platforms in deeper waters ranges in frequencies from 10 to 4,000 Hz, and therefore audible to all cetacean and pinniped species within the AOI. Drilling sound source levels from semi-submersible platforms are estimated at 154 dB re 1 μPa-m. Source levels for drillships have been reported to be as high as 191 dB re 1 μPa during drilling. It is expected that marine mammals would detect drilling-related noises within a radius of audibility. The range of audibility radii is based on the sound source level and local attenuation from factors such as water depth, seafloor characteristics, and sea state conditions. Based on the 120dB_{rms} re 1 μPa acoustic sub-injurious threshold established by NMFS for continuous sounds, it is expected that jack-up drilling operations would affect only baleen whales, and semi-submersible rigs would affect all marine mammal species within the 120-dB acoustic radii; for 154-dB source levels from a semisubmersible

(**Chapter 3.5.1.2.2**), the 120-dB radius would be 50 m. It is expected that these sources of noise would elicit alterations of behavior, i.e., changes in swimming direction or speed. However, studies indicate that the sensitivity of marine mammals to drilling sound varies between and within species (Richardson et al., 1990).

There are few drilling operations associated with the proposed activity (up to three COST wells and up to five shallow test wells). Mitigation measures associated with Alternative A of this analysis state that drilling operations (as well as surveys involving seismic sources (airguns)) would not be authorized within within critical habitat area and the Mid-Atlantic and Southeast United States' SMAs for the North Atlantic right whale during the times when vessel speed restrictions are in effect under 50 CFR 224.105. With these measures in place, most impacts on North Atlantic right whales (the baleen whale species most likely to regularly occur within inner shelf waters of the AOI) are expected to be avoided by the time-area closure. Although North Atlantic right whales could occur anywhere within the AOI, they are most likely to be found in the calving/nursery areas during the winter months and/or near the coast along their migratory corridor (Knowlton et al., 2002). Considering the low number of drilling operations, the continuous nature of sounds produced during drilling operations, and the mitigation measures in place for Alternative A, it is expected that impacts from drilling operations would be **minor**.

Vessel Traffic

Many marine mammal species may be vulnerable to physical disturbance from or collisions (ship strike) with moving vessels (Laist et al., 2001; Douglas et al., 2008; Pace, 2011). Most reports of collisions involve large whales, but collisions with smaller species also occur (van Waerebeek et al., 2007). Laist et al. (2001) provides records of the following vessel types associated with collisions with whales (listed in descending order): tanker/cargo vessels; whale watch vessels; passenger liners; ferries; naval vessels; recreational vessels; USCG vessels; fishing vessels; research vessels; dredges; and pilot boats. Most severe and lethal whale injuries involved large ships of lengths greater than 80 m (262 ft). Vessel speed was also found to be a significant factor, with most (89%) of the records involving vessels moving at 14 kn (26 km/hr) or greater. There are reports of collisions between moving vessels and most of the listed species that occur within the study area, particularly the fin whale (IWC, 2011b). Collision with vessels is the leading human-caused source of mortality for the endangered North Atlantic right whale (USDOC, NMFS, 2005). Their slow movements, time spent at the surface, and time spent near the coast make them highly vulnerable to being struck by ships.

Marine mammal species of concern for possible ship strike with all vessels operating at speed include primarily slow-moving species (e.g., North Atlantic right whales) and deep-diving species while on the surface (e.g., sperm whales, pygmy/dwarf sperm whales, and beaked whales). Generally, it is assumed that the probability of this encounter, and thus impact, is very low. However, vessel operations within areas such as the North Atlantic right whale critical habitat and migration corridor during calving and nursing or migration periods may increase the probability of ship strike with this species. Certain cetacean species, including bottlenose dolphin and other dolphin species (e.g., *Stenella* spp.), actively approach vessels moving at speed to swim within the pressure wave produced by the vessel's bow.

Under the proposed action, all authorizations for shipboard surveys would include guidance for vessel strike avoidance similar to Joint BOEM-BSEE NTL 2012-G01 ("Vessel Strike Avoidance and Injured/Dead Protected Species Reporting"), which incorporates NMFS "Vessel Strike Avoidance Measures and Reporting for Mariners" addressing protected species identification, vessel strike avoidance, and injured/dead protected species reporting (USDOI, BOEM and BSEE, 2012a). The guidance also incorporates elements of NMFS Compliance Guide for the Right Whale Ship Strike Reduction Rule (50 CFR 224.105), which limits vessel speed to 10 kn (18.5 km/h) in the Mid-Atlantic and Southeast U.S. SMAs for North Atlantic right whales during migration. Vessel speed restrictions in these areas are in effect between November 1 and April 30 in the Mid-Atlantic and between November 15 and April 15 in the Southeast U.S. With these mitigation measures in place, G&G survey vessels are unlikely to strike marine mammals. Seismic vessels, which account for most of the project-related vessel traffic associated with Alternative A activities, survey at a speed of approximately 4.5 kn (8.3 km/hr). In addition, waters surrounding survey vessels on survey would be monitored by protected species observers for the presence of marine mammals. During transit to and from shore bases, seismic vessels and other G&G survey vessels are expected to travel at greater speeds. However, as noted above, these vessel movements would be subject to joint BOEM-BSEE guidance for vessel strike avoidance and be required to reduce speed in certain areas to comply with the Right Whale Ship Strike Reduction Rule.

In this analysis, the likelihood of a collision between a project-related vessel and a marine mammal within the AOI is considered to be very low because of several factors: relatively low vessel speeds (particularly within seasonal restricted areas and inshore waterways), the presence of protected species observers on board certain survey vessels, and adherence to vessel operations guidelines for avoidance of vessel strikes with listed species. Under these conditions, vessel collisions with marine mammals would be avoided and impacts would be **negligible**. In the unlikely event a collision did occur, its impact would depend upon the number of individuals and the population status of the species affected. The impact would be most severe if the continued viability of the population was seriously threatened, including serious diminishment of annual rates of recruitment or survival. However, it is very unlikely that a collision between a survey vessel and marine mammal would occur. Interactions between marine mammals attracted to project-related vessel traffic are not considered to constitute a negative impact.

Aircraft Traffic and Noise

Remote sensing surveys associated with oil and gas exploration and development activities would include aeromagnetic surveys (**Chapter 3.2.2.6.5**) and the installation of COST and shallow test wells (**Chapter 3.2.2.4**). The BOEM anticipates that one or two aeromagnetic surveys may be conducted in the AOI during the time period covered by the Draft Programmatic EIS. As discussed in detail in **Chapter 3.5.1.4**, the surveys would be conducted by fixed-wing aircraft flying at speeds of about 250 km/hr (135 kn) (Reeves, 2005). Most offshore aeromagnetic surveys are flown at altitudes between 61 and 152 m (200-500 ft). Line spacing varies depending on the objectives, but typical grids are 0.5 by 1.0 mi or 1.0 by 1.0 mi. It is expected that a typical aeromagnetic survey may require 1-3 months to complete. In addition, helicopters are a potential source of aircraft noise during drilling of COST wells and shallow test wells. The oil and gas scenario assumes that up to three COST wells and up to five shallow test wells would be drilled in the Mid- or South Atlantic Planning Areas during the time period of the Programmatic EIS. It is expected that drilling activities would be supported by a helicopter making one round-trip daily between the drilling rig and onshore support base.

Potential IPFs to marine mammals from aircraft traffic and noise include noise and physical (visual) disturbance. Noises generated by project-related aircraft that are directly relevant to marine mammals include both airborne sounds to individual mammals resting on the sea surface and underwater sounds from air-to-water transmission from passing aircraft. Both helicopters and fixed-wing aircraft generate noise from their engines, airframe, and propellers. The dominant tones for both types of aircraft are generally below 500 Hz (Richardson et al., 1995) and is within the within the auditory range of all marine mammals (**Appendix H**). Richardson et al. (1995) reported received sound pressure levels (in water) from aircraft flying at altitudes of 152 m (500 ft) were 109 dB re 1 μPa for a Bell 212 helicopter and 101 dB re 1 μPa for a small, fixed-wing aircraft (B-N Islander). Helicopters are about 10 dB louder than fixed-wing aircraft of similar size (Richardson et al., 1995). Penetration of aircraft noise into the water is greatest directly below the aircraft; at angles greater than 13º from the vertical, much of the sound is reflected and does not penetrate into the water (Richardson et al., 1995). The duration of underwater sound from passing aircraft is much shorter in water than air; for example, a helicopter passing at an altitude of 152 m (500 ft) that is audible in air for 4 min may be detectable underwater for only 38 s at 3 m (10 ft) depth and for 11 s at 18 m (59 ft) depth (Richardson et al., 1995). Levels of noise received underwater from passing aircraft depend on the aircraft's altitude, the aspect (direction and angle) of the aircraft relative to the receiver, receiver depth and water depth, and seafloor type (Richardson et al., 1995). Because of the relatively high expected airspeed (250 km/hr [135 kn]) and these physical variables, aircraft-related noise (including both airborne and underwater noise) is expected to be brief in duration.

The physical presence of low-flying aircraft can disturb marine mammals, particularly individuals resting on the sea surface. Observations made from low altitude aerial surveys report behavioral responses of marine mammals are highly variable and range from no observable reaction to diving or rapid changes in swimming speed or direction (Efroymson et al., 2002; Smultea et al., 2008). Minke whales have responded to helicopters at an altitude of 230 m (750 ft) by changing course or slowly diving (Leatherwood et al., 1982). Observational data of marine mammals exposed to sound from other sources (i.e., non-aircraft) may also be relevant in evaluating aircraft-based noise exposure impacts. For example, Frankel and Clark (1998) note that humpback whales exposed to low frequency sound may be responding to features of the source of the sound such as sound gradient or changes in the frequency spectrum rather than to the level itself.

Considering the relatively low numbers of aeromagnetic surveys and the low number of COST and shallow test wells associated with the proposed activity, along with the short duration of potential exposure of aircraft–related noise and physical disturbance to marine mammals because of survey airspeed, it is expected that effects are restricted to behavioral disruptions. Potential impacts from this activity are expected to be **negligible** to **minor**.

Trash and Debris

Lost and discarded marine debris, particularly those items made of synthetic materials, is a major form of marine pollution. The types of objects most commonly encountered in offshore waters include plastic bags, wrappers, bottles, cups, and raw plastic pellets; synthetic rope; glass bottles; metal cans; lumber; and cigarette butts (Laist, 1996, 1997; Barnes et al., 2009; Gregory, 2009). Factors that account for recent increases in marine debris include unlawful disposal practices, proliferation of synthetic materials that are resistant to degradation in the marine environment, and increasing numbers of people using and disposing of more synthetic items. Marine debris poses two types of potentially negative impacts to marine biota, including marine mammals: (1) entanglement, and (2) ingestion. Records suggest that entanglement is a far more likely cause of mortality to marine mammals than ingestion-related interactions. Entanglement records for marine mammals show that entanglement is most common in pinnipeds, less common in mysticete cetaceans, and rare among odontocete cetaceans (Laist et al., 1999). Entanglement data for mysticete cetaceans may reflect a high interaction rate with active fishing gear rather than with marine debris. Abrasion and chafing scars from rope and line have been reported on numbers of photographed North Atlantic right whales in the western North Atlantic. These scars were attributed to entanglement in fishing gear (USDOC, NMFS, 2005). Entanglement records for odontocete cetaceans that are not clearly related to bycatch in active fisheries are almost absent (Laist, 1996).

G&G survey operations generate trash made of paper, plastic, wood, glass, and metal. Most of this trash is associated with galley and offshore food service operations. The discharge of trash and debris is prohibited (33 CFR 151.51-77) unless it is passed through a comminutor (a machine that breaks up solids) and can pass through a 25-mm mesh screen. All other trash and debris must be returned to shore for proper disposal with municipal and solid waste. Some personal items, such as hardhats and personal flotation devices, are occasionally accidentally lost overboard. However, USCG and USEPA regulations require operators to become proactive in avoiding accidental loss of solid waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. Under the proposed action, all authorizations for offshore G&G activities would include guidance for the handling and disposal of marine trash and debris, similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012).

Taking into account the USCG and USEPA regulations and BSEE guidance, it is unlikely that significant amounts of trash and debris from G&G activities would be released into the marine environment. Therefore, debris entanglement and ingestion impacts on marine mammals are expected to be **negligible**.

4.2.2.3. Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes a diesel spill ranging from 1.2 to 7.1 bbl. Spills occurring at the ocean surface would disperse and weather. Volatile components of the fuel would evaporate. Fuel and diesel used for operation of survey vessels is light and would float on the ocean surface. There is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink.

Marine mammals could be affected by accidentally spilled diesel fuel from a vessel associated with project activities. Effects of spilled oil on marine mammals are discussed by Geraci and St. Aubin (1980, 1982, 1985, 1990) and Lee and Anderson (2005), as well as within spill-specific study results (e.g., *Exxon Valdez*; Frost and Lowry, 1994; Paine et al., 1996; Hoover-Miller et al., 2001; Peterson et al., 2003). Quantities of diesel fuel on the sea surface may affect marine mammals through various pathways: surface contact of the fuel with skin and other mucous membranes, inhalation of concentrated petroleum vapors, or ingestion of the fuel (direct ingestion or by the ingestion of oiled prey). As discussed in **Chapter 3.5.2.1**, the likelihood of a fuel spill during G&G activities is considered to be remote, and the potential for impacts to marine mammals would depend greatly on the size and location of a spill, and meteorological conditions at the time of the spill.

It is assumed that spilled fuel would rapidly spread to a layer of varying thickness and break up into narrow bands or windrows parallel to the wind direction. The rate at which the fuel spreads would be determined by the prevailing conditions such as temperature, water currents, tidal streams, and wind speeds. Lighter, volatile components of the fuel would evaporate to the atmosphere almost completely in a few days. Evaporation rate may increase as the oil spreads because of the increased surface area of the slick. Rougher seas, high wind speeds, and high temperatures also tend to increase the rate of evaporation and the proportion of oil lost by this process (American Petroleum Institute, 1999; USDOC, NOAA, 2006).

An accidental diesel fuel spill adjacent to or within the North Atlantic right whale critical habitat during the winter calving period may result in the direct contact of the spilled fuel with both adult and newly born whales. It is presumed but not substantiated that the animals would avoid areas with heavy fuel sheen, and the fuel would disperse and weather rapidly. Impacts from this event are not likely to seriously injure individual whales and thus are expected to be **minor**. Fuel spills in other areas of the AOI are expected to result in **negligible** to **minor** impacts to marine mammals.

4.2.2.4. Cumulative Impacts

The cumulative impacts scenario (**Chapter 3.6**) includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation, including research vessels; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea.

The IPFs for these cumulative activities that may affect marine mammals include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, dredges, vessel traffic, and other active sound sources; (2) discharges of drilling fluid, produced water, and other effluents from drilling rigs; (3) the physical presence of offshore structures; (4) accidental releases of trash and debris; (5) vessel collisions; (6) depletion of prey species from fishing pressure; (7) interactive effects of climate change, including impacts on preferred habitats and food sources; and (8) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Among the IPFs identified above for the cumulative impacts scenario, six sources of potential impacts to marine mammals have been identified in association with proposed G&G activities, including (1) underwater noise; (2) vessel and equipment noise; (3) vessel traffic and collisions; (4) aircraft traffic and noise; (5) trash and debris; and (6) accidental fuel spills.

Impact analyses presented in **Chapters 4.2.2.2** and **4.2.2.3** determined that activities projected to occur under Alternative A would result in **negligible** or **minor** impacts to marine mammals. The determination of noise-related impacts to marine mammals was made with the assumption that seismic survey protocols and associated mitigation measures would prevent the lethal take of any marine mammal through noise exposure. The determination of vessel traffic impacts was based on the very low likelihood of vessel strikes on marine mammals. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Underwater Noise Including Active Acoustic Sound Sources

For the purposes of this analysis, and in consideration of the documented increases in marine transportation volumes along the U.S. Atlantic coast, it is assumed that underwater noise from vessel traffic and other anthropogenic sources within the AOI is increasing (Jensen et al., 2009). Most ambient underwater noise is broadband, encompassing virtually the entire frequency spectrum. Vessel traffic is recognized as a major contributor to anthropogenic ocean noise, primarily in the low frequency bands between 5 and 500 Hz. Naturally occurring noise such as spray and bubbles from breaking waves is also a major contributor to ambient noise, primarily in the 500-100,000-Hz range. Impacts associated with the cumulative activities scenario, such as vessel and aircraft noise, are predicted to fall predominantly within the negligible impacts category; localized, short-term minor noise impacts might be realized in association with specific military activities (e.g., sonars, explosives), however, available mitigation measures (e.g., observation and clearance of safety zones) should minimize noise impacts from these active acoustic sources. These safety zone guidelines are specific to each activity (e.g., explosive testing or military sonar testing) and are required by regulatory agencies (NMFS and FWS) prior to each activity.

Noise from G&G operations would be survey- or activity-based and so would occur on a transient and intermittent basis over the period of interest. Impacts to marine mammals from underwater noise produced from sound sources associated with proposed G&G activities would be **minor** (**Chapter 4.2.2.2**). Active acoustic noise sources including seismic survey noise, sound sources associated with HRG surveys for renewable energy and marine minerals sites, and G&G vessel and equipment noise from activities associated with the proposed action would contribute to overall ambient noise levels within the AOI. Underwater noise associated with the proposed action would be similar to the existing underwater noise under the cumulative scenario (e.g., vessel and equipment noise, sonars, active sound sources). As a result, there would be substantial yet localized increases in ambient noise levels within specific portions of the AOI during G&G operations, resulting primarily in Level B harassment takes of individual mammals in proximity of ongoing active acoustic sound source surveys.

Considering the inclusion of mitigation measures under Alternative A, including seasonal time-area closures to protect North Atlantic right whales within their designated critical habitat and select areas within their migration route and calving and nursery grounds (U.S. SMAs), as well as seismic survey protocols (including visual monitoring for both seismic airgun surveys and non-airgun HRG surveys, and acoustic sound source ramp-up procedures for all surveys using airguns), it is anticipated that most Level A take impacts to marine mammals would be avoided. With these mitigation measures in place, most Level A takes should be eliminated. The potential for these takes would remainbecause of the uncertainty of the effectiveness of these mitigation measures. No mortalities of either listed or nonlisted species were predicted from the analysis. Level B takes, constituting behavioral responses to noise exposure, would be reduced but not eliminated as a result of seismic survey protocols and associated mitigation measures. Because there are no significant noise impacts evident from the cumulative activities scenario, and there is no evidence of ambient noise levels approaching a threshold level where marine mammals might be significantly affected, impacts to marine mammals from noise associated with the proposed action would result in a minor incremental increase in ambient noise levels under the cumulative scenario.

Vessel Traffic

For the purposes of this analysis, it is expected that recent trends showing increases in marine transportation and shipping levels at U.S. east coast ports will continue and that overall vessel traffic within the AOI will increase during the period of interest (Ward-Geiger et al., 2005). Increases in vessel traffic increase the likelihood of vessel-marine mammal interactions, including vessel strikes.

Vessel traffic associated with G&G operations would involve relatively small numbers of survey-related vessels operating within offshore waters on a transient and intermittent basis over the period of interest. From the analysis of routine operations associated with the proposed action, it was concluded that the probability for G&G survey or support vessel collisions with most marine mammal species is unlikely, considering the relatively slow speeds of G&G survey vessels and the speed and agility of most marine mammal species, particularly within an open ocean environment. However, certain slow-moving species such as the North Atlantic right whale or deep-diving species that may spend periods of time resting on the sea surface may be at somewhat greater risk for collisions with moving vessels.

It is expected that the likelihood of a collision between a project-related vessel and a marine mammal within the AOI is very low, considering the low number of G&G survey vessels (relative to overall vessel traffic) and their relatively low speed of travel, the presence of protected species observers on board certain survey vessels, and adherence to vessel operations guidelines for avoidance of vessel strikes with listed species. Impacts to marine mammals from vessel traffic and collision were expected to be

negligible. From this analysis, it is expected that vessel traffic associated with the proposed action would result in a minor incremental increase in the potential for vessel collisions with marine mammals under the cumulative scenario.

Aircraft Traffic and Noise

Remote sensing surveys associated with oil and gas exploration and development activities would include an unspecified number of aeromagnetic surveys, each of which is conducted using fixed-wing aircraft flying at an altitude between 61-152 m (200-500 ft) and at speeds of about 250 km/hr (135 kn). Potential IPFs to marine mammals from aeromagnetic survey aircraft include noise and physical (visual) disturbance. Impacts to marine mammals from aircraft traffic and noise were expected to range from **negligible** to **minor**. It is expected that these surveys would add a negligible amount of aircraft flight activity to the overall volume of aircraft traffic within the AOI. Because of the relatively low number of surveys within the AOI and the high relative speed of the aircraft, survey aircraft-related noise (including both airborne and underwater noise) is expected to be limited to few geographic areas and brief in duration. It is expected that aircraft traffic associated with the proposed action would result in a negligible increase in potential impacts to marine mammals under the cumulative scenario.

Trash and Debris

The release of trash and debris into offshore waters potentially may occur from any of the activities identified in the cumulative activities scenario. Vessel operators, crew, and personnel present on offshore structures, are expected to comply with the requirements of Federal regulations, which incorporate the requirements of MARPOL 73/78, including Annex V. In addition, all authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012). Compliance with Federal regulations, which include MARPOL requirements and BSEE guidance, ensures that the volume of trash and debris that may be intentionally dumped offshore is very limited. Impacts to marine mammals from cumulative activities within the AOI are expected to be **negligible**.

The G&G vessel operations would operate under Federal regulations, which incorporate MARPOL and Annex V trash and debris disposal restrictions. The G&G activities conducted under the proposed action would potentially add a very small amount of accidentally released trash and debris into offshore waters. Therefore, the accidental release of trash or debris during G&G activities would result in a minor incremental increase in ambient levels of trash and debris within the AOI. Only minor incremental increases in impacts to marine mammals are expected from the accidental release of trash and debris under the cumulative scenario.

Accidental Fuel Spills

The cumulative scenario considers a significant volume of overall vessel traffic, particularly around ports along the U.S. eastern seaboard. All vessel movements are associated with a risk of collision or grounding with a subsequent loss of fuel into offshore or nearshore waters. The relative contribution from an accidental fuel spill from a vessel collision under the proposed action to the cumulative scenario is expected to be minor.

The likelihood of a diesel fuel spill during G&G activities is considered to be remote and the associated impacts to marine mammals are expected to range from negligible to minor, depending on a series of factors, including whether spilled diesel fuel directly contacts individual animals, the quantity of fuel encountered, the degree of weathering to which the fuel has been exposed, and duration of contact. It is reasonable to assume that the potential for fuel spills from vessels involved in the cumulative activities scenario would be considerably higher than that expected from vessels associated with activities under the proposed action because of the relative magnitude of overall vessel activity in the AOI when compared to G&G activities. Therefore, the incremental increase in potential for accidental fuel spills arising from vessel collision during G&G activities would be expected to be extremely small. Based on the low probability of a G&G activity-related fuel spill during the period of interest, the incremental increase in diesel spill-related impacts to marine mammals under the cumulative scenario is expected to be minor.

Chapter 3.6.1 outlines the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts on marine mammals would vary, depending on factors such as geographic location (including distance from shore), the time of year, and the size of the spill. It is expected that spill plans would be developed and approved during the applicable lease sale and spill response infrastructure would be in place prior to drilling activities. Impacts from an accidental spill within the AOI from project-related drilling activities are expected to be negligible if no animals were contacted by the spilled oil. If contact with spilled oil resulted in the loss of life or life-threatening injury to an individual or group(s) of marine mammals, the impact would be moderate. A major impact would occur if the level of mortality or debilitating injuries was in sufficiently high numbers that the continued viability of the population was seriously threatened. Before a proposed exploration well could be drilled in the Atlantic OCS, potential impacts would be analyzed in a lease sale EIS, and a project-specific EA would be prepared and submitted by the operator. Within the EA, all potential impacts from a crude oil spill released from an accidental well blowout would be examined, including an analysis of site-specific information regarding listed and nonlisted marine mammal species distributions and relative densities, preferred or critical habitats, and temporal concerns such as feeding and/or calving periods, as well as mitigation measures taken to minimize impacts to marine mammals from routine drilling activities and potential accidental crude oil spills. Considering the low number of potential drilling activities presented in the proposed action scenario, the remote probability of an accidental spill, and environmental protections analyzed in the EIS and EA process and enforced through permits, including impact avoidance and mitigation measures, the incremental increase in impacts to marine mammals in the cumulative scenario from a well blowout arising from exploratory drilling operations associated with the proposed action would be **negligible**.

4.2.3. Sea Turtles

4.2.3.1. Description of the Affected Environment

Five sea turtle species occur in the AOI (**Table 4-15**): loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), Kemp's ridley turtle (*Lepidochelys kempii*), and leatherback turtle (*Dermochelys coriacea*). The leatherback is classified under Family Dermochelyidae, whereas the other four are in Family Cheloniidae. Loggerhead, leatherback, and green turtles are more commonly found within the AOI at certain periods (nesting season) and life stages. Kemp's ridley and particularly hawksbill turtles are less common within the AOI. Green, leatherback, and loggerhead turtles use coastal beaches within the AOI as primary nesting sites, with the main nesting beaches in southeast Florida. However, loggerhead turtles also nest along the southeast coast as far north as Virginia.

All sea turtles are protected under the ESA. Because sea turtles use terrestrial and marine environments at different life stages, FWS and NMFS share jurisdiction over sea turtles under the ESA. The FWS has jurisdiction over nesting beaches, and NMFS has jurisdiction in the marine environment. The hawksbill, Kemp's ridley, and leatherback turtles are listed under the ESA as endangered. The green turtle is listed as threatened, except for the Florida breeding population, which is endangered (USDOC, NMFS, 2011g). The Northwest Atlantic population of the loggerhead turtle is currently classified as threatened (*Federal Register*, 2011e; USDOC, NMFS, 2011h).

The FWS and NMFS have designated critical habitat for the green, hawksbill, and leatherback turtles (**Table 4-15**), but there is no critical habitat within or adjacent to the AOI. On February 17, 2010, FWS and NMFS were jointly petitioned to designate critical habitat for Kemp's ridley sea turtles for nesting beaches along the Texas coast and marine habitats in the Gulf of Mexico and Atlantic Ocean (WildEarth Guardians, 2010). The NMFS is currently reviewing the petition.

Important marine habitats for sea turtles in and near the AOI include nesting beaches, estuaries and embayments, nearshore hard substrate areas, and the Gulf Stream. Within the AOI, sea turtle nesting occurs on sandy beaches from Virginia to Florida. The distribution and densities of sea turtle nests reported from individual counties within the AOI during the 2010 nesting season are shown in **Figure 4-14**. Most sea turtle species move geographically, either seasonally or between nesting activities. Some species may move seasonally into foraging habitats through migration corridors and to nesting beaches (Mansfield et al., 2009; Hawkes et al., 2011). The size of "resident" foraging habitats appears to vary with species and location. Studies suggest that resident foraging area size in the western North Atlantic decreases in a north-to-south gradient, possibly because of available food resources and the width of the continental shelf, which also decreases in a north-to-south gradient (Griffin, 2002).

Nesting beaches within the AOI are subject to periodic impacts from tropical cyclones (including hurricanes and tropical storms). Studies suggest that tropical cyclones are a significant factor in observed sea turtle nesting declines (van Houtan and Bass, 2007). It is anticipated that the frequency of these storm events is likely to increase with changes in global climate (Webster et al., 2005; Pike and Stiner, 2007). Generally, storm-induced impacts to nesting beaches include beach flooding and the displacement of large volumes of sand (Pike and Stiner, 2007). Sea turtle eggs lose and gain water quickly depending on nest conditions, and nests exposed to seawater may be lost because of inhibited oxygen exchange or rapid water loss to saline seawater (Packard, 1999). Displacement of sand during storm events may expose and destroy established nests or may alter beach morphology to where is it not suitable for nesting habitat. Factors that may affect nesting success during storm seasons include the distance of the nest from shore and/or the nest depth, and nesting season.

Embayments such as Chesapeake Bay and Delaware Bay provide important foraging and developmental habitat for sea turtles (Musick, 1988; Coles, 1999; Spotila et al., 2000). Exposed hard substrate in shallow nearshore areas off eastern Florida provides important foraging and developmental habitats for cheloniid sea turtles, particularly juveniles and subadults (CSA International, Inc., 2009). The Gulf Stream is a key oceanographic feature that is utilized by sea turtles for various purposes, such as migration (Hoffman and Fritts, 1982). *Sargassum* mats that form in convergence zones associated with the Gulf Stream provide shelter and foraging habitat for hatchling and post-hatchling sea turtles (Carr and Meylan, 1980; SAFMC, 2002).

4.2.3.1.1. Loggerhead Turtle

Range and Spatial Distribution

Loggerhead turtles are likely to be the most common sea turtle species in the AOI. The loggerhead is a large cheloniid sea turtle, with adults reaching up to 1.1 m (3.5 ft) in carapace length and 181 kg (400 lb) in mass. It is a circumglobal species that is found from tropical to temperate regions. In the Atlantic Ocean, the loggerhead turtle is reported from Newfoundland, the Caribbean Sea, the Gulf of Mexico, and along the east coast of the U.S. Loggerhead turtles, like other sea turtles, are highly migratory, making various seasonal and annual migrations (Godley et al., 2003). Moncada et al. (2010) reported that it is common for loggerhead turtles to make extended transoceanic journeys and then later return to specific nesting beaches.

Overall, the population structure of the loggerhead turtle is complex and challenging to evaluate (Bolten and Witherington, 2003). According to the Loggerhead Biological Review Team, there are nine significant populations of loggerhead turtles termed distinct population segments (DPSs) (Conant et al., 2009). The Northwest Atlantic Ocean population segment occurs in an area bounded by 60º N latitude to the north and the equator to the south, with 40º W longitude as the eastern boundary. The NMFS has also identified four recovery units with the Northwest Atlantic DPS (USDOC, NMFS and USDOI, FWS, 2008) (**Figure 4-15**). Two of these recovery units are within the AOI: the Northern Recovery Unit (NRU), extending from the Florida-Georgia border through southern Virginia (the northern extent of the nesting range), and the Peninsular Florida Recovery Unit (PFRU), extending south from the Florida-Georgia border through Pinellas County on the west coast of Florida, excluding the islands west of Key West, Florida. Roughly one-third of NRU turtles are distributed on the wide continental shelf off South Carolina and Georgia where they occupy year-round home ranges of approximately 200-400 km^2 (77-154 mi^2). The remaining two-thirds of the NRU occupies a seasonal range that extends as far north and east as the continental shelf edge off New Jersey during summer months and retracts southwards to a narrow area of continental shelf off North Carolina and South Carolina during winter (Hawkes et al., 2011). Inner shelf waters off Virginia and North Carolina provide important seasonal habitat for this species, especially waters near Cape Hatteras, North Carolina, which act as a seasonal "migratory bottleneck" (Mansfield et al., 2009). Turtles within the much larger PFRU travel outside of western Atlantic waters into the Gulf of Mexico and into waters outside of the U.S. EEZ (e.g., Mexico and Cuba) (Hawkes et al., 2011). Based on nesting information, loggerhead turtle nests are primarily located in four of the seven states in the AOI: Florida (91%), South Carolina (6.5%), Georgia (1.5%), and North Carolina (1%). The northern subpopulation is the second largest in the U.S., and South Carolina represents about 65 percent of those nests (South Carolina Department of Natural Resources [SCDNR], 2005a).

Population Status

Estimating sea turtle populations is challenging given the lack of information for many of the life-history parameters that are needed to model populations, e.g., hatchling survival rates and adult natural and anthropogenic mortality rates. In general, the status of the population is often estimated based on the number of annual nests at different locations within a region, anthropogenic threats, and mortality estimates (Conant et al., 2009); models require using various assumptions. Based on available data for the Atlantic OCS region (Florida Bay to New York), various estimates have been calculated. Results for nine specific areas within the Northwest Atlantic (in-water assessment) showed that there were five time-series without a distinct population trend (i.e., increasing or decreasing), two with an increasing trend, and three with a decreasing trend (USDOC, NMFS and USDOI, FWS, 2008).

The southeast U.S. coast is among the most important areas in the world for loggerhead nesting. The east Florida coast is the most important area (**Figure 4-16**). The USDOC, NMFS and USDOI, FWS (2008) report that about 80 percent of loggerhead nesting in this region occurs in six Florida counties: Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward. Brevard County is located within the AOI, while Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties are south of the AOI. Within this region there is a 20-mi (32.2-km) section of coastline from Melbourne Beach to Wabasso Beach that comprises the Archie Carr NWR, which has been identified as the most important nesting area for loggerhead turtles in the western hemisphere (USDOC, NMFS and USDOI, FWS, 2008); this stretch of coastline borders the AOI (**Figure 4-14**). The Archie Carr NWR is critical to the recovery and survival of loggerhead turtles; it has been estimated that 25 percent of all loggerhead nesting in the U.S. occurs in the Archie Carr NWR. Nesting densities have been estimated at 625 nests per km (1,000 nests per mile) within the Archie Carr NWR. Other important nesting locations occur in South Carolina (6.5%), Georgia (1.5%), North Carolina (1%), and Virginia (<1%), but not at the same magnitude as in Florida (USDOC, NMFS and USDOI, FWS, 2008).

Overall, the total number of nests per year in the U.S. over the last decade has been estimated at between 47,000 and 90,000 (USDOC, NMFS and USDOI, FWS, 2008). The current recovery plan reported that the number of nests in the NRU averaged 5,215 annually during 1989 through 2008, and the nesting trend declined 1.3 percent. In the PFRU, the number of nests averaged 64,513 annually during 1989 through 2007, and the nesting trend declined 1.6 percent. Similar to most sea turtle populations, the loggerhead turtle is severely depleted; however, the population is probably the most stable of any sea turtle. To date, projections indicated that the Northwest Atlantic loggerhead turtle population was slightly declining but expected to recover in the next 50-150 years (USDOC, NMFS and USDOI, FWS, 2008). The SCDNR (2005a) recently reported that juvenile loggerheads were more abundant now in South Carolina coastal waters than they were in the 1970's. Most of the nests in South Carolina were reported near Georgetown (44.5%), Charleston (26.4%), and Beaufort (21.9%). Even so, the population is still at risk of extinction given the current continuing threats (Conant et al., 2009).

Conservation and Management

The conservation and recovery of the loggerhead turtle is administered through various domestic regulatory and nonregulatory mechanisms such as implementing and meeting specific recovery plan objectives, habitat protection efforts, protecting nesting females, and funding research. Other conservation measures imposed by NMFS include restrictions on commercial fishery activities (requiring circle hooks in the pelagic longline fishery and turtle excluder devices [TEDs] in trawls) to prevent serious injury and mortality to sea turtles and endorsing several international agreements such as Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). Moreover, NMFS has developed a Strategy for Sea Turtle Conservation and Recovery in Relation to Atlantic and Gulf of Mexico Fisheries, which focuses on specific commercial fishing gear-related criteria.

Although critical habitat has not yet been designated for the loggerhead turtle, the agencies received a petition in 2007 requesting that loggerhead turtles in the Northwest Atlantic be reclassified as endangered and that critical habitat be designated (USDOC, NMFS and USDOI, FWS, 2008). Currently, the agencies are evaluating the scientific information (*Federal Register*, 2010g) and a decision is pending. Threats to the loggerhead population are similar to those for other sea turtles and include numerous anthropogenic threats, including but not limited to commercial fisheries, habitat loss (nesting beaches), climate change (e.g., sea level rise, shifts in prey availability), pollution, boat strikes, and disease (Conant et al., 2009; Hawkes et al., 2009; Witt et al., 2010a).

Ecology and Life History

Loggerhead turtles use three different types of marine habitats throughout their life: terrestrial (beaches), neritic (nearshore waters), and oceanic (open ocean) (USDOC, NMFS and USDOI, FWS, 2008). Most of our knowledge on loggerhead turtle biology is inferred from nesting and when they are found in coastal and nearshore waters. Overall, there is some information about various aspects of turtle biology such as diet, morphology, genetics, and reproduction. Loggerhead turtles are carnivores, feeding primarily on mollusks and crustaceans (USDOC, NMFS and USDOI, FWS, 2008). Loggerhead turtle nesting is from April to September, with peak nesting occurring in June and July (Weishampel et al., 2006); females nest every 2.5-3.7 years. Age at sexual maturity is late in life at around 35 years of age; average clutch size is between 100 and 126 eggs, and incubation is between 42 and 75 days. The mean clutch is 3-5.5 per breeding season, with internesting intervals ranging from 12 to 15 days (USDOC, NMFS and USDOI, FWS, 2008). The life span of the loggerhead turtle is 57 years or more.

Immediately after loggerhead turtle hatchlings emerge from the nest, they actively swim offshore into oceanic areas of local convergence zones and major gyre systems, often characterized by accumulations of floating *Sargassum*. The duration of this oceanic post-hatchling-juvenile stage is variable but generally ranges between 7 and 12 years (Bolten and Witherington, 2003). Afterward, oceanic juveniles actively migrate to nearshore (neritic) developmental habitats. Within the western North Atlantic, including the AOI, some neritic juveniles make seasonal foraging migrations into temperate latitudes as far north as New York. Most juveniles are south of Cape Hatteras, Florida, by January (Musick and Limpus, 1997). Neritic juvenile loggerhead turtles are likely to occupy shallow water developmental habitats in nearshore areas of the AOI.

Information about daily movement and dive behaviors of loggerheads in the open ocean is limited, but new technology has allowed researchers to recently study this type of behavior in the turtles' natural environment (Sobin, 2008). In shallow environments, loggerhead turtles have been observed diving and feeding, and their behaviors have been evaluated. Houghton et al. (2000) recorded observations of loggerhead turtles around the Greek Island of Kefalonia and discovered that these individuals made frequent shorter-duration dives than previously reported in the literature. On average, four loggerhead turtles made 96 dives over 29 days, with dive durations ranging from 1 to 5 min. Off Hawaii, four turtles (two loggerhead turtles and two olive ridley turtles) were monitored to evaluate their dive depth distributions to understand how mitigation measures could be implemented for longline fisheries. Based on the research, Polovina et al. (2003) found that there were diurnal and species differences in dive profiles. Overall, the researchers found that all the turtles spent more time at the surface and dove deeper during the day than at night. Loggerhead turtles spent 40 percent of their time at or near the surface and at less than 100-m (328-ft) depths; most (70%) of the dives were no deeper than 5 m (16.4 ft). The deepest dive recorded for one of the loggerhead turtles was 178 m (584 ft). Loggerhead diving behavior has also been investigated off Japan by Hatase et al. (2007), who found that diving behavior is somewhat size-dependent. In southwest Florida, Sobin (2008) reported that loggerhead turtles spent more time near the surface in the morning (08:00-12:00 h) than in the evening, which was different than previous studies.

4.2.3.1.2. Green Turtle

Range and Spatial Distribution

The green turtle is the largest cheloniid sea turtle; adults can reach 0.91 m (3 ft) in carapace length and range between 136 and 159 kg (300 and 350 lb) in mass. The green turtle is a circumglobal species found in the Mediterranean Sea and the Pacific, Indian, and Atlantic Oceans (USDOC, NMFS and USDOI, FWS, 1991, 2007a). The green turtle can be found in tropical and subtropical waters between 30° N and 30° S latitude, and, to a lesser extent, in temperate waters (USDOC, NMFS and USDOI, FWS, 2007a). Satellite tagging data indicate that, similar to other sea turtles, green turtles display highly migratory behavior, making vast seasonal coastal and annual transoceanic migrations (Godley et al., 2003, 2008, 2010). In the western North Atlantic, green turtles can be found on various coastal beaches during the nesting season and at other times feeding or swimming along nearshore or offshore waters from Florida to Massachusetts (USDOC, NMFS and USDOI, FWS, 2007a). Green turtles are vulnerable to cold temperatures, so in many locations they are found only seasonally within the AOI (Folley et al., 2007). Based on satellite tagging research by Hart and Fujisaki (2010), green turtles display daily and seasonal movement patterns that are associated with foraging strategies. The researchers indicated that locations with optimal habitats (e.g., sources of marine algae) are likely locations where small juvenile green turtles may be found. Based on this study, it is probable that juvenile green turtles may be found in various shallow-water inshore areas in the AOI where macroalgae (seagrass) is reported. In fact, McClellan and Read (2009) documented the seasonal habitat-use patterns of juvenile green turtles in the estuaries (i.e., salt marshes, tidal creeks, and marsh islands) of North Carolina (Pamlico Sound, Cape Hatteras region). Green turtles are also reported to use not only the coastal waters of North Carolina as summer foraging habitat, but the waters of Virginia as well (Mansfield et al., 2009). Further south, green turtles have been reported to use the Indian River Lagoon (Florida) and areas south of the AOI (Florida Bay and the Florida Keys) as feeding areas. Green turtles, however, appear to occupy smaller home ranges than loggerhead turtles (Seminoff et al., 2002; Makowski et al., 2006; Broderick et al., 2007). Important nesting areas for green turtles include Florida beaches within Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties. Most green turtles nest in Brevard County (USDOC, NMFS and USDOI, FWS, 2007a). Except for the beaches of Brevard County, the primary green turtle nesting sites are south of the AOI.

Population Status

The green turtle population is considered severely depleted in comparison to its estimated historical levels (USDOC, NMFS and USDOI, FWS, 2007a). Currently, there is no reliable green turtle population estimate, but inferences have been attempted using age-based survivability models and nesting data (Bjorndal et al., 2003). Nesting data indicate that between 200 and 1,100 females nest annually on continental U.S. beaches (within the AOI). The recent 5-year status review (USDOC, NMFS and USDOI, FWS, 2007a) reported that the total mean annual green turtle nesting abundance was around 5,600 nests (Florida east coast) during 2000 through 2006, and the number of nests appears to be increasing. Overall, the number of green turtle nests in Florida has increased over the last 18 years (USDOC, NMFS and USDOI, FWS, 2007a). In addition, the numbers of immature green turtles incidentally captured at the St. Lucie power plant (St. Lucie County, Florida, south of the AOI) has also increased during the past 26 years, which could indicate the population is improving (Florida Power and Light Company and Quantum Resources, Inc., 2005). It is difficult to evaluate how common or rare green turtle occurrence is in comparison to the other sea turtles (excluding hawksbill and Kemp's ridley) found within the AOI, but in terms of the number of nests surveyed in Florida in 2010, green turtles ranked second (Florida Fish and Wildlife Conservation Commission, 2011).

Conservation and Management

The green turtle is protected and managed by NMFS and FWS. Under the leadership of these Federal agencies, various conservation and recovery strategies have been implemented since green turtles were listed under the protection of the ESA. Some of these management measures include international and domestic environmental policies, which include numerous laws, rules, and regulations. In 1998, the agencies jointly designated critical habitat for the green turtle as the waters of Culebra Island, Puerto Rico, and its outlying keys (*Federal Register*, 1998a). Under the designation process, NMFS identified critical habitat for green turtles as specific geographical areas that have those physical or biological features essential to the conservation of the green turtle that may require special management considerations. Besides designating critical habitat, other conservation measures include establishing various conservation programs under the green turtle recovery plan and implementing a variety of restrictions on commercial fishery activities (e.g., requiring the use of circle hooks in pelagic longline fisheries and TEDs in trawls) to prevent serious injury and mortality to sea turtles; NMFS has also developed a Strategy for Sea Turtle Conservation and Recovery for Atlantic and Gulf of Mexico fisheries (gear-based approach). Moreover, there are also various other types of restrictions to protect sea turtles such as beach nesting site (beach lighting) and hopper dredging window restrictions during the sea turtle nesting season, which is generally from late spring to late summer. Besides commercial fishery interactions, green turtles have various other anthropogenic threats, such as habitat loss (i.e., beach nourishment), global climatic changes (sea level rise), and fibropapillomatosis (USDOC, NMFS and USDOI, FWS, 2007a). Given these inadvertent impacts, there are numerous global research priorities that focus on understanding these threats and how to reduce their negative impacts to sea turtle populations (Hamann et al., 2010).

Ecology and Life History

Hatchling green turtles swim offshore to areas of convergence zones characterized with driftlines and patches of *Sargassum.* It is interesting to note that experiments with post-hatchling green turtles in the laboratory, along with their strong counter-coloration, suggest that they are more open-water animals than loggerhead or hawksbill turtles and so may avoid floatlines of *Sargassum* (Musick and Limpus, 1997). Data also suggest that recruitment of green turtles into neritic developmental habitats occurs at smaller body sizes (30-40 cm) than for loggerhead turtles (Bjorndal and Bolten, 1988). Neritic developmental habitats in the western North Atlantic range from Long Island Sound to south Florida and the tropics. These habitats include shallow nearshore hard substrate, and embayments and other inshore habitats (e.g., Indian River Lagoon [Florida]). Juvenile green turtles occupying developmental habitats north of Florida must migrate south in autumn (Musick and Limpus, 1997). Therefore, neritic juvenile green turtles may occur within nearshore and inshore habitats throughout the AOI.

Green turtle distribution and diet is well documented. The USDOC, NMFS and USDOI, FWS (2007a) status review highlights that the Florida east coast (Indian River Lagoon and the waters off Brevard County [within the AOI] through Broward County [south of the AOI]) is a prime foraging area for green turtles. However, because green turtle diet consists of seagrasses and macroalgae, it is possible that green turtles use other sites within the AOI (Virginia-Florida) where macroalgae is found. In the southeastern U.S., nesting generally occurs from June-September; females nest at 2- to 4-year intervals. Similar to other sea turtles, age at sexual maturity is not reached until late in life at around 20-50 years of age; clutch size varies from 75 to 200 eggs, and incubation is between 20 and 50 days. Female green turtles usually deposit two or three clutches per breeding season, with internesting intervals ranging from 12 to 14 days (USDOC, NMFS and USDOI, FWS, 2007a).

Hazel et al. (2009) documented various interesting daily diving behaviors of green turtles in nearshore foraging habitats in Australia. The researchers found that the majority of the turtles spent most of time (89-100%) at depths (<5 m [16.4 ft]) near the surface. They also found that dives were shorter and shallower during the day than at night, suggesting that green turtles rest at night and forage during the day. Hazel et al. (2009) also indicated that this phenomenon was consistent with the requirement to surface more often during increased activity (daytime foraging). In addition, Hazel et al. (2009) found that green turtle dives became longer as water temperatures decreased. Despite the ability for sea turtles to dive to deep depths, Hazel et al. (2009) postulated that green turtles chose not to dive to deeper depths at night given the distance (3 or 6 km [1.9 or 3.7 mi]) it was from shallow (foraging areas) to deeper waters. Off the Hawaiian Islands, Rice and Balazs (2008) documented the diving behavior of two adult green turtles in the open-ocean environment. Findings demonstrated that green turtles also displayed a shallow daytime and deeper nighttime dive pattern. In general, the two green turtles spent the day near the surface and dove to around 35 or 55 m (115 or 180 ft) at night; mean duration was 33-44 min. The maximum depths recorded were two dives by one female greater than 135 m (443 ft) and one dive by one male to 100 m (328 ft) (Rice and Balazs, 2008).

4.2.3.1.3. Hawksbill Turtle

Range and Spatial Distribution

The hawksbill turtle is a medium-size cheloniid sea turtle. Adults can reach to 1.1 m (3.5 ft) in carapace length and 82 kg (180 lb) in mass (USDOC, NMFS and USDOI, FWS, 2007b). The hawksbill turtle is a circumglobal species found in the Pacific, Indian, and Atlantic Oceans (USDOC, NMFS and USDOI, FWS, 2007b). The hawksbill turtle can be found in tropical and subtropical waters between latitudes 30° N and 30° S (USDOC, NMFS and USDOI, FWS, 2007b). Hawksbill turtles display highly migratory behavior, with satellite tagging data demonstrating that these turtles display short and long migrations from nesting to foraging grounds (USDOC, NMFS and USDOI, FWS, 2007b; Blumenthal et al., 2009). In the western North Atlantic, hawksbill turtles can be found from Florida to Massachusetts, but they are rarely reported north of Florida and within the AOI. In comparison to the other sea turtles potentially found within the region, the hawksbill turtle has a restricted distribution and range given that its habitat (foraging) preference is coral reefs, which are found only in near coastal areas to the south of the AOI. Limited information on hawksbill turtle home ranges suggests they are smaller than for other sea turtle species (Witt et al., 2010b). Although it is a rare occurrence, USDOC, NMFS and USDOI, FWS (1993) report that hawksbill nesting has been reported not only in south Florida counties (Miami-Dade, Broward, Palm Beach, and Martin) but also in Volusia County, which is within the AOI. Juvenile hawksbill turtles have been reported to use offshore floating mats of *Sargassum* as habitat, so it is possible that hawksbill turtles are found in the offshore areas of the AOI that are associated with the Gulf Stream (USDOC, NMFS and USDOI, FWS, 1993); the Gulf Stream often transports large patches of *Sargassum* as it moves from south to north. In addition to offshore and reef habitats, hawksbill turtles are also known to use mangrove-fringed bays, estuaries (Carr, 1952), and Caribbean seagrass habitats (Bjorndal and Bolten, 1988, 2010). Based on this information, it is therefore possible that hawksbill turtles may occur in other southern sections of the AOI.

Population Status

The hawksbill turtle population is severely depleted and continues to be threatened (Bjorndal, 1999). Although there is no reliable hawksbill turtle population estimate, conclusions have been made from nesting data. There are no nesting estimates for hawksbill turtles within the AOI, but the number of nesting females per season in the Caribbean ranges from 3 to 19 in Bonaire to 400-833 in Cuba (USDOC, NMFS and USDOI, FWS, 2007b). The recent 5-year status review reported that the number of hawksbill turtles nesting in the western North Atlantic has decreased over the last 20 years (USDOC, NMFS and USDOI, FWS, 2007b). However, nesting populations of hawksbill turtles in this region are much larger than in some other regions (e.g., Indo-Pacific Ocean), where populations continue to decline. Limpus and Miller (2008) reported that the hawksbill turtle nesting population in north Queensland, Australia, has declined 3 percent in recent time. However, in Barbados, West Indies, hawksbill turtle nesting data show some promise that the population is improving (Beggs et al., 2007). Beggs et al. (2007) reported increases from 316 nests and 77 females in 1992 to 2016 nests and 492 females in 2004. Based on these data, Beggs et al. (2007) indicated that the hawksbill turtle population in Barbados could be the second largest rookery in the wider Caribbean; the largest rookery is in Mexico. Despite showing some signs of recovery, the hawksbill turtle population has not reached an adequate level that warrants delisting or reclassification (USDOC, NMFS and USDOI, FWS, 2007b).

Conservation and Management

The conservation and recovery of the hawksbill turtle is administered through various regulatory mechanisms such as designating critical habitat and implementing conservation regulations. Critical habitat for the hawksbill turtle was originally designated in 1982 and subsequently in 1998 (*Federal Register*, 1998a). Critical habitat for the hawksbill turtle includes Mona, Culebrita, and Culebra Islands in Puerto Rico, and the waters surrounding the islands of Mona and Monito (3-5 km [1.9-3.1 mi]). Critical habitat also includes specific beaches on Culebra Island (Playa Resaca, Playa Brava, and Playa Larga). Other conservation measures governed by Federal agencies include implementing various recovery plan and commercial fishery measures to prevent further serious injury and mortality to sea turtles. The agencies also support several international agreements for the conservation of sea turtles, such as the South-East Asian Marine Turtle Memorandum of Understanding in the Indian Ocean. Campbell et al. (2009) indicate that the co-management between local communities and government agencies is a strategy to improve fisheries management that has the potential to reduce sea turtle fishery interactions. The recovery of the hawksbill turtle population is threatened by many ongoing anthropogenic threats, including commercial fishery interactions, habitat loss (i.e., reefs), global climatic changes (sea level rise), and fibropapillomatosis (USDOC, NMFS and USDOI, FWS, 2007b). In addition, the continued overutilization of hawksbill turtles for commercial, recreational, scientific, or educational purposes is another major threat to the recovery of the species (USDOC, NMFS and USDOI, FWS, 2007b).

Ecology and Life History

Hatchling hawksbill turtles emerge from the nest and actively swim offshore at night to areas of water mass convergence. Hawksbill post-hatchlings in the laboratory appear to be attracted to patches of floating *Sargassum*, which they use as protective cover (Musick and Limpus, 1997). Data suggest that juvenile (or post-hatchling) hawksbills move into nertitic developmental habitats at a smaller size than either loggerhead or green turtles; neritic developmental habitats include shallow coral reefs and mangrove estuaries (Witzell, 1983). Because of their preference for these habitats, neritic juvenile hawksbill turtles may occur only within the southernmost areas of the AOI.

Adult hawksbill turtles specialize on a diet of sponges and feed very selectively on specific species of demosponges (Bjorndal, 1997). They may also consume a variety of other food items such as algae and other benthic invertebrates (Márquez, 1990). In the Caribbean, hawksbill turtles are often sighted feeding along coral reefs and hard bottom communities (Blumenthal et al., 2009). Unlike some of the other sea turtles found within Atlantic OCS waters, hawksbill turtles primarily nest on Mexican (Yucatán Peninsula) and Caribbean (Puerto Rico [Culebra, Mona, and Vieques Islands] to Barbados) beaches; some nesting has been reported in South Florida and the Florida Keys, but this is rare (USDOC, NMFS and USDOI, FWS, 1993). Depending on the location, nesting season occurs during various summer and fall months (USDOC, NMFS and USDOI, FWS, 1993). For example, hawksbill nesting occurs from July-October on Buck Island (U.S. Virgin Islands) and from August-October on Mona Island (Puerto Rico), with females nesting at 2- or 3-year intervals. In Barbados, West Indies, Beggs et al. (2007) reported that nesting occurred year-round during 1997 through 2004, with peak months from June-August. These researchers also discovered that nesting interval ranged from 2 to 6 years with a mean of 2.5 years. Overall, the average 6-month nesting season for the hawksbill turtle is longer than for other sea turtle (USDOC, NMFS and USDOI, FWS, 1993). Female hawksbill turtles usually deposit from 3 to 5 clutches per breeding season (~14 days) (Beggs et al., 2007; USDOC, NMFS and USDOI, FWS, 2007b). Age at sexual maturity is between 20 and 40 years; average clutch size is around 135 eggs, and incubation is around 60 days.

There is some information about the diving behavior of hawksbill turtles. In Milman Island, Australia, Bell and Parmenter (2008) recorded the diving behavior of nine female hawksbill turtles that had previously laid eggs and two females that had not successfully laid any eggs. Results from the study showed that the nine hawksbill turtles primarily spent their time near the surface but did make occasional deeper dives. The maximum depth recorded was 21.5 m (70.5 ft), and the researchers did not find any significant difference between day and night dive behaviors. On average, the dive time and surface interval for the nine turtles were 31.2 and 1.6 min, respectively. On the reefs of Mona Island, Puerto Rico, van Dam and Diez (1997) reported the diving patterns of five juvenile hawksbill turtles. Results showed that mean dive behavior associated with foraging ranged from 8 to 10 m (26 to 33 ft), dive durations ranged from 19 to 26 min, and surface intervals ranged from 37 to 64 s. Night dives ranged from 7 to 10 m (23 to 33 ft), dive durations ranged from 35 to 47 min, and surface intervals ranged from 36 to 60 s (van Dam and Diez, 1997).

4.2.3.1.4. Kemp's Ridley Turtle

Range and Spatial Distribution

The Kemp's ridley is the smallest sea turtle; adults reach only 76 cm (30 in) in carapace length and range from 36 to 45 kg (80-100 lb) in mass. The Kemp's ridley turtle is generally found in the Gulf of Mexico and is occasionally sighted along the east coast from Florida to New England (USDOC, NMFS et al., 2010). Overall, it may be the least abundant sea turtle in the region.

Foraging areas along the Atlantic coast include various embayments and estuarine systems from Florida to New York. Coles (1999) reported that Kemp's ridley turtles were frequently sighted in Chesapeake Bay during the summer over a continuous 18-year sea turtle stranding survey and indicated that Kemp's ridleys ranked second in the number of strandings per year in the MAB. Coles (1999) also indicated that the MAB is an important foraging area for juvenile Kemp's ridley turtles during spring through fall. Satellite tracking data document seasonal migration along the inner shelf of the eastern U.S. from New England to Florida. Wintering habitats for Kemp's ridley turtles in the northwestern Atlantic include shelf habitats off Florida and waters south of Cape Hatteras, North Carolina (Gitschlag, 1996).

There is some evidence of Kemp's ridley turtles nesting on beaches within the AOI, but this is considered rare (USDOC, NMFS et al., 2010). Johnson et al. (1999) reported that Kemp's ridley turtles nest on the beaches of North Carolina, South Carolina, and Florida (Ponce Inlet and New Smyrna Beach, Volusia County); all of these locales are adjacent to the AOI. Johnson et al. (1999) also reported Kemp's ridley turtles nesting in Palm Beach County, Florida, which is south of the AOI.

Similar to other sea turtles, Kemp's ridley turtles display some seasonal and coastal migratory behavior; satellite tagging data indicate that Kemp's ridley turtles transit between nearshore and offshore waters (within 28 km [50 mi]) from spring/summer to fall/winter, which coincides with seasonal water temperature changes (USDOC, NMFS et al., 2010). The home ranges of Kemp's ridley turtles may be similar to those of loggerhead turtles (Shaver et al., 2005).

Population Status

The Kemp's ridley turtle population is severely depleted, and it is considered the most endangered sea turtle (USDOI, FWS, 1999). Kemp's ridley turtles were once abundant, especially in the Gulf of Mexico, but today they are struggling. The draft recovery plan states that at one single nesting event (arribada) in Rancho Nuevo, Mexico, during 1947, approximately 42,000 nesting females were reported (USDOC, NMFS et al., 2010). However, by the mid-1980's, the number of nests had declined from 40,000 to about only 700 nests per year. Today, the population is stressed and there are no reliable Kemp's ridley turtle population estimates. Given that most of the Kemp's ridley turtle population nests in one location, better population estimates have been inferred from nesting data (USDOI, FWS, 1999). Using various assumptions, the current population estimate of Kemp's ridley turtles is approximately 738 females, but the number of nesting Kemp's ridley turtles continues to improve. Márquez (2001) indicated that the annual number of nests in Tamaulipas, Mexico, has increased between 8 and 12 percent since 1988. USDOC, NMFS et al. (2010) reported that the number of nests per season in Rancho Nuevo, Mexico, recently exceeded 20,000 and stated that the nesting population is growing exponentially.

Conservation and Management

The conservation and recovery of the Kemp's ridley turtle is conducted through various regulatory mechanisms, such as habitat protection efforts, protecting nesting females, and maintaining or increasing hatchling production levels. Other conservation measures include restrictions on commercial fishery activities to prevent serious injury and mortality to sea turtles, and several international agreements, such as CITES. Critical habitat has not been designated, but the agencies were petitioned on February 17, 2010, under the ESA to designate Kemp's ridley critical habitat (USDOC, NMFS, 2011i). The agencies are currently evaluating the data and considering whether the scientific information warrants designating the areas (i.e., Texas nesting locations and feeding locations along the east coast [Ten Thousand Islands, Florida, in the Gulf of Mexico and Pamlico Sound, Chesapeake Bay, Long Island

Sound, Charleston Harbor, and Delaware Bay] to water depth of 40 m [131 ft]) listed under the petition (WildEarth Guardians, 2010).

The recovery of the Kemp's ridley turtle is threatened by many activities such as commercial fishery interactions, ongoing habitat loss, global disease, climatic changes, pollution, and ecosystem alterations (USDOC, NMFS et al., 2011). Given that the majority of the population nests in one location in Mexico, human population growth and urban development are serious threats to Kemp's ridley nesting beaches (USDOI, FWS, 1999). Despite these issues, Mexico and the U.S. (NMFS) continue to collaborate under the Kemp's ridley Restoration and Enhancement Program (Head Start) in Rancho Nuevo, Tamaulipas, Mexico. This government program and Natural Reserve continues today and has expanded to include the state of Veracruz. Today, there are over 200 km (124 mi) of nesting sites that are protected under the program (Márquez, 2001). Besides international collaboration efforts, NMFS also continues to implement various conservation regulations in commercial fisheries such as the use of TEDs to protect all sea turtles, including the Kemp's ridley. Some of the other threats to the Kemp's ridley include dredging operations; hopper dredging activities occur throughout the AOI on a regular basis, especially from North Carolina to Florida.

Ecology and Life History

Hatchling Kemp's ridley turtles leave the nest at night and actively swim offshore into the anticyclonic Mexican Current and into the northern Gulf of Mexico. Some oceanic post-hatchling and juvenile Kemp's ridleys are retained in the northern Gulf until they migrate inshore to neritic developmental habitats, while others may be swept into the Loop Current and north into the Gulf Stream (Collard, 1990). Neritic developmental habitats include shallow coastal areas in the Gulf of Mexico and in areas of the western North Atlantic as far north as Long Island Sound. Chesapeake Bay is an important developmental habitat for this species (Musick and Limpus, 1997). Neritic juvenile Kemp's ridleys undergo seasonal migrations within the AOI.

The Kemp's ridley turtle is a carnivore throughout its life cycle (Márquez, 1990). Adult and subadult Kemp's ridley turtles are benthic feeders that primarily feed on crabs. Other preferred food items include shrimps, mollusks, sea urchins, and fishes (opportunistically) (USDOC, NMFS et al., 2011). In the western North Atlantic Ocean, Kemp's ridley turtles primarily nest on Gulf of Mexico beaches in Mexico (Tamaulipas and Veracruz) during April through July. The mean clutch is 2.5 per breeding season (14-28 days), average clutch size is around 100 eggs, and incubation is between 45 and 58 days; females nest at 2-year intervals (USDOC, NMFS et al., 2011). Age at sexual maturity for wild Kemp's ridleys has been reported to be between 10 and 16 years.

Available information about Kemp's ridley turtles in the open ocean is limited, but there is some information about their diving behavior. In the Gulf of Mexico, Schmid et al. (2002) reported a surface interval between 1 and 88 s and a mean submergence duration of 8.4 min. Overall, these researchers did not find any differences between day and night surface activities but did find a diel difference in some years (1994 vs. 1995). The data also showed that the mean submergence interval during the night was longer than during the day (Schmid et al., 2002).

4.2.3.1.5. Leatherback Turtle

Range and Spatial Distribution

The leatherback turtle is the largest sea turtle and the largest reptile; adults reach up to 1.8 m (6 ft) in carapace length and 907 kg (2,000 lb) in mass. They are easily distinguished from all other sea turtle species by their large spindle-shaped, leathery, and unscaled carapaces that possess a series of parallel dorsal ridges, or keels (Márquez, 1990). The leatherback turtle is a cosmopolitan species that is found in the Mediterranean Sea and Indian, Pacific, and Atlantic Oceans; it is reported as having the widest distribution of any sea turtle (USDOC, NMFS and USDOI, FWS, 2007c). In the Atlantic Ocean, the leatherback turtle is reported throughout the North Sea, Canadian waters, and along the east coast of the U.S. and into the Gulf of Mexico and Caribbean Sea. Leatherback turtles are found throughout the AOI, depending on the season. In Virginia, Coles (1999) reported from sea turtle stranding data that leatherback turtles were frequently sighted and stranded in Chesapeake Bay during 1979 through 1997.

Off South Carolina, leatherback turtles are primarily found from April-June when cannonball jellyfish (*Stomolophus meleagris*) are abundant, and again in October and November (SCDNR, 2005b).

Along the U.S. east coast, the principal nesting beaches for leatherback turtles are in Florida. According to SCDNR (2005b), leatherback turtles have also been documented to nest in Georgia, South Carolina (four leatherback nests since 1996), North Carolina, and possibly in Maryland.

Satellite tagging data demonstrate that leatherback turtles display wide ranging coastal and transoceanic movements (Hays et al., 2006; USDOC, NMFS et al., 2010) and have the most wide-ranging distribution of any sea turtle. Because leatherback turtles appear to adapt quickly to local environmental conditions, they do not display any restricted distributional and movement behaviors (Hays et al., 2006; USDOC, NMFS and USDOI, FWS, 2007c). James et al. (2005a,b) described only few high-use areas for Atlantic leatherback turtles compared with the total area traveled through, suggesting a low fidelity to any particular area. In fact, Eckert (2006) reported that leatherback turtles tagged in Trinidad were later reported off Newfoundland (Flemish Cap), Canada, and subsequently in Mauritanian waters. Genetic techniques have been used to distinguish five groups or populations in the western North Atlantic Ocean: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean (includes northern Brazil), and Southern Brazil (USDOC, NMFS and USDOI, FWS, 2007c). Genetic studies support the natal homing hypothesis, which has been reported for other sea turtles (Godley et al., 2010). Leatherback turtles tend to use specific beach sites within their respective regions for nesting.

Population Status

Similar to other sea turtles, the leatherback turtle population is also depleted; however, in comparison to other sea turtles, the population is more stable (USDOC, NMFS and USDOI, FWS, 2007c). Spotila et al. (1996) estimated there were about 115,000 individuals in 1980. The most recent population estimate for leatherback turtles in the Atlantic is smaller – between 34,000 and 94,000 – but apparently stable (USDOC, NMFS and USDOI, FWS, 2007c). Leatherback turtles are highly migratory (Shillinger et al., 2008) and migrate further than any other reptile (USDOC, NMFS and USDOI, FWS, 2007c). Recent survey data clearly show that the nesting numbers have dramatically increased, from 98 nests in 1988 to around 850 nests in the early 2000's (USDOC, NMFS and USDOI, FWS, 2007c). Using the number of nests as a population index, the estimated annual growth rate for leatherback turtles is around 1.17 (USDOC, NMFS and USDOI, FWS, 2007c).

Conservation and Management

The conservation and recovery of the leatherback turtle is governed through various regulatory mechanisms such as attempting to meet specific recovery plan objectives, habitat protection efforts, and protecting nesting females. Other conservation measures include imposing restrictions on commercial fishery activities to prevent serious injury and mortality to sea turtles (e.g., circle hook requirements in the pelagic longline fishery and the use of TEDS in trawls) and supporting several international agreements, such as the Inter-American Convention for the Protection and Conservation of Sea Turtles. Moreover, NMFS has developed and is attempting to implement a Strategy for Sea Turtle Conservation and Recovery in Relation to Atlantic and Gulf of Mexico Fisheries, which focuses on specific commercial fishing gear-related criteria. To assist decision makers, agencies also fund many research projects, e.g., the South Carolina nearshore aerial and nesting surveys, and short-term telemetry studies (SCDNR, 2005b).

Critical habitat was initially designated for the leatherback turtle in 1979 (*Federal Register*, 1979). Critical habitat was defined as specific areas for the U.S. Virgin Islands: a strip of land 0.2-mi (0.3-km) wide at Sandy Point Beach, St. Croix, and the waters adjacent to the site (shore to 100-fathom curve). In February 2010, NMFS and FWS were petitioned to revise critical habitat to include the offshore waters to allow for safe and timely passage and access to/from/within nesting sites at San Miguel, Paulinas, and Convento Beaches in the Northeast Ecological Corridor of Puerto Rico, and to protect reproductive activities offshore of these sites (Sierra Club, 2010). In July 2010, NMFS concluded that the petition did not warrant revision of the critical habitat (*Federal Register,* 2010h). Leatherback turtles have various anthropogenic threats to their recovery, which include but are not limited to commercial fisheries, habitat loss (nesting), climatic change (e.g., sea level rise, shifts in prey availability), pollution, overutilization for commercial, recreational, scientific, or education purposes (e.g., egg harvesting), and disease (USDOC, NMFS and USDOI, FWS, 2007c).

Ecology and Life History

Like other sea turtle species, hatchling leatherback turtles leave the nest and swim actively offshore. Post-hatchling and oceanic juvenile leatherbacks are more active than other sea turtle species (Wyneken and Salmon, 1992). These oceanic juveniles virtually disappear for 4 years (Musick and Limpus, 1997). Their requirements for gelatinous prey suggest that they may search for areas of major upwelling. Juvenile (as well as adult) leatherbacks recruit seasonally to temperate and boreal coastal habitats to feed on concentrations of jellyfish (Lutcavage and Lutz, 1986). In the western North Atlantic, juveniles appear in these habitats at a body length of 110-120 cm (43-47 in) (Musick and Limpus, 1997). It is likely that post-hatchling and oceanic juvenile leatherback turtles may be present within offshore and coastal waters of the AOI.

Leatherback turtles have a wide-ranging distribution and apparently are able to adapt and tolerate cold water temperatures; most sea turtles sighted in the Chesapeake Bay were in waters between 25 and 29 degrees Celsius (°C) (Coles, 1999). Coles (1999) indicated that sea turtle distribution may not be random but may be associated with specific water temperature ranges. Adult leatherback turtles have been reported to migrate from equatorial to temperate waters to forage, which is unique for sea turtles (USDOC, NMFS and USDOI, FWS, 2007c). Leatherback turtles primarily feed on pelagic gelatinous invertebrates such as scyphomedusae (jellyfish) and pelagic tunicates (USDOC, NMFS and USDOI, FWS, 1992; Bjorndal, 1997), and seasonal movements appear to be correlated with jellyfish seasonal abundance (SCDNR, 2005b). Unlike other sea turtles, leatherback turtles can begin nesting much earlier in the year. Leatherback turtles have been reported to nest as early as February or March, with peak nesting in July; females nest at 2- or 3-year intervals. In Atlantic OCS waters and within the AOI, the leatherback turtle is reported to nest mainly on Florida beaches. Age at sexual maturity has been reported to be much younger than for other sea turtles, at around 6-10 years. The average clutch size is around 100 eggs, and incubation is between 60 and 65 days; females deposit between five and seven nests per breeding season, with internesting intervals ranging from approximately 8-12 days (USDOC, NMFS and USDOI, FWS, 2007c).

Knowledge about leatherback turtles in their open ocean environment is limited, but there is some published information about daily movement and dive behaviors. Off South Africa, Sale et al. (2006) investigated leatherback turtle diving behavior during oceanic movements. Results from that study demonstrated that leatherback turtles primarily dove to depths less than 200 m (656 ft), and maximum dive durations were between 30 and 40 min. Findings also showed that leatherback turtles displayed differences in dive patterns depending on the time of day. At night and at specific periods, leatherback turtles dove longer. Interestingly, the researchers reported some of the deepest and longest dives during the day for a few individuals. Using tagging data from nine turtles (181-431 days), Hays et al. (2006) also recorded seasonal movements from the south (Caribbean) to the north (northeastern coast of the U.S.) during the summer and from the north to the south during the fall. With these seasonal movements, the researchers found that as the individuals moved from southern to northern latitudes, the dives were initially longer but then became progressively shallower and shorter. In addition, Hays et al. (2006) documented that leatherback turtles also displayed a diel dive pattern with more diving and shallower diving at night than during the day for the individuals located between 18° and 30° N. Mean dive duration ranged from 3-5 to 30 min, and mean dive depth ranged from surface waters to almost 250 m (820 ft). The overall swimming speed ranged from 2.5 to 82.5 km (1.5 to 51 mi) per day; most leatherback turtles swam between 32.5 and 42.5 km (20 and 26 mi) per day. Hays et al. (2006) concluded that leatherback turtles do not display highly migratory behavior (i.e., swim from southern to northern waters) just to forage at specific "hotspots" but instead continuously feed as they travel. However, the researchers noted that leatherback turtles did remain in specific areas for short durations to feed, and their daily diving patterns were correlated with prey abundance.

4.2.3.1.6. Summary of Sea Turtle Hearing Capabilities

A brief overview of sea turtle hearing is presented here. For more information, see **Appendix I**. Few studies have examined the role acoustic cues play in the ecology of sea turtles (Mrosovsky, 1972; Samuel et al., 2005; Nunny et al., 2008). There is evidence that sea turtles may use sound to communicate, but the few vocalizations described for sea turtles are restricted to the "grunts" of nesting females (Mrosovsky, 1972). These sounds are low frequency and relatively loud, thus leading to speculation that nesting females use sounds to communicate with conspecifics (Mrosovsky, 1972). Very little is known about the extent to which sea turtles use their auditory environment. The acoustic environment for sea turtles changes with each ontogenetic habitat shift. In the inshore environment where juvenile and adult sea turtles generally reside, the ambient environment is noisier than the open ocean environment of the hatchlings; this inshore environment is dominated by low frequency sound (Hawkins and Myrberg, 1983) and, in highly trafficked areas, virtually constant low frequency noises from shipping and recreational boating (Hildebrand, 2009).

Much of the research on the hearing capacity of sea turtles is limited to gross morphological dissections (Wever, 1978; Lenhardt et al., 1985). Based on the functional morphology of the ear, it appears that sea turtles receive sound through the standard vertebrate tympanic middle ear path. The sea turtle ear appears to be a poor receptor for aerial sounds but is well adapted to detect underwater sound. The dense layer of fat under the tympanum acts as a low-impedance channel for underwater sound. Furthermore, the retention of air in the middle ear of these sea turtles suggests that they are able to detect sound pressures.

Electrophysiological studies on hearing have been conducted on juvenile green turtles (Ridgway et al., 1969; Bartol and Ketten, 2006), juvenile Kemp's ridley turtles (Bartol and Ketten, 2006), and juvenile loggerhead turtles (Bartol et al., 1999; Lavender et al., 2010, 2011). Electrophysiological responses, specifically auditory evoked potentials (AEPs), are the most widely accepted technique for measuring hearing in situations in which normal behavioral testing is impractical. Most AEP research has concentrated on responses occurring within the first 10 ms following presentation of a click or brief tone, which has been termed the auditory brainstem response (ABR).

Ridgway et al. (1969) measured AEPs of green turtles using both aerial and vibrational stimuli. Green turtles detect a limited frequency range (200-700 Hz) with best sensitivity at the low tone region of about 400 Hz. Though this investigation examined two separate modes of sound reception (i.e., air and bone conduction), sensitivity curves were relatively similar, suggesting that the inner ear is the main structure for determining frequency sensitivity. To measure electrophysiological responses to sound stimuli, Bartol et al. (1999) collected ABRs from juvenile loggerhead turtles. Thresholds were recorded for both tonal and click stimuli. Best sensitivity was found in the low frequency region of 250-1,000 Hz. The decline in sensitivity was rapid above 1,000 Hz, and the most sensitive threshold tested was at 250 Hz. More recently, Bartol and Ketten (2006) collected underwater ABRs from hatchling and juvenile loggerhead and juvenile green turtles using speakers suspended in air while the turtle's tympanum remained submerged. All turtles tested responded to sounds in the low frequency range, from at least 100 Hz (lowest frequency tested) to no greater than 900 Hz. The smallest turtles tested, hatchling loggerheads, had the greatest range of hearing (100-900 Hz), while the larger juveniles responded to a much narrower range (100-400 Hz). Hearing sensitivity of green turtles also varied with size; smaller greens had a broader range of hearing (100-800 Hz) than that detected in larger subjects (100-500 Hz). Using underwater speakers as a sound source, Lavender et al. (2010, 2011) measured underwater AEPs in loggerhead turtles ranging from yearlings to subadults and detected responses to frequencies between 50 and 1,000 Hz.

4.2.3.2. Impacts of Routine Events

Preliminary screening discussed in **Chapter 4.1.1** identified five IPFs from routine G&G activities that may affect sea turtles: (1) active acoustic sound sources; (2) vessel and equipment noise; (3) vessel traffic; (4) aircraft traffic and noise; and (5) trash and debris (**Table 4-2**). Significance criteria are presented below, followed by discussion of individual IPFs.

4.2.3.2.1. Significance Criteria

Negligible impacts to sea turtles would include those where little to no measurable impacts are observed or expected. There would be (1) no mortality or serious and permanent injury to any individual sea turtle; (2) brief disruption(s) of behavioral patterns or other non-injurious effects; and (3) no displacement of sea turtles from preferred feeding or breeding areas, nesting beaches, or migratory routes.

Minor impacts to sea turtles would be detectable but neither severe nor extensive. Minor impacts to sea turtles would include (1) non-life-threatening injuries to one or more individuals of a sea turtle species; (2) short-term displacement of sea turtles from preferred feeding or breeding areas, nesting beaches, or migratory routes; and (3) little disruption of critical, time-sensitve behaviors such as nesting, breeding, or the emergence and dispersion of hatchlings.

Moderate impacts to sea turtles would be detectable and extensive but not severe. Limited impacts to sea turtles would include (1) limited serious injuries or mortalities in low enough numbers such that the continued viability of the population is not threatened; (2) protracted displacement of individual sea turtles from preferred feeding or breeding areas, nesting beaches, or migratory routes; and (3) limited disruption of critical, time-sensitive behaviors such as nesting, breeding, or the emergence and dispersion of hatchlings resulting in the loss of breeding and egg-bearing adults and hatchlings. Because of the relatively low numbers of sea turtles affected, the viability or continued existence of affected local sea turtle populations would not be threatened, although some impacts such as physical injuries and the reduction in productivity from disrupted or lost nesting opportunities may be long-term or irreversible.

Major impacts to sea turtles would be detectable, extensive, and severe. Major impacts to sea turtles would include (1) extensive serious (life-threatening) injuries or mortalities in sufficiently high numbers that the continued viability of the local population is seriously threatened; (2) long-term or permanent displacement of individual sea turtles from preferred feeding or breeding areas, nesting beaches, or migratory routes; (3) substantial disruption (i.e., affecting large numbers of the local population) of critical, time-sensitive behaviors such as nesting, breeding, the emergence and dispersion of hatchlings resulting in the loss of breeding and egg-bearing adults and hatchlings; and (4) destruction or adverse modification of sea turtle habitats, including feeding or breeding areas, nesting beaches, or migratory routes.

4.2.3.2.2. Evaluation

Active Acoustic Sound Sources

Source Characteristics

Active acoustic sound sources included in the proposed action are airguns as well as various electromechanical sources such as boomer and chirp subbottom profilers, side-scan sonars, and multibeam depth sounders. Source characteristics are summarized in **Table 3-11**, and detailed characteristics and acoustic modeling assumptions are presented in **Appendix D**.

Airguns would be used as seismic sources during deep penetration seismic airgun surveys for oil and gas exploration and for postlease HRG surveys of oil and gas leases. The BOEM does not anticipate that airguns would be used for HRG surveys in the renewable energy or marine minerals programs. The renewable energy scenario includes the possibility of a deep penetration seismic survey to evaluate formation suitability for carbon sequestration. However, given the much greater number and extent of seismic airgun surveys included in the oil and gas scenario, a single seismic survey for carbon sequestration is not analyzed separately.

For this Programmatic EIS, two sizes of airgun arrays were modeled, based on current usage in the Gulf of Mexico, and considered representative for potential Atlantic G&G seismic airgun surveys:

- large airgun array (5,400 in^3) – this array was used to represent sound sources for deep penetration seismic airgun surveys, including 2D, 3D, WAZ, and other variations; and
- small airgun array (90 in^3) – this array was used to represent sound sources for HRG surveys for oil and gas exploration sites.

Broadband source levels are 230.7 dB re 1 μPa for the large airgun array and 210.3 dB re 1 μPa for the small array (**Table 3-11**). Although airguns have a frequency range from about 10-2,000 Hz, most of the acoustic energy is radiated at frequencies below 200 Hz. Sea turtle hearing and sensitivity to acoustic impacts are reviewed in **Appendix I** and summarized in **Chapter 4.2.3.1**. From this review of existing information, it is known that underwater noise from airguns is expected to be within the functional hearing range of sea turtles (generally between 100-1,000 Hz) and is likely to be audible to them.

Detailed acoustic characteristics of electromechanical sources, including side-scan sonars, subbottom profilers, and depth sounders, are discussed in **Appendix D**. Acoustic signals from electromechanical sources other than the boomer are not likely to be detectable by sea turtles. The boomer has an operating frequency range of 200 Hz–16 kHz, and so may be audible to sea turtles. However, it has a very short pulse length (120, 150, or 180 µs) and a very low source level, with a 180-dB radius of less than 5 m (16 ft) (**Appendix C**).

Types of Impacts on Sea Turtles

Active acoustic sound sources could have a range of effects on sea turtles. In order of decreasing severity, these could include death, physical injury, hearing threshold shift, auditory masking, and behavioral responses. Hearing threshold shifts, auditory masking, and behavioral responses are discussed in detail below. There are no data demonstrating death or injury of sea turtles from airguns, which are the sound sources with the highest source levels. Behavioral responses are the most likely impact, with a limited potential for hearing threshold shift and masking effects for sea turtles close to an airgun array.

Hearing Threshold Shift: Auditory impacts such as TTS or PTS could occur in sea turtles. However, unlike marine mammals, criteria have not been developed for these effects in sea turtles, mainly because of the few data that exist on sea turtles hearing. The TTS, by definition, is a temporary and recoverable damage to hearing structures (sensory hair cells) and can vary in intensity and duration. For individuals experiencing TTS, normal hearing abilities would return over time; however, animals may lack the ability to detect prey and predators and assess their environment during the recovery period. In contrast, PTS results in the permanent though variable loss of hearing through the loss of sensory hair cells (Clark, 1991). Few studies have looked at hair cell damage in reptiles, and studies do not indicate precisely if sea turtles are able to regenerate injured sensory hair cells (Warchol, 2011).

Because there are no hearing criteria for sea turtles, NMFS, during their Section 7 ESA consultations, typically apply the criteria for marine mammals to evaluate the potential for similar impacts. The current NMFS criterion for Level A harassment of cetaceans is a received SPL of 180 dB re 1 µPa; although not explicitly referring to TTS, this criterion is based on the potential for "overt behavioral, physiological, and hearing effects on marine mammals in general" (HESS, 1999). Calculations in **Appendix D** indicate that this zone could extend up to 2.1 km (1.3 mi) from a large airgun array (5,400 in^3) and up to 186 m (610 ft) from a small airgun array (90 in^3). However, the actual extent of the TTS zone is likely to be much smaller than this. Southall et al. (2007) proposed two TTS criteria for cetaceans, one involving sound exposure level (which cannot be readily calculated here) and the other based on a received SPL of 230 dB re 1 µPa (peak). The 230 dB level would occur within a few meters of the center of an airgun array. If TTS occurs at similar received levels in sea turtles, the actual risk of auditory system impacts is likely to be limited to areas within an airgun array.

Auditory Masking: Noise below the TTS and PTS levels may have the potential to mask relevant sounds in the environment or induce simple behavioral changes in sea turtles such as evasive maneuvers (e.g., diving or changes in swimming direction and/or speed). Masking sounds can interfere with the acquisition of prey or mates, the avoidance of predators and, in the case of sea turtles the identification of an appropriate nesting site (Nunny et al., 2008). These maskers could have diverse origins, ranging from natural to anthropogenic sounds (Hildebrand, 2009). Because sea turtles appear to be low frequency specialists, the potential masking noises would fall mainly within the range of 50-1,000 Hz. There are no quantitative data demonstrating masking effects for sea turtles. Behavioral changes that may occur from masking sounds may have ecological consequences for sea turtles, although there are no quantitative data demonstrating these effects.

Behavioral Responses: Limited data exist on noise levels that may induce behavioral changes in sea turtles. Avoidance reactions to seismic signals have been observed at levels between 166 and 179 dB re 1 µPa (Moein et al., 1995; McCauley et al., 2000a); however, both of these studies were done in a caged environment, so the extent of avoidance could not be monitored. In experiments attempting to use airguns to repel turtles from dredging operations, Moein et al. (1995) observed a habituation effect to airguns; the animals stopped responding to the signal after three presentations. From these results, it was not clear whether this lack of behavioral response was a result of behavioral habituation, or physical effects from TTS or PTS.

Analysis of the Proposed Action Scenario

Over the 2012-2020 time period, the proposed action includes 617,775 line km of 2D surveys, 2,500 blocks of 3D surveys, 900 line km of 3D WAZ and FAZ coil surveys, 1,280 line km of VSP surveys, and 175,465 line km of HRG surveys (**Table 3-9**). These activities could occur anywhere within the AOI, with the exception of areas within the North Atlantic right whale time-area closure (which would also protect other marine mammals as well as sea turtles), as discussed in **Chapter 2**.

The proposed action includes extensive HRG surveys in both the renewable energy and marine minerals programs. The renewable energy program is estimated to include 211,585 km of HRG surveys (**Table 3-6**). The marine minerals program would include approximately 100-3,200 km (62-1,988 mi) of prospecting surveys, 850-4,300 km (528-2,672 mi) of prelease/design surveys, and 900-4,600 km (559-2,858 mi) of on-lease surveys (**Table 3-7**). However, these HRG surveys typically would use only the electromechanical sources described previously, which are expected to be beyond the functional hearing range of sea turtles.

Based on the scope of the proposed action, seismic airgun surveys could affect individuals from all sea turtle species within the AOI, potentially including hawksbill turtles within the southernmost part of the AOI. Subadult and adult turtles may be more likely to be affected by seismic airgun noise than post-hatchling turtlesbecause of the time that the former remain submerged and at depth. Post-hatchling turtles generally reside at or near the sea surface and may be less likely to be injured by the sound field produced by an airgun array during a survey. It is anticipated that seismic airgun surveys conducted close to the inshore limit of the AOI may affect a greater number of individual turtles, particularly species other than leatherbacks. Deepwater surveys are likely to affect fewer individual turtles but are more likely to affect leatherback turtles, particularly within areas of upwelling where individuals may be found in feeding aggregations. Also, surveys conducted during summer sea turtle nesting periods may affect greater numbers of adult turtles, particularly loggerhead, green, and leatherback turtles, than surveys conducted during non-nesting periods.

Appendix C discusses the operational mitigation measures that would be implemented during seismic airgun surveys, including ramp-up of airgun arrays, visual monitoring of an exclusion zone by protected species observers, and startup and shutdown requirements. The purpose of these operational measures is to prevent serious injury to sea turtles and marine mammals by ensuring that they are not present within an exclusion zone around the airgun array. If the operational mitigation measures were 100 percent successful, then most auditory impacts on sea turtles would be avoided. The BOEM expects that mitigation measures would not be 100 percent effective, and therefore there is the potential to expose some sea turtles to sound levels that could cause TTS or PTS. However, no deaths or life-threatening injuries are expected.

The operational mitigation measures during seismic airgun surveys would not prevent behavioral disturbance to sea turtles at distances beyond the exclusion zone. As noted previously, avoidance reactions to seismic signals have been observed in sea turtles at received SPLs between 166 and 179 dB re 1 μPa (Moein et al., 1995; McCauley et al., 2000a). Received SPLs of 160 dB re 1 μPa could extend up to 15 km (9.3 mi) from a large airgun array (5,400 in^3) and up to 3 km (1.9 mi) from a small airgun array (90 in^3), depending on the geographic location and season modeled.

Detection of sea turtles by visual monitoring during seismic airgun surveys can be problematic. Sea turtles spend most of their life below the sea surface. Individuals on the sea surface, particularly subadults and juveniles, are generally not demonstrative and may be difficult to detect during visual surveys, particularly during periods of elevated sea states or low visibility. Most post-hatchling sea turtle species tend to aggregate in mats of floating *Sargassum* within or near zones of ocean current convergence, though it is unlikely that a visual observer would detect their presence during visual mitigation monitoring surveys. Species such as green turtles and leatherback turtles tend to avoid *Sargassum* mats and may be even more difficult to detect during these mitigation surveys.

It is possible that sea turtles would move away from approaching and/or increasing levels of sound during the ramp-up period of a seismic survey. However, a sea turtle's response could also include diving below the airgun array, which would increase the likelihood of auditory impacts.

Based on the preceding analysis, most impacts of active acoustic sound sources on sea turtles are expected to be **negligible** or **minor**. The most likely impacts would be short-term behavioral responses of individuals in proximity to airgun arrays. In cases where individual sea turtles cannot or do not avoid airgun arrays and are not detected by visual observers, TTS or PTS could occur, but no deaths or life-threatening injuries are expected. Other active acoustic sources such as subbottom profilers, sonars, and depth sounders are largely beyond the functional hearing range of sea turtles and are expected to have negligible effects.

In general, seismic airgun surveys would not be expected to result in the long-term or permanent displacement of sea turtles from preferred coastal habitats such as seagrass beds, nearshore or inshore hard substrate habitats, or embayments. During seismic airgun surveys, the source vessel typically travels at speeds of about 4.5 kn (8.3 km/hr). Assuming that behavioral responses could extend in a 15-km (9.3-mi) radius from a large airgun array and a 3-km (1.9-mi) radius from a small airgun array, as noted previously, the duration of disturbing sound levels for a stationary sea turtle would range from about 45 min to 3.5 hr.

Seismic airgun surveys conducted off of heavily used nesting beaches during the nesting season could temporarily displace breeding and nesting adult turtles and potentially disrupt time-critical activities. As discussed in **Chapter 4.2.3.1**, beaches of southeast Florida have been identified as the most important nesting area for loggerhead turtles (part of the Penisular Florida Recovery Unit) in the western hemisphere (USDOC, NMFS and USDOI, FWS, 2008). The northern segment of the Archie Carr NWR borders the AOI, and it has been estimated that 25 percent of all loggerhead nesting in the U.S. occurs there (USDOI, FWS, 2011a). During the 2010 nesting season, there were over 31,000 loggerhead nests in Brevard County, where the Archie Carr NWR is located. It is likely that large numbers of sea turtles would be present in nearshore and inner shelf waters of Brevard County during the nesting season from May 1 through October 31. Many adult females linger near the nesting beaches before and between nesting events, resting under rocky ledges and outcrops in inner shelf waters for periods of weeks. Depending on various factors including (1) the distance of the survey from shore; (2) local factors such as seafloor topography and seafloor substrate that may affect the lateral propagation of underwater sound; and (3) the duration and intensity of survey effort in this area, it is likely that in these cases breeding adults, nesting adult females, and hatchlings could be exposed to airgun seismic survey-related sound exposures at levels of 180 dB re 1 μPa or greater. Because of these potentially large sound fields in shallow water, the exposure of individual turtles to these elevated levels of sound intensity would be protracted, even with an underway survey vessel on transect. Potential impacts could include auditory injuries to adults and dispersion of hatchlings, though the latter may be somewhat insulated from the most harmful components of the propagated sound field because of their relative distributions at or near the sea surface. From this analysis, seismic airgun survey impacts on sea turtles would be expected to range from **minor** to **moderate**.

The HRG surveys of renewable energy and marine minerals sites would use only electromechanical sources such as side-scan sonar, boomer and chirp subbottom profilers, and multibeam depth sounders. Acoustic signals from electromechanical sources other than the boomer are not likely to be detectable by sea turtles, whose best hearing is mainly below 1,000 Hz (**Appendix I**). The effects from these sources on sea turtles are expected to range from **no effect** to **negligible**, based on the audibility of the source to sea turtles (which may be a function of distance). The boomer has an operating frequency range of 200 Hz–16 kHz, and so may be audible to sea turtles. However, it has a very short pulse length (120, 150, or 180 μs) and a very low source level, with a 180-dB radius of less than 5 m (16 ft) (**Appendix C**). Therefore, impacts from HRG surveys using boomer subbottom profilers on sea turtles are expected to range from **negligible** to **minor**, based on the distance of the individual sea turtle from the sound pulse.

Vessel and Equipment Noise

G&G activities in all three program areas would generate vessel and equipment noise that could disturb sea turtles or contribute to auditory masking. As discussed in **Chapter 3.5.1.2**, vessel noise is a combination of narrow-band (tonal) and broadband sound (Richardson et al., 1995). Tones typically dominate up to about 50 Hz, whereas broadband sounds may extend to 100 kHz. The dominant source of noise from vessels is from the propeller operation, including cavitation, singing and propulsion, and the intensity of this noise is largely related to ship size and speed. Vessel and equipment noise from G&G vessels, including survey and support vessels associated with activities described in the proposed action, would produce low levels of noise. Broadband source levels for most small ships (a category that would include seismic survey vessels and support vessels for drilling of COST wells or shallow test wells) are anticipated to be in the range of 170-180 dB re 1 μPa at 1 m and source levels for smaller boats (a category that would include survey vessels for renewable energy and marine minerals sites) are in the range of 150-170 dB re 1 µPa at 1 m (Richardson et al., 1995).

Seismic survey vessels conducting 2D and 3D seismic airgun surveys are the largest vessels and would account for most of the line miles traveled. Based on the permit applications received by BOEM, these surveys could occur anywhere within the AOI. Vessels conducting G&G surveys or sampling for renewable energy would be smaller and operate mainly at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Similarly, vessels conducting G&G surveys or sampling for marine minerals would be operating mainly at specific borrow sites in water depths less than 30 m (98 ft). Survey vessels for renewable energy and marine minerals projects are expected to make daily round trips to their shore base, whereas the larger seismic vessels can remain offshore for weeks or months.

Other sound sources associated with the proposed activity include drilling-related noises during the completion of up to three COST wells and up to five shallow test wells to be drilled in the Mid- or South Atlantic Planning Areas during the time period of the Programmatic EIS. As discussed in **Chapter 3.5.1.2**, noise from drilling operations includes strong tonal components at low frequencies (<500 Hz), including infrasonic frequencies in at least some cases (Richardson et al., 1995). Machinery noise can be continuous or transient, and variable in intensity. Noise levels vary with the type of drilling rig and the water depth. Drilling-related noise from jack-up platforms is continuous and generally of very low frequencies (near 5 Hz). Sound source levels, however, may range from 119 to 127 dB re 1 µPa at nearfield locations. Drilling-related noises from semi-submersible platforms range in frequencies from 10 to 4000 Hz, with estimated sound levels of 154 dB re 1 µPa-m. Source levels for drillships have been reported to be as high as 191 dB re 1 µPa during drilling. Because of the very low sound frequencies produced from jack-up platforms, it is likely that drilling activities from these platforms are inaudible to sea turtles. In contrast, it is likely that drilling-related sounds from semi-sumbersible drilling vessels would be audible to sea turtles. It is expected that drilling-related noises would elicit only behavioral responses in sea turtles.

The most likely effects of vessel and equipment noise on sea turtles would include behavioral changes and possibly auditory masking. Vessel and equipment noise is transitory and generally does not propagate at great distances from the vessel, and the source levels are too low to cause death or injuries such as auditory threshold shifts. Based on existing studies on the role of hearing in sea turtle ecology, it is unclear whether masking would realistically have any effect on sea turtles. Behavioral responses to vessels have been observed but are difficult to attribute exclusively to noise rather than to visual or other cues. It is conservative to assume that noise associated with survey vessels may elicit behavioral changes in individual sea turtles near these vessels. These behavioral changes may include evasive maneuvers such as diving or changes in swimming direction and/or speed. This evasive behavior is not expected to adversely affect these individuals or the population; impacts would be **negligible**.

Drilling-related noises during the completion of COST wells and shallow test wells may be audible to sea turtles, particularly if activities utilize semi-submersible plartforms. Drilling-related noise is continuous, and it is expected that the sound source may elicit behavioral responses in sea turtles that may include temporary avoidance or displacement of sea turtles from a very small radius around the drilling area. Studies of sea turtles in the proximity of platforms are not conclusive on whether the turtles may habituate to the continuous sound source. Therefore, impacts to sea turtles from drilling-related noises associated with the proposed activity would be **negligible**.

Vessel Traffic

G&G survey vessels could strike and injure or kill sea turtles. Propeller and collision injuries to turtles arising from their interactions with boats and ships are common. From 1997-2005, 14.9 percent of all stranded loggerhead turtles in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injuries. This study did not indicate what proportion of these injuries was post- or ante-mortem (USDOC, NMFS and USDOI, FWS, 2008). The incidence of propeller wounds reported in sea turtles rose from approximately 10 percent in the late 1980's to a record high of 20.5 percent in 2004. Documented propeller wounds have the highest frequency of occurrence in southeast Florida (Palm Beach through Miami-Dade Counties); during some years, as many as 60 percent of the loggerhead strandings found in these areas had propeller wounds (USDOC, NMFS and USDOI, FWS, 2008). Green turtle recovery off the U.S. west coast has been hampered by vessel collisions, especially when turtles are struck by an engaged propeller (USDOC, NMFS and USDOI, FWS, 1998a). In contrast, vessel collisions are not listed as a current threat to leatherback turtle recovery (USDOC, NMFS and USDOI, FWS, 1992, 1998b). It is likely that these reported injuries to sea turtles were largely caused by collisions with high-speed recreational powerboats because of the high volumes of these vessels operating in waters off southeast Florida and in other areas of the U.S.

There have been no documented sea turtle collisions with drilling and service vessels in areas such as the Gulf of Mexico, although it is possible that such collisions with small or submerged sea turtles may go undetected. Under the proposed action, all authorizations for shipboard surveys would include guidance for vessel strike avoidance. The guidance would be similar to Joint BOEM-BSEE NTL 2012-G01 ("Vessel Strike Avoidance and Injured/Dead Protected Species Reporting"), which incorporates NMFS "Vessel Strike Avoidance Measures and Reporting for Mariners" addressing protected species identification, vessel strike avoidance, and injured/dead protected species reporting (USDOI, BOEM and BSEE, 2012a). With these mitigation measures in place, G&G survey vessels are unlikely to strike sea turtles. Seismic vessels, which account for most of the project-related vessel traffic associated with Alternative A activities, survey at a speed of approximately 4.5 kn (8.3 km/hr). In addition, waters surrounding survey vessels on survey would be monitored by protected species observers for the presence of sea turtles. During transit to and from shore bases, seismic vessels and other G&G survey vessels are expected to travel at greater speeds. However, these vessel movements would be subject to joint BOEM-BSEE guidance for vessel strike avoidance and be required to reduce speed in certain areas to comply with the Right Whale Ship Strike Reduction Rule.

Sea turtles spend at least 20 to 30 percent of their time at the surface for respiration, basking, feeding, orientation, and mating (Lutcavage et al., 1997). Because sea turtles spend most of their lives submerged, a collision between a project-related survey vessel and a sea turtle within the AOI is unlikely. In addition, the risk of vessel strikes on sea turtles is expected to be minimized because of (1) the guidelines for vessel strike avoidance that would be part of all authorizations for shipboard surveys under the proposed action; (2) the typical slow speed of seismic vessels; and (3) the use of protected species observers to scan the sea surface around seismic survey vessels. Any project-related vessel strike with a sea turtle is expected to result in the death of the turtle. However, considering the relatively slow operational speed of these vessels, combined with the implementation of vessel strike avoidance measures during all operations, vessel strikes are expected to be avoided and vessel traffic-related impacts would be **negligible**.

Aircraft Traffic and Noise

Remote sensing surveys associated with oil and gas exploration and development activities would include aeromagnetic surveys (**Chapter 3.2.2.6.5**) and the installation of COST and shallow test wells (**Chapter 3.2.4**). The BOEM anticipates that one or two aeromagnetic surveys may be conducted in the AOI during the time period covered by the Draft Programmatic EIS. As discussed in detail in **Chapter 3.5.1.4**, the surveys would be conducted by fixed-wing aircraft flying at speeds of about 250 km/hr (135 kn) (Reeves, 2005). Most offshore aeromagnetic surveys are flown at altitudes between 61-152 m (200-500 ft). Line spacing varies depending on the objectives, but typical grids are 0.5 by 1.0 mi or 1.0 by 1.0 mi. It is expected that a typical aeromagnetic survey may require 1-3months to complete. In addition, helicopters are a potential source of aircraft noise during drilling of COST wells and shallow test wells. The oil and gas scenario assumes that up to three COST wells and up to five shallow test wells would be drilled in the Mid- or South Atlantic Planning Areas during the time period of the Programmatic EIS. It is expected that drilling activities would be supported by a helicopter making one round-trip daily between the drilling rig and onshore support base. Potential impacts to sea turtles from aircraft conducting aircraft traffic include noise and physical (visual) disturbance.

Noises generated by project-related survey aircraft that are directly relevant to sea turtles include both airborne sounds to individual turtles on the sea surface and underwater sounds from air-to-water transmission from passing aircraft. Both helicopters and fixed-wing aircraft generate noise from their engines, airframe, and propellers. The dominant tones for both types of aircraft are generally below 500 Hz (Richardson et al., 1995) and are within the auditory range of all sea turtles (**Appendix I**). Aircraft noise entering the water depends on aircraft altitude, the aspect (direction and angle) of the aircraft relative to the receiver, and sea surface conditions. The level and frequency of sounds propagating through the water column are affected by water depth and seafloor type (Richardson et al., 1995). Because of the expected airspeed and these physical variables, noise (including airborne and underwater) generated by survey aircraft is expected to be brief in duration.

The physical presence of low-flying aircraft can disturb sea turtles, particularly those on the sea surface. Behavioral responses to flying aircraft include diving or rapid changes in swimming speed or direction.

Considering the relatively low numbers of aeromagnetic surveys and low number of COST and shallow test wells associated with the proposed activity, along with the short duration of potential exposure of aircraft–related noise and physical disturbance to sea turtles because of survey airspeed, it is expected that potential impacts from this activity would be **negligible**.

Trash and Debris

Lost and discarded marine debris, particularly those items made of synthetic materials, is a major form of marine pollution (Laist, 1997). Marine debris poses two types of negative impacts to sea turtles: (1) entanglement, and (2) ingestion. USDOC, NMFS and USDOI, FWS (2008) note that loggerhead turtles have been found entangled in a wide variety of materials, including steel and monofilament line, synthetic and natural rope, plastic onion sacks, and discarded plastic netting. From 1997-2005, 1.6 percent of stranded loggerheads found on Atlantic and Gulf of Mexico beaches were entangled in fishing gear. Monofilament line appears to be the principal source of entanglement for loggerheads in U.S. waters (0.9 percent; 1997-2005 average), followed by pot/trap line (0.4 percent; 1997-2005 average) and fishing net (0.3 percent; 1997-2005 average). Less than 1 percent of stranded sea turtles in 2005 were found entangled in other marine debris (NMFS, unpublished data, as cited in USDOC, NMFS and USDOI, FWS, 2008).

The G&G survey operations generate trash made of paper, plastic, wood, glass, and metal. Most of this trash is associated with galley and offshore food service operations. The discharge of trash and debris is prohibited (33 CFR 151.51-77) unless it is passed through a comminutor (a machine that breaks up solids) and can pass through a 25-mm mesh screen. All other trash and debris must be returned to shore for proper disposal with municipal and solid waste. Some personal items, such as hardhats and personal flotation devices, are occasionally accidentally lost overboard. However, USCG and USEPA regulations require operators to become proactive in avoiding accidental loss of solid waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. In addition, all authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012).

Taking into account the USCG and USEPA regulations and BSEE guidance, it is unlikely that significant amounts of trash and debris from G&G activities would be released into the marine environment, which appreciably reduces the likelihood of sea turtles encountering marine debris from the proposed activity. Therefore, debris entanglement and ingestion impacts on sea turtles are expected to be **negligible**.

Incomplete and Unavailable Information on Sea Turtle Impacts

The BOEM concludes that there is incomplete or unavailable information (40 CFR 1502.22) about sea turtles using the AOI with respect to: (1) basic biology and their physiology for underwater hearing; (2) their susceptibility to underwater noise; (3) alteration of behavior in response to sound; and (4) the masking effects of noise in the sea. All of these variables may be relevant to reasonably foreseeable adverse impacts on sea turtles that are subject to active acoustic sound sources, i.e., airguns. However, what is known about the biology and hearing physiology of representative species, in combination with observations of behavioral response to stimuli, allows inferences and conclusions about reasonably foreseeable adverse impacts on sea turtles to be understood with an adequate degree of certainty. The BOEM has therefore determined that data or information on sea turtle biology, hearing physiology, susceptibility to underwater noise, alteration of behavior in response to sound, and the masking effects of noise in the sea identified as incomplete or unavailable is not essential to a reasoned choice among the alternatives, including the No Action alternative.

Smaller than marine mammals and more difficult to observe in natural conditions, sea turtles present a challenge understanding how underwater noise affects them and how they respond to it. Moreover, a more complete knowledge base for all types of sea turtles that use the AOI and that bears on the factors listed above is not available and the acquisition of such information cannot be acquired without exorbitant cost. Such information certainly cannot be acquired in a time frame to make it available for this evaluation. While there will never be complete scientific information on sea turtles that live in OCS waters, a body of biological and physiological data and information about the underwater hearing of sea turtles and their use of the AOI is available to us. Thus, while we report where limited data and insufficient knowledge challenge our ability to understand how and when specific types of sea turtle species use the AOI and how noise affects them, incomplete or unavailable information does not affect our ability to understand and assign impacts or design mitigation strategies. We are able to draw basic conclusions despite incomplete or unavailable information, discuss results using available scientifically credible information, and apply that information using accepted scientific methodologies.

4.2.3.3. Impacts of Accidental Fuel Spills

Sea turtles could be affected by an accidental diesel fuel spill during G&G activities. Effects of spilled oil on sea turtles are discussed by Geraci and St. Aubin (1987), Lutcavage et al. (1995, 1997), and Milton et al. (2003). Oil, including refined diesel fuel may affect sea turtles through various pathways including direct contact, inhalation of the fuel and its volatile components, and ingestion (directly or indirectly through the consumption of fouled prey species) (Geraci and St. Aubin, 1987). Several aspects of sea turtle biology and behavior place them at risk, including lack of avoidance behavior, indiscriminate feeding in convergence zones, and inhalation of large volumes of air before dives (Milton et al., 2003). Studies have shown that direct exposure of sensitive tissues (e.g., eyes, nares, other mucous membranes) and soft tissues to diesel fuel or volatile hydrocarbons may produce irritation and inflammation. Diesel fuel can adhere to turtle skin or shells. Turtles surfacing within or near a diesel release would be expected to inhale petroleum vapors, causing respiratory stress. Ingested diesel fuel, particularly the lighter fractions, can be acutely toxic to sea turtles.

A small, accidental diesel fuel spill from a G&G survey vessel would be expected to disperse quickly in the open ocean; small diesel spills (500-5,000 gal) will usually evaporate and disperse within a day or less, even in cold water (USDOC, NOAA, 2006). It is assumed that the spilled fuel would rapidly spread to a layer of varying thickness and break up into narrow bands or windrows parallel to the wind direction. The rate at which the oil spreads would be determined by the prevailing conditions (e.g., temperature, water currents, tidal streams, wind speeds). The fuel spill is not likely to result in the death or life-threatening injury of individual turtles or hatchlings, or the long-term displacement of adult turtles from preferred feeding, breeding, or nesting habitats or migratory routes. It is unlikely that a small diesel fuel spill in the ocean would reach turtle nests, which are usually positioned above the high tide line. Therefore, potential impacts to sea turtles within the AOI are expected to range from **negligible** (if the fuel does not contact individual turtles) to **minor** (if individual turtles encounter the dispersed windrows of the surface slick).

4.2.3.4. Cumulative Impacts

The cumulative impacts scenario (**Chapter 3.6**) includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation, including research vessels; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs for these cumulative activities that may affect sea turtles include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, and other active sound sources; (2) discharges of drilling fluid, produced water, and other effluents from drilling rigs; (3) the physical presence of offshore structures; (4) vessel collisions with surfaced sea turtles; (5) accidental releases of trash and debris; (6) alteration or destruction of preferred nearshore and coastal (nesting) habitats because of pipelines, pipeline landfalls, and other coastal construction activities; (7) bycatch in fishing gear (Finkbeiner et al., 2011); (8) interactive effects of climate change, including impacts on nesting success and the relative sex ratios of hatchlings, and impacts on food sources (marine macroalgae and seagrasses, jellyfish, and motile and sessile benthic marine organisms); and (9) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Among the IPFs identified above for the cumulative impacts scenario, six sources of potential impact to sea turtles have been identified in association with proposed G&G activities, including (1) underwater noise; (2) vessel and equipment noise; (3) vessel traffic and collisions; (4) aircraft traffic and noise; (5) trash and debris; and (6) accidental fuel spills. Impact analyses presented in **Chapter 4.2.3.2** determined that activities projected to occur under Alternative A would result in negligible or minor impacts to sea turtles, with the exception of active acoustic sound sources produced off of heavily used nesting beaches during the nesting season which could temporarily displace breeding and nesting adult turtles and potentially disrupt time-critical activities, a **moderate** impact. The determination of noise-related impacts to sea turtles was made with the assumption that seismic survey protocols and associated impact mitigation measures would prevent the lethal take of any individual turtle. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Underwater Noise Including Active Acoustic Sound Sources

Increased levels of marine transportation have been documented along the U.S. Atlantic coast in recent years. It is assumed that underwater noise from vessel traffic and other anthropogenic sources within the AOI is increasing. Most ambient underwater noise is broadband, encompassing virtually the entire frequency spectrum. Vessel traffic is recognized as a major contributor to anthropogenic ocean noise, primarily in the low frequency bands between 5 and 500 Hz. Naturally occurring noise such as spray and bubbles from breaking waves is also a major contributor to ambient noise, primarily in the 500-100,000-Hz range. Noise-related impacts associated with the cumulative activities scenario are expected to fall predominantly within the **negligible** impacts category; localized, short-term **minor** noise impacts might be realized in association with specific military activities (e.g., sonars, explosives), however, available mitigation measures (e.g., observation and clearance of safety zones) should minimize noise impacts from these active acoustic sources.

Underwater noise from sound sources associated with proposed G&G activities may result in **negligible, minor**, or **moderate** impacts to sea turtles (**Chapter 4.2.3.2**). Active acoustic noise sources, including both airgun and electromechanical sources, and vessel and equipment noise from the proposed action would contribute to overall ambient noise levels within the AOI. Noise from G&G operations would be survey- or activity-based and would occur on a transient and intermittent basis over the period of interest. Underwater noise associated with the proposed action would be similar to the existing underwater noise under the cumulative scenario (e.g., vessel and equipment noise, sonars, active sound sources). These sources of noise are not expected to significantly add to natural sources of noise, such as normal and seasonal weather-driven storm events; rather, their contributions would result in only temporary minor increases in ambient noise levels within specific portions of the AOI during G&G operations, and the effects from these activities are expected to be minor.

The use of seismic survey protocols (including visual monitoring for both seismic airgun surveys and non-airgun HRG surveys, and acoustic sound source ramp-up procedures for all surveys using airguns) would provide protection to sea turtles that may be present within the safety zone. Consequently, no mortalities of listed sea turtles species are expected. However, sea turtles may respond to noise outside of the safety zone and alter their behavior.

There are only negligible, short-term, and minor noise-related impacts evident from the cumulative activities scenario. The G&G–related sound sources are predominantly in the low frequency bands and within sea turtle hearing capabilities. Seismic survey protocols and mitigation monitoring requirements would be implemented prior to and during all seismic survey activities. Consequently, the impacts associated with the proposed action would result in a negligible incremental increase in ambient noise levels under the cumulative scenario.

Vessel Traffic

For the purposes of this analysis, it is expected that recent trends showing increases in marine transportation and shipping levels at U.S. east coast ports would continue and that overall vessel traffic within the AOI would increase during the period of interest. Increases in vessel traffic increase the likelihood of vessel-sea turtle interactions, including vessel strikes.

Vessel traffic associated with G&G operations would involve relatively small numbers of oil and gas survey-related vessels operating within offshore waters on a transient and intermittent basis over the period of interest. Because all sea turtle species are currently listed as endangered or threatened under the ESA, any collision between a G&G vessel and an individual sea turtle would result in a **major** impact. However, the probability for G&G survey or support vessel collisions with sea turtles is expected to be unlikely, considering the relative time that sea turtles spend submerged, guidelines for vessel strike avoidance that would be part of all authorizations for shipboard surveys under the proposed action, the typical slow speed of seismic vessels, and the use of protected species observers to scan the sea surface around seismic survey vessels during mitigation monitoring surveys. Therefore, vessel traffic impacts to sea turtles from project activities are expected to be **negligible**.

Vessel traffic associated with G&G operations during the period of interest would involve small numbers of survey-related vessels operating on a transient and intermittent basis. Because of the low number of G&G survey vessels in operation at a given time (relative to overall vessel traffic), the relatively slow operating speeds of G&G vessels during a survey, existing vessel strike avoidance regulations, and requirements for mitigation monitoring prior to and during all seismic survey activities, the impacts associated with the proposed action would result in a negligible incremental increase in the risk of vessel collisions with sea turtles under the cumulative scenario.

Aircraft Traffic and Noise

Aircraft traffic over the waters of the AOI includes commercial, private, military, and survey aircraft. Generally, aircraft operating at altitudes that may affect sea turtles within the AOI are more concentrated over near coastal waters, with the exception of periodic military training operations and surveys (e.g., marine mammal and sea turtle surveys). The addition of aeromagnetic survey activities associated with the proposed activity is not expected to significantly increase the overall volume of aircraft traffic within the AOI. It is also expected that impacts associated with aircraft traffic and noise in the AOI are **negligible**, and there would be only a negligible incremental increase in traffic under the cumulative scenario.

Trash and Debris

The release of trash and debris into offshore waters potentially may occur from any of the activities identified in the cumulative impacts scenario. Vessel operators, crew, and personnel present on offshore structures are expected to comply with the requirements of Federal regulations, which have implemented the requirements of MARPOL 73/78, including Annex V. Compliance with these regulations ensures that the volume of trash and debris that may be intentionally dumped offshore is very limited. Impacts to sea turtles within the AOI under Alternative A are expected to be **negligible**.

The G&G vessel operations would operate under Federal regulations, which incorporate the requirements of MARPOL and Annex V restrictions. In addition, all authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012). The G&G activities conducted under the proposed action would potentially add a very small amount of accidentally released trash and debris into offshore waters. Therefore, the accidental release of trash or debris during G&G activities would result in a minor incremental increase in impacts to sea turtles from trash and debris under the cumulative scenario.

Accidental Fuel Spills

The cumulative scenario considers a significant volume of overall vessel traffic, particularly around ports along the U.S. eastern seaboard. All vessel movements are associated with a risk of collision or grounding with a subsequent loss of fuel into offshore or nearshore waters. The impacts to sea turtles arising from an accidental fuel spill from a vessel collision under the cumulative scenario are expected to range from negligible to minor, depending on a series of factors, including whether spilled diesel fuel directly contacts individual animals, the quantity of fuel encountered, local sea state and the direction and intensity of local surface currents, the degree of weathering to which the fuel has been exposed, and duration of contact.

The likelihood of a diesel fuel spill during G&G activities is expected to be remote and the associated impacts to sea turtles are expected to range from **negligible** to **minor**, depending on a series of factors, including whether the oil directly contacts individual turtles, the quantity of fuel encountered, the degree of weathering to which the fuel has been exposed, and duration of contact. It is reasonable to assume that the potential for fuel spills from vessels involved in the cumulative activities scenario would be considerably higher than that expected from vessels associated with activities under the proposed actionbecause of the relative magnitude of overall vessel activity in the AOI when compared to G&G activities. Therefore, the incremental increase in potential for accidental fuel spills arising from vessel collision during G&G activities would be considered to be extremely small. Based on the low probability of a G&G activity-related fuel spill during the period of interest, the incremental increase in diesel spill-related impacts to sea turtles under the cumulative scenario is expected to be negligible.

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts on sea turtles from an accidental crude oil spill would vary, depending on factors such as geographic location (including distance from shore), time of year, and size of the spill. It is expected that impacts from a spill could range from negligible, if no animals were contacted by the spilled oil, to moderate or major, if contact resulted in the injury or loss of life to one or more individual turtles of any species or age group, or resulted in a substantial disruption of nesting, breeding, or hatchling emergence.

Before a proposed exploration well could be drilled in the Atlantic OCS, potential impacts would be analyzed in a lease sale EIS and a project-specific EA would be prepared and submitted by the operator. In the EA, all potential impacts from a crude oil spill released from an accidental well blowout would be examined, including an analysis of site-specific information regarding sea turtle distributions, nesting locations and periods, and preferred habitats (e.g., nearshore developmental habitats), as well as mitigation measures taken to minimize impacts to sea turtles from drilling activities and potential accidental crude oil spills. Considering the low number of potential drilling activities presented in the proposed action scenario, the remote probability of an accidental spill, and environmental protections analyzed in the EIS and EA process and enforced through permits, including impact avoidance and mitigation measures, the incremental increase in oil spill-related impacts to sea turtles from a well blowout arising from exploratory drilling operations under the cumulative scenario is expected to be very small.

4.2.4. Marine and Coastal Birds

4.2.4.1. Description of the Affected Environment

The Atlantic coast supports a diverse avifauna and includes a variety of coastal habitats that are important to the ecology of coastal and marine bird species. The status, general ecology, general distribution, migratory movements, and abundance of these birds are discussed below.

This discussion focuses on three distinct taxonomic and ecological groups: seabirds, waterfowl, and shorebirds. Seabirds are defined here as those species that live in the marine environment and feed at sea (Schreiber and Burger, 2002). Seabirds may be categorized by the marine zones in which they tend to forage. Pelagic birds forage away from the coastal zone and in open ocean and shorebirds forage in coastal waters, while other seabirds use both nearshore and pelagic zones (Michel, 2011). Seabirds within the AOI include members from five taxonomic orders: Charadriiformes (skuas, jaegers, gulls, terns, skimmers, alcids); Gaviiformes (loons); Pelicaniformes (pelicans, frigatebirds, gannets, boobies, tropicbirds, cormorants); Podicepiformes (grebes); and Procellariiformes (albatrosses, petrels, storm-petrels, fulmars, shearwaters).

Certain waterfowl (Order Anseriformes) taxa commonly termed sea ducks feed and rest within coastal (nearshore and inshore) waters outside of their breeding seasons. They typically form large flocks and are often observed in large rafts on the sea surface during this period.

Shorebirds utilize coastal environments for nesting, feeding, and resting. They are included within Order Charadriiformes (along with gulls and terns). The shorebird group consists of four families and includes sandpipers, plovers, and stilts.

Within the AOI there are three species listed under the ESA and one candidate species. A discussion of the listed species and their status is provided below, followed by a discussion of nonlisted species.

4.2.4.1.1. Threatened and Endangered Species

Under the ESA, there are three threatened and endangered species of marine and coastal birds within the AOI: piping plover, roseate tern, and Bermuda petrel (or cahow) (USDOI, FWS, 2011b). In addition, there is one "Priority 3" candidate species, the red knot. Piping plover and red knot are shorebirds that are unlikely to come into contact with G&G activities. Roseate terns are more likely to come into contact with G&G activities, as they forage offshore and feed by plunge-diving, often submerging completely when diving for fish. The Bermuda petrel is also known to occur within the AOI but feeds by snatching prey from the sea surface.

Piping Plover

The piping plover (*Charadrius melodus)* is a small, migratory shorebird that breeds on beaches from Newfoundland to North Carolina (and occasionally in South Carolina) and winters along the Atlantic coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USDOI, FWS, 1996; Elliot-Smith and Haig, 2004). According to USDOI, FWS (2009), piping plovers that breed on the Atlantic coast belong to the subspecies *C. melodus melodus*. The Atlantic coast population is classified as threatened, whereas other piping plover populations inhabiting the Northern Great Plains and Great Lakes watershed are endangered (USDOI, FWS, 2011c). The Great Lakes piping plover population is the smallest, and its wintering population is distributed along the Atlantic and Gulf of Mexico coastlines (Stucker and Cuthbert, 2006).

The FWS first designated critical habitat for the wintering population of piping plovers in 142 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas on July 10, 2001 (*Federal Register*, 2001). Critical habitat areas were subsequently revised in North Carolina in 2008 (*Federal Register*, 2008c) and in Texas in 2009 (*Federal Register*, 2009b). Thirty-three percent of these designated critical habitat areas are known to be used by Great Lakes piping plovers (Stucker and Cuthbert, 2006).

Piping plovers inhabit coastal sandy beaches and mudflats. They use open, sandy beaches close to the primary dune of the barrier islands for breeding, preferring sparsely vegetated open sand, gravel, or cobble for a nest site. They feed on marine worms, fly larvae, beetles, insects, crustaceans, mollusks, and other small invertebrates. They forage along the wrack zone, or line, where dead or dying seaweed, marsh grass, and other debris is left on the upper beach by the high tide (USDOI, FWS, 2011c).

A key threat to the Atlantic coast population is habitat loss resulting from shoreline development (USDOI, FWS, 1996). Piping plovers are very sensitive to human activities, and disturbances from anthropogenic activities can causes the parent birds to abandon their nests. Since the listing of this species under the ESA in 1986, the Atlantic coast piping plover population has increased 234 percent (USDOI, FWS, 2009). Although increased abundance has reduced near-term vulnerability to extinction, piping plovers remain sparsely distributed across their Atlantic coast breeding range, and populations are highly vulnerable to even small declines in survival rates of adults and fledged juveniles (USDOI, FWS, 2009).

Roseate Tern

The roseate tern (*Sterna dougallii*) is a worldwide species that is divided into five subspecies. The Atlantic subspecies (*S. dougallii dougallii*) breeds in two discrete areas in the western hemisphere (USDOI, FWS, 1998). The northeastern population, which is endangered, breeds from New York north to Maine and into adjacent areas of Canada. However, historically this population bred as far south as Virginia, and this state is shown as the southern extent by USDOI, FWS (2011d). Northeastern roseate terns are thought to migrate through the eastern Caribbean and along the north coast of South America and to winter mainly on the east coast of Brazil (USDOI, FWS, 2010a). A second population breeds on islands around the Caribbean Sea from the Florida Keys to the Lesser Antilles; this population, which is listed as threatened, also occurs along the U.S. southeast coast, where there are occasional breeding records from North Carolina, South Carolina, and Georgia (USDOI, FWS, 2011d). Reasons for the initial listing of the roseate tern included the concentration of the population into a small number of breeding sites and to a lesser extent, declines in population (USDOI, FWS, 1998). The most important factor in breeding colony loss was predation by herring gulls and/or great black-backed gulls. No critical habitat has been designated for the roseate tern.

The roseate tern is a medium-sized tern that is primarily pelagic along seacoasts, bays, and estuaries, going to land only to nest and roost (Sibley, 2000). They forage offshore and roost in flocks typically near tidal inlets in late July to mid-September. Along the Atlantic coast, they nest on islands on sandy beaches, open bare ground, and grassy areas, typically near areas with cover or shelter (NatureServe, InfoNatura, 2010).

Roseate terns forage mainly by plunge-diving and contact-dipping or surface-dipping over shallow sandbars, reefs, or schools of predatory fish. They are adapted for fast flight and relatively deep diving and often submerge completely when diving for fish (USDOI, FWS, 2011d).

Bermuda Petrel

The Bermuda petrel, or cahow (*Pterodroma cahow*), is a member of the "gadfly petrel" group (Genera *Lugensa* and *Pterodroma*), which are highly pelagic birds widespread in tropical and subtropical seas (Warham, 1990). The Bermuda petrel is a Bermuda endemic species that breeds on rocky inlets in Castle Harbour, Bermuda (October-June) (Warham, 1990; Onley and Scofield, 2007). Its distribution outside of the breeding season is poorly known, though the species is probably widespread in the North Atlantic, following the warm waters on the western edges of the Gulf Stream. There are confirmed sightings of Bermuda petrels offshore of North Carolina (Lee, 1984, 1987). The Bermuda petrel and other gadfly petrels are usually colonial when breeding but are often solitary at sea, feeding within oceanic waters on surface and near-surface prey. They are extremely aerial birds and so rarely land on the sea (Warham, 1990). Bermuda petrels feed by snatching food by "dipping" or by scavenging dead or dying prey floating on or near the sea surface (Warham, 1990). They and other gadfly petrels are known to feed at night primarily on squids, but also on fishes and invertebrates to a lesser degree. Studies on other gadfly petrels found that their prey consisted of species associated with deep scattering layers (Warham, 1996).

Exploitation of nesting Bermuda petrels by early colonists and predation by introduced mammals decimated their numbers. They were initially listed by FWS as endangered in 1970 (USDOI, FWS, 2011e). Successful conservation efforts have increased the population, but it remains listed as endangered (*Federal Register*, 2007).

4.2.4.1.2. Candidate Species

Candidate species are identified by FWS as species for which sufficient information is available to support a proposal to list as endangered or threatened, but for which preparation and publication of a proposal is precluded by higher priority listing actions (*Federal Register*, 2006b). There is one shorebird species that is currently a candidate species for listing, the red knot. The red knot, as are most bird species, is also protected under the Federal Migratory Bird Treaty Act of 1918 (50 CFR 10.13), which is the primary legislation in the U.S. established to conserve migratory birds and prohibits the taking, killing, or possessing of migratory birds unless permitted by regulation.

Red Knot

The red knot (*Calidris canutus*) is a medium-sized shorebird that migrates in large flocks long distances between breeding grounds in the mid- and high-arctic areas and wintering grounds in southern South America (Harrington, 2001; Morrison et al., 2001b; USDOI, FWS, 2010b; Normandeau Associates, Inc., 2011). They migrate northward through the contiguous U.S. in April-June and southward in July-October. Delaware Bay is the most important spring migration stopover in the eastern U.S. because it is the final stop at which the birds can refuel in preparation for their nonstop leg to the Arctic (Clark and Niles, 2000; Harrington, 2001; NatureServe, InfoNatura, 2010; USDOI, FWS, 2010b). Approximately 90 percent of the entire population of the red knot can be present in Delaware Bay in a single day (USDOI, FWS, 2010b). In addition to the large flocks traditionally found in Delaware Bay, flocks of up to 6,000 red knots have been observed from Georgia to Virginia in recent years (USDOI, FWS, 2010b).

The red knot was added to the list of candidate species under the ESA (*Federal Register*, 2006b) in September 2006. Surveys at wintering areas and at Delaware Bay during spring migration indicated a substantial decline in the red knot population in recent years (Morrison et al., 2001b; USDOI, FWS, 2010b,c). The primary threat to the red knot has been attributed to the reduction in key food resources resulting from reductions in horseshoe crabs, which are harvested primarily for use as bait and secondarily to support a biomedical industry (Morrison et al., 2004; USDOI, FWS, 2010b,c). Other identified threat factors include habitat destruction resulting from beach erosion and various shoreline protection and stabilization projects, the inadequacy of existing regulatory mechanisms, human disturbance, and competition with other species for limited food resources.

Along the Mid-Atlantic and southeastern coasts, red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks (USDOI, FWS, 2010b). In Delaware Bay, they feed primarily on horseshoe crab eggs, and the timing of their arrival within the bay typically coincides with the annual peak of the horseshoe crab spawning period (USDOI, FWS, 2010b).

4.2.4.1.3. Other Marine and Coastal Birds

Within the AOI, there are numerous marine and coastal bird species present, including both resident and migratory species. Resident species are present throughout the year, whereas migratory species may be present only during breeding and wintering seasons, or they may only migrate through the AOI.

The other marine and coastal birds present within the AOI include three groups: seabirds, waterfowl, and shorebirds, which comprise 18 taxonomic families (**Table 4-16**). Species within a given taxonomic family of birds share common physical and behavioral characteristics that allow these birds to be presented in this document by family rather than by individual species. Because of these common characteristics, the potential for exposure to G&G activities would be similar for species within a given family that share similar behavioral characteristics.

Seabirds

Five taxonomic orders of seabirds (broadly defined as those species that spend a large portion of their lives on or over water), including 13 families, are found in both offshore and coastal waters of the AOI during their annual cycle. Many species are present throughout the entire AOI and may be classified into four categories, according to their spatial and/or temporal residence: summer migrant pelagics, summer residents, wintering marine species, or permanent residents. Other species are present in only portions of the AOI; some are present only in the southern portion of the area (Florida to Virginia), while others may be present only in the northern portion of the area (North Carolina to Delaware) (Peterson, 1980; Clapp et al., 1982a,b, 1983).

Seabirds generally feed on localized concentrations of prey in single- or mixed species aggregations. Modes of prey acquisition include picking from or diving to the sea surface, plunging below the sea surface, and diving from the sea surface to depths of several meters (Shealer, 2002). Species that dive below the sea surface may be exposed to underwater noise produced during G&G surveys. Seabird families that occur within the AOI that regularly dive below the sea surface include Procellariidae, Pelecanoididae, Sulidae, Phalacrocoracidae, Laridae, and Alcidae.

Waterfowl

Waterfowl that may occur within coastal and inshore waters of the AOI include members of two subfamilies: Aythyinae (diving ducks) and Merginae (sea ducks) (Sibley, 2000). Diving ducks include the canvasback, redhead, tufted duck, ring-necked duck, and scaup. They are gregarious and are mainly found on fresh water or on estuaries, though species such as the greater scaup become marine during the winter. Diving ducks feed on aquatic vegetation, mollusks, and crustaceans. Sea ducks that may occur within the AOI include eiders, scoters, mergansers, goldeneyes, buffleheads, scaups, long-tailed ducks, stifftails, and harlequin ducks. Most sea duck species are essentially marine outside of their breeding season. Depending on the species, they feed on fishes, mollusks, and small invertebrates (Sibley, 2000). Similar to diving seabirds, sea ducks and some diving ducks may be vulnerable to underwater noise produced during G&G activities.

Shorebirds

The term shorebird applies to a large group of birds commonly called sandpipers and plovers but also includes oystercatchers, avocets, and stilts. Fifty-three species of shorebirds regularly occur in the U.S. (Brown et al., 2001). Representatives from four shorebird families are present in the AOI during their annual cycle. All four families are in one taxonomic order, Charadriiformes, and are found primarily along the coastline. Most of these species are present throughout the AOI during migration but also remain throughout the breeding and wintering periods, but a few species are present only in the Mid-Atlantic (Peterson, 1980; Helmers, 1992). The total number of shorebirds present varies by latitude and time of year, e.g., the southern portion of the AOI has higher concentrations of spring migrant bird species and wintering species, and the northern portion of the AOI has higher numbers of summer/fall migrant species (Helmers, 1992). Recent trend analyses of shorebird populations in various parts of the U.S. indicate that many species are declining, including many species that are present in the AOI (Morrison et al., 2001a, 2006). The Atlantic coast beaches and bays have high quality environments that are essential to shorebirds as habitat and also provide critical stopover areas during migration (Brown et al., 2001).

4.2.4.1.4. Migration

A migratory bird is any species or family of birds that lives, reproduces, or migrates within or across international borders at some point during their annual life cycle. Migratory movements of most marine and coastal birds across North America are known only in general terms (Harrington and Morrison, 1979). Many North American birds seasonally migrate long distances between their northern habitats in the high Arctic, New England, and Canada and their southern habitats in Florida and Central and South America, often traveling as far as 12,000 km (7,457 mi) from breeding to wintering grounds (Helmers, 1992). There are significant species differences with regard to the path or shape of the migratory route (Rappole, 1995). Many marine and coastal birds as well as terrestrial birds use the Atlantic Flyway, which extends from the offshore waters of the Atlantic coast west to the Allegheny Mountains and then continues across the prairie provinces of Canada and the Northwest Territories to the arctic coast of Alaska (**Figure 4-17**), for migration. The coastal route of this flyway originates in the eastern arctic islands and the coast of Greenland and generally follows the shoreline along the Atlantic coast (http://birdnature.com/flyways.html; Brown et al., 2001; Morrison et al., 2001b). There is an additional route (not shown in **Figure 4-17**) termed the North Atlantic or Shorebird Route that is exclusively oceanic and passes directly over the Atlantic Ocean from Labrador and Nova Scotia to the Lesser Antilles, continuing on to South America (Rappole, 1995). This route is followed by thousands of birds, including some shorebirds that nest on the arctic tundra, that fly across Canada to the Atlantic coast and follow this oceanic course to South America (http://birdnature.com/flyways.html; Morrison et al., 2001b). These migratory birds and their nests are protected under the Migratory Bird Treaty Act.

The northern portion of the AOI (Delaware, Maryland, and Virginia) is extremely important for transient shorebirds during both northbound and southbound migrations (Clark and Niles, 2000). During migration, stopover areas play a vital role in the accumulation of fat reserves that are needed for the substantial amount of energy expended by all species (Brown et al., 2001; McWilliams and Karasov, 2005). Disturbance along the shoreline where the migrating birds forage can cause additional energy requirements for the migrating birds (Helmers, 1992).

4.2.4.1.5. Bird Conservation Regions and Birds of Conservation Concern

The Fish and Wildlife Conservation Act was amended in 1988 to mandate FWS to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing" under the ESA. The FWS prepared a document (USDOI, FWS, 2008) to identify birds of conservation concern as an effort to comply with this mandate. The overall goal of the document was to accurately identify the migratory and non-migratory bird species, in addition to those already designated as federally threatened or endangered, that represent the highest conservation priorities. The development of the birds of conservation concern took into account three distinct geographic scales—North American Bird Conservation Initiative (NABCI) Bird Conservation Regions (BCRs), FWS Regions, and National (USDOI, FWS, 2008).

The NABCI BCRs were developed by a mapping team comprising members from the U.S., Mexico, and Canada to develop a consistent spatial framework for bird conservation for North America. The efforts resulted in the establishment of a hierarchical framework of nested ecological units, or BCRs. There are three BCRs located within the AOI: 27) Southeastern Coastal Plain, 30) New England/Mid-Atlantic Coast, and 31) Peninsular Florida (U.S. NABCI Committee, 2000). Tables 25, 28, and 29 in USDOI, FWS (2008) include all bird species potentially present in the AOI. Shorebirds are of high conservation concern (U.S. NABCI Committee, 2009), and nearly half of the ocean bird species in the U.S. are of conservation concern (U.S. NABCI Committee, 2011).

4.2.4.1.6. Important Bird Areas

The Important Bird Area (IBAs) Program was established by the National Audubon Society as a global effort to identify and conserve areas that are vital to birds and other biodiversity. IBAs are sites that provide essential habitat for one or more species of bird, and include sites for breeding, wintering, and/or migrating birds. By definition (National Audubon Society, 2011), IBAs are sites that support

- species of conservation concern (e.g., threatened or endangered species);
- restricted-ranges species (species vulnerable because they are not widely distributed);
- species that are vulnerable because their populations are concentrated in one general habitat type or biome; and/or
- species or groups of similar species (such as waterfowl or shorebirds) that are vulnerable because they occur at high densities because of their congregatory behavior.

The IBA sites designated along the coast or in nearshore waters are listed in **Table 4-17**. Three of the North Carolina IBA sites include nearshore waters within the AOI: Outer Banks Inshore Ocean, Outer Continental Shelf, and Onslow Bay. All of the other IBA sites are located along the coast.

4.2.4.2. Impacts of Routine Events

This section discusses the potential impacts of routine events associated with Alternative A on marine and coastal birds. As discussed in **Chapter 4.1.1**, through preliminary screening of the activities and affected resources, IPFs for marine and coastal birds include (1) active acoustic sound sources, (2) vessel and equipment noise, (3) vessel traffic, (4) aircraft traffic and noise, and (5) trash and debris (**Table 4-2**). Since all G&G survey activities within all three programs are performed using vessels, all activities have the potential to impact marine and coastal birds. Active acoustic sound sources including airgun noise and electromechanical sources have the potential to impact marine and coastal birds that may be present in the survey area via sound exposure. Vessel traffic and its associated noise along with equipment noise can disrupt and potentially displace marine and coastal birds from the survey area and are discussed together. The potential for impacts from the release of trash and debris to marine and coastal birds is also discussed below. The accident scenario is presented in detail in **Chapter 3.5.2.1** and included the accidental fuel spill of between 49.6 and 297.3 gal (or 1.2 and 7.1 bbl) of fuel, which has the potential to adversely affect marine and coastal birds.

As discussed in **Chapter 4.2.4.1**, there are three main groups of marine and coastal birds (seabirds, waterfowl, and shorebirds). Marine and coastal bird species of concern include three threatened or endangered species that occur within the AOI: piping plover, roseate tern, and Bermuda petrel. In addition, there is one "Priority 3" candidate species, the red knot, present in the AOI. In addition, shorebirds are of high conservation concern, while nearly half of the ocean bird species in the U.S. are of conservation concern (U.S. NABCI Committee, 2011).

There are three BCRs located within the AOI, including the Southeastern Coastal Plain, the New England/Mid-Atlantic Coast, and Peninsular Florida. In addition, IBA sites designated along the coast or in nearshore waters include three inshore or offshore North Carolina (i.e., Outer Banks Inshore Ocean, Outer Continental Shelf, Onslow Bay). All of the remaining IBA sites within the AOI are located along the coast. The potential impacts to these regions and areas are addressed below.

4.2.4.2.1. Significance Criteria

Negligible impacts to marine and coastal birds would include those where little to no measurable impacts are observed or expected. No mortality or serious injury to any individual marine or coastal bird would occur. Negligible impacts would include limited, short-term displacement or disturbance of marine or coastal bird species from non-critical habitats and activities, or incidental disruption of behavioral patterns or other non-injurious effects to marine or coastal bird species.

Minor impacts to marine and coastal birds would include those that are detectable but are neither severe nor extensive. Minor impacts to marine and coastal birds would include short-term displacement of any species from preferred feeding, breeding, or nursery grounds or migratory routes (including critical habitat for listed species); short-term disruption of behavioral patterns that may adversely affect a marine or coastal bird species; or mortality to or life-threatening injury of individuals (other than listed species) in small numbers that would not adversely affect the population.

Moderate impacts to marine and coastal birds would be detectable and extensive but not severe. Moderate impacts to marine and coastal birds would include limited levels of serious injury or mortality to either listed or nonlisted species but in low enough numbers such that the continued viability of the population is not threatened. Moderate impacts would also include extended displacement of a coastal bird species from preferred feeding, breeding, or nursery grounds or migratory routes (including critical habitat for listed species); extensive damage to critical habitat for marine and coastal birds; or extensive disruption of behavioral patterns that may adversely affect a marine or coastal bird species. The viability or continued existence of affected marine and coastal bird populations would not be threatened, although some impacts may be irreversible.

Major impacts to marine and coastal birds would be detectable, extensive, and severe. Major impacts to marine and coastal birds would include mortality to or life-threatening injury to individuals of a listed (endangered/threatened) species, or mortality to or life-threatening injury to nonlisted species, either of which would be in sufficient numbers to adversely affect the population. Major impacts to marine and coastal birds would also include mortality to, or permanent (or long-term) displacement of, a coastal bird species from preferred feeding, breeding, or nesting grounds or migratory routes (including critical habitat for listed species) to the extent that the long-term survivability of the species may be adversely affected; extensive, long-term damage to critical habitat for marine and coastal birds; or chronic disruption of behavioral patterns that may adversely affect a marine or coastal bird species.

4.2.4.2.2. Evaluation

Active Acoustic Sound Sources

The primary potential for impact to marine and coastal birds from airguns and other active acoustic electromechanical sources is to seabirds and waterfowl that dive below the water surface and are exposed to underwater noise (Turnpenny and Nedwell, 1994). Among the listed (i.e., threatened, endangered) and candidate species, piping plover and red knot are shorebirds that are unlikely to come into contact with G&G activities. Roseate terns are more likely to come into contact with G&G activities, as they forage offshore and feed by plunge-diving, often submerging completely when diving for fish. The Bermuda petrel is also known to occur within the AOI but feeds by snatching prey from the sea surface. Only those species that plunge dive are at risk of exposure to active acoustic sound sources since seismic pulses are directed downward and are highly attenuated near the surface. In addition, active acoustic sound sources such as side-scan sonar and subbottom profilers are highly directive (e.g., downward, towards the seafloor), with beam widths as narrow as a few degrees; this directivity and narrow beam width also diminishes the risk to bird species other than plunge diving species. Because of these factors, other species of seabirds, waterfowl, and shorebirds would not be affected by active acoustic sound sources and are not discussed further for this IPF.

Active acoustic sound sources include both airguns and electromechanical sources, each of which produce similar impacts to seabirds and waterfowl that dive below the water surface, including the roseate tern as well as members of the Alcidae, Gaviidae, Phaethontidae, Phalacrocoracidae, Sulidae, Hydrobatidae, Procellariidae, Podicipediformes, and Anatidae families. Proposed activities under Alternative A include the use of airguns as seismic sources during deep penetration seismic airgun surveys for oil and gas exploration, and for postlease HRG surveys of oil and gas leases. The BOEM does not anticipate that airguns would be used for renewable energy site assessment activities or for HRG surveys of marine minerals sites. Electromechanical sources would be used during HRG surveys for renewable energy development and sand source evaluation, where a high-resolution boomer or chirp subbottom profiler is typically used to delineate near-surface geologic strata and features and typically includes single beam and multibeam depth sounders and side-scan sonar. The AUV surveys for oil and gas leases include a similar equipment suite. These sources may also be operated simultaneously with the airguns during deep penetration seismic airgun surveys.

Birds have a relatively restricted hearing range, from a few hundred hertz to about 10 kHz (Dooling and Popper, 2000). However, this hearing range is for airborne noise; there are limited data regarding bird hearing range for underwater noise, and there is no evidence that birds use underwater sound.

Airguns have a frequency range from about 10-2,000 Hz; however, most of the acoustic energy is radiated at frequencies below 200 Hz with zero-to-peak SLs for individual airguns ranging typically between 220 and 235 dB re 1 μPa at 1 m (~1–6 bar•m), with larger airguns generating higher peak pressures than smaller ones (see **Appendix D**). Airgun pulses are directional, with the majority of the sound energy directed towards the seafloor and lower sound energy levels evident lateral to the airgun array. Other survey equipment produces higher frequencies. Electromechanical sources usually have one or two (sometimes three) main operating frequencies. The frequency ranges for representative sources are 200 Hz–16 kHz for the boomer; 100 and 400 kHz for the side-scan sonar; 3.5, 12, and 200 kHz for the chirp subbottom profiler; and 240 kHz for the multibeam depth sounder. Broadband source levels for the representative electromechanical sources analyzed in this Programmatic EIS range from 212 to 226 dB re 1 μPa at 1 m (**Chapter 3.5.1.1.2**). The low-frequency underwater noise generated by airguns would fall within the airborne hearing range of birds, as do several types of survey equipment (e.g., subbottom profilers), whereas noise generated by other types of survey equipment (e.g., side-scan sonar, depth sounders) is outside of their airborne hearing range and should be inaudible to birds. Therefore, if birds can hear within the same range for underwater noise as their airborne hearing range, the G&G survey activities included in Alternative A that have the potential to impact diving seabirds and waterfowl are deep penetration seismic airgun surveys for oil and gas exploration, postlease HRG surveys of oil and gas leases postlease, HRG surveys for renewable energy, and HRG surveys for marine minerals surveys.

Some seabirds and waterfowl, including members of the families Laridae, Rhyncopidae, Pelicanidae, Fregatidae, and Anatidae, either rest on the water surface or shallow-dive for only short durations. Most of the seabirds and waterfowl that would be resting on the water surface in the area surrounding the vessel would be dispersed; and therefore, would not come into contact with the active acoustic sounds. Many of the members of these families of marine and coastal birds that would not be dispersed would not come in contact with active acoustic sounds generated from seismic airgun surveys or low frequency equipment used for HRG surveys since they typically rest on the surface. However, those birds that shallow-dive, could come into contact with active acoustic sounds, but airgun pulses are directional, with the majority of the sound energy directed towards the seafloor and lower sound energy levels evident lateral to the airgun array. Therefore, the energy level that these diving birds could be exposed to would be for such a short time and have a lower sound energy that it would result in a **negligible** impact.

Diving seabirds and waterfowl such as members of the families Alcidae, Gaviidae, Phaethontidae, Phalacrocoracidae, Sulidae, Hydrobatidae, Procellariidae, Podicipediformes, and Anatidae could be susceptible to active acoustic sounds generated from seismic airgun surveys, especially those species that would would probably dive, rather than fly away from a vessel (e.g., grebes, loons, alcids, and some diving ducks). However, seismic pulses are directed downward and highly attenuated near the surface; therefore, there is only limited potential for direct impact from the low-frequency noise associated with G&G seismic airgun surveys to affect diving birds. In addition, active acoustic sound sources such as side-scan sonar and subbottom profilers are highly directive, with beam widths as narrow as few degrees or narrower; the ramifications of this directionality include a lower risk of high level exposure to diving birds that may forage close to (but lateral to) a seismic vessel.

Investigations into the effects of airguns on seabirds are extremely limited, however limited studies performed by Stemp (1985) and Lacroix et al. (2003) indicated that they did not observe any mortality to the several species of seabirds studied when exposed to seismic survey noise; further, they did not observe any differences in distribution or abundance of those same species as a result of seismic survey activity. Based on the directionality of the sound generated from seismic airgun surveys and low frequency equipment used for HRG surveys and the limited study results available, it is expected that there would be no mortality or life-threatening injury and little disruption of behavioral patterns or other non-injurious effects of any diving seabirds or waterfowl from this direct impact, resulting in a **negligible** impact.

As discussed in **Chapter 4.2.4.1.5**, there are three BCRs within the AOI that include coastal waters. These BCRs are important feeding areas for seabirds and waterfowl. Underwater noise generated from active acoustic sound sources (airguns or other survey equipment) would dissipate prior to reaching nearshore waters. This noise dissipation, or transmission loss, is the weakening of sound between the source and another point in the field. In deepwater operations, this noise spreads in all directions (i.e., spherical spreading). In addition, transmission losses are higher in shallow waters (<50 m [164 ft]), which results in a smaller potentially affected area (Turnpenny and Nedwell, 1994) resulting in most of the underwater noise dissipating prior to reaching the coastal BCRs. Because of the noise produced from active acoustic sound sources during seismic airgun surveys or low frequency equipment used for HRG surveys, there is the potential of an indirect impact resulting from temporary displacement from small portions of the BRCs during survey activities for some prey for the seabirds and waterfowl that use these areas. However, if prey species exhibit avoidance of the area in which the survey is performed, it is expected to be limited to a very small portion of a bird's foraging range. Therefore, there is the potential for minor, temporary displacement of species from a portion of feeding areas from noncritical activities during nonmigration seasons, resulting in **negligible** impacts. However, if seismic airgun survey activities and the potential associated temporary displacement of species from a portion of preferred feeding areas occurred during bird species migration, then the impact would be considered **minor**.

As discussed in **Chapter 4.2.4.1.6**, there are three offshore IBAs off the coast of North Carolina. The area contained within these IBAs continues offshore into open water where seismic airgun surveys could occur. These IBAs are important foraging grounds for many species of marine and coastal birds. Because of the noise produced from active acoustic sound sources during seismic airgun surveys, there is the potential for an indirect impact of some prey for seabirds and waterfowl that use these areas to be temporarily displaced from portions of the IBAs during survey activities. Depending on the season of the surveys, this could result in additional energetic requirements for the migrating birds from having to find additional or different locations for foraging. However, these IBAs are large areas that range from 30,362 to 245,612 ha (75,026 to 606,921 ac), and it is unlikely that bird prey species would be affected by seismic airgun survey activities to a level that would affect foraging success. If prey species exhibit avoidance of the area in which the survey is performed, it is expected to be limited to a very small portion of a bird's foraging range. Therefore, there is the potential for minor, temporary displacement of species from a portion of preferred feeding grounds during migration and minor, short-term displacement of marine and coastal bird species from noncritical activities during nonmigration seasons, resulting in **negligible** impacts. However, if G&G activities and the potential associated temporary displacement of species from a portion of preferred feeding areas occurred during bird species migration, then the impact would be considered **minor**.

Vessel and Equipment Noise and Vessel Traffic

The primary potential impacts to marine and coastal birds from vessel traffic and noise are from underwater vessel and equipment noise, attraction to vessels and subsequent collision or entanglement, disturbance to nesting or roosting, and disturbance to feeding or modified prey abundance (Schwemmer et al., 2011). Since all G&G survey activities included in Alternative A are performed from vessels in all three programs, with the exception of remote sensing conducted via aircraft and satellites, most survey activities have the potential to impact marine and coastal birds from vessel traffic and the associated vessel and equipment noise.

Underwater Noise

The sound generated from individual vessels can contribute to overall ambient noise levels in the marine environment on variable spatial scales. As stated above, birds have a relatively restricted hearing range, from a few hundred hertz to about 10 kHz (Dooling and Popper, 2000) for airborne noise, with few data available regarding bird hearing range for underwater noise. Vessel noise is one of the main contributors to overall noise in the sea (NRC, 2003; Jasny et al., 2005). The G&G survey vessels would contribute to the overall noise environment by transmitting noise through both air and water. Underwater noise produced by vessels is a combination of narrow-band (tonal) and broadband sound. Tones typically dominate up to about 50 Hz, whereas broadband sounds may extend to 100 kHz. According to Southall (2005) and Richardson et al. (1995), vessel noise typically falls within the range of 100-200 Hz. Noise levels dissipate quickly with distance from the vessel. The underwater noise generated from the survey vessels would dissipate prior to reaching the coastline and the shore/beach habitats of shorebirds, including threatened, endangered, and candidate species present in the AOI (i.e., piping plover, roseate tern, and red knot). Because of the dissipation of underwater noise from survey vessels prior to reaching the shore/beach habitat, it is expected that underwater noise would produce **negligible** impacts to shorebird species, including piping plover and red knot.

Some seabirds and waterfowl, including members of the families Laridae, Rhyncopidae, Pelicanidae, and Fregatidae, as well as the endangered Bermuda petrel, either rest on the water surface, skim the water surface, or shallow-dive for only short durations. Because of these behaviors, members of these families would not come in contact with underwater vessel and equipment noise generated from G&G survey vessels, or the contact would be for such a short time that it would result in little disruption of behavioral patterns or other non-injurious effects. Therefore, impacts to these seabirds and waterfowl (including the Bermuda petrel) from vessel and equipment noise would be a **negligible**.

Diving seabirds and waterfowl including the roseate tern as well as members of the families Alcidae, Gaviidae, Phaethontidae, Phalacrocoracidae, Sulidae, Hydrobatidae, Procellariidae, and Anatidae could be susceptible to underwater noise generated from G&G survey vessels and equipment. The number of vessels typically involved in a G&G survey can range between one and three, depending on the type of G&G survey being performed. This level of vessel activity per survey event is not a significant increase in the existing vessel and equipment noise, the vessels are typically moving as slow speeds, and noise levels dissipate quickly with distance from the vessel. In addition as discussed in **Chapter 3.5.1.2**, drilling-related noise that would be associated with the installation of up to three COST wells and up to five shallow test wells associated with oil and gas exploration G&G activities is continuous and generally of low frequencies (<500 Hz), including infrasonic frequencies in at least some cases (Richardson et al., 1995). Machinery noise can be continuous or transient, and variable in intensity. Noise levels vary with the type of drilling rig and the water depth. Drilling-related noise from jack-up platforms is continuous, and generally of very low frequencies (near 5 Hz). Drilling-related noises from semi-submersible platforms range in frequencies from 10 to 4000 Hz, with estimated sound levels of 154 dB re 1 μPa-m. Source levels for drillships have been reported to be as high as 191 dB re 1 μPa during drilling. Therefore most noise from drilling operations would not be expected to within the hearing range of diving seabirds and waterfowl. Because of this noise dissipation, only a very small area of the AOI would experience vessel and equipment noise and potential associated disruption. Therefore, impacts of underwater noise from survey vessels to the roseate tern and members of these eight seabird and waterfowl families are expected to be **negligible**.

The three BCRs within the AOI are important feeding areas for seabirds and waterfowl. Most of the underwater noise generated from survey vessels would dissipate prior to reaching the nearshore waters of the BCRs. Impacts to marine and coastal birds using the BCRs are expected to be **negligible**.

There are three offshore IBAs off the coast of North Carolina. The area contained within these IBAs continues offshore into open water where G&G surveys could occur. These IBAs are important foraging grounds for many species of marine and coastal birds. Because of the noise produced from G&G survey vessels, there is the potential for the roseate tern and some diving seabirds and waterfowl that use these areas to come into contact with survey vessel and equipment noise. However, because of noise dissipation, only a very small area of the IBAs would experience vessel and equipment noise. Therefore, impacts to seabirds and waterfowl present within offshore IBAs from the underwater noise from survey vessels and equipment are expected to be **negligible**. However, if G&G activities and the associated underwater noise occurred during bird species migration, there would be the potential to affect preferred feeding grounds. Under such circumstances, the impact would be considered **minor** for diving seabirds and waterfowl.

Vessel Attraction

The number of vessels typically involved in a G&G survey can range between one and three, depending on the type of G&G survey being performed (i.e., renewable energy and marine minerals surveys require a single vessel, oil and gas program surveys could require as many as three vessels). This level of vessel traffic is not a significant increase when compared to existing vessel traffic in nearshore or offshore waters. In addition, vessels performing surveys are relatively slow moving (approximately 7.4-11.1 km/hr [4-6 kn]), which allows for marine and coastal birds to easily move out of the way of survey vessels.

The potential for bird strikes on a vessel is not expected to be significant to individual birds or their populations. However, a number of seabird species, including members of the Procellariidae, Pelicanoididae, Laridae, and Alcidae families, are generally attracted to offshore rigs and vessels. It is believed that this attraction is due to light attraction at night (Montevecchi et al., 1999; Weise et al., 2001; Black, 2005; Montevecchi, 2006). However, some birds engage in ship-following as a foraging strategy, especially with commercial or recreational fishing vessels. In addition, in an open environment like the ocean objects are easy to detect and birds locate vessels easily from long distances and approach to investigate. Bird mortality has been documented as a result of light-induced attraction and subsequent collision with vessels. Birds exhibiting this behavior are typically alcids and petrels, with bird strikes typically occurring at night and occasionally resulting in mortality (Black, 2005). In addition, alcids may also dive to escape disturbance, increasing their potential for collision with a vessel or gear in the water. Seismic survey equipment (e.g., sound sources, streamers) is typically towed behind the vessels at water depths ranging from 1 to 3.5 m (3.3-11.5 ft) below the surface. Vessels are also required to have down-shielded lighting to minimize the potential attraction of birds. However, even if roseate terns or birds within the Procellariidae, Pelicanoididae, and Alcidae families were attracted to the survey vessels or dove near a survey vessel, there is a very low potential for either vessel collision or entanglement since the vessels are moving relatively slowly (7.4-11.1 km/hr [4-6 kn]) and the gear is towed from 1 to 3.5 m (3.3 to 11.5 ft) below the surface. There is no empirical evidence indicating that these types of marine and coastal birds could become entangled in seismic survey gear (e.g., hydrophone streamers) in spite of the potential for attraction to this gear. Given the low potential for collision or gear entanglement, the impacts are not expected to result in mortality or serious injury to individual birds, resulting in a **negligible** impact to these types of seabirds from vessel attraction.

Shorebirds including the piping plover and red knot that reside along the shorelines are not known to be attracted to vessels. Therefore, there would not be impacts to shorebirds from vessel attraction. The Bermuda petrel is a member of Family Procellariidae, which is highly pelagic, and could be attracted to survey vessels offshore. However, as discussed above for other pelagic bird families, there is a low potential of impact from vessel collision or gear entanglement; therefore, the impacts are expected to be **negligible** to individual birds and their populations, as the Bermuda petrel is rarely present in the AOI.

Three offshore IBAs occur off the coast of North Carolina. These IBAs are important foraging grounds for many species of marine and coastal birds and often have large populations present. However, even if seabirds and waterfowl were attracted to the survey vessels, there is a very low potential for either vessel collision or entanglement since the vessels are moving relatively slowly (7.4-11.1 km/hr [4-6 kn]) and the gear is towed from 1 to 3.5 m (3.3 to 11.5 ft) below the surface. Given the low potential for collision or gear entanglement, impacts are not expected to result in mortality or serious injury to individual birds, resulting in a **negligible** impact to seabirds and waterfowl within the IBAs from vessel attraction.

Disturbance to Nesting or Roosting

There is the potential for impact to marine and coastal birds from the potential disturbance of breeding colonies by airborne noise from vessels and equipment (Turnpenny and Nedwell, 1994). Most marine and coastal bird species nest and roost along the shore and on coastal islands. Survey vessels for renewable energy and marine minerals projects are expected to make daily round trips to their shore base, whereas the larger seismic vessels performing surveys for oil and gas exploration and postlease activities can remain offshore for weeks or months and are likely to remain offshore for most of the survey duration. Seismic vessels may be supported by supply vessels operating from ports along the Atlantic coast. For this analysis, five potential support bases or shore bases were identified: Norfolk, Virginia; Wilmington, North Carolina; Charleston, South Carolina; Savannah, Georgia; and Jacksonville, Florida.

Vessels could cause a disturbance to breeding birds, with the potential to adversely affect egg and nestling mortality, if a vessel approached too close to a breeding colony. The G&G surveys would not occur close enough to land to affect marine and coastal bird breeding colonies during survey activities. However, survey vessels for renewable energy and marine minerals projects would typically transit from a shore base to offshore and return daily. The expectation is that this daily vessel transit would occur at one of the shore bases identified or at other established ports, which have established transiting routes for ingress and egress in the coastal areas and existing vessel traffic. Because of this existing vessel traffic, it is not anticipated that marine and coastal birds would roost in adjacent areas, or if they did already roost nearby, the addition of G&G survey vessels would not significantly increase the existing vessel traffic. In addition, noise generated from the survey vessels and equipment would typically dissipate prior to reaching the coastline and the nesting habitats of coastal birds. Impacts of airborne vessel and equipment noise to nesting or roosting marine and coastal birds would be **negligible**.

The piping plover, roseate tern, and red knot are all ground nesters along the shoreline. As discussed above, these bird species would not nest in areas that would be disturbed by G&G survey vessels transiting from port to offshore or coastal locations; therefore, there would be no impact to the nesting of these shorebird species. The Bermuda petrel nests only on small, rocky offshore islets in Castle Harbor, Bermuda, and is only occasionally present in the AOI during the non-breeding season; therefore, this species would not experience nesting impacts from G&G survey activities.

There are three BCRs within the AOI that include coastal waters. However, as discussed previously, G&G surveys would not occur close enough to land to affect marine and coastal bird breeding colonies during survey activities, and the potential daily transits for some survey vessels would occur to/from established ports, which currently have existing vessel traffic. The addition of G&G survey vessels would not significantly increase the vessel traffic in these areas. Therefore, impacts of airborne vessel and equipment noise to nesting or roosting marine and coastal birds in the BCRs would be **negligible**.

There are three IBAs off the coast of North Carolina. The area contained within these IBAs continues offshore into open water where G&G survey activities could occur. These IBAs are important foraging grounds for many species of marine and coastal birds, however the coastal areas of the IBAs where nesting and roosting would take place would not experience the same potential impacts from vessel traffic as offshore areas. Therefore, the impact of airborne vessel and equipment noise to nesting or roosting marine and coastal birds within IBAs would be **negligible**. However, if a G&G survey were to take place adjacent to one of the three IBAs during nesting or breeding season, the impact from airborne vessel and equipment noise in these sensitive areas would be of short duration and would be **minor**.

Disturbance to Feeding or Modified Prey Abundance

Marine and coastal birds require specialized habitat requirements for feeding (Kushland et al., 2002). Survey vessel and equipment noise could cause pelagic bird species, including members of the families Laridae, Stercorariidae, Alcidae, Pelicanidae, Phaethontidae, Sulidae, Fregatidae, Hydrobatidae, Hydrobatidae, and Procellariidae, to be disturbed by the survey vessel and equipment noise and relocate to alternative areas, which could result in a localized, temporary displacement and disruption of feeding. These alternative areas may not provide food sources (prey) or habitat requirements similar to that of the original (preferred) habitat and could result in additional energetic requirements expended by the birds and diminished foraging opportunity. However, it is expected that if these species temporarily moved out of the area it would be limited to a very small portion of a bird's foraging range, and it would be unlikely that this temporary relocation because of noise from seismic survey vessels would affect foraging success.

Impacts to pelagic birds from disturbance associated with vessel and equipment noise would be **negligible**.

There are several locations within the AOI (Delaware, Maryland, and Virginia) that are extremely important for transient shorebirds during both northbound and southbound migrations (**Chapter 4.2.1.4**). Marine and coastal birds require specialized habitat requirements for nesting and/or feeding, and the IBAs include those specialized habitats (Kushland et al., 2002). Possible indirect impacts to marine and coastal birds from vessel and equipment noise may include relocation of some prey species, which is primarily linked to seasonality. During their annual migrations, a number of marine and coastal birds have very specific stopover locations for species-specific foraging to accumulate fat reserves (i.e., red knot in Delaware Bay to forage on horseshoe crabs) (Brown et al., 2001; McWilliams and Karasov, 2005; USDOI, FWS, 2010b). Because of the noise produced from G&G survey vessels, there is the potential for an indirect impact of modified prey abundance and distribution that migrating birds rely on for the accumulation of fat reserves to fuel their migration, which could result in additional energetic requirements for the migrating birds. However, it is unlikely that bird prey species would be affected by G&G survey vessels to a level that would affect foraging success. As noted previously, surveys would not take place within coastal nearshore areas or within bays (e.g., Delaware Bay). If prey species exhibit avoidance of the area in which a survey is performed, it is expected to be limited to a very small portion of a bird's foraging range and for a limited duration. Therefore, there is the potential for minor, temporary displacement of species from a portion of preferred feeding grounds during migration and minor, short-term displacement of marine and coastal bird species from non-critical activities during non-migration seasons resulting in **minor** impacts.

Piping plover, roseate tern, and red knot are shorebirds that feed along the shoreline and would not be impacted by vessel and equipment noise. The Bermuda petrel is present in the AOI only in non-breeding season; as a member of the Procellariidae family, Bermuda petrel would experience temporary displacement. This would be limited to a very small portion of a bird's foraging range. It is unlikely that this temporary relocation resulting from G&G survey vessel noise would affect foraging success of the Bermuda petrel.

Aircraft Traffic and Noise

Remote sensing surveys associated with oil and gas exploration and development activities would include aeromagnetic surveys (**Chapter 3.2.2.6.5**) and the installation of COST and shallow test wells (**Chapter 3.2.4**). The BOEM anticipates that one or two aeromagnetic surveys may be conducted in the AOI during the time period covered by the Draft Programmatic EIS. As discussed in detail in **Chapter 3.5.1.4**, the surveys would be conducted by fixed-wing aircraft flying at speeds of about 250 km/hr (135 kn) (Reeves, 2005). Most offshore aeromagnetic surveys are flown at altitudes between 61-152 m (200-500 ft). Line spacing varies depending on the objectives, but typical grids are 0.5 by 1.0 mi or 1.0 by 1.0 mi. It is expected that a typical aeromagnetic survey may require 1-3 months to complete. In addition, helicopters are a potential source of aircraft noise during drilling of COST wells and shallow test wells. The oil and gas scenario assumes that up to three COST wells and up to five shallow test wells would be drilled in the Mid- or South Atlantic Planning Areas during the time period of the Programmatic EIS. It is expected that drilling activities would be supported by a helicopter making one round-trip daily between the drilling rig and onshore support base. Potential impacts to marine and coastal birds from aircraft traffic include noise disturbance and collision.

Noises generated by project-related survey aircraft that are directly relevant to birds include airborne sounds from passing aircraft for both individual birds on the sea surface and birds in flight above the sea surface. Both helicopters and fixed-wing aircraft generate noise from their engines, airframe, and propellers. The dominant tones for both types of aircraft are generally below 500 Hz (Richardson et al., 1995) and is within the within the airborne auditory range of birds. Aircraft noise entering the water depends on aircraft altitude, the aspect (direction and angle) of the aircraft relative to the receiver, and sea surface conditions. The level and frequency of sounds propagating through the water column are affected by water depth and seafloor type (Richardson et al., 1995). Because of the expected airspeed (250 km/hr [135 kn]), noise generated by survey aircraft is expected to be brief in duration, and birds may return to relaxed behavior within 5 min of the overflight (Komenda-Zohnder et al., 2003); however, birds can be disturbed up to 1 km away from an aircraft (Efroymson et al., 2000).

The physical presence of low-flying aircraft can disturb marine and coastal birds, including those on the sea surface as well as in flight. Behavioral responses to flying aircraft include flushing the sea surface into flight or rapid changes in flight speed or direction. These behavioral responses can cause collision with the survey aircraft. However, Efroymson et al. (2000) reported that the potential for bird collision decreases for aircrafts flying at speed greater than 150 km/h. In addition, the FAA recommends that aircraft fly at a minimum altitude of 2,000 ft (610 m) or more above ground over noise sensitive areas such as National Parks, National Wildlife Refuges, Waterfowl Production Areas, and Wilderness Areas (USDOT, FAA, 2004).

Considering the relatively low numbers of aeromagnetic surveys and low number of COST wells and shallow test wells associated with the proposed activity (one to two during the period analyzed in this Programmatic EIS), along with the short duration of potential exposure of aircraft–related noise, physical disturbance, and potential collision to marine and coastal birds, it is expected that potential impacts from this activity would range from **negligible** to **minor**.

Trash and Debris

Plastic is found in the surface waters of all of the world's oceans and poses a potential hazard to most marine life, including seabirds through entanglement or ingestion (Laist, 1987). The ingestion of plastic by marine and coastal birds can cause obstruction of the gastrointestinal tract, which can result in mortality. Plastic ingestion can also include blockage of the intestines and ulceration of the stomach. In addition, plastic accumulation in seabirds has also been shown to be correlated with the body burden of polychlorinated biphenyls (PCBs), which can cause lowered steroid hormone levels and result in delayed ovulation and other reproductive problems (Pierce et al., 2004).

G&G survey activities including surveying, sampling, and COST and shallow well drilling operations generate trash comprising paper, plastic, wood, glass, and metal. Most trash is associated with galley and offshore food service operations. However, over the last several years, companies operating offshore have developed and implemented trash and debris reduction and improved handling practices to reduce the amount of offshore trash that could potentially be lost into the marine environment. These trash management practices include substituting paper and ceramic cups and dishes for those made of styrofoam, recycling offshore trash, and transporting and storing supplies and materials in bulk containers when feasible and have resulted in a reduction of accidental loss of trash and debris. In addition, all authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012).

All survey vessels performing work within the U.S. jurisdictional waters are expected to comply with Federal regulations, which implement MARPOL 73/78. Within MARPOL Annex V, Regulations for the Control of Pollution by Garbage from Ships, as implemented by 33 CFR 151, are regulations designed to protect the marine environment from various types of garbage generated on board vessels. Therefore, the amount of trash and debris dumped offshore would be expected to be minimal, as only accidental loss of trash and debris is anticipated, some of which could float on the water surface. Therefore, impacts from trash and debris on marine and coastal birds, as generated by G&G survey vessels or sampling, shallow or COST well drilling, and other G&G related activities would be **negligible**.

4.2.4.3. Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes a diesel spill ranging from 1.2 to 7.1 bbl. Spills occurring at the ocean surface would disperse and weather. Volatile components of the fuel would evaporate. Fuel and diesel used for operation of survey vessels is light and would float on the water surface. There is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink. This accidental spill could occur either offshore or nearshore, and the marine and coastal bird species affected and the type of effect would differ depending on the location of the spill (Weise and Jones, 2001; Castege et al., 2007). If the accident occurred in nearshore waters, including the BCRs, shorebirds including piping plover, roseate tern, and red knot; waterfowl; and coastal seabirds such as members of the Laridae, Rhyncopidae, Gaviidae, Pelicanidae, Phalacrocoracidae, Fregatidae, and Podicipedidae families could be impacted either directly or indirectly. Direct impacts would include physical oiling of individuals. The effects of oil spills on coastal and marine birds include the potential of tissue and organ damage from oil ingested during feeding and grooming from inhaled oil, and stress that could result in interference with food detection, predator avoidance, homing of migratory species, and respiration issues.

Indirect effects could include oiling of nesting and foraging habitats and displacement to secondary locations. The potential of a vessel collision occurring is quite low, with the potential for a resultant spill even lower. An accidental event could result in release of fuel or diesel by a survey vessel, but such an event has a remote probability of occurring, and if it did occur, it is anticipated that because of the relatively small spill size (1.2-7.1 bbl) that the area of impact would be a very small portion of the AOI. Therefore, an accidental fuel spill within nearshore waters would not be expected to result in significant impacts to these types of coastal and marine birds. Impacts to birds from accidents are unlikely; however, if they occur, there could be possible impacts on their food supply. However, impacts to shorebirds, waterfowl, and seabird species would range from **negligible** to **minor** depending on timing and location. Since the populations of piping plover, roseate tern, and red knot are already in peril, if an accidental fuel spill occurred that affected any of these species or their food supply, there would be a **moderate** impact to these species since birds are very susceptible to oiling impacts.

If the accidental event occurred in offshore waters, fuel and diesel would float on the water surface. There is potential for oceanic and pelagic seabirds such as members of the Alcidae, Sulidae, Phaethontidae, Hydrobatidae, and Procellariidae families to be directly and indirectly affected by spilled diesel fuel. Impacts would include oiling of plumage and ingestion (resulting from preening). Indirect impacts could include oiling of foraging habitats and displacement to secondary locations. The potential of a vessel collision occurring is quite low, with the potential for a resultant spill even lower. Because of the relatively small spill size (1.2-7.1 bbl), the area of impact would be relatively small. Dispersal, weathering, and evaporation would reduce the amount of fuel remaining on the sea surface. Impacts to oceanic and pelagic birds from a spill incident involving survey vessels within offshore waters would range from **negligible** to **minor**. However, since populations of Bermuda petrel are already imperiled, if an accidental fuel spill occurred that affected the Bermuda petrel, there would be a **moderate** impact to that species since birds are very susceptible to oiling impacts.

Within IBAs, there is expected to be a greater presence of marine and coastal birds. If the diesel spill were to occur within or adjacent to the IBAs, there would be a greater potential for impact to oceanic and pelagic birds present in the IBA. Impacts from incidents involving survey vessels within IBAs would range from **negligible** to **minor** depending on timing and location.

4.2.4.4. Cumulative Impacts

The cumulative impacts scenario is discussed in detail in **Chapter 3.6** and includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs for these cumulative activities that have the potential to affect marine and coastal birds include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, and other active sound sources; (2) presence of structures (including vessels); (3) accidental releases of trash and marine debris; (4) changes in coastal habitats because of interactive effects of climate change along with impacts on calcification in plankton, corals, crustaceans, and other marine organisms because of ocean acidification; and (5) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Among the IPFs identified above for the cumulative impacts scenario, six sources of potential impact to marine and coastal birds have been identified in association with proposed G&G activities including (1) active acoustic sound sources; (2) vessel and equipment noise; (3) vessel traffic; (4) aircraft traffic and noise; (5) trash and debris; and (6) accidental fuel spills. For example, the presence of structures under the cumulative impacts scenario is similar to vessel attraction, as outlined in the G&G activity scenario and associated IPFs. Impact analyses presented in **Chapters 4.2.4.2** and **4.2.4.3** determined that activities projected to occur under Alternative A would result in **negligible**, **minor**, or **moderate** impacts to marine and coastal birds, depending upon the IPF. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Underwater Noise Including Active Acoustic Sound Sources and Vessel and Equipment Noise

While no long-term noise measurements for the AOI are currently available, there is consensus that noise in the world's oceans has significantly increased over the past several decades. With documented increases in marine transportation volumes along the U.S. Atlantic coast, underwater noise from vessel traffic and other anthropogenic sources within the AOI is increasing, with vessel traffic representing a major contributor to ambient noise levels, particularly in the low-frequency bands.

Underwater noise from G&G activities was determined to cause a **negligible** or **minor** impact to marine and coastal birds, depending on the location of the G&G activities (**Chapter 4.2.4.2**). Active acoustic sound sources, including both airgun and electromechanical sources, and vessel and equipment noise projected under Alternative A would contribute to ambient noise levels within the AOI. Noise from G&G operations would be survey- or activity-based, occurring on a transient and intermittent basis over the period of interest. Because the type of underwater noise associated with the proposed action would be similar to the existing underwater noise under the cumulative scenario (e.g., vessel and equipment noise, sonars, active sound sources), the proposed action activities would be a very minor) incremental increase in the overall in the level of human activity within the AOI resulting in negligible increases in ambient noise levels within specific portions of the AOI during G&G operations. As discussed in **Chapter 4.2.4.2**, birds have a relatively restricted hearing range, from a few hundred hertz to about 10 kHz (Dooling and Popper, 2000) for airborne noise, with few data available regarding bird hearing range for underwater noise. There are no studies that provide definitive data that marine and coastal birds are affected by underwater noise, but if their airborne hearing range is similar to their underwater hearing range, then many sources of underwater noise (mid- or high-frequency) should be inaudible to birds. According to Southall (2005), vessel noise typically falls within the range of 100-200 Hz and noise levels dissipate quickly with distance from the vessel; therefore, based on the airborne hearing range of birds, some vessel noise would be below the hearing range of birds and should be inaudible to them. The proposed action activities represent a very minor (short-term) incremental increase in the overall in the level of human activity and resulting underwater noise within the AOI; therefore, the impacts associated with the proposed action would result in a negligible incremental increase in noise impacts to marine and coastal birds under the cumulative scenario.

Presence of Structures Including Vessel and Helicopter Traffic

Cumulative scenario activities including oil and gas exploration, renewable energy, geosequestration, and LNG terminals potentially may include the presence of structures within the AOI. As discussed in **Chapter 4.2.4.2**, members of the Procellariidae, Pelicanoididae, and Alcidae families are generally attracted to offshore rigs and vessels. It is believed that this attraction is due to light attraction (Montevecchi et al., 1999; Weise et al., 2001; Black, 2005; Montevecchi, 2006). However, some birds engage in ship-following as a foraging strategy, especially with commercial or recreational fishing vessels. In addition, in an open environment like the ocean objects are easy to detect and birds locate vessels easily from long distances and approach to investigate. The cumulative scenario could include the presence of structures in the AOI, some for short durations (e.g., drill rigs, LNG vessels offloading cargo) and others that may be long-term or permanent (e.g., wind turbines) to which which members of these marine bird families would be attracted. However, during the time period analyzed in the Programmatic EIS (2012-2020), is anticipated that there would be drilling of up to three COST wells and up to five shallow test wells with associated short-term structures. Currently, there are no geosequestration well installations or LNG facilities planned for the AOI, although these activities could potentially occur and would include either short- or long-term presence of structures. In addition, there is the potential for the placement of long-term or permanent wind turbines within the AOI that could also attract these types of seabirds. However, prior to placement of these structures, BOEM would require that a site-specific environmental analysis be performed to evaluate the potential impacts to marine and coastal birds. In addition, based on the projections of the level of cumulative activities (**Chapter 3.6**), it is not anticipated that the number of either short-term or long-term/permanent structures to be installed would be significant and prior to installation, a site-specific evaluation of impacts would be required. The area that these structures would encompass would be a very small area of the total AOI. Therefore, with the protective measures of requiring a site-specific environmental analysis and the limited number of structures to be placed under the cumulative scenario, the limited number of structures anticipated from the proposed action would result in a negligible incremental increase in the impact to these marine and coastal birds from the presence of structures.

Vessel traffic under the cumulative impacts scenario would originate from many activities, including oil and gas exploration and development, marine minerals use, renewable energy development, geosequestration, LNG terminals, commercial and recreational fishing, military range complexes and civilian space program use, shipping and marine transportation, and dredged material disposal. Shipping and marine transportation and commercial and recreational fishing represent the most significant sources of traffic, with traffic heavily concentrated in the vicinity of U.S. east coast ports. Helicopter traffic would result from oil and gas exploration activities in the cumulative scenario as they are often used for transporting personnel to offshore oil rigs. Seventy-two percent of bird strikes with aircraft happened within 305 m (1,000 ft) of ground level. Waterfowl and gulls made up 56 percent of the bird-aircraft interactions in the U.S. (Nelson, 2009).

Prior to oil and gas exploration operations (e.g., placement of drilling rigs for oil and gas exploration or geosequestration), BOEM would require that site-specific information regarding all activities, including the use of helicopters, be evaluated for environmental impacts. This evaluation would include the associated potential environmental impacts to marine and coastal birds be provided. The BOEM would use this information to ensure that the impacts to marine and coastal birds are minimized; therefore, marine and coastal birds would be protected from impacts from the cumulative scenario activities, and the incremental impacts are expected to be negligible.

Vessel traffic would increase as a result of Alternative A G&G activities. As discussed in **Chapter 4.2.4.2**, marine and coastal birds have the potential for collision with vessels. Based on the projected level of G&G activity, impacts to marine and coastal birds from vessel traffic was determined to be **negligible** or **minor**. Additional vessel traffic from G&G operations under Alternative A would not represent a significant increase to existing vessel traffic from cumulative operations within the AOI. Therefore, G&G activities would produce only a negligible incremental impact from vessel traffic (i.e., presence of structures) to marine and coastal birds under the cumulative scenario.

Trash and Debris

As discussed in **Chapter 4.2.4.2**, impacts from trash and debris on marine and coastal birds, as generated by G&G survey vessels, sampling and shallow or COST well drilling activities, and other G&G related activities would be **negligible**.

G&G survey activities including surveying, sampling, and COST and shallow well drilling operations generate trash comprising paper, plastic, wood, glass, and metal. Most trash is associated with galley and offshore food service operations. However, over the last several years, companies operating offshore have developed and implemented trash and debris reduction and improved handling practices to reduce the amount of offshore trash that could potentially be lost into the marine environment. These trash management practices include substituting paper and ceramic cups and dishes for those made of styrofoam, recycling offshore trash, and transporting and storing supplies and materials in bulk containers when feasible and have resulted in a reduction of accidental loss of trash and debris. In addition, all authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012). These improved practices would also apply to all activities included under the cumulative scenario.

All vessels performing work within the U.S. jurisdictional waters are expected to comply with Federal regulations, which include MARPOL 73/78. Within MARPOL Annex V, Regulations for the Control of Pollution by Garbage from Ships, as implemented by 33 CFR 151, are regulations designed to protect the marine environment from various types of garbage generated on board vessels. Therefore, the amount of trash and debris dumped offshore would be minimal, as only accidental loss of trash and debris is anticipated, some of which could float on the water surface. Therefore, impacts from trash and debris on marine and coastal birds, as generated by G&G survey vessels or sampling, shallow or COST well drilling, and other G&G related activities would result in a negligible incremental impact to marine and coastal birds under the cumulative scenario.

Accidental Fuel Spills

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to marine and coastal birds, would vary depending on the location, timing, and size of the spill. Impacts would include physical oiling of individuals and compromising feather integrity (Leighton, 1993; Clark, 1984; Frazier et al., 2006; O'Hara and Morandin, 2010). Other effects of oil spills on coastal and marine birds include the potential of tissue and organ damage from oil ingested during feeding and grooming, stress that could result in impared reproduction; behavioral changes such as nest abandonment and failure to incubate as well as respiration issues from inhaled oil (Leighton, 1993; Clark, 1984). However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prepared prior to any wells being drilled. This EA would require site-specific information regarding marine and coastal birds and mitigation measures that would be implemented to minimize impacts to this resource from drilling activities and a potential accidental crude oil spill. In addition, with the required mitigation measures in place and with oversight of these activities by the BSEE, as included in CFR Title 30 Chapter II, Part 250, an accidental crude oil spill from an exploratory well is not anticipated; however, a spill still could occur. With these measures in place, the impacts to marine and coastal birds from the cumulative activities would range from negligible to moderate, depending on location, timing, and size.

The potential for fuel spills from vessels involved in the cumulative activities scenario is considered remote. Fuel and diesel used for operation of support vessels and fishing vessels is light and would float on the water surface where is it subjected to weathering, dispersion, and dissolution. Heavier fuels may be used in larger commercial vessels involved in marine transportation.

Under the cumulative activities scenario, an accidental spill could occur either offshore or nearshore, and the marine and coastal bird species affected would differ depending on the location and timing of the spill. If the accident occurred in nearshore waters, including the BCRs, shorebirds including piping plover, roseate tern, and red knot; waterfowl; and coastal seabirds (such as members of the Laridae, Rhyncopidae, Gaviidae, Pelicanidae, Phalacrocoracidae, Fregatidae, and Podicipedidae families) could be impacted. Impacts would include physical oiling of individuals. The effects of oil spills on coastal and marine birds include the potential of tissue and organ damage from oil ingested during feeding and grooming from inhaled oil, and stress that could result in interference with food detection, predator avoidance, homing of migratory species, and respiration issues. Indirect effects of a spill under the cumulative scenario could include oiling of nesting and foraging habitats and displacement to secondary locations (Clark, 1984).

With the use of Automatic Identification System (AIS) on large sea-going vessels, radar, and licensing of vessel captains, the potential of a vessel collision occurring is quite low, with the potential for a resultant spill even lower. An accidental fuel spill from a support or fishing vessel could occur, but such an event has an extremely remote possibility of occurring. If an accidental fuel spill did occur, it is anticipated that spill size would be relatively small and the area of impact would be a very small portion of the AOI; the type and severity of impacts to marine and coastal birds would differ depending on the location and timing of the spill. Impacts to the food supply of shorebird, waterfowl, and seabird species would range from negligible to minor. However, since the populations of piping plover, roseate tern, and red knot are already in peril, any indirect impacts to these species from an accidental fuel spill would result in a moderate impact to these species.

If the accidental fuel spill under the cumulative scenario occurred in offshore waters, fuel and diesel would float on the water surface. There is potential for oceanic and pelagic seabirds such as members of the Alcidae, Sulidae, Phaethontidae, Hydrobatidae, and Procellariidae families to be affected by spilled diesel fuel. Impacts would include oiling of plumage and ingestion (resulting from preening). Additional impacts could include oiling of foraging habitats and displacement to secondary locations. The potential of a vessel collision occurring is quite low, with the potential for a resultant spill even lower. It is anticipated that the spill would be relatively small and the resulting area of impact would be relatively small; however the type and severity of the impact to marine and coastal birds would differ depending on the location and timing of the spill. Dispersal, weathering, and evaporation would reduce the amount of fuel remaining on the sea surface. Impacts to oceanic and pelagic birds from a spill incident involving vessels under the cumulative scenario operating in offshore waters would range from negligible to minor. However, since populations of Bermuda petrel are already imperiled, any impacts from an offshore accidental event would result in a moderate impact.

The likelihood of a fuel spill occurring during G&G surveys or other G&G activities is considered to be remote (**Chapter 4.2.4.3**); impacts associated with a small diesel fuel spill are expected to be variable. Impacts to shorebirds, waterfowl, and coastal seabirds would range from **negligible** to **minor**. Because the populations of listed species (i.e., piping plover, roseate tern, and red knot) are already in peril, any direct and indirect impacts to these species from an accidental fuel spill would result in a moderate impact to these species. The G&G activities would only slighty increase vessel traffic activity in the AOI and would slightly increase the risk of collision. The G&G vessel activities would produce only a negligible incremental increase in impacts to marine and coastal birds from a collision-based fuel spill.

4.2.5. Fisheries Resources and Essential Fish Habitat

4.2.5.1. Description of the Affected Environment

4.2.5.1.1. Fish Resources

The AOI encompasses demersal and pelagic habitats ranging from the shoreline to the open ocean that support approximately 600 fish species (Ray et al., 1998; Smith-Vaniz et al., 1999). From a geographic perspective, the AOI straddles two broad eco-regions: (1) the MAB from Delaware Bay to Cape Hatteras, North Carolina; and (2) the SAB from Cape Hatteras to Cape Canaveral, Florida. These geographic regions are generally used by scientists and fishery managers as natural biogeographic units, and the terminology is followed here even though there is some question regarding the use of these two descriptors (Richards, 1999). Fish species distributions vary in species-specific fashion relative to major environmental factors such as water depth, salinity, temperature, and habitat type, but when viewed on a broad scale they collectively segregate into recognizable multi-species assemblages. This phenomenon provides a framework for describing demersal and pelagic fish resources from an area as extensive as the AOI.

The following discussion is divided into demersal resources (including hard bottom fishes and soft bottom fishes) and pelagic resources (including coastal pelagic fishes, epipelagic fishes, and mesopelagic fishes). Within the demersal classes, assemblages are characterized by cross-shelf distribution or depth-related patterns. Ichthyoplankton and EFH are discussed after the description of fish assemblages.

Demersal Resources

Demersal Hard Bottom Fishes

Within the AOI, hard bottom generally refers to exposed rock but includes other substrata such as coral and artificial structures. Hard bottom features provide structurally complex shelter, feeding opportunities, and hydrodynamic benefits for permanent and temporary fish associates. Hard bottom supports assemblages of sessile organisms including algae, sponges, octocorals, and stony corals. These epibiota contribute smaller scale structure to the larger features, providing habitat for smaller fishes and invertebrate prey items for larger fishes (Levin and Hay, 1996; Ross and Quattrini, 2007, 2009; Kendall et al., 2009). In addition to providing shelter, hard bottom features influence circulation patterns important to individual fishes in feeding, resting, and larval settlement/advection. Hard bottom habitats and their associated fish assemblages have been characterized by various depth-related schemes

(Strushaker, 1969; Miller and Richards, 1980; Grimes et al., 1982; Chester et al., 1984; Sedberry and Van Dolah, 1984). For this Programmatic EIS, various schemes were summarized into the following strata: inner shelf (0-20 m [0-66 ft]), intermediate shelf (20-75 m [66-246 ft], shelf-edge (75-200 m [246-656 ft]), and upper slope strata (200-400 m [656-1,312 ft]).

In the SAB, hard bottom is distributed across the shelf from shallow nearshore (0-4 m [0-ft]) waters to the upper slope. In some areas hard bottom features form semi-continuous trends along bathymetric contours, and in other areas they exist as more discrete units. Hard bottom also occurs on the shelf and slope within the MAB but more sparsely than in the SAB. In the MAB, much of the hard bottom found along the shelf edge and upper slope is provided by submarine canyons. Known hard bottom occurrence within the AOI is shown in **Figures 4-3** and **4-4**.

Common families of hard bottom associated fishes within the AOI are moray eels (Muraenidae), squirrelfishes (Holocentridae), groupers and sea basses (Serranidae), scorpionfishes (Scorpaenidae), grunts (Haemulidae), snappers (Lutjanidae), porgies (Sparidae), wrasses (Labridae), damselfishes (Pomacentridae), angelfishes (Pomacanthidae), blennies (Labrisomidae and Blenniidae), and triggerfishes (Balistidae). Individual species from these families exhibit differential distributions across the shelf, generally depending on water depth.

Nearshore hard bottom falls within the inner shelf assemblage but is restricted to the very southern (Florida) portion of the AOI and consists of shore-parallel rocky outcrops in water depths ranging from 0 to 4 m (0 to 13 ft) (Gilmore et al., 1981; CSA International, Inc., 2009). Numerically dominant species characterizing this habitat include grunts (*Haemulon* spp.), porgies (*Diplodus* spp.), slippery dick (*Halichoeres bivittatus*), damselfishes (*Stegastes variabilis*), and hairy blenny (*Labrisomus nuchipinnis*). Assemblages found on nearshore hard bottom tend to be numerically dominated by early life stage individuals. Some species such as blennies and wrasses utilize this habitat for life, whereas others, including grunts and snappers, migrate across the shelf into deeper waters as they mature (Lindeman et al., 2000; CSA International, Inc., 2009). Farther out onto the inner shelf, hard bottom stratum species typically found are scup (*Stenotomus chrysops*), sand perch (*Diplectrum formosum*), tomtate (*Haemulon aurolineatum*), planehead filefish (*Stephanolepis hispidus*), and bank sea bass (*Centropristis ocyurus*) (Miller and Richards, 1980; Wenner, 1983; Sedberry and Van Dolah, 1984).

Hard bottom outcrops in the intermediate shelf range from fairly level exposed hard bottom supporting sponges, soft corals, ascidians, and bryozoans to high-relief outcrops (Miller and Richards, 1980; Sedberry and Van Dolah, 1984). Parker et al. (1983) estimated that 24 percent of the SAB shelf area between 27 and 101 m (89 and 331 ft) (9,443 km^2 [3,646 mi^2]) is hard bottom habitat. A conspicuous intermediate shelf feature is Gray's Reef offshore Georgia; this site supports more than 150 species of hard bottom fishes (Parker et al., 1994; Gray's Reef National Marine Santuary, 2011). SAB intermediate shelf assemblages generally support the highest diversity along the cross-shelf gradient with over 120 species known (Powles and Barans, 1980; Grimes et al., 1982; Wenner, 1983; Chester et al., 1984). Common species are black sea bass (*Centropristis striata*), gag grouper (*Mycteroperca microlepis*), red snapper (*Lutjanus campechanus*), vermilion snapper (*Rhomboplites aurorubens*), whitebone porgy (*Calamus leucosteus*), and tomtate. This portion of the shelf is influenced by warm Gulf Stream waters that favor the occurrence of tropical species including spotfin butterflyfish (*Chaetodon ocellatus*), reef butterflyfish (*C. sedentarius*), blue angelfish (*Holacanthus bermudensis*), jackknife fish (*Equetus lanceolatus*), hogfish (*Lachnolaimus maximus*), twospot cardinalfish (*Apogon pseudomaculatus*), and white grunt (*Haemulon plumieri*) (Miller and Richards, 1980). The Gulf Stream influence also facilitated colonization of the invasive Indo-Pacific red lionfish (*Pterois volitans*) to intermediate hard bottom habitats of the region (Whitfield et al., 2002; Meister et al., 2005; Ruiz-Carus et al., 2006).

Shelf-edge reefs consist of rocky ledges, high profile scarps, and flat pavement (Barans and Henry, 1984) to large thickets of *Oculina* coral (Koenig et al., 2000; Reed, 2002b; Reed et al., 2006). Although many of the species found on intermediate shelf hard bottom may occur on the shelf-edge, deepwater fish assemblages are distinguished by the presence of snowy grouper (*Epinephelus niveatus*), yellowfin bass (*Anthias nicholsi*), wrasse bass (*Liopropoma eukrines*), greater amberjack (*Seriola dumerili*), yellowtail reeffish (*Chromis enchrysura*), spotfin hogfish (*Bodianus pulchellus*), bank butterflyfish (*Chaetodon aya*), red hogfish (*Decodon puellaris*), blueline tilefish (*Caulolatilus microps*), red snapper, silk snapper (*Lutjanus vivanus*), and red porgy (*Pagrus pagrus*). The shelf-edge fish assemblages also exhibit a strong tropical component where the Gulf Stream current contributes propagules and ameliorates water temperature (Barans and Henry, 1984; Parker and Ross, 1986; Parker and Mays, 1998; Quattrini et al., 2004; Quattrini and Ross, 2006; Schobernd and Sedberry, 2009).

The most distinctive assemblage along the gradient occurs on hard bottom features of the upper slope (Weaver and Sedberry, 2001; Reed et al., 2006; Ross and Quattrini, 2007, 2009; Schobernd and Sedberry, 2009). Upper slope hard bottom ranges from high-relief rocky outcrops such as the Charleston Bump (Popenoe and Manheim, 2001; Wenner and Barans, 2001) to deep coral banks composed of living and dead deepwater corals (Reed, 2002b; Reed et al., 2006; Ross and Quattrini, 2007). Deepwater stony corals (e.g., *Lophelia pertusa*), soft corals, tunicates, and sponges colonize rocky ridges, rubble mounds, and other underlying substrata to form deep coral bank habitats that are concentrated on the Blake Plateau region of the SAB. Individual banks typically rise above the seafloor 80-100 m (262-328 ft) over a 1-km (0.6-mi) horizontal distance, with extensive rubble accumulations around their margins (Ross and Quattrini, 2007, 2009).

With the exception of scorpionfishes and sea basses, most fish families associated with hard bottom habitats of the upper slope differ from those described above for the shelf and shelf-edge fishes. Hagfishes (Myxinidae), conger eels (Congridae), grenadiers (Macrouridae), morid cods (Moridae), phycid hakes (Phycidae), anglerfishes (Chaunacidae and Lophiidae), roughies (Trachichthyidae), and alfonsinos (Berycidae) all reside on upper slope hard bottom. A total of 99 fish taxa was documented for deep coral banks, transitional habitat, and adjacent level bottom on the Blake Plateau within the SAB by Ross and Quattrini (2007). Fifty of these species associated exclusively with deep coral banks and were numerically dominated by blackfin codling (*Laemonema melanurum*), roughtip grenadier (*Nezumia sclerorhynchus*), alfonsino (*Beryx decadactylus*), and blackbelly rosefish (*Helicolenus dactylopterus*). Less abundant but frequently occurring only on deep coral banks were swallowtail bass (*Anthias woodsi*), conger eel (*Conger oceanicus*), and cutthroat eel (*Dysomma rugosa*). On upper slope hard bottom areas (Charleston Bump) with less coral cover, alfonsinos, wreckfish (*Polyprion americanus*), and Darwin's slimehead (*Gephyroberyx darwinii*) were commonly observed (Weaver and Sedberry, 2001). Fishes residing around these features generally forage away from the structure over adjacent soft bottom or depend upon transport of planktonic food across the feature with prevailing currents. Weaver and Sedberry (2001) documented that upper slope hard bottom fishes fed upon mesopelagic prey.

Compared to the SAB, MAB hard bottom habitats are sparsely distributed over the shelf and are composed of bare rock, gravel, shell hash, and artificial structures rather than limestone outcrops covered by algae, sponges, and soft corals (Eklund and Targett, 1990, 1991; Steimle and Zetlin, 2000). Fish assemblages found on intermediate shelf hard bottom have not been extensively studied, but available information indicates that the black sea bass is the single numerically dominant species, followed by spotted hake (*Urophycis regia*), tautog (*Tautoga onitis*), red hake (*Urophycis chuss*), conger eel, scup, and ocean pout (*Macrozoarces americanus*) (Eklund and Targett, 1990, 1991; Steimle and Zetlin, 2000). On outer shelf (shelf-edge) and upper slope of the MAB, hard bottom is similarly sparse and generally occurs within and around the many submarine canyons that intersect the continental slope throughout the region. Ichthyofauna of the canyons has not been extensively studied, but the most conspicuous inhabitants are cutthroat eels (*Synaphobrancus kaupi*) and various grenadier species that are not restricted to hard bottom habitat in these water depths (Markle and Musick, 1974; Sulak, 1982). In some canyons, structured habitat provided by the burrowing action of tilefish (*Lopholatilus chamaeleonticeps*) is utilized by other fishes such as conger eel, hakes (*Urophycis* spp.), and blackbelly rosefish (*Helicolenus dactylopterus*) (Grimes et al., 1986).

Demersal Soft Bottom Fishes

Soft bottom or sedimentary habitat covers most of the shelf and upper slope in both the SAB and MAB. In the SAB, soft bottom is composed of medium to coarse carbonate sands distributed over an extensive continental shelf. In the MAB, sediments are generally quartz with some areas of carbonate shell hash. Soft bottom is not always flat or featureless but forms structures at various spatial scales, including large shoals, medium sand waves, smaller sand ripples, and finally interstitial space among sediment grains (McBride and Moslow, 1991; Auster et al., 2003; Diaz et al., 2003; Slacum et al., 2006; Scharf et al., 2006). The presence and form of these features vary with distance from shore, latitude, water depth, proximity to river discharge, prevailing currents, and wave energy.

Families of soft bottom demersal fishes commonly occurring on the shelf of the SAB portion of the AOI include skates (Rajidae), rays (Dasyatidae, Myliobatidae, and Gymnuridae), snake eels

(Ophichthidae), searobins (Triglidae), drums and croakers (Sciaenidae), lizardfishes (Synodontidae), sand flounders (Paralichthyidae), and tonguefishes (Cynoglossidae). Members of these families (as well as others) are distributed widely across the shelf and upper slope, but in most cases individual species are represented in different depth-related assemblages. The inner shelf (0-20 m [0-60 ft]) is characterized by spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), weakfish (*Cynoscion* spp.), banded drum (*Larimus fasciatus*), and roughtail stingray (*Dasyatis centroura*) (Hoese, 1973; Wenner and Sedberry, 1989). Soft bottom demersal fishes in the AOI include one endangered species, the smalltooth sawfish (*Pristis pectinata*), and one candidate species for listing under the ESA, the Atlantic sturgeon (*Acipenser oxyrinchus*) (**Chapter 4.2.6**). Beam trawl studies have shown that demersal soft bottom fish assemblages of the SAB include considerable numbers of immature individuals (Walsh et al., 2006). Soft bottom demersal assemblages vary with season; many species migrate offshore in response to colder inshore water temperatures, whereas others remain inshore throughout the year. Intermediate shelf assemblages are characterized by scup, inshore lizardfish (*Synodus foetens*), snakefish (*Trachinocephalus myops*), dusky flounder (*Syacium papillosum*), spotted hake, and sand perch. Fish assemblages occurring within the intermediate segment of the shelf are dynamic and greatly influenced by seasonal changes in water temperatures (Wenner et al., 1979, 1980).

Families characteristic of the continental slope in SAB include hagfishes, catsharks (Scyliorhinidae), skates, grenadiers, codlings (Moridae), eelpouts (Zoarcidae), and greeneyes (Chlorophthalmidae). Species collected by trawling on the upper slope include spotted hake, Gulf Stream flounder (*Citharichthys arctifrons*), shortnose greeneye (*Chlorophthalmus agassizi*), lizardfish (*Synodus poeyi*), pygmy argentine (*Glossanodon pygmaeus*), deepbody boarfish (*Antigonia capros*), and armored searobin (*Peristedion gracile*) (Wenner et al., 1979, 1980). The upper continental slope area offshore of Cape Hatteras is environmentally and faunistically unique (Hecker, 1994; Sulak and Ross, 1996). Fishes found in unusual abundances there include wolf eelpout (*Lycenchelys verrillii*), hagfish (*Myxine glutinosa*), witch flounder (*Glyptocephalus cynoglossus*), and marlin-spike (*Nezumia bairdi*). In addition to unusual local abundance, individuals of these and other species do not grow to normal size, but remain small; the entire assemblage was termed "Lilliputian" by Sulak and Ross (1996). One explanation for this phenomenon is related to high input of organic carbon and subsequent decomposition. Because of interactions between the slope topography and convergence of several water masses, considerable organic matter is deposited over a relatively small area. Decomposition of this organic input causes episodic hypoxic conditions that may affect the composition of the assemblage as well as growth of individual species.

Soft bottom demersal fish assemblages in the MAB are less diverse than those reported for the SAB. Common families contributing to MAB demersal soft bottom assemblages are skates, hakes (Merlucciidae, Phycidae), searobins, drums, porgies, and sand flounders. Bottom water temperatures in the MAB are much cooler (8-12 ºC for the MAB vs. 15-22 ºC in the SAB), especially in the winter, and, accordingly, species composition is dynamic. When water temperatures increase in the spring, warm temperate fishes move into the MAB from southern SAB waters; at the same time, several cold water species migrate back to areas north of the MAB. After shelf waters cool during fall and early winter, warm temperate species migrate back south and offshore while some of the cold temperate forms move into the area (Grosslein and Azarovitz, 1982). Typical warm temperate forms found in the MAB during spring and summer include black sea bass, northern searobin (*Prionotus carolinus*), scup, spotted hake, and summer flounder (*Paralichthys dentatus*) (Grosslein and Azarovitz, 1982; Colvocoresses and Musick, 1984; Gabriel, 1992; Mahon et al., 1998; Love and Chase, 2007). Northern or boreal species found in MAB waters during winter and spring include goosefish (*Lophius americanus*), red hake, offshore silver hake (*Merluccius albidus*), and spiny dogfish (*Squalus acanthias*) (Colvocoresses and Musick, 1984). There is a cross-shelf pattern in the MAB. Inner shelf species are red hake, silver hake (*Merluccius bilinearis*), northern searobin, summer flounder, and windowpane (*Scophthalmus aquosus*) (Maurer and Tinsman, 1980). In intermediate shelf waters, the most common species found are clearnose skate (*Raja eglanteria*), little skate (*Leucoraja erinacea*), northern searobin, fourspot flounder (*Paralichthys oblongus*), and summer flounder (Love and Chase, 2007). On the slope of the MAB, families represented are hagfishes, lantern sharks (Etmopteridae), cutthroat eels (Synaphobranchidae), hakes, grenadiers, eelpouts, and scorpionfishes (Markle and Musick, 1974; Sulak, 1982). An important member of the upper slope soft bottom assemblage is tilefish, mentioned above regarding its role as a habitat engineer. Tilefish occur throughout the AOI in 120-300 m (394-984 ft) water depths (Grossman et al., 1985).

Pelagic Resources

Coastal Pelagic Fishes

Although coastal pelagic species will associate with structured bottom, they respond primarily to water column structure (temperature, salinity, dissolved oxygen) and circulation (currents, eddies, fronts), which vary seasonally and spatially within the AOI. Large-scale influences on water column structure and circulation also vary across the shelf. Inner shelf waters are driven primarily by river discharge, winds, and tidal action. Intermediate shelf waters are mostly wind driven, whereas shelf-edge and upper slope waters (in the SAB) are influenced primarily by the Gulf Stream and its associated eddies and upwellings (Lee et al., 1981; Atkinson and Targett, 1983).

The primary coastal pelagic families occurring in the AOI (SAB and MAB) are requiem sharks (Carcharhinidae), dogfish sharks (Squalidae), anchovies (Engraulidae), herrings (Clupeidae), mackerels (Scombridae), jacks (Carangidae), mullets (Mugilidae), bluefish (Pomatomidae), and cobia (Rachycentridae). Coastal pelagic species traverse shelf waters of the AOI throughout the year.

Large coastal pelagic fishes are generally predatory species such as spiny dogfish, sharks (*Carcharhinus* spp., *Rhizoprionodon terraenovae*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), bluefish (*Pomatomus saltatrix*), cobia (*Rachycentron canadum*), jack crevalle (*Caranx hippos*), and little tunny (*Euthynnus alletteratus*) that are also important fishery species (Grosslein and Azarovitz, 1982). These species tend to school, undergo migrations, and are generally piscivorous. With the exception of the sharks, these species grow rapidly, mature early, and exhibit high fecundity. Smaller coastal pelagic fishes exhibit similar life history characteristics, but the species are usually planktivorous. Smaller coastal pelagic fishes occurring in the AOI include herrings such as alewife (*Alosa pseudoharengus*), American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), Atlantic herring (*Clupea harengus*), thread herring (*Opisthonema oglinum*), Spanish sardine (*Sardinella aurita*), round herring (*Etrumeus teres*), and Atlantic menhaden (*Brevoortia tyrannus*). These species exhibit two basic migratory patterns: the alewife, American shad, and blueback herring are anadromous, migrating from the sea into freshwater rivers to spawn, whereas Atlantic herring, thread herring, Spanish sardine, round herring, and Atlantic menhaden spawn in continental shelf waters.

Epipelagic Fishes

Epipelagic fishes inhabit the upper 200 m (656 ft) of the water column in oceanic waters beyond the continental shelf edge within the AOI, including SAB and MAB subregions. In general, oceanic pelagic species associate with the western edge of the Gulf Stream and travel near this edge as they migrate through the SAB and MAB subregions. Families of epipelagic fishes include sharks (Lamnidae and Sphyrnidae), flyingfishes (Exocoetidae), halfbeaks (Hemiramphidae), oarfishes (Regalecidae and Lophotidae), snake mackerels (Gempylidae), jacks (Carangidae), dolphin (Coryphaenidae), pomfrets (Bramidae), marlins, sailfish, and spearfish (Istiophoridae), swordfish (Xiphiidae), tunas (Scombridae), medusafishes (Centrolophidae), molas (Molidae), and triggerfishes (Balistidae). A number of these species, e.g., dolphin (*Coryphaena hippurus*), sailfish (*Istiophorus platypterus*), white marlin (*Tetrapterus albidus*), blue marlin (*Makaira nigricans*), and tunas, are important to commercial and recreational fisheries. All of the epipelagic species are migratory, but species-specific patterns are not well understood. Many of the oceanic species associate with flotsam, which provides forage areas and/or nursery refuge. Some species, particularly dolphin, tunas, and wahoo (*Acanthocybium solandri*), feed upon small fishes attracted to *Sargassum* and other flotsam (Manooch and Mason, 1984; Morgan et al., 1985; Rudershausen et al., 2010). Floating seaweed (*Sargassum*), jellyfishes, siphonophores, and various flotsam attract juvenile and adult epipelagic fishes (Dooley, 1972; Moser et al., 1998; Casazza and Ross, 2008). Larger predators forage around flotsam. As many as 80 fish species are closely associated with floating *Sargassum* at some point in their life cycle, but only two spend their entire lives there: the sargassumfish (*Histrio histrio*) and the sargassum pipefish (*Syngnathus pelagicus*) (Adams, 1960; Dooley, 1972; Casazza and Ross, 2008). Most fishes associated with *Sargassum* are temporary residents, such as juveniles of species that reside in shelf or coastal waters as adults. However, several larger species of recreational or commercial importance, including dolphin, yellowfin tuna (*Thunnus albacares*), blackfin tuna (*Thunnus atlanticus*), skipjack tuna (*Katsuwonus pelamis*), Atlantic bonito (*Sarda sarda*), little tunny, and wahoo, feed on the small fishes and invertebrates attracted to *Sargassum* (Manooch and Mason, 1984; Morgan et al., 1985; Rudershausen et al., 2010).

Mesopelagic Fishes

Below the epipelagic zone, the water column may be layered into mesopelagic (200-1,000 m [656-3,280 ft]) and bathypelagic (>1,000 m [3,280 ft]) zones. Taken together, these two zones and their inhabitants may be referred to as midwater. In the mesopelagic zone of the AOI, fish assemblages are numerically dominated by lanternfishes (Myctophidae), bristlemouths (Gonostomatidae), and hatchetfishes (Sternoptychidae). Lanternfishes are small silvery fishes that can be extremely abundant, often responsible for the deep scattering layer in sonar images of the deep sea. Lanternfishes and other mesopelagic fishes spend the daytime in depths of 200-1,000 m (656-3,280 ft) but migrate vertically at night into food-rich, near-surface waters. Mesopelagic fishes, while less commonly known, are ecologically important because they transfer significant amounts of energy between mesopelagic and epipelagic zones over each daily cycle. Lanternfishes are important prey for meso- and epipelagic predators (e.g., tunas), upper slope hard bottom fishes (Weaver and Sedberry, 2001), and particularly the mesopelagic dragonfishes (Stomiiformes). Gartner et al. (2006) reported large aggregations of mesopelagic fishes associating with submarine canyons in the AOI.

In the AOI, the Gulf Stream forms the boundary between two distinct mesopelagic fish assemblages: the Slope Water assemblage and the Northern Sargasso Sea assemblage (Backus, 1987). Slope Water representatives include predominantly temperate and subpolar-temperate species, whereas Northern Sargasso Sea water supports tropical and subtropical species. Slope Water assemblages are numerically dominated by glacier lanternfish (*Benthosema glaciale*), with three other species (Madeira lanternfish [*Ceratoscopelus maderensis*], Bermuda lanternfish [*Hygophum hygomii*], and Dofleini's lanternfish [*Lobianchia dofleini*]) accounting for most of the rest. A variety of other mesopelagic fishes occurring in Slope Water are broadly distributed in the tropical and subtropical Atlantic and reflect inputs by warm core rings from the Gulf Stream (Backus et al., 1977; Backus, 1987). Abundant species in the Northern Sargasso Sea assemblage include Warming's lanternfish (*Ceratoscopelus warmingii*), half-naked hatchetfish (*Argyropelecus hemigymnus*), Madeira lanternfish, smoothcheek lanternfish (*Bolinichthys indicus*), and Bermuda laternfish. The Gulf Stream tends to have an intermediate assemblage. Mesopelagic fishes generally reflect the patterns described for other species groups: the slope of the MAB is likely to have a more temperate mesopelagic fish assemblage than the SAB portion of the AOI, which is closer to the Gulf Stream and a source of tropical and subtropical species (Backus, 1987).

Deeper dwelling bathypelagic fishes inhabit in the water column at depths greater than 1,000 m (3,280 ft). This group is composed of strange, little known species such as snipe eels (Nemichthyidae), slimeheads (Trachichyhyidae), deep-sea anglers (Melanocetidae), bigscales (Melamphaidae), and whalefishes (Cetomimidae). Most species are capable of producing and emitting light (bioluminescence) to aid in communicating in an environment devoid of sunlight.

4.2.5.1.2. Ichthyoplankton

With the exception of sharks, rays, and anadromous species, most of the fishes described above produce abundant dispersive eggs and larvae that are broadcast into the water column, where currents, tides, and other mechanisms transport or retain these propagules over a variety of spatial scales. Surveys of eggs and larvae (ichthyoplankton) within the AOI reveal a great diversity and density of early life stages in the water column (e.g., Berrien et al., 1978; Morse et al., 1987).

Pelagic eggs and larvae found in the SAB are products of spawning mainly from warm temperate and tropical regions (Powles and Stender, 1976; Powell and Robbins, 1994; Hare et al., 2001; Marancik et al., 2005; Sedberry et al., 2006). The warm temperate species are spawned within the SAB, whereas the tropical eggs and larvae are carried into the area from more southerly spawning locations. Several of the region's commercially important species, including Atlantic menhaden, Atlantic croaker, spot, summer flounder, and southern flounder (*Paralichthys lethostigma*), migrate from nearshore shelf waters to the shelf edge to spawn (Miller et al., 1984; Taylor et al., 2010). The larvae of these species are transported back across the shelf and eventually into inshore/estuarine nursery areas.

Within the SAB, fish eggs and larvae are generally distributed in an onshore/offshore pattern (Powles and Stender, 1976). Depending on the position of the Gulf Stream front, the ichthyoplankton in the SAB will form a mixture of slope and shelf/slope groups. The slope group is typified by lanternfish throughout the year. During spring, mackerel (Scombridae) larvae reach peak abundance. Members of the slope group at other times of the year include inshore species such as gobies, wrasses (Labridae), and flounders (Bothidae and Paralichthyidae). The shelf/slope group includes fishes such as lefteye flounders, jacks, mullets (*Mugil* spp.), bluefish, filefish (Monacanthidae), goatfish (Mullidae), and sea basses (Serranidae); several of these are economically important species. The composition and abundance of ichthyoplankton at any particular time will depend upon the position of the Gulf Stream front (Govoni, 1993).

Fish eggs and larvae found in the MAB come from warm temperate, cold temperate, and boreal regions (Doyle et al., 1993). In general, the most abundant fish eggs and larvae found during winter months are those of cold temperate species originating in more northerly waters. During spring, summer, and fall months, ichthyoplankton is dominated by warm temperate species originating from more southerly waters.

Within the MAB, fish eggs and larvae are generally distributed in an onshore/offshore pattern including inner shelf, outer shelf, and slope/oceanic groups (Doyle et al., 1993; Hare et al., 2001). Factors such as temperature, salinity, frontal boundary positions, and locations of adult spawning sites contribute to the formation and maintenance of these groups (Grosslein and Azarovitz, 1982; Cowen et al., 1993). Depending on the position of the Gulf Stream front, the outer shelf or slope/oceanic groups would be the most likely larvae occurring along the slope. Lanternfishes (*Benthosema glaciale* and *Ceratoscopelus maderensis*) define the slope/oceanic group (Doyle et al., 1993). *B. glaciale* reaches peak abundance in winter and spring, whereas *C. maderensis* is most abundant in spring, summer, and fall. The slope/oceanic group also includes shelf species whose distribution extends somewhat into the slope/oceanic areas. In spring, Atlantic mackerel (*Scomber scombrus*) larvae are abundant, and in summer, silver hake and some flatfish larvae occur with *C. maderensis*. The outer shelf group includes witch flounder, silver hake, Atlantic bonito, cusk-eels (Ophidiidae), and species from more southerly waters such as razorfish (*Xyrichtys* spp.), lefteye flounders (Bothidae), and gobies (Gobiidae) (Hare and Cowen, 1991; Cowen et al., 1993; Doyle et al., 1993).

4.2.5.1.3. Essential Fish Habitat and Managed Species

The Magnuson-Stevens FCMA (16 U.S.C. § 1801-1882) established regional FMCs and mandated that FMPs be developed to responsibly manage exploited fish and invertebrate species in U.S. Federal waters. When Congress reauthorized this Act in 1996 as the Sustainable Fisheries Act, several reforms and changes were made. One change was to charge NMFS with designating and conserving EFH for species managed under existing FMPs. This is intended to minimize, to the extent practicable, any adverse effects on habitat caused by fishing or non-fishing activities, and to identify other actions to encourage the conservation and enhancement of such habitat.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" [16 U.S.C. § 1801(10)]. The EFH final rule summarizing EFH regulation (50 CFR 600) outlines additional interpretation of the EFH definition. Waters, as defined previously, include "aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate." Substrate includes "sediment, hard bottom, structures underlying the waters, and associated biological communities." Necessary is defined as "the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem." "Fish" includes "finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds," whereas "spawning, breeding, feeding or growth to maturity" covers the complete life cycle of those species of interest.

The AOI covers a broad geographic and bathymetric region that features a dynamic mix of fishery species managed by four different Federal entities. The two primary FMCs responsible for fisheries and habitats in Federal waters of AOI are the Mid-Atlantic Fishery Management Council (MAFMC) and the SAFMC. These two councils manage the MAB and SAB regions, respectively. Because of regular seasonal movement of additional species into the AOI from New England waters, species under the jurisdiction of another management council, the NEFMC, were included in this review. Each of these FMCs has developed EFH descriptions in either separate documents or as amendments to existing FMPs (MAFMC, 1998a,b,c; NEFMC, 1998a,b; SAFMC, 1998; MAFMC and NEFMC, 1999). In addition to the FMPs prepared by these councils, highly migratory species (tunas, billfishes, sharks, and swordfish) prevalent in the AOI are managed by the Highly Migratory Species Management Unit, Office of Sustainable Fisheries, NMFS. This group prepared an FMP for highly migratory species that was updated in 2009 and includes descriptions of EFH for sharks, swordfish, and tunas (USDOC, NMFS, 2009a).

Within the EFH designated for various species, particular areas termed HAPCs are also identified. HAPCs either play important roles in the life history (e.g., spawning areas) of federally managed fish species or are especially vulnerable to degradation from fishing or other human activities.

Species or species groups managed by the SAFMC, MAFMC, NEFMC, and NMFS found within the AOI are listed in **Table 4-18**. Species listed in the table were selected based on examination of the FMPs and with the assistance of NOAA's essential fish habitat mapper (http://www.csc.noaa.gov/digitalcoast/tools/ efhmapper/index.html).

Description of EFH for managed plant, invertebrate, and fish species is organized similarly to the information presented above on fish resources into broad habitat classes of demersal and pelagic. Managed species and species groups for demersal and pelagic habitats are listed in **Table 4-18** for each management council or NMFS.

Members of these groups occur in the AOI for at least a portion of their life cycles. The following accounts briefly describe the EFH and HAPCs for these species and life stages as outlined by the management entities.

Demersal Resources

Coral, Coral Reefs, and Live/Hard Bottom Habitats

For the SAB portion of the AOI, EFH for ahermatypic corals, black corals (*Antipatharia*), octocorals, and sea pens is as follows:

- ahermatypic stony corals – defined hard substrate in subtidal to outer shelf depths throughout the management area.
- black corals (*Antipatharia*) – rough, hard, exposed, stable substrate, offshore in high (30-35 ppt) salinity waters in depths exceeding 18 m (54 ft), not restricted by light penetration on the outer shelf throughout the SAB.
- octocorals, excepting the order *Pennatulacea* (sea pens and sea pansies) – rough, hard, exposed, stable substrate in subtidal to outer shelf depths within a wide range of salinity and light penetration throughout the SAB.
- *Pennatulacea* (sea pens and sea pansies) – includes muddy, silty bottoms in subtidal to outer shelf depths within a wide range of salinity and light penetration throughout the SAB.

The HAPCs for coral, coral reefs, and live/hard bottom habitats of the AOI include the following: The 10-Fathom Ledge, Big Rock, and The Point (North Carolina); Hurl Rocks and the Charleston Bump (South Carolina); Gray's Reef NMS (Georgia); the *Phragmatopoma* (tube worm) reefs off the central east coast of Florida; *Oculina* Bank off the east coast of Florida from Ft. Pierce to Cape Canaveral; and nearshore (0-4 m; 0-12 ft) hard bottom off the east coast of Florida from Cape Canaveral to Broward County (SAFMC, 1998).

Spiny Lobster

Spiny lobster EFH consists of hard bottom, coral reefs, crevices, cracks, and other structured bottom in shelf waters of the AOI from Cape Canaveral to Cape Fear, North Carolina. The Gulf Stream provides an important mode of transport for early life history stages of spiny lobster. No HAPCs for spiny lobster were identified within the AOI.

Hard Bottom Fishes (Snapper-Grouper Complex)

The reef fish (snapper-grouper) management unit consists of 73 species from 10 families. Only the most important species of snapper, grouper, porgy, temperate bass, and tilefish families are listed in **Table 4-19**. Families not listed in the table are grunts, jacks, spadefishes, wrasses, and triggerfishes. The

EFH for adults of this species group consists of hard bottom features such as live bottom, artificial reefs, coral reefs, and rocky outcrops. These features extend from nearshore out to at least 800-m (2,625-ft) water depths on the upper continental slope (SAFMC, 1998). Many of the early life stage individuals of reef fishes such as gag grouper, gray snapper (*Lutjanus griseus*), lane snapper (*L. synagris*), and scup have EFH in inshore waters not present in the AOI. Although the fisheries and adult habitat of these species exist primarily within the SAB portion of the AOI, three species (black sea bass, scup, and tilefish) are also managed by the MAFMC and have EFH in the MAB as well (SAFMC, 1998; MAFMC, 2008a).

The HAPCs for the reef fish species complex that exist in the AOI include mangrove habitat, seagrass habitat, oyster/shell habitat, and all coastal inlets (SAFMC, 1998). Areas that meet the criteria for EFH-HAPCs for species in the snapper-grouper management unit include medium- to high-profile offshore hard bottoms where spawning normally occurs; localities of known or likely periodic spawning aggregations; nearshore hard bottom areas; The Point, Ten Fathom Ledge, and Big Rock (North Carolina); Charleston Bump (South Carolina); mangrove habitat; seagrass habitat; oyster/shell habitat; all coastal inlets; all State-designated nursery habitats of particular importance to snappers-groupers (e.g., primary and secondary nursery areas designated in North Carolina); pelagic and benthic *Sargassum*; Hoyt Hills for wreckfish; the *Oculina* Bank HAPC; all hermatypic coral habitats and reefs; manganese outcroppings on the Blake Plateau; and Council-designated Artificial Reef Special Management Zones (SAFMC, 1998).

Mollusks

Four bivalve mollusk species managed by Federal management agencies occur in the AOI: surfclam (*Spisula solidissima*), ocean quahog (*Arctica islandica*), sea scallop (*Placopecten magellanicus*), and calico scallop (*Argopecten gibbus*). The surfclam and ocean quahog occur in shelf waters of the MAB portion of the AOI. The sea scallop is most abundant north of the AOI, but the southern portion of its distribution extends into the MAB (NEFMC, 1998a). **Table 4-20** gives EFH information for these species in the AOI. The calico scallop occurs in clusters in the SAB primarily offshore of Cape Canaveral, Florida; Cape Fear, North Carolina; and off the Georgia-South Carolina border (SAFMC, 1998). HAPCs were not designated for any of the mollusk species mentioned above.

Shrimps

Penaeid shrimps managed by the SAFMC and occurring in the AOI are brown shrimp (*Farfantepenaeus aztecus*), pink shrimp (*F. duorarum*), and white shrimp (*Litopenaeus setiferus*). Other members of this management unit important to fisheries of the region include rock shrimp (*Sicyonia brevirostris*) and royal red shrimp (*Pleoticus robustus*). **Table 4-20** presents EFH information for life stages of these species within the AOI.

The HAPCs for penaeid, rock, and royal red shrimps include all State-designated habitat of particular importance to shrimp and State-designated overwintering areas.

Crabs

Two deep-dwelling crabs of the family Geryonidae occur in the AOI. The red crab (*Chaceon quinquedens*) is most abundant in the MAB and north (NEFMC, 2002), whereas the golden crab (*Chaceon fenneri*) is most abundant in the SAB (SAFMC, 1998). **Table 4-20** provides EFH information for life stages of the red and golden crabs for the AOI.

The HAPCs have not been identified for red crab (NEFMC, 2002) or golden crab (SAFMC, 1998).

Pelagic Resources

Sargassum

The brown alga *Sargassum* floats at the sea surface, often forming large mats. These accumulations attract numerous small fishes and invertebrates that become mobile epipelagic assemblages. Larger fishes, particularly dolphin, tunas, billfishes, and wahoo, associate with *Sargassum* mats in search of prey and possibly shelter (SAFMC, 1998, 2002, 2003). Some fish families, including jacks, triggerfishes

(Balistidae), filefishes (Monacanthidae), and drift fishes (Stromateidae), use *Sargassum* as nursery habitat. The EFH and HAPC for *Sargassum* is simply the shelf waters and the Gulf Stream to the limits of the EEZ.

Squids

Two squid taxa support fisheries in the MAB portion of the AOI: long-finned squid (*Loligo pealei*) and shortfin squid (*Illex* spp.), a complex of closely-related species nominally referred to as *Illex illecebrosus*. Long-finned squid, a member of the family Loliginidae, occurs primarily in shelf and shelf edge waters. Adults move offshore in fall and remain there until April, when adults and young migrate back into shelf waters for the summer (Lange and Sissenwine, 1980). Spawning reportedly occurs year-round with major peaks in spring (April and May) and fall (August and September). Eggs are attached to hard surfaces and vegetation (NEFMC, 1998a). The shortfin squid belongs to Family Ommastrephidae, a family consisting entirely of oceanic species. It is distributed accordingly in oceanic and shelf-edge waters of the MAB to Cape Hatteras, North Carolina (Lange and Sissenwine, 1980). It migrates into shallower waters (10-50 m [33-164 ft]) during summer months; in late fall it moves south and offshore in the area from Georges Bank to Cape Hatteras (Lange and Sissenwine, 1980).

Coastal Pelagic Fishes

The coastal pelagic category is used formally by the SAFMC to define a management unit including cobia, Spanish mackerel, king mackerel, and little tunny (SAFMC, 1998). Other managed species that inhabit the coastal pelagic habitat of the AOI include coastal sharks (small and large), managed by USDOC, NMFS (2009a); spiny dogfish, managed by MAFMC and NEFMC (1999); and Atlantic herring (*Clupea harengus*), Atlantic mackerel, butterfish (*Peprilus triacanthus*), and bluefish, managed by MAFMC (1998c, 2008b). Specific EFH information for these species is presented in **Table 4-21**.

The HAPCs designated for the SAFMC coastal pelagic species group within the AOI include sandy shoals of Cape Lookout, Cape Fear, and mid-Cape Hatteras, The Point, The Ten-fathom Ledge, and Big Rock (North Carolina); The Charleston Bump and Hurl Rocks (South Carolina); and nearshore hard bottom (Florida) (SAFMC, 1998). For the species managed by the MAFMC and NMFS, no HAPCs have been designated.

There are five small coastal sharks with EFH in the AOI: Atlantic angel shark (*Squatina dumeril*), bonnethead shark (*Sphyrna tiburo*), Atlantic sharpnose shark (*Rhizoprionodon terraenovae*), blacknose shark (*Carcharhinus acronotus*), and finetooth shark (*C. isodon*). **Table 4-22** provides details for each species and life stage.

Large coastal sharks are those species commonly occurring in shelf waters. Seventeen large coastal shark species including basking shark (*Cetorhinus maximus*), great hammerhead (*Sphyrna mokarran)*, white shark (*Carcharodon carcharias*), blacktip (*Carcharhinus limbatus*), bull (*Carcharhinus leucas*), lemon (*Negaprion brevirostris*), tiger (*Galeocerdo cuvier*), and sand tiger (*Carcharias taurus*) occur in the AOI (**Table 4-23**) (USDOC, NMFS, 2009a). The HAPCs were not identified for small or large coastal sharks (USDOC, NMFS, 2009a).

Highly Migratory Species (Epipelagic Species)

Many highly migratory species including dolphin, wahoo, tunas (*Thunnus* spp. and *Katsuwonus pelamis*), swordfish (*Xiphias gladius*), and billfishes (Istiophoridae) occur in the AOI because of the proximity of the Gulf Stream and the extensive expanse of open ocean beyond the shelf edge. Swordfish and Atlantic bluefin tuna (*Thunnus thynnus*) migrate along the outer shelf and into New England waters (USDOC, NMFS, 2009a). Other tunas and billfishes including sailfish, blue marlin, longbill spearfish (*Tetrapturus pfluegeri*), roundscale spearfish (*T. georgei*), and white marlin also occur in the AOI (**Table 4-24**), in addition to several pelagic shark species (**Table 4-25**).

4.2.5.1.4. Summary of Fish and Invertebrate Hearing Capabilities

A brief overview of fish and invertebrate hearing capabilities is presented in the following synthesis. The bulk of the information pertains to fishes, reflecting the general lack of information on sound and its affects on invertebrates. For more information, see **Appendix J**.

Sound plays a major role in the lives of all fishes (e.g., Zelick et al., 1999; Fay and Popper, 2000). This is particularly the case since sound travels much farther in water than other potential signals, and it is not impeded by darkness, currents, or obstacles in the environment. Thus, fishes can glean a great deal of information about biotic (living) and abiotic (environmental) sources and get a good "image" of the environment to a very substantial distance from the animal (e.g., Fay and Popper, 2000; Popper et al., 2003; Slabbekoorn et al., 2010).

In addition to listening to the overall environment and being able to detect sounds of biological relevance (e.g., the presence of a reef, the sounds produced by swimming predators), many species of bony fishes (but not elasmobranchs) communicate with sounds and use sounds in a wide range of behaviors including, but not limited to, mating and territorial interactions (see Zelick et al. [1999] for review). Consequently, anything that impedes the ability of a fish to hear biologically relevant sounds such as those produced by anthropogenic sound sources could interfere with the normal behaviors and even the survival of individuals, populations, or a species. Much more-detailed discussions of all aspects of fish bioacoustics can be found Fay and Megala-Simmons (1999), Zelick et al. (1999), Popper et al. (2003), and Webb et al. (2008). Broad discussions of interactions of anthropogenic sounds and fishes can be found in Popper and Hastings (2009a,b) and Popper and Hawkins (2011).

Besides being able to detect sounds, a critical role for hearing is to be able to discriminate between different sounds (e.g., frequency and intensity), detect biologically relevant sounds in the presence of background noises (called maskers), and determine the direction and location of a sound source in the space around the animal. While actual data are available on these tasks for only a few fish species, all species are likely to have similar capabilities (reviewed in Fay and Megela-Simmons, 1999; Popper et al., 2003; Fay, 2005).

Germane to issues of effects of loud sounds on fishes is that the sensory hair cells in fishes, as in mammals (including humans), can be damaged or actually killed by exposure to very loud sounds (Le Prell et al., 2011). In humans, once sensory cells die they are not replaced, resulting in deafness, whereas fishes are able to repair and replace cells that die (e.g., Lombarte et al., 1993; Smith et al., 2006). Moreover, whereas in humans the ear has its full complement of sensory hair cells at birth, fishes continue to produce (proliferate) sensory hair cells for much of their lives, which results in fishes having more sensory hair cells as they age (Popper and Hoxter, 1984; Lombarte and Popper, 1994). Indeed, large Mediterranean hake (*Merluccius merluccius*) have been shown to have a million or more sensory hair cells in a single saccule (Lombarte and Popper, 1994), as compared to humans, which have, at birth, no more than 20,000 sensory cells in the auditory part of the ear. Because fishes have the ability to repair damaged sensory hair cells and continuously add to their number, fishes are not likely to ever become permanently deaf. There is some chance of temporary hearing loss, but this is quickly repaired (Smith et al., 2006), and there is no evidence in fishes for permanent hearing loss.

Basic data on hearing provide information about the range of frequencies that a fish can detect and the lowest sound level that a fish is able to detect at a particular frequency; this level is often called the "threshold." Hearing thresholds have been determined for perhaps 100 species (Fay, 1988; Popper et al., 2003; Ladich and Popper, 2004; Nedwell et al., 2004; Ramcharitar et al., 2006; Popper and Schilt, 2008). **Table 4-26** summarizes data for selected species of interest for this analysis. These data demonstrate that, with few exceptions, fishes cannot hear sounds above about 3-4 kHz, and the majority of species are only able to detect sounds to 1 kHz or below. There have also been studies on a few species of cartilaginous fishes, with results suggesting that they detect sounds to no more than 600 or 800 Hz (e.g., Myrberg et al., 1976; Myrberg, 2001; Casper et al., 2003; Casper and Mann, 2006).

Because most fish tissue is similar in density to water, sound vibrations propagate through the body of a fish, affected only by tissue, bone, or organs of differing density. Any structures within the body with different densities vibrate differently from other tissues and provide a mechanism for sound detection (Helfman et al., 1997). Available data, while very limited, suggest that the majority of marine species do not have specializations to enhance hearing and probably rely on both particle motion and sound pressure for hearing. Most importantly, it should be noted that hearing capabilities vary considerably between different bony fish species, and there is no clear correlation between hearing capability and environment. There is also broad variability in hearing capabilities within fish families (**Table 4-26**). Data presented in **Table 4-26** have been organized by fish taxa (family level) because data are often not available for individual species of interest. However, it is possible to extrapolate between broad groups of fishes in most cases. **Table 4-26** also identifies only the highest likely frequency of hearing, leaving out the low frequency portion of the hearing bandwidth. Emphasis on highest likely hearing frequency reflects sampling issues, given that what is known about low frequency hearing is often a function of the equipment used in the study and not what the fish actually hears. As a consequence, the low frequency range, with a few exceptions, must be viewed with caution. However, it is accurate to state that most, if not all, fishes can detect sounds to below 100 Hz and likely to below 50 Hz.

In addition, **Table 4-26** does not show the lowest sound levels that a fish can hear, nor does it indicate at what frequency best hearing occurs. Results indicate that there is wide variation in fish hearing data even for a single species, which is likely a result of differences in experimental design.

With these caveats, it is possible to make some useful generalizations with regard to fish hearing that remove some of the "variability" in the data and help focus understanding of fish hearing capabilities. Such generalizations also make it possible to "predict" hearing range and sensitivity of some species for which there are data on the structure of the ear and auditory system but no hearing data. For example, for bluefin tuna, despite lack of hearing data, it is possible to predict that the hearing range for this species is similar to that of other tuna based on similarities in ear structure (Song et al., 2006). Similarly, morphological data on the ears of deep-sea grenadiers leads to the suggestion that these species have inner ear specializations that are often associated with fishes that hear to 2,500-4,000 Hz and have good hearing sensitivity (Deng et al., 2011); a similar observation has been made for myctophids (Popper, 1980).

Based on this kind of analysis, it is possible to "categorize" fish groups as to their hearing capabilities. This is presented in **Table 4-26** where a column provides the categories of each species represented, which are defined as follows:

- *Group 1*: Fishes that do not have a swim bladder. These fishes are likely to use only particle motion for sound detection. The highest frequency of hearing is likely to be no greater than 400 Hz, with poor sensitivity compared to fishes with a swim bladder. Fishes within this group would include flatfish, some gobies, some tunas, and all sharks and rays (and relatives).
- *Group 2*: Fishes that detect sounds from below 50 Hz to perhaps 800-1,000 Hz (though several probably detect sounds only to 600-800 Hz). These fishes have a swim bladder but no known structures in the auditory system that would enhance hearing, and sensitivity (lowest sound detectable at any frequency) is not very great. Sounds would have to be more intense to be detected when compared to fishes in Group 3. These species detect both particle motion and pressure, and the differences between species are related to how well the species can use the pressure signal. A wide range of species fall into this category, including tuna with swim bladders, sturgeons, salmonids, etc.
- *Group 3*: Fishes that have some kind of structure that mechanically couples the inner ear to the swim bladder (or other gas bubble), thereby resulting in detection of a wider bandwidth of sounds and lower intensities than fishes in other groups. These fishes detect sounds to 3,000 Hz or more, and their hearing sensitivity, which is pressure driven, is better than in fishes of Groups 1 and 2. There are not many marine species known to fit within Group 3, but this group may include some species of sciaenids (Ramcharitar et al., 2006). It is also possible that a number of deep-sea species fall within this category, but that is only predicted based on morphology of the auditory system (e.g., Popper, 1980; Deng et al., 2011). Other members of this group would include all of the Otophysan fishes, though few of these species other than catfishes are found in marine waters.
- *Group 4*: All of these fishes are members of the herring family and their relatives (Clupeiformes). Their hearing below 1,000 Hz is generally similar to fishes in Group 1, but their hearing range extends to at least 4,000 Hz, and some species (e.g., American shad) are able to detect sounds to over 180 kHz (Mann et al., 2001).

Appendix J discusses the limited available information on sound use by aquatic invertebrates and summarizes potential impacts. Although there is little known about hearing in aquatic invertebrates, available information suggests that particle motion, not pressure, is the component of the sound field used by invertebrates. Several taxa produce sounds (e.g., snapping shrimps), presumably for communication; sound use by invertebrates remains relatively unstudied. Thus, a determination of whether masking or other behavioral effects are relevant to invertebrates cannot be assessed. Available data include both seismic and low frequency sound exposure study results. Seismic noise does not affect the behavior of shrimp (e.g., Andriguetto-Filho et al., 2005). Exposure to low frequency noise has been shown to damage statocyst tissue in cephalopods (Andre et al., 2011), however, there are questions regarding methodology associated with this latter study effort (**Appendix J**).

4.2.5.2. Impacts of Routine Events

Potential impacts of routine events involved in the proposed action on fisheries resources and EFH are discussed in this section. The details of G&G surveys, equipment, and temporal and geographic coverage were treated in **Chapter 3**. A screening of different IPFs associated with these surveys is provided in **Chapter 4.1.1**. Although there is little specific information on any of these impacts in relation to fisheries resources or EFH in the AOI, the following discussion will assume that at least some members of the regional ichthyofauna including the demersal and pelagic categories discussed above in **Chapter 4.2.5.1** could be affected to some degree by G&G activities.

IPFs related to fisheries resources and EFH identified in the initial screening (**Table 4-2**) included (1) active acoustic sound sources (i.e., airguns, electromechanical sources [e.g., subbottom profilers, side-scan sonar, etc.]), (2) vessel and equipment noise, (3) seafloor disturbance; and (4) drilling discharges. The following subsections briefly discuss these IPFs.

4.2.5.2.1. Significance Criteria

Negligible impacts to fisheries resources and EFH would include those where little to no measurable impacts are observed or expected. There would not be any adverse effects on a federally managed fish species or the absence of any adverse effect on EFH.

Minor impacts to fisheries resources and EFH would include those that are detectable but are neither severe nor extensive. Minor impacts to fisheries resources and EFH would include temporary displacement or disruption of important behavioral patterns of federally managed fish species. Minor impacts would also include spatially-limited impact to EFH.

Moderate impacts to fisheries resources and EFH would be detectable and extensive but not severe. Moderate impacts to fisheries resources and EFH would include some degree of population-level physiological/anatomical damage to, population-level mortality to, or extended displacement of, large numbers of (i.e., population-level) a federally managed fish species. Moderate impacts would also include extensive damage (quantifiable loss depending on the habitat type) to EFH, or extensive disruption of behavioral patterns (including spawning, feeding, or ontogenetic migrations) that may adversely affect a species.

Major impacts to fisheries resources and EFH would be detectable, extensive, and severe. Major impacts to fisheries resources and EFH would include a high level of physiological/anatomical damage to, mortality to, or extended, long-term displacement of, a federally managed fish species. Major impacts would also include extensive, long-term damage (quantifiable loss depending on the habitat type) to EFH, or extensive, chronic disruption of behavioral patterns (including spawning, feeding, or ontogenetic migrations) that would adversely affect a species.

4.2.5.2.2. Evaluation

Active Acoustic Sound Sources

The potential effects of noise such as active acoustic sound sources (e.g., airgun noise) on fishes can be categorized in increasing order of severity as follows:

- behavioral responses;
- masking of biologically important sounds;
- temporal threshold shifts (hearing loss);
- physiological/anatomical effects; and
- mortality.

A review of available research on the effects of sound on fishes is provided in **Appendix J**. At present, there are no examples of sound effects on fishes or habitats from the AOI, but general information on auditory anatomy, physiology, and behavior is available and has been summarized below.

Potential for any of the aforementioned effects is related to sound levels and frequencies, distance from sound source, and species-specific hearing sensitivity. Fishes hear biologically relevant sounds and detect near-field particle motion with auditory anatomy, lateral lines, and sensory pore systems (Lobel, 2009). As noted in **Appendix J**, available scientific information on hearing sensitivity for fishes indicates that there are currently hearing thresholds for only about 100 fish species. Findings showed that many fishes cannot detect sounds above about 3-4 kHz, and most are only able to detect sounds to 1 kHz or below. Based on limited studies, it appears that a few species of cartilaginous fishes can only detect sounds that are around 600 or 800 Hz (Myrberg et al., 1976; Myrberg, 2001; Casper et al., 2003; Casper and Mann, 2006). Several of the commercially important fish families that occur within the AOI have similar hearing sensitivity characteristics (**Appendix J, Table 1**). The highest frequency detected for some commercially important fish families (Labridae, Lutjanidae, Moronidae, Sciaenidae, and Scombridae) was around 1,000 Hz. However, members of the Clupeidae (important baitfishes) can detect higher frequencies that are around 4,000 Hz, and shad and menhaden can detect some very high frequencies that are greater than 120,000 Hz. In general, commercial fish species would be most susceptible to the low frequency sound sources, including airguns and subbottom profilers.

At greater distances from seismic sound sources, temporary hearing loss, masking of biologically relevant sounds, and increased stress would be more likely. Ultimately, such effects would be species-specific and would likely be more of a concern for fishes that utilize sound for communication or environmental detection. The TTS effects have been difficult to detect in trials with fishes. Popper et al. (2003) documented TTS, based on measurement of auditory brainstem response, in northern pike and lake chub. A received sound exposure level of 177 dB re 1 μPa^2-s showed no TTS.

Behavioral responses to the active acoustic sound sources are the most likely effects expected for the fisheries resources of the AOI. Members of the demersal and pelagic categories described in **Chapter 4.2.5.1**, including some federally managed species, utilize sound to some extent for sensing their environment (which includes other soniferous species), calling to mates, sensing predators, or warding off aggressors (Rountree et al., 2006). Demersal soft bottom species best known for their use of sound in reproductive signaling are the drums (Sciaenide), including the federally managed red drum. Because most species (weakfish, black drum, silver perch, and Atlantic croaker) of this family engage in species-specific chorusing during spawning periods, passive acoustic instruments have been used to identify spawning areas inside bays and estuaries (e.g., Mok and Gilmore, 1983; Rountree et al., 2006; Luczkovich et al., 2008). It is reasonable to assume that some sciaenid taxa are using sound to coordinate spawning activities in coastal and shelf waters of the AOI. Other demersal families known to produce sounds include stargazers, cusk-eels, and hakes. Several hard bottom demersal taxa such as groupers, drums, grunts, porgies, squirrelfishes, damselfishes, toadfishes, grenadiers, and gobies produce sounds (Myrberg and Fuiman, 2002; Rountree et al., 2006). Some pelagic species, particularly herrings (Clupeidae), have very sensitive hearing (**Appendix J**). Detrimental physiological/anatomical effects of active acoustic noise on fish populations would represent moderate to severe levels of impact. Of the various types of seismic equipment discussed in **Chapter 3**, airguns have the greatest potential to affect fishes physiologically because of the nature of their sound output. The frequencies of sounds produced by airguns used in seismic airgun surveys range from 10 to 200 Hz, and sound source (pressure) levels range from 225 to 260 dB re 1 μPa. Airgun sounds are also pulsed and have a rapid rise time, a feature that can greatly increase the potential for physiological impacts. At close range (~10-20 m [33-66 ft]), airgun noise can damage auditory and non-auditory anatomy in fishes of all life stages (e.g., eggs and larvae). Physiological/anatomical effects caused by very loud sounds with rapid rise times primarily affect fishes with swim bladders but can be a threat in any situation where gas bubbles are embedded in soft tissues. In some cases, the sensory cells lining the auditory system of fishes have been shown to be irreparably damaged by sounds produced by seismic survey equipment. Popper (2005) and Wardle et al. (2001) note that the potential for pathological damage (i.e., to hearing structures) depends on the energy level of the received sound, its rise time, and the species-specific hearing characteristics of the species of interest. Few studies have assessed the pathological effects of seismic sound on fishes; available exposure study results also carry notable caveats (i.e., repetitive sound exposures are greater than would be realized by fishes during a seismic survey). McCauley et al. (2003) found that exposure to airgun sounds (i.e., SPL of ~223 dB re 1 μPa, peak to peak; exposure to 600 pulses) produced observable anatomical damage to the auditory maculae of pink snapper. In most fish species, these cells continuously regenerate, and loss of auditory function would be restored once the source has terminated. Such impacts would be most severe when the individual is close to the source.

In seismic airgun surveys, the sound source is constantly moving and intense sounds would rarely be close enough to individuals to inflict physiological or anatomical damage. Various sonar units emit semi-continuous noise that would not inflict physical damage to individuals unless at very close range. During normal seismic airgun surveys, the vessels are moving at 4.5-6 kn (8.3-11 km/hr).

Effects of seismic airgun noise on the survival of early life stages of fishes are also of interest. Results of a Norwegian risk assessment of the effects of seismic airgun noise on fish eggs and larvae showed that effects were indistinguishable from natural variability (Booman et al., 1996; Saetre and Ona, 1996).

Airguns are used as the seismic source for deep penetration and high-resolution surveys for oil and gas but are not expected to be used for HRG surveys in the renewable energy, and marine minerals programs. The highest amount of activity is expected in association with HRG and 2D seismic airgun surveys conducted for oil and gas exploration (**Table 3-9**). For example, 2D surveys cover large areas over relatively long periods (2-12 months). HRG surveys focus on individual OCS lease blocks or groups of OCS lease blocks. Thus, with HRG surveys, the area exposed to airgun noise would be more concentrated, but survey duration would be shorter (days). Longer duration surveys over broad areas would likely cross schools or aggregations of fishes. Depending on water depth, these would include coastal pelagic, epipelagic, and demersal hard bottom species. Interactions with these fisheries resources would be temporary because the survey vessel is constantly moving, but because of the broad survey areas, the likelihood of encountering fisheries resources increases. Spatially focused surveys using airguns would present a greater threat to fishes because of the concentrated nature of the sound source. Long duration but widespread vs. short duration over small areas presents different impact situations, both of which could lead to adverse impacts. Spawning aggregation sites, feeding areas, hard bottom habitats, artificial reefs, and any other habitats where fishes aggregate would be susceptible to impacts from airgun noise. Repeated passes by a seismic survey vessel conducting a site-specific survey could displace or disrupt spawning behavior of federally managed grouper and snapper species. Deepwater MPAs also support other species including snappers, sea basses, and tilefishes. Deepwater MPAs protecting such sites are discussed in **Chapter 4.2.11.1.2**.

Affected species would be expected to either vacate the survey area, experience short-term threshold shift (hearing loss), experience masking of biologically relevant sounds, or be completely unaffected. Mortality is very unlikely for the reasons stated above. Overall background noise would increase during surveys of particular pre-plotted areas of seafloor such as individual OCS lease blocks, renewable energy buoy sites, and sand borrow areas. Ambient noise levels would return once the survey ends and the noise source is terminated, and stress-related behavioral response by fishes would end (McCauley et al., 2000a,b). The mobile nature of the surveys, the temporary (short-term) nature of surveying small areas of the seafloor relative to the overall area, and the propensity of fishes to temporarily move away from noise that is affecting them suggest that the impacts from active acoustic sound sources to fisheries resources and EFH would be **minor**.

Vessel and Equipment Noise

Most of the G&G survey activity described in **Chapter 3** would be conducted from vessels. Vessel noise is a combination of narrow-band (tonal) and broadband sound (Richardson et al., 1995). Tones typically dominate up to about 50 Hz, whereas broadband sounds may extend to 100 kHz. Broadband source levels for most small ships (a category that would include seismic survey vessels and support vessels for drilling of COST wells or shallow test wells) are anticipated to be in the range of 170-180 dB re 1 μPa at 1 m (Richardson et al., 1995). Broadband source levels for smaller boats (a category that would include survey vessels for renewable energy and marine minerals sites) are in the range of 150-170 dB re 1 μPa at 1 m (Richardson et al., 1995). In addition as discussed in **Chapter 3.5.1.2**, drilling-related noise that would be associated with the installation of up to three COST wells and up to five shallow test wells associated with oil and gas exploration G&G activities is continuous, and generally of low frequencies (<500 Hz) including infrasonic frequencies in at least some cases (Richardson et al., 1995). Machinery noise can be continuous or transient, and variable in intensity. Noise levels vary with the type of drilling rig and the water depth. Drilling-related noise from jack-up platforms is continuous, and generally of very low frequencies (near 5 Hz). Drilling-related noises from semi-submersible platforms range in frequencies from 10 to 4000 Hz, with estimated sound levels of 154 dB re 1 μPa. Source levels for drillships have been reported to be as high as 191 dB re 1 μPa during drilling. Noise of these levels falls within the general range of hearing in fishes (Amoser et al., 2004; **Appendix J**). Vessel and equipment sound source levels below those that can cause mortality, physiological/anatomical damage, or hearing loss may induce behavioral responses such as avoidance, alteration of swimming speed and direction, and alteration of schooling behavior (Sarà et al., 2007). Additionally, such noise can mask sounds that affect communication between fishes. Presently there are few areas within the AOI that do not experience vessel noise of some kind; regional fishes are likely to have habituated to this noise (**Appendix J**; Lobel, 2009). Although vessel and equipment noise would increase in the AOI as a result of the proposed action scenario, negative effects on fish behavior are expected to be short-term and localized to areas where increased activity is concentrated. For these reasons, the impacts of vessel and equipment noise on fisheries resources and EFH are expected to be **minor**.

Seafloor Disturbance

Sources of seafloor disturbance that may result from G&G activities are bottom sampling (cores and grabs); placement of anchors, nodes, cables, or other bottom-founded equipment; COST and shallow test well drilling; and placement of anchored monitoring buoys (**Table 3-10**). The primary concern is the potential for physical damage to demersal hard bottom and hard bottom associated fisheries resources. Similarly, EFH (coral, coral reefs, and live/hard bottom habitats) and federally managed species such as spiny lobster and members of the snapper/grouper complex could be affected by physical damage to hard bottom (**Chapter 4.2.5.1.1**). Placement of equipment on the seafloor would damage areas where direct contact with the seafloor occurs. On soft bottom, the damage can mean loss of small patches of epifauna and infauna; on hard bottom, contact can crush epibiota and damage structure of the founding hard bottom. Many well known hard bottom areas are designated as HAPCs or, in the case of Gray's Reef, an NMS and thus would be avoided during G&G survey activities. Damage to unknown or unseen hard bottom could be adverse, but because of the small area covered by most bottom-tended equipment, such impacts would not be significant. Soft bottom areas where deployments are made would lose benthic organisms (because of burial and crushing), and bottom-feeding fishes would be temporarily displaced from feeding areas.

The proposed action scenario indicates that individual grab samples, core samples, COST wells, test wells, and bottom-founded meteorological buoys would affect a relatively small portion of the seafloor within the AOI (**Chapter 3.5.1.8**). Grab and core samples individually would, on average, disturb an area of 10 m^2. When multiplied by the number of samples estimated for the proposed action scenario, the total area of seafloor disturbed would be about 11 ha (27 ac), or 0.00001 percent of the AOI. Seafloor area disturbed by individual COST and shallow test wells would vary with equipment and water depth but is projected to be about 16 ha (40 ac), or about 0.00002 percent of the AOI. A maximum of 38 meteorological buoys may be placed on the seafloor in the AOI to support G&G activities. Seafloor disturbance caused by anchors and anchor sweep is expected to disturb about 129 ha (319 ac), or 0.0002 percent of the AOI. At present, there is no estimate in the proposed action scenario for seafloor disturbance associated with placement of nodes, cables, and sensors that support ocean cable, nodal, vertical cable, VSP, CSEM, and MT surveys (**Chapter 3.5.1.8**). Given these estimates of minimal seafloor disturbance by projected G&G activities, the impacts to fishery resources and EFH are expected to be **negligible**.

Drilling Discharges

Discharges from COST and shallow test wells consist of drilling fluids and cuttings that would affect limited portions of the water column and seafloor surrounding individual wells. Two types of fluids are used in exploratory drilling: water-based drilling fluids (WBF) and synthetic-based drilling fluids (SBF) (**Chapter 3.5.1.9**). WBFs are used in shallow wells or the shallow segment of deeper wells, whereas SBFs are routinely used in deeper wells. The WBFs would be discharged on site at or near the ocean surface along with drill cuttings. These materials would be deposited on the seafloor around the well, resulting in localized impact to infaunal assemblages that form the prey base for benthic feeding fishes. SBFs are recycled and are not dischared directly; however, some SBF is retained on cuttings particles that are discharged; cuttings and adhering SBFs would be deposited on the seafloor at and near the wellsite. Impacts of drilling muds and cuttings are due to direct smothering by the muds and cuttings, increased organic load from WBF and SBF constituents, altered grain size, and elevation of sediment trace metals and organics (USDOI, MMS, 2007c). Drilling discharges can temporarily affect infaunal communities through alteration of benthic community structure, similar to impacts associated with seafloor disturbances noted previously. The proposed action scenario described in **Chapter 3.5.1.9** indicates that the total volumes generated from drilling one to three COST wells would range from 2,000 to 6,000 bbl of cuttings and 8,350 to 25,050 bbl of drilling fluid for the AOI. Because of the small areas affected by proposed G&G well drilling activities, the impacts to fisheries resources and EFH because of drilling discharges are expected to be **negligible**.

4.2.5.3. Impacts of Accidental Fuel Spills

Vessels used for G&G surveys could spill diesel fuel following a collision or other accident. Given the specifications for vessels used in G&G activities, a spill of 1.2-7.1 bbl of diesel fuel was developed (**Chapter 3.5.2.1**). Diesel is acutely toxic oil to algae, invertebrates, and fishes, and any contact with a diesel spill can result in death. However, small spills in open water such as the one described in **Chapter 3.5.2.1** rapidly dissipate, and fish kills rarely result. For the duration of such a spill, species and life stages residing in the upper water column are most at risk for contact with the spilled fuel. Coastal pelagic and epipelagic adults (see **Chapter 4.2.5.1.1**) that forage at the ocean surface would be most likely to encounter a surface spill. Spanish mackerel (*Scomberomorus maculatus*), king mackerel (*Scomberomorus cavalla*), little tunny (*Euthynnus alletteratus*), and yellowfin tuna (*Thunnus albacares*), species known to feed at the ocean surface, are at the greatest risk of exposure but would likely swim away from a small diesel spill. Planktonic early life stages (i.e., eggs of both demersal and pelagic species) would be less able to avoid a spill and, therefore, are most vulnerable to toxic properties of the diesel (e.g., Mos et al., 2008).

Numerous federally managed species described previously (see **Chapter 4.2.5.1.3**) have pelagic eggs and larvae that would be at risk if they encountered a diesel spill. The EFH most at risk from a small diesel spill would be pelagic *Sargassum*. Drifting in windrows or mats, *Sargassum* supports numerous fishes and invertebrates including the young of several federally managed species such as greater amberjack (*Seriola dumerili*), almaco jack (*Seriola rivoliana*), gray triggerfish (*Balistes capriscus*), blue runner (*Caranx crysos*), dolphin (*Coryphaena hippurus*), and wahoo (*Acanthocybium solandri*). Because the exposure of spilled diesel fuel on early life stages and *Sargassum* is expected to last for a day or less and have limited spatial extent, the impacts of a small accidental diesel fuel spill from G&G activities would be **minor**.

4.2.5.4. Cumulative Impacts

The cumulative impacts scenario is discussed in detail in **Chapter 3.6** and includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs for these cumulative activities that have the potential to affect fisheries resources and EFH include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, and other active sound sources and vessel and equipment noise; (2) seafloor disturbance; (3) presence of structures (including vessels); and (4) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents(smaller accidental events or low-probability large scale catastrophic events).

Among the IPFs identified above for the cumulative impacts scenario, five sources of potential impact to fisheries resources and EFH have been identified in association with proposed G&G activities including (1) active acoustic sound sources; (2) vessel and equipment noise; (3) seafloor disturbance; (4) drilling discharges; and (5) accidental fuel spills. Impact analyses presented in **Chapters 4.2.5.2** and **4.2.5.3** determined that activities projected to occur under Alternative A would result in negligible to minor impacts to fisheries resources and EFH, with the level of impact dependent upon the specific IPF being considered. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Underwater Noise Including Active Acoustic Sound Sources and Vessel and Equipment Noise

Anthropogenic contributions to ambient noise in the sea are primarily from vessel traffic, but also include oil and gas operations, nearshore construction activities, dredging, and sonar. Long term noise data for the AOI have not been published. For the purposes of this analysis, and in consideration of the documented increases in marine transportation volumes along the U.S. Atlantic coast, it is assumed that underwater noise from vessel traffic and other anthropogenic sources within the AOI is increasing. Most ambient noise is broadband and encompasses virtually the entire frequency spectrum, with vessel traffic recognized as a major contributor to ocean noise in the low-frequency bands between 5 and 500 Hz. Naturally occurring noise (e.g., spray and bubbles from breaking waves) are also a major contributor to ambient noise in the 500- to 100,000-Hz range. Ambient noise can affect fisheries resources via temporary hearing loss and alteration of normal, biologically relevant behavior (**Appendix J**). Noise impacts to fisheries resources and EFH from activities under the cumulative scenario are expected to be localized, either intermittent or continous, and relatively minor.

The G&G activities would contribute numerous sources of noise during the Programmatic EIS period including seismic surveys (airguns and electromechanical sources) and vessel and equipment noise. Noise-producing activities expected for the proposed G&G scenario were presented in **Chapter 3.5.1** and **Table 3-3**. Several noise-producing G&G activities such as 2D and 3D seismic airgun surveying are expected to decrease incrementally from 2012-2020, whereas others including HRG surveys would increase from 2018-2020. For active acoustic sound sources, overall background noise would increase during surveys of particular pre-plotted areas of seafloor such as individual OCS lease blocks, renewable energy buoy sites, and sand borrow areas. Ambient noise levels would return once the survey ends and the noise source is terminated. The mobile nature of the surveys as well as the temporary surveying of small areas of the seafloor relative to the overall area and the propensity of fishes to temporarily move away from noise that is affecting them suggest that the incremental increase in impacts to would be small. For vessel and equipment noise exposure, masking and short-term behavior modifications are likely; for this reason, the incremental increase in impacts from G&G activity-based vessel and equipment noise is expected to be minor.

As noted previously, it is assumed that noise levels associated with non-G&G activities would increase throughout the 2012-2020 period, producing minor impacts to fisheries resources and EFH over the course of the Programmatic EIS time period. Noise from G&G operations would be survey- or activity-based, occurring on a transient and intermittent basis over the period of interest. Because the type of underwater noise associated with the proposed action would be similar to the existing underwater noise under the cumulative scenario (e.g., vessel and equipment noise, sonars, active sound sources), there would be minor increases in ambient noise levels within specific portions of the AOI during G&G operations. Because only minor noise impacts are expected from the cumulative activities scenario, and there is no evidence to suggest that noise from G&G activities would push ambient noise levels above a threshold level where fisheries resources and EFH might be significantly affected, the impacts associated with the proposed action would result in a minor incremental increase in ambient noise levels under the cumulative scenario.

Presence of Structures Including Vessel and Helicopter Traffic

Cumulative scenario activities, including oil and gas exploration, renewable energy, geosequestration, and LNG terminals, have the potential for the emplacement of structures within the AOI. Permanent and temporarily moored structures, including drilling rigs, barges, buoys, wind turbines, platforms, and other structures, would attract fishes. Pelagic and demersal species would be attracted to particular structures. Specific concerns and impacts associated with the presence of structures resulting from the cumulative activities scenario would include the diversion of species from normal migratory pathways, feeding areas, and/or spawning areas. In addition, individuals attracted to structures would then be subjected to chronic noise, routine discharges, or increased vulnerability to overfishing. Lights would enhance attractiveness for some species that are active at night. Incremental impacts to fisheries resources and EFH arising from structure presence, including vessel and helicopter traffic, under the cumulative activities scenario are expected to be negligible.

Most G&G activities would be of short duration and are not expected to cause permanent alteration of migratory, feeding, or breeding schedules in fishery species. Because of the small size of structures and the relatively short duration of deployments, the incremental increase in impacts to fisheries resources and EFH from the presence of structures under Alternative A is negligible.

Seafloor Disturbance

Seafloor disturbance can damage or alter hard or soft demersal habitats important to fisheries resources and, in some cases, designated EFH (**Chapter 4.2.5.2**). Non-G&G activities in the AOI known to disturb the seafloor include geosequestration, commercial fishing (bottom trawling and dredging), dredged material disposal, LNG terminal placement, and military range complexes and civilian space program use. Gesequestration involves drilling wells, placing anchors, and laying pipelines on the seafloor. Currently there are no geosequestration facilities planned for the AOI and none expected in the foreseeable future. Commercial fishing with bottom trawls or dredges can inflict considerable damage to demersal habitats. The extent of the seafloor disturbance caused by bottom tending fisheries within the AOI has not been quantified. Use of bottom-tending gear is not expected to increase for the 2012-2020 duration of the Programmatic EIS. Placement of LNG terminals would involve seafloor disturbance; however, no activity is expected during the Programmatic EIS time period. Disposal of dredged material in offshore waters can potentially smother demersal biota. The AOI currently has 13 designated offshore dredge disposal material sites from Virginia south to Florida (**Chapter 3.6.9**). These sites are expected to be used at current levels for the 2012-2020 period. Military range complexes and civilian program use could involve placement of buoys or other equipment that could potentially disturb the seafloor. These actions would affect a relatively small are of seafloor within the AOI for the duration of the Programmatic EIS period. Incremental impacts to fisheries resources and EFH attributed to seafloor disturbance under the cumulative activities scenario are expected to be negligible.

Seafloor disturbance expected from the proposed G&G action scenario would be caused by bottom sampling, well drilling, coring, anchoring, sand dredging, pipeline installation, and emplacement of structures (wind turbines, buoys, etc). As reviewed previously (**Chapter 4.2.5.2**), the small footprint of individual contacts would be minimal, and for the entire G&G scenario seafloor impacts would account for a small fraction of the total seafloor area of the AOI for the 2012-2020 period. The G&G operations for the 2012-2020 period are expected to contribute minor incremental impacts to EFH in the form of seafloor disturbance within the AOI.

Accidental Fuel Spills

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to fisheries resources or EFH would vary depending on the location and size of the spill. However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prior to any wells being drilled. In addition, a project-specific EA would require an analysis of site-specific information regarding fisheries resources and EFH and mitigation measures taken to minimize impacts from drilling activities and potential accidental crude oil spills. In addition, with the required mitigation measures in place and with oversight of these activities by the BSEE, an accidental crude oil spill from an exploratory well is not anticipated; however, a spill still could occur. With these mitigation measures in place, the impacts to fisheries resources and EFH from exploratory drilling operations would be expected to range from negligible to minor depending on location.

A significant amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The risk of accidental fuel spills arising from a vessel collision under the cumulative scenario is expected to range from negligible to minor.

Each G&G activity that involves survey vessels has the potential to result in an accidental fuel spill. A survey vessel colliding with another vessel or structure could result in a diesel fuel spill ranging from 1.2 to 7.1 bbl (**Chapter 3.5.2.1**). The likelihood of such a spill is considered remote for the G&G activity scenario. Spilled diesel fuel would evaporate, disperse, and break down within a day, resulting in a negligible impact to fisheries resources and EFH. Non-G&G activity at risk for spilled fuel include geosequestration, commercial and recreational fishing, military activity, and dredged material disposal. Assuming a similar spill scenario for non-G&G activity, the incremental impacts to the cumulative scenario attributed to G&G activities are expected to range from negligible to minor.

4.2.6. Threatened and Endangered Fish Species

4.2.6.1. Description of the Affected Environment

This section discusses marine fishes that are listed as threatened or endangered under the ESA. The NMFS has jurisdiction over most marine and anadromous fishes listed under the ESA, including the species discussed here. In addition to ESA-listed species, this chapter addresses proposed and candidate species. A proposed species is one for which NMFS has conducted a status review and issued an official proposal in the *Federal Register* to list the species as endangered or threatened (USDOC, NMFS, 2011j). A candidate species is any species that is undergoing a status review that NMFS has announced in a *Federal Register* notice (USDOC, NMFS, 2011j).

One marine fish species occurring in the AOI, the smalltooth sawfish (*Pristis pectinata*), is currently listed as endangered. An endangered anadromous fish species potentially occurring in the AOI is the shortnose sturgeon (*Acipenser brevirostrum*), which inhabits rivers along the Atlantic coast but rarely ventures into coastal marine waters (USDOC, NMFS, 1998). Also occurring in the AOI is the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), which is a proposed threatened/endangered species. The NMFS also has evaluated Atlantic bluefin tuna (*Thunnus thynnus*) for ESA listing, but announced on May 27, 2011, that ESA listing is not warranted for the species at this time (*Federal Register*, 2011f). Bluefin tuna is now designated as a species of special concern. On November 2, 2011, NMFS announced that two anadromous species – the blueback herring (*Alosa aestivalis*) and the alewife (*Alosa pseudoharengus*) – were undergoing a status review to be listed as threatened (*Federal Register*, 2011g). Both of these species occur in the AOI as adults and are currently listed as candidates for listing under ESA.

4.2.6.1.1. Smalltooth Sawfish (*Pristis pectinata*)

Status (Endangered)

In response to a petition from the Ocean Conservancy, NMFS conducted a status review of the smalltooth sawfish in 2000 (USDOC, NMFS, 2000). The status review determined that smalltooth sawfish in U.S. waters comprise a DPS and that the DPS is in danger of extinction throughout its range. On April 1, 2003, NMFS published a final rule (*Federal Register*, 2003b) listing this DPS as endangered under the ESA.

Over the past 200 years, smalltooth sawfish populations have declined considerably, primarily because of incidental capture by fishing gear as well as destruction of habitat. The ESA listing was based on the following considerations: the threatened destruction, modification, or curtailment of habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; inadequacy of existing regulatory mechanisms; and other natural and manmade factors affecting the continued existence of the species. Critical habitat was designated in 2009 (*Federal Register*, 2009c). **Figure 4-18** shows the location of critical habitat in southern and southwestern Florida. Maintenance and protection of habitat is an important component of the recovery plan for this species (USDOC, NMFS, 2009b). Recent studies indicate that key habitat features (particularly for immature individuals) consist of shallow water, especially near mangroves, with estuarine conditions.

Distribution

The historic range of smalltooth sawfish extended throughout the Gulf of Mexico and north to Long Island Sound on the east coast but has contracted considerably in U.S. coastal waters over the past 200 years. Currently, the core of the smalltooth sawfish DPS is surviving and reproducing in the waters of southwest Florida and Florida Bay, primarily within the jurisdictional boundaries of Everglades National Park where important habitat features are still present and less fragmented than in other parts of the historic range (Simpfendorfer and Wiley, 2005; USDOC, NMFS, 2009b). This area includes most of the critical habitat shown in **Figure 4-18**.

A search of the National Sawfish Encounter Database (Simpfendorfer and Wiley, 2006), which is managed by the Florida Museum of Natural History Sawfish Implementation Team, revealed only two recent sightings of smalltooth sawfish in the AOI (**Figure 4-19**). One sighting was offshore northeastern Florida, and another offshore Georgia was reported by a bottom longline fishery observer who documented the capture of an estimated 4-m (13-ft) adult from depths of 46-73 m (152-242 ft) (USDOC, NMFS, 2010c).

Life History

Little is known about smalltooth sawfish habitat use, age, growth, reproduction, feeding, or predators and competitors (USDOC, NMFS, 2009b, 2010c). The smalltooth sawfish normally inhabits shallow waters (<10 m [33 ft]), often near river mouths or in estuarine lagoons over sandy or muddy substrates, but may also occur in deeper waters (<50 m [164 ft]) of the continental shelf. Shallow water less than 1 m (3 ft) appears to be important nursery area for young smalltooth sawfish. Smalltooth sawfish grow slowly and mature at about 10 years of age. Females bear live young, and litters reportedly range from 1 to 20 embryos (USDOC, NMFS, 2009b).

Smalltooth sawfish feed on benthic invertebrates and fishes. The saw has been considered as a trophic apparatus, used to herd and even impale shallow-water schooling fishes such as herrings and mullets (Breder, 1952). It appears more likely that the saw is used to rake the seafloor to uncover partially buried invertebrates.

Small juvenile sawfishes may be susceptible to predation from bull sharks (*Carcharhinus leucas*) and lemon sharks (*Negaprion brevirostris*) that inhabit similar water depths as the smalltooth sawfish. The toothed saw of fish of all sizes will readily entangle in nets, ropes, monofilament line, discarded pipe sections, and other debris (Seitz and Poulakis, 2006). Some sawfish are caught incidentally on hook-and-line by fishers seeking sharks, tarpon, or groupers, and though most are released unharmed, many of these interactions will result in death of the individual. There was and may still be some incentive to collecting the saws as curios, but this has not been well documented. There have been no studies on competition between sawfishes and other co-occurring species.

4.2.6.1.2. Shortnose Sturgeon (*Acipenser brevirostrum*)

Status (Endangered)

The shortnose sturgeon belongs to the family Acipenseridae and is one of several members of the family found exclusively in North America. This species was originally listed as endangered on March 11, 1967 (*Federal Register*, 1967) under the Endangered Preservation Act of 1966. Subsequently, NMFS prepared a recovery plan for the species under the ESA (*Federal Register*, 1998b), and at present there are 19 east coast rivers considered to support DPSs (USDOC, NMFS, 1998b). Population declines were attributed to habitat loss or alteration, pollution, and incidental capture in nets set for other species.

Distribution

The shortnose sturgeon is primarily an estuarine and riverine species and rarely enters the coastal ocean of the AOI. Most of the river systems listed as DPSs are in North Carolina, South Carolina, Georgia, and northern Florida (USDOC, NMFS, 1998b). Although these systems drain into the estuaries or the coastal ocean portion of the AOI, shortnose sturgeon have rarely been found in coastal or shelf waters (Dadswell et al., 1984; Moser and Ross, 1995; Collins and Smith, 1997). Collins and Smith (1997) reviewed available records and reported 39 individuals ranging from 60 to 100 cm (2 to 3.3 ft) total length caught offshore of South Carolina from January to March. Dadswell et al. (1984) reported eight records from the Atlantic Ocean between Cape Henry, Virginia, and Cape Fear, North Carolina.

Life History

The shortnose sturgeon is an anadromous species found in larger rivers and estuaries of the North America eastern seaboard from the St. Johns River in Florida to the St. Johns River in Canada. Although shortnose sturgeon occur primarily in fresh and estuarine waters, they occasionally will enter the coastal ocean. Adults ascend rivers to spawn from February to April; eggs are deposited over hard bottom, in shallow, fast-moving water (Dadswell et al., 1984; Murdy et al., 1997). Fecundity ranges from 27,000 to 208,000 eggs per female (Murdy et al., 1997). Growth is relatively slow, with females reaching maturity in 6-7 years, whereas males mature in 3-5 years. Shortnose sturgeon can live to be over 67 years, with an average life span of 30-40 years.

4.2.6.1.3. Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

Status (Proposed Threatened, Proposed Endangered)

A petition to list the Atlantic sturgeon under the ESA was received by NMFS in 1997. After a status review, it was determined that the species did not merit listing under the ESA at that time. In 2009, the National Resources Defense Council (NRDC, 2009) petitioned NMFS to list the species as endangered. The NRDC requested that the species be segregated into five DPSs, including Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic (**Figure 4-20**). The NMFS agreed with this approach and published two proposed listings in the *Federal Register* on October 6, 2010, for the Northeast Region (*Federal Register*, 2010i) and Southeast Region (*Federal Register*, 2010j). The current status of Atlantic sturgeon is "proposed threatened" for the Gulf of Maine DPS and "proposed endangered" for the other four DPSs, which are in the AOI. The final status determination was scheduled for October 6, 2011, but is currently not available. If the species is listed, there would be no critical habitat designated because of lack of information on individual DPSs.

Distribution

Historically, Atlantic sturgeon were distributed along the east coast and inhabited 38 coastal rivers from the St. Johns River, Florida, to Hamilton Inlet, Labrador. Today they inhabit 32 coastal rivers over a reduced geographic range, with the center of abundance being the New York Bight (Atlantic Sturgeon Status Review Team, 2007; Dunton et al., 2010).

Life History

The Atlantic sturgeon is an anadromous species that resides for much of each year in estuarine and marine waters, but ascends coastal rivers in spring to spawn in freshwater. Spawning populations occur in 20 of the 32 east coast rivers that support Atlantic sturgeon. Atlantic sturgeon are generally slow growing and late maturing, and mature individuals may not spawn every year; generally, the range between spawning is 1-5 years. Spawning takes place in flowing freshwater. Depending on their size, mature females produce between 400,000 and 8 million eggs. The eggs are adhesive and attach to gravel or other hard substrata. Larvae develop as they move downstream to the estuarine portion of the spawning river, where they reside as juveniles for years. Subadults will move into coastal ocean waters where they may undergo extensive movements usually confined to shelly or gravelly bottoms in 10-50 m (33-164 ft) water depths (Stein et al., 2004; Erickson et al., 2011). Fish distribution varies seasonally within this depth range. During summer months (May to September) fish are primarily found in the shallower depths of 10-20 m (33-66 ft). In winter and early spring (December to March), fish move to depths between 20 and 50 m (66 and 165 ft) (Erickson et al., 2011). Shelf areas <18 m (59 ft) deep off Virginia and the sandy shoals offshore of Oregon Inlet, North Carolina, appear to be areas of concentration during summer months (Laney et al., 2007). The area of high concentration offshore of Virginia was centered from 15 to 37.5 km (9.3 to 23.3 mi) from shore, and the maximum distance from shore during winter was about 112.5 km (70 mi). Although there is considerable intermingling of populations in the coastal oceans, adults return to their natal rivers to spawn. Adults grow to lengths of 4.3 m (14 ft) and weights of 363 kg (800 lb) and live for up to 60 years. Age at maturity varies with subpopulation but ranges from 5 to 10 years in South Carolina to 22-34 years in the St. Lawrence River, Canada.

4.2.6.1.4. Blueback Herring (*Alosa aestivalis*)

Status (Candidate Threatened)

On August 5, 2011, NMFS was petitioned by the NRDC requesting that the blueback herring be listed as threatened under the ESA throughout much of its geographic range. The NRDC requested that the species be segregated into three DPSs, including Central New England, Long Island Sound, and Chesapeake Bay. The NMFS published the proposed listing in the *Federal Register* on November 2, 2011 (*Federal Register*, 2011g).

Distribution

The blueback herring is found from Nova Scotia to the St. Johns River in northern Florida (Kells and Carpenter, 2011).

Life History

The blueback herring is an anadromous species that lives in the marine environment but ascends freshwater rivers to spawn. Adults occur primarily in coastal and inner shelf waters but also occur over the outer shelf. The blueback herring is a coastal migratory pelagic that forms large schools and feeds on plankton. Water temperature initiates spawning migrations, which generally occur from March to May. Mature fish enter rivers when water temperatures drop to between 41 and 50°F (5 and 10°C). Evidence suggests that individual fish return to natal rivers to spawn. Spawning takes place in moving freshwaters, generally over hard substrate. Young reside in fresh or brackish waters including ponds and lakes with access to the ocean (Loesch and Lund, 1977).

4.2.6.1.5. Alewife (*Alosa pseudoharengus*)

Status (Candidate Threatened)

The August 5, 2011, petition by NRDC described above for blueback herring included the closely related alewife (*Alosa pseudoharengus*). The NRDC requested that the alewife be listed as threatened under the ESA as four DPSs, including Central New England, Long Island Sound, Chesapeake Bay, and

Carolina. The NMFS published the proposed listing in the *Federal Register* on November 2, 2011 (*Federal Register*, 2011g).

Distribution

The alewife is found along the coast of eastern North America from the Gulf of St. Lawrence to South Carolina (Kells and Carpenter, 2011).

Life History

The alewife is an anadromous species that resides in the ocean for most of its adult life but spawns in freshwater reaches of coastal rivers within its geographical range. During fall and winter, most of the population overwinters in coastal waters of the continental shelf. In spring when water temperatures reach 46-54°F (8-12 °C), mature adults averaging between 3 and 4 years of age enter coastal rivers and migrate to freshwater to spawn (Scott and Scott, 1988). Females produce between 48,000 and 360,000 eggs that are fertilized in the water column and hatch after about 3-5 days. Young grow rapidly durng the first year and reach a maximum age of 12 years (Scott and Scott, 1988).

4.2.6.2. Impacts of Routine Events

Preliminary screening in **Chapter 4.1.1** identified six IPFs from routine G&G activities that may affect threatened and endangered fishes: (1) active acoustic sound sources; (2) vessel and equipment noise; (3) vessel traffic; (4) trash and debris; (5) seafloor disturbance; and (6) drilling discharges (**Table 4-2**). Two endangered species (smalltooth sawfish and shortnose sturgeon), one proposed for endangered status (Atlantic sturgeon), and two proposed for threatened status (blueback herring and alewife) occur in the AOI. Ecological characteristics, geographic distribution, and life history information for these species were presented previously (**Chapter 4.2.6.1**). The following text briefly discusses impacts resulting from identified IPFs. Significance criteria are presented below, followed by discussion of individual IPFs.

4.2.6.2.1. Significance Criteria

Negligible impacts to threatened and endangered fish species would include those where little to no measurable impacts are observed or expected.

Minor impacts to threatened and endangered fish species would include those that are detectable but are neither severe nor extensive. Minor impacts to threatened and endangered fish species would include temporary displacement or disruption of important behavioral patterns of federally listed fish species.

Moderate impacts to threatened and endangered fish species would be detectable and extensive but not severe. Moderate impacts to threatened and endangered fish species would include some degree of mortality to, or extended displacement of, a federally listed fish species. Moderate impacts would also include extensive disruption of behavioral patterns (including spawning, feeding, or ontogenetic migrations) that may adversely affect a federally listed fish species.

Major impacts to threatened and endangered fish species would be detectable, extensive, and severe. Major impacts to threatened and endangered fish species would include a high level of mortality to, or extended, long-term displacement of, a federally listed fish species. Major impacts would also include extensive, chronic disruption of behavioral patterns (including spawning, feeding, or ontogenetic migrations) that would adversely affect a federally listed fish species.

4.2.6.2.2. Evaluation

Active Acoustic Sound Sources

Active acoustic sound sources included in the proposed action and described in **Chapter 3.5** include two general types: airguns and electromechanical (boomer and chirp subbottom profilers, side-scan sonars, and multibeam depth sounders). Airguns are used for oil and gas exploration surveys, whereas electromechanical equipment is used for HRG surveys conducted in conjunction with renewable energy and minerals management programs. Active acoustic sound level can reach 230.7 dB re 1 µPa for the large airgun array and 210.3 dB re 1 μPa for the small array (**Table 3-11**). Airguns generally have a frequency range from about 10-2,000 Hz; however, most of the acoustic energy is radiated at frequencies below 200 Hz. Electromechanical sources vary in terms of operating frequency and sound levels (213-226 dB re 1 μPa) (**Table 3-11**). Based on the proposed action summary presented in **Table 3-3**, seismic airgun surveys would potentially cover 617,775 line km of 2D surveys, 2,500 blocks of 3D surveys, 900 line km of 3D WAZ and FAZ coil surveys, 1,280 line km of VSP surveys, and 175,465 line km of HRG surveys (using electromechanical equipment).

Effects of various sound sources on behavior and physiology of fishes are detailed in **Appendix J**. In general, potential effects of active acoustic sound sources on endangered and threatened fishes can be categorized as follows:

- behavioral responses;
- masking;
- temporary threshold shifts (hearing loss);
- physiological/anatomical effects; and
- mortality.

To determine if active acoustic sounds in the AOI would result in any of these effects on threatened and endangered fish species requires an understanding of the sound source (sound levels and frequency), distance from the sound source, and the biological characteristics of the exposed species (species-specific hearing capabilities).

Smalltooth Sawfish

No specific information is available on hearing range in smalltooth sawfish, thus inferences must be made by examing available data on other elasmobranchs (sharks and rays). From this perspective, the smalltooth sawfish likely hears sounds within a very low frequency range (600 or 800 Hz) and relies on water particle motion to sense these sounds (Myrberg et al., 1976; Myrberg, 2001; Casper et al., 2003; Casper and Mann, 2006). Therefore, sound from airguns (10-2,000 Hz) projected for the proposed action are within the audible range of the smalltooth sawfish. With the exception of the boomer subbottom profiler (0.2-16 kHz), sounds from the electromechanical equipment fall within a much higher frequency range (3.5-400 kHz) than the airguns (**Table 3-11**) and outside of the smalltooth sawfish's hearing range. Airgun noise would be of primary concern where it affects behavior of individuals, particularly those involved in reproduction or foraging. Smalltooth sawfish are currently absent from areas north of North Carolina (Mid-Atlantic Planning Area) and rare between Cape Canaveral, Florida, and Cape Hatteras, North Carolina (South Atlantic Planning Area). Surveys of sand borrow areas or renewable energy sites conducted in inner shelf or coastal waters would be the most likely G&G activities to encounter smalltooth sawfish. Renewable energy and marine minerals surveys are not expected to use airguns, with the possible exception of a deep penetration seismic survey for geosequestration. For these reasons, impacts of active acoustic sound on smalltooth sawfish are expected to be **negligible**.

Shortnose Sturgeon

As with smalltooth sawfish, little is known about hearing in shortnose sturgeon. Studies on other sturgeon species indicate hearing at very low frequencies (<800 Hz) (**Appendix J**). Interestingly, some sturgeon species apparently produce sounds prior to reproduction that can be higher (2 kHz) than their detectable hearing range (Johnston and Phillips, 2003). From this information it can be assumed that shortnose sturgeon hearing is probably in the range of frequencies generated by airguns and subbottom profilers described in **Table 3-11**. The severity of impacts caused by the airgun sounds would depend on the intensity and distance from the source. For Alternative A, the most likely effects of active acoustic noise on shortnose sturgeon would be temporary hearing loss, masking, and behavioral changes. The fact that most individual shortnose sturgeon are residing primarily within eastuaries and rivers outside of the AOI suggests that any effects would be limited in space and over time. Certainly some segment of the shortnose sturgeon population enters into the coastal ocean where seismic airgun surveys are proposed, but interactions with G&G surveys using active acoustic equipment would be rare. The broad depth ranges in which seismic surveys are expected would further reduce the likelihood of survey activity within shallower waters where shortnose sturgeon may be present. Therefore, the effect of active acoustic sound sources noise on shortnose sturgeon is expected to be **negligible**.

Atlantic Sturgeon

As described above for the shortnose sturgeon, Atlantic sturgeon likely has underwater hearing sensitivity that is limited to less than 800 Hz, suggesting that this species is most susceptible to low-frequency noise sources. Active acoustic sound sources, particularly airguns, produce sounds in low frequency ranges that overlap with the presumed hearing range of Atlantic sturgeon. Unlike the smalltooth sawfish and shortnose sturgeon, the Atlantic sturgeon occurs widely over the shelf of the AOI. Concentrations of this species occur offshore of North Carolina and Virginia in the Mid-Atlantic Planning Area and South Carolina in the South Atlantic Planning Area. Active acoustic sound produced by surveys using airguns would be most prevalent in the Mid-Atlantic Planning Area, primarily because of G&G activities associated with oil and gas exploration (**Table 3-9**). If this species is formally listed, delineation of critical habitat for proposed DPSs within the AOI would allow for a more complete assessment. However, the proposed action scenario indicates that the level of 2D, 3D, and active acoustic geophysical surveying proposed for the AOI could temporarily disrupt or displace Atlantic sturgeon in areas of known concentration. Impacts on Atlantic sturgeon are expected to be **minor**.

Blueback Herring

The blueback herring and its close relatives have specialized hearing anatomy enabling it to detect very high frequency (25-135 kHz) sounds. Studies on the American shad (*Alosa sapidissima*) revealed a specialized hearing anatomy for this species and members of the clupeid subfamily Alosinae, the latter of which includes blueback herring (Mann et al., 1997; Popper et al., 2004). Unlike most fishes, the members of this subfamily can hear sounds in the ultrasonic range (>120 kHz). It is thought that the ability to perceive such high frequency sounds evolved as a means of sensing the presence of echolocating predators such as bottlenose dolphin (*Tursiops truncatus*), which are primary predators of these fish in the coastal oceans (Popper et al., 2004). Experimental tests conducted with blueback herring in the Savannah River (Georgia-South Carolina border) confirmed avoidance reactions to high frequency sound (Nestler et al., 1992). Results also determined a maximum avoidance response to sounds ranging from 124.6 to 130.9 kHz at 187-200 dB re 1 μPa emitted by a single electromechanical transducer positioned 180 ft (60 m) from the fish. Comparative trials using lower frequency sounds resulted in limited or no reaction from test subjects (Nestler et al., 1992). These results and others on the related alewife (detailed below) confirm that behavioral responses to high-frequency sounds emitted by active acoustic sources used in G&G operations in the AOI would likely affect the behavior of blueback herring in a detectable way. Because the use of electromechanical transducers would be mostly from moving vessels and individual surveys would be temporary and spatially limited, the impacts on blueback herring individuals and populations are expected to be **minor**.

Alewife

As described previously for blueback herring, the alewife can also hear high-frequency sounds (Dunning et al., 1992). Reaction of alewives to sounds emitted from electromechanical transducers was tested in Lake Ontario. Ross et al. (1996) found that sounds ranging from 122 to 128 kHz at a maximum intensity of 190 dB re 1 μPa were effective in deterring alewife schools from entering water intakes of a power plant. This suggests that alewives, like blueback herring, would avoid G&G survey vessels using high-frequency equipment during active acoustic surveys. No masking or temporary hearing loss is expected from active acoustic sources. Because of the limited spatial and temporal components of the proposed G&G surveys relative to alewife distribution in the AOI, impacts are expected to be **minor**.

Vessel and Equipment Noise

The G&G activities from oil and gas, marine minerals, and renewable energy programs would involve vessel traffic within the AOI. Seismic airgun survey vessels are the largest vessels and would account for most of the line miles traveled. Based on expected G&G activity levels, these surveys could occur anywhere within the AOI. Vessels conducting HRG surveys or sampling for renewable energy and marine minerals programs tend to be smaller and operate mainly at specific sites, usually in coastal or inner shelf waters (<100 m; 338 ft). Seismic airgun surveys conducted from large vessels may last for weeks or months, whereas small support vessels are expected to make daily round trips from shore bases to offshore facilities (**Chapter 3.5.1.3**). Vessel noise is a combination of narrow-band (tonal) and broadband sound (Richardson et al., 1995). Tones typically dominate up to about 50 Hz, whereas broadband sounds may extend to 100 kHz. Broadband source levels for most small ships (a category that would include seismic survey vessels and support vessels for drilling of COST wells or shallow test wells) are anticipated to be in the range of 170-180 dB re 1 μPa at 1 m (Richardson et al., 1995). Broadband source levels for smaller boats (a category that would include survey vessels for renewable energy and marine minerals sites) are in the range of 150-170 dB re 1 μPa at 1 m (Richardson et al., 1995). Noise levels dissipate quickly with distance from the vessel.

In addition, as discussed in **Chapter 3.5.1.2**, drilling-related noise that would be associated with the installation of up to three COST wells and up to five shallow test wells associated with oil and gas exploration G&G activities is continuous and generally of low frequencies (<500 Hz), including infrasonic frequencies in at least some cases (Richardson et al., 1995). Machinery noise can be continuous or transient, and variable in intensity. Noise levels vary with the type of drilling rig and water depth. Drilling-related noise from jack-up platforms is continuous and generally of very low frequencies (near 5 Hz). Drilling-related noises from semi-submersible platforms range in frequencies from 10 Hz to 4 kHz, with estimated sound levels of 154 dB re 1 μPa-m. Source levels for drillships have been reported to be as high as 191 dB re 1 μPa during drilling.

Smalltooth Sawfish

The G&G activities would introduce vessel and equipment noise throughout the AOI. Smalltooth sawfish could be adversely affected by vessel and equipment noise, but because of limited geographical distribution and abundance within the AOI coupled with the fact that they are bottom dwellers situated away from the source, exposures to such noise would be rare. The impacts of vessel and equipment noise on smalltooth sawfish individuals in the AOI would be **negligible**.

Shortnose Sturgeon

Hearing in shortnose sturgeon is limited to perception of particle motion. Shortnose sturgeon could be adversely affected by vessel and equipment noise generated by G&G operations if individuals were concentrated in areas of G&G vessel activity. However, it is not likely that shortnose sturgeon would be subjected to vessel and equipment noise associated with the G&G activity scenario for several reasons, e.g., distribution and habitat preference. The species occurs regularly in estuaries and rivers adjacent to, but only rarely in, the coastal and shelf waters of the AOI (Laney et al., 2007; Erickson et al., 2011). The shortnose sturgeon is a bottom dweller; individuals would be far from vessel and equipment noise produced by G&G vessels. Given these factors, the impacts of vessel and equipment noise on shortnose sturgeon would be **negligible**.

Atlantic Sturgeon

As with the aforementioned species, vessel and equipment noise could adversely affect the behavior of Atlantic sturgeon in the waters of the AOI. The G&G activities would increase the levels of vessel traffic, and therefore noise, in the AOI. Unlike the shortnose sturgeon, Atlantic sturgeon regularly occurs in coastal and shelf waters of the AOI; available information indicates that concentrations of fish occur offshore of North Carolina and Virginia in the Mid-Atlantic Planning Area and South Carolina in the South Atlantic Planning Area (Laney et al., 2007; Erickson et al., 2011). This suggests that Atlantic sturgeon would be exposed to increased vessel noise related to G&G activities. However, because of this species' benthic association, increased noise levels associated with G&G vessel traffic and equipment are not expected to adversely affect Atlantic sturgeon. Impacts are expected to be **negligible**.

Blueback Herring

As described previously, blueback herring can hear high frequency sounds in a range of 120-130 kHz. Vessel and equipment noise is predominantly in the low frequency range, although a limited amount of high frequency noise may be produced. Only the high frequency components of vessel and equipment noise have the potential to interfere with hearing in this species. Blueback herring could suffer some degree of temporary masking and behavioral responses during those occasions when a G&G vessel passes close to a school. Because of the temporary nature of vessel and equipment operations, the limited high frequency component of vessel and equipment noise, and the the limited spatial coverage of vessel activity, these impacts to blueback herring are expected to be **minor**.

Alewife

Impacts of vessel and equipment noise generated by G&G activities in the AOI would be very similar to that previously described for blueback herring. For these same reasons – temporary nature of vessel and equipment operations, the limited high frequency component of vessel and equipment noise, and the the limited spatial coverage of vessel activity – the impacts of vessel and equipment noise on alewife are expected to be **minor**.

Vessel Traffic

Vessel traffic has the potential to affect endangered and threatened fish species through interaction (i.e., vessel strikes) with motor vessels, particularly those operating in shallow water (relative vessel draft). Fish interactions with vessels have been documented for estuarine/riverine Atlantic sturgeon (Brown and Murphy, 2010). This phenomenon has been documented in the Delaware River estuary where the main channel is narrow relative to the beam and draft of large cargo vessels that regularly traverse these waters. Propeller wash from large vessels can entrain adult, bottom-dwelling sturgeon causing direct injury from contact with the propellers. Mortalities, recorded primarily during spawning season as adult fish were moving upstream, would likely hamper recovery efforts of Atlantic sturgeon (Brown and Murphy, 2010). Although ship strikes within estuaries and rivers are a significant source of mortality for Atlantic sturgeon, it is not expected to be a problem in the open shelf of the AOI where vessel traffic associated with most G&G activities would take place. Vessel strike mortality from increased vessel traffic associated with the proposed action scenario is expected to be **negligible**.

Trash and Debris

All survey vessels performing work within U.S. jurisdictional waters are expected to comply with Federal regulations, implementing MARPOL 73/78. Within MARPOL Annex V, Regulations for the Control of Pollution by Garbage from Ships, as implemented by 33 CFR 151, are requirements designed to protect the marine environment from various types of garbage generated on board vessels. In addition, all authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012).

Certain types of trash and debris produced by the proposed G&G activities (**Chapter 3.5.1.7**) could be accidentally lost overboard, with subsequent effects to smalltooth sawfish. Plastic lines, cables, rope, and other marine debris generated by survey vessels, if accidentally released, could impact individual smalltooth sawfish. Because of their long, toothed rostrum, smalltooth sawfish are susceptible to entanglement in various discarded material (Seitz and Poulakis, 2006). With compliance with existing Federal regulations, the amount of trash and debris dumped offshore would be minimal as only accidental loss of trash and debris is anticipated, some of which could sink to the seafloor. With disposal restrictions in place to reduce trash and debris, coupled with the fact that smalltooth sawfish are very sparsely distributed in the AOI, impacts to smalltooth sawfish from trash and debris would be **negligible**. Trash and debris would not be a concern for shortnose sturgeon, Atlantic sturgeon, blueback herring, or alewife.

Seafloor Disturbance

Sources of seafloor disturbance that may result from G&G activities are grab and core sampling; placement of anchors, nodes, cables, or other bottom-founded equipment; COST and shallow test well drilling; and placement of anchored monitoring buoys (**Table 3-10**). Grab and core samples are expected to disturb a total of approximately 11 ha (27 ac) of seafloor within the AOI. Total seafloor area disturbed by individual COST and shallow test wells would vary with equipment and water depth but is projected to be about 16 ha (40 ac). A maximum of 38 meteorological buoys may be placed on the seafloor in the AOI to support G&G activities. Seafloor disturbance caused by anchors and anchor sweep is expected to be about 129 ha (319 ac). Presently, no estimates are available for seafloor disturbance by placement of nodes, cables, and sensors that support ocean cable, nodal, vertical cable, VSP, CSEM, and MT surveys (**Chapter 3.5.1.8**). Collectively, these activities would disturb a very small fraction of the seafloor in the AOI, and although a few disturbances would be permanent, most would be temporary. For the threatened and endangered fishes, seafloor disturbance would only affect the bottom feeding species – smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon – by potentially displacing individuals from feeding areas and by reducing the available benthic prey organisms. The two herrings (blueback herring and alewife) are water column dwellers that feed on plankton and would not be affected by seafloor disturbance. These potential impacts to bottom feeders and their prey would be **negligible** for smalltooth sawfish and shortnose sturgeon because of their scarcity in the AOI. Atlantic sturgeon is more prevalent in the shelf waters of the AOI than smalltooth sawfish or shortnose sturgeon, but the small aeral extent of seafloor disturbance is unlikely to negatively influence habitat use by this species. Accordingly, impacts on Atlantic sturgeon are expected to be **negligible**.

Drilling Discharges

Drilling discharges from COST wells associated with G&G activities include drilling fluids (WBF) and cuttings drilled with both WBF and SBF (**Chapter 3.5.1.9**). WBF are used in shallow wells or the shallow segments of deeper wells, whereas SBFs are used only on deeper wells or well segments. WBFs are discharged on site from near the ocean surface along with the drill cuttings. SBFs are recovered, reused, and recycled; cuttings generated during drilling using SBFs are discharged, typically with small amounts of adhering SBF whose discharge concentrations are regulated by permit. These materials would cover the seafloor around the well, with deposition thickness and areal extent determined by discharge volume, water depth, and prevailing currents. Drilling activities expected to occur in the AOI under Alternative A project that the total volumes generated from drilling one to three COST wells would range from 2,000 to 6,000 bbl of cuttings and 8,350 to 25,050 bbl of drilling fluid. The primary environmental concerns related to the discharge of fluids and cuttings are increased water column turbidity and accumulation of drilling muds and cuttings on the seafloor. The benthic deposition of drilling muds and cuttings can increase the organic load of the benthos and promote anoxic conditions. Drilling discharges can also alter the ambient sediment grain size and introduce trace metals and organics to benthic sediments. Drilling muds and cuttings deposition would result in localized changes to the benthic infaunal community, including infaunal species important to benthic feeding fishes. Loss of benthic prey is important to bottom feeding fishes such as smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon. Elevated water column turbidity can affect fish eggs and larvae and possibly the feeding of mid-water species.

Because of the small seafloor area affected by drilling discharges under Alternative A, impacts to bottom feeding threatened and endangered fishes are expected to be **negligible**. Elevated water column turbidity may be detrimental to water column feeders such as the proposed-threatened blueback herring and alewife. Because of the relatively small volumes of drilling discharges and the localized nature of increased water column turbidity, impacts on blueback herring and alewives from drilling discharges are expected to be **negligible**.

4.2.6.3. Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes a diesel spill volume ranging from 1.2 to 7.1 bbl. Spills occurring at the ocean surface would disperse and weather. Volatile components of the fuel would evaporate. Fuel and diesel used for operation of survey vessels is light and would float on the ocean surface. There is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink. Particulate matter contaminated with diesel fuel would eventually reach the benthos either within or outside the AOI, depending upon spill location, water depth, ambient currents, and sinking rate. Because of their life histories, none of the threatened or endangered fish species would have sensitive eggs or larvae in the water column of the AOI where they would be exposed to accidentally spilled diesel fuel. Therefore, the expected impact of an accidental diesel fuel spill is expected to be **negligible** for all five of these species.

4.2.6.4. Cumulative Impacts

The cumulative impacts scenario is discussed in detail in **Chapter 3.6** and includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs for these cumulative activities that have the potential to affect threatened and endangered fish species include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, and other active sound sources and vessel and equipment noise; (2) vessel traffic; (3) seafloor disturbance; (4) trash and debris; and (5) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Among the IPFs identified above for the cumulative impacts scenario, seven sources of potential impact to threatened and endangered fish species have been identified in association with proposed G&G activities, including (1) active acoustic sound sources; (2) vessel and equipment noise; (3) vessel traffic; (4) seafloor disturbance; (5) drilling discharges; (6) trash and debris; and (7) accidental releases. Impact analyses presented in **Chapters 4.2.6.2** and **4.2.6.3** determined that activities projected to occur under Alternative A would result in **negligible** to **minor** impacts to threatened and endangered fish species, with the level of impact dependent upon the specific IPF and the particular species of concern being considered. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

As mentioned previously, among the two listed (smalltooth sawfish and shortnose sturgeon), one candidate species (Atlantic sturgeon), and two proposed species (blueback herring and alewife), only the candidate and proposed species occur with any regularity within the AOI.

Underwater Noise Including Active Acoustic Sound Sources and Vessel and Equipment Noise

Long-term noise data for the AOI have not been published. For the purposes of this analysis, and in consideration of the documented increases in marine transportation volumes along the U.S. Atlantic coast, it is assumed that underwater noise from vessel traffic and other anthropogenic sources within the AOI is increasing. Most ambient noise is broadband and encompasses virtually the entire frequency spectrum, with vessel traffic recognized as a major contributor to ocean noise in the low frequency bands between 5 and 500 Hz. Naturally occurring noise (e.g., spray and bubbles from breaking waves) are also a major contributor to ambient noise in the 500-100,000-Hz range. Sources of active acoustic sound within the cumulative activities scenario would include sonars and explosions, both from military exercises within multiple operational areas.

Underwater noise from proposed G&G activities (i.e., active acoustic sound sources) has been shown to cause a **negligible** to **minor** impact to threatened and endangered fish species (**Chapter 4.2.6.2**). Active acoustic noise sources including both airgun and electromechanical sources and vessel and equipment noise from the proposed action would result in a minor incremental increase in impacts to threatened and endangered fish species under the cumulative scenario.

Smalltooth Sawfish

There is no specific information on the effects of noise on the ecology and behavior of smalltooth sawfish, but it can be assumed that some of the potential effects discussed for fishes in general and presented in **Appendix J** would apply. The G&G activities described in the proposed scenario such as seismic airgun surveys, vessel traffic, well drilling, and dredging would all contribute to the cumulative noise within the AOI (**Chapter 3.5.1**). As discussed previously, because of the relative rarity of smalltooth sawfish in the AOI, exposure to noise levels under Alternative A over the course of the Programmatic EIS period are expected to result in **negligible** impacts to this species. Minor incremental increases in ambient noise levels under the cumulative scenario are not expected to result in significant impacts to smalltooth sawfish.

Shortnose Sturgeon

Shortnose sturgeon may be adversely affected by cumulative noise in the AOI, but specific details for this species are lacking (**Appendix J**). The proposed G&G activities scenario for the 2012-2020 period is expected to contribute to the cumulative noise in the AOI. Non-G&G activity, especially vessel traffic, is expected to continue to increase incrementally. Because individuals rarely occur in AOI waters, noise impacts on the shortnose sturgeon are expected to be **negligible**. Minor incremental increases in ambient noise levels under the cumulative scenario are not expected to result in significant impacts to shortnose sturgeon.

Atlantic Sturgeon

Unlike smalltooth sawfish and shortnose sturgeon, the Atlantic sturgeon does regularly occur in some areas of the AOI (**Chapter 4.2.6.2**). Atlantic sturgeon wintering in shelf waters of the AOI may be affected by cumulative sounds contributed by G&G and non-G&G operations. Cumulative impacts resulting from increased ambient noise would include temporary hearing loss, masking of relevant sounds, and potential behavioral modifications. The impacts of noise attributed to G&G activities under Alternative A scenario are expected to be **minor**. Minor incremental increases in ambient noise levels under the cumulative scenario are not expected to result in significant impacts to Atlantic sturgeon.

Blueback Herring

Blueback herring occur throughout the AOI. Impacts on blueback herring individuals and populations from active acoustic sound sources and vessel and equipment noise are expected to be **minor**. Minor incremental increases in ambient noise levels under the cumulative scenario are not expected to result in significant impacts to blueback herring.

Alewife

Alewife occur throughout the AOI, preferring coastal waters of the continental shelf. Alewife are expected to avoid G&G survey vessels using high-frequency equipment during active acoustic surveys. No masking or temporary hearing loss is expected from active acoustic sources. Because of the limited spatial and temporal components of the proposed G&G surveys relative to alewife distribution in the AOI, impacts are expected to be **minor**. Minor incremental increases in ambient noise levels under the cumulative scenario are not expected to result in significant impacts to alewife.

Trash and Debris

The accidental release of trash and debris can potentially occur from any of the nine activities identified in the cumulative impacts scenario. Vessel operators would be expected to comply with Federal regulations, which include the requirements of MARPOL 73/78, including Annex V. Companies operating offshore have developed and implemented trash and debris reduction and improved handling practices over the last several years to reduce the amount of offshore trash that could potentially be lost to the marine environment. With compliance with Federal regulations, which include the requirements of MARPOL, the amount of trash and debris intentionally dumped offshore would be very limited, and only accidental loss of trash and debris is expected. Trash and debris, particularly ropes, lines, and wire, would primarily affect smalltooth sawfish (**Chapter 4.2.6.2**) via potential entanglement with the rostrum. Under the cumulative scenario, fishing line from commercial and recreational sources is more likely to be a source of entanglement. Smalltooth sawfish is relatively uncommon in the AOI, which further reduces the change of interactions with trash and debris. Impacts to smalltooth sawfish are expected to be **negligible**. Negligible incremental increases in trash and debris under the cumulative scenario are not expected to result in significant impacts to smalltooth sawfish.

Seafloor Disturbance

Seafloor disturbance can damage or alter hard or soft demersal habitats important to threatened and endangered fish species (**Chapter 4.2.6.2**). Non-G&G activities in the AOI known to disturb the seafloor include geosequestration, commercial fishing (bottom trawling and dredging), dredged material disposal, LNG terminal placement, and military range complexes and civilian space program use. Gesequestration involves drilling wells, placing anchors, and laying pipelines on the seafloor. Currently there are no geosequestration facilities planned for the AOI and none expected in the foreseeable future. Commercial fishing with bottom trawls or dredges can inflict considerable damage to demersal habitats. The extent of the seafloor disturbance caused by bottom tending fisheries specifically within the AOI is difficult to estimate but is presumed to be appreciable. Impacts to benthic communities caused by commercial and recreational fishing activities have been estimated to affect approximately 53 percent of the world's continental shelf (Watling and Norse, 1998). Use of bottom-tending gear is not expected to increase for the 2012-2020 duration of the Programmatic EIS. Placement of LNG terminals would involve seafloor disturbance; however, no activity is expected during the Programmatic EIS time period. Disposal of dredged material in offshore waters can potentially smother demersal biota. The AOI currently has 13 designated offshore dredged material disposal sites from Virginia south to Florida (**Chapter 3.6.9**). These sites are expected to be used at current levels for the 2012-2020 period. Military range complexes and civilian space program use could involve placement of buoys, or other equipment that could potentially disturb the seafloor.

Under Alternative A, impacts from seafloor disturbance would be **negligible** for smalltooth sawfish and shortnose sturgeon because of their scarcity in the AOI. There would be no impacts to blueback herring and alewives because both species are pelagic water column dwellers. Impacts on Atlantic sturgeon would be **negligible** because of the relatively small footprint of sampling and bottom tending operations. Seafloor disturbance from the proposed action would result in a negligible incremental increase in total area of seafloor disturbed under the cumulative scenario, with a negligible incremental increase in impacts from seafloor disturbance to threatened and endangered fish species.

Smalltooth Sawfish

Installation of anchors, jack-up rigs, and other structures associated with G&G activity would disturb the seafloor, generate turbidity, and crush benthos, as detailed in **Chapter 4.2.6.2**. Smalltooth sawfish is a demersal feeding species that could be adversely affected by seafloor disturbance. Seafloor disturbance could result in individuals being displaced from staging or feeding areas in shelf waters of the AOI. The critical habitat for smalltooth sawfish is outside of the AOI; however, adults are present (very rarely) in inner shelf waters, with the greatest likelihood of occurrence offshore of Florida and Georgia. For seafloor-disturbing activities under Alternative A, impacts on smalltooth sawfish are **negligible**. Negligible incremental increases in areas affected by seafloor disturbance under the cumulative scenario are not expected to result in significant impacts to smalltooth sawfish.

Shortnose Sturgeon

Shortnose sturgeon is a bottom feeding demersal species also subject to the effects of seafloor disturbance from G&G and non-G&G activities. Shortnose sturgeon rarely move from coastal rivers into the AOI, and there is no indication that this pattern would change over the 2012-2020 time frame. Thus, although bottom-tending activities could adversely affect individual shortnose sturgeon, the chance of an encounter with such activities is very low because the amount of seafloor disturbance from G&G activities is small fraction of the total seafloor in the AOI. In addition, shortnose sturgeon occur only sparsely in AOI waters. For this reason, impacts of seafloor disturbance on shortnose sturgeon are expected to be **negligible**. Negligible incremental increases in areas affected by seafloor disturbance under the cumulative scenario are not expected to result in significant impacts to shortnose sturgeon.

Atlantic Sturgeon

Seafloor-disturbing activities would primarily affect adult Atlantic sturgeon during cooler months of the year when they move from coastal rivers into shelf waters. Adult Atlantic sturgeon can be expected to move out of the area of installation activity. The disruption of benthic invertebrate assemblages can indirectly affect bottom-feeding Atlantic sturgeon by reducing a small fraction of the available invertebrate prey in localized areas. The projected activity scenario (**Chapter 3.6**) shows that most G&G related activities that disturb the seafloor do so on a limited spatial scale and would not increase incrementally throughout the period of the Programmatic EIS (**Tables 3-5** and **3-6**). Non-G&G activities that would potentially damage the seafloor in the AOI include geosequestration, commercial and recreational fishing, LNG import terminals, and military range complexes and civilian space program use. Of these, only commercial and recreational fishing (specifically commercial trawling and dredging) pose an appreciable threat to seafloor condition. LNG terminals and geosequestration facilities would not be important because neither facility type is planned for the AOI in the foreseeable future. Military range complexes and civilian space program use would result in small-scale impacts to the seafloor through anchoring or placement of equipment in localized areas. Fishing with bottom tending gear and military operations in the AOI are expected to continue at present levels through the proposed 2012-2020 activity scenario for this Programmatic EIS. Impacts of seafloor disturbance on Atlantic sturgeon are expected to be **negligible**. Negligible incremental increases in impacts to threatened and endangered fish species (i.e., smalltooth sawfish) from trash and debris are expected under the cumulative scenario.

Accidental Fuel Spills

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to listed or candidate fish species would vary depending on the location and size of the spill. However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prior to any wells being drilled. A project-specific EA would require an analysis of site-specific information regarding listed and candidate fish species and mitigation measures taken to minimize impacts from drilling activities and potential accidental crude oil spills. In addition, with the required mitigation measures in place and with oversight of these activities by the BSEE, an accidental crude oil spill from an exploratory well is not anticipated; however, a spill still could occur. With these mitigation measures in place, the impacts to listed and candidate fish species from exploratory drilling operations would be expected to range from negligible to minor depending on location.

A sizeable amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The cumulative impacts associated with an accidental fuel spill arising from a vessel collision under the cumulative scenario are expected to range from negligible to minor.

Chapter 3.5.2.1 presents an accidental spill scenario for G&G activities that assumes a diesel fuel spill ranging from 1.2 to 7.1 bbl. This scenario also assumes that spilled diesel fuel would evaporate, disperse, and break down in the short term, indicating that in the open waters of the AOI incremental increases in spilled fuel would be minor. Non-G&G operations that would potentially spill fuel through vessel collisions or accidents are geosequestration, commercial and recreational fishing, military activity, and dredged material disposal. The greatest risk of a fuel spill, such as the one portrayed in the accidental scenario, is to fishes at various life stages that occur near or at the surface. Direct exposure would only occur in the water column near the discharge point, thus pelagic adults and planktonic eggs and larvae are most susceptible. Smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon do not have pelagic life stages in AOI waters, while blueback herring and alewife are anadromous (with spawing occurring in freshwater reaches of coastal rivers); therefore, the expected impact of an accidental diesel fuel spill is expected to be **negligible** for all five of these species. Negligible incremental increases in impacts to threatened and endangered fish species are expected from accidental fuel spills from G&G activities under the cumulative scenario.

4.2.7. Commercial Fisheries

4.2.7.1. Description of the Affected Environment

The AOI supports regionally and nationally important commercial fisheries. In 2009, the latest year for which data are available, total commercial landings within the AOI were 276,909.4 metric tons (mt), which were valued at approximately $380.5 million (USDOC, NMFS, 2011k). Southwick Associates, Inc. (SAI, 2006) reported that, in 2004, commercial finfish fisheries in the seven coastal states adjacent to the AOI supported 5,700 jobs. Commercial fisheries support not only numerous directly related jobs (fishing crews) but also many indirectly related industries such as seafood distributors, restaurants, and suppliers of commercial fishing gear.

Several ports within the AOI have among the highest commercial fishing revenues in the U.S. In 2009, Hampton Roads, Virginia, ranked sixth in overall commercial fishing value at $68.1 million, followed by Beaufort-Morehead City, North Carolina (ranked 56th; $9.9 million), Engelhard-Swanquarter, North Carolina (ranked 59th; $9.1 million), Mayport, Florida (ranked 60th; $9.1 million), Charleston-Mt. Pleasant, South Carolina (ranked 62nd; $7.6 million), and Cape Canaveral, Florida (ranked 72nd; $6.2 million) (USDOC, NMFS, 2011k).

Because the fishing industry is so integrated with local business, these commercial fishing ports often support entire coastal fishing communities. Fisheries within the AOI support 108 fishing communities located along the coast from Delaware to Florida (USDOC, NMFS, 2009c). In the Mid-Atlantic region (Delaware, Maryland, and Virginia, excluding New York and New Jersey), NMFS identified 26 commercial and recreational fishing communities in 2006. Of the total, 12 were located in Virginia, 9 in Maryland, and 5 in Delaware (USDOC, NMFS, 2009c). In the South Atlantic region (North Carolina to Florida east coast), NMFS indicates there were 82 commercial and recreational fishing communities in 2006 (USDOC, NMFS, 2009c). These included 26 fishing communities in North Carolina, 24 in Florida (east coast), 19 in South Carolina, and 13 in Georgia.

4.2.7.1.1. Commercial Landings

Table 4-27 shows commercial landings in states within the AOI (Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and the Florida east coast) during 2006-2009 (USDOC, NMFS, 2011k). Overall, total annual commercial landings during this period were stable with no significant trend. In 2009, commercial landings in Virginia generated the most revenue ($152.7 million), followed by North Carolina ($77 million), Maryland ($76.1 million), Florida ($40.9 million), South Carolina ($16.9 million), Georgia ($9.2 million), and Delaware ($7.5 million) (USDOC, NMFS, 2011k). Total commercial landings in Virginia during 2006 through 2009 ranged from 193,320.9 mt ($109 million) in 2006 to 220,110.7 mt ($133.5 million) in 2007, with a mean of 199,040.4 mt ($136.3 million). In Delaware, the state with the least amount of commercial landings, total commercial landings during 2006 through 2009 ranged from 1,981.6 mt ($5.7 million) in 2006 to 2,272.6 mt ($7.5 million) in 2009, with a mean of 2,112.6 mt ($6.7 million).

Figure 4-21 shows monthly variations in total (combined) commercial landings in 2009 for the seven states within the AOI (USDOC, NMFS, 2011k). Commercial landings and the associated value increased steadily from winter (February) to late summer and peaked in August (53,522 mt).

Commercial fisheries in the AOI target a variety of fish and invertebrate species in both State and Federal waters. The primary commercial species landed during 2006-2009 are summarized by state in **Table 4-28**.

Commercial fishing landings within the AOI vary with distance from shore (**Table 4-29**). According to USDOC, NMFS (2011k), in 2009 most of the commercial fishing landings in Delaware, Maryland, and North Carolina were in State waters (4.8 km [3 mi] from shore), while landings in Virginia and Florida (east coast) were primarily in Federal waters (4.8-322 km [3-200 mi] from shore). South Carolina had approximately the same landings (by weight) in State and Federal waters.

4.2.7.1.2. Commercial Fishing Gears

The main commercial fishing gears used along the Atlantic east coast are pots/traps, dredges, trawls, longlines (bottom and pelagic), gillnets, purse seines, and pound nets. These gears are described below.

- *Pot or Traps* are rectangular, square, or cylindrical enclosed devices with one or more gates or entrances set on the bottom to target benthic fishes and invertebrates such as lobsters, conch (Strombidae), black sea bass, and red deep-sea crabs (*Chaceon quinquedens*). Pots/traps are usually marked at the surface with a buoy (float) that is attached to the pot or trap by a rope. This type of gear is usually set in string near natural or artificial structure or hard bottom. Pots are connected by "mainlines" that either float off the bottom or sink to the bottom (Stevenson et al., 2004).
- *Dredges* are a steel frame box or bag-shaped device used to target benthic sessile species such as bivalve mollusks (clams, oysters, scallops, and mussels). Dredges are towed behind a fishing vessel along the bottom at about 4.6 km/ hr (2.5 kn); the vessel slows down as the dredge collects clams. The typical dredge is 3.7-m (12-ft) wide and about 6.7-m (22-ft) long and uses pressurized water jets to wash clams out of the bottom. The water jets penetrate the sediment in front of the dredge to a depth of about 20-25 cm (8-10 in), which dislodges the clams. On the leading bottom edge of the dredge there is a "cutting bar" opening that guides the clams into the body of the dredge, which is sometimes referred to as "the cage" (Stevenson et al., 2004).
- *Trawls* are large bag-shape nets constructed with natural fibers or synthetic materials that are rectangular or polygon in shape (mouth openings). Trawls are towed at specific water depths (surface, mid-water, or bottom), depending on the target species. Trawls are classified by their function, bag construction, or method of maintaining the mouth opening (Stevenson et al., 2004). Bottom trawls are designed to be towed along the seafloor to catch a variety of demersal fish and invertebrate species, e.g., Atlantic mackerel, summer flounder, black sea bass, scup, Atlantic croaker (*Micropogonias undulatus*), and winter flounder. Mid-water trawls are designed to catch pelagic species in the water column such as squids (Chuenpagdee et al., 2003).
- *Longlines* typically consist of 1.6-64.4 km (1-40 mi) of monofilament line that has baited hooks (gangions) attached at regular predetermined intervals. The mainline is attached to a series of floats, highflyers, and radio beacons at regular intervals. Longlines are classified by where the gear is set in the water column. Longline gear is either set at the surface or on the bottom. Longlines either drift with the currents or are stationary (anchored to the bottom) and are used to target benthic (e.g., tilefish and large coastal sharks), coastal pelagic (e.g., dolphin and wahoo), or pelagic (e.g., tunas, swordfish, or pelagic sharks) species (Chuenpagdee et al., 2003; Stevenson et al., 2004).
- *Gillnets* are a large wall of rectangular panel netting constructed of monofilament or synthetic materials that is suspended vertically in the water column; gillnets can be set to suspend at the surface, mid-water, or near the bottom. Gillnets are equipped with floats at the top and lead weights along the bottom. Bottom gillnets are anchored or staked in position, and surface gillnets drift with the currents and wind.

Drift gillnets are used to target Atlantic bonito (*Sarda sarda*), weakfish, and bluefish, while stake gillnets are used to target Atlantic menhaden, Atlantic croaker, butterfish, spot, northern kingfish, bluefish, weakfish, and smooth dogfish (Chuenpagdee et al., 2003; Stevenson et al., 2004).

- *Purse seines* are a type of net constructed with natural fibers or synthetic materials that are used to encircle a school of fish. Once the net has captured a school of fish, it is then cinched. Purse seines are used to target Atlantic menhaden and Atlantic herring (*Clupea harengus*), and also sometimes bluefish in nearshore waters (Chuenpagdee et al., 2003).
- *Pound nets* are a fixed entrapment gear constructed of netting that is attached to piles or stakes driven into the seafloor. Pound nets consist of three sections: a leader (net body or crib with a netting floor and open top), at least one heart leading into the crib, and the pound. The leader or leaders can be as long as 400 m (1,300 ft); the leader is used to direct fish into the heart(s) of the net. The heart section then funnels fish into the pound section to prevent escapement. The pound holds fish until the net is emptied; pound sections can be as large as a 15 m (50 ft). In general, these nets are used in shallow waters <50 m (160 ft) deep. Pound nets are used to catch a wide variety of inshore finfishes, such as striped bass, bluefish, catfish, croaker, flounder, menhaden, perch, spot, weakfish, and river herring (Chuenpagdee et al., 2003; Stevenson et al., 2004).

In addition, hook-and-line is another type of commercial fishing gear used in the AOI, but it is relatively important only in Florida and South Carolina in terms of landings and value (USDOC, NMFS, 2011k).

The landings and value in the AOI during 2009 attributable to each of the seven principal gear types are shown in **Figure 4-22** (USDOC, NMFS, 2011k). Overall, pots/traps and dredges accounted for more than 50 percent of the total value. However, 88 percent of the landings from pots and traps were contributed by blue crabs taken primarily within bay waters, which are not within the AOI.

Excluding pots and traps, commercial landings with dredge gear represented 22 percent of the total value at $64.7 million. Dredge gear was used to land various types of valuable mollusks, e.g., clams, sea scallops, and oysters, from South Carolina ($77,729) to Delaware ($1.3 million); however, 78 percent ($50.8 million) of the revenue was associated with landings in Virginia (USDOC, NMFS, 2011k).

The third greatest revenue associated with a commercial fishing gear in the AOI was otter trawls. Otter trawls were used to land a variety of species (e.g., shrimp, fish, crab, and scallop) throughout the AOI from Florida to Maryland. Overall, fisheries landed with otter trawls represented 13 percent ($39.7 million) of the total value, with most (43%) of the revenue attributed to fish ($8.6 million) and shrimp ($8.3 million) landings in North Carolina (USDOC, NMFS, 2011k).

Purse seines were another type of gear that was used to land valuable fisheries. Although most landings and revenue were associated with Virginia (99.99 percent or $23.2 million), purse seines were also used off Florida on a limited basis, with landings of 1.2 mt. In general, purse seine gear is used to land only a single species, Atlantic menhaden. In comparison to the other primary gears used in the AOI, purse seines represented the largest percentage of the total commercial landings at 62 percent but contributed only about 8 percent of the revenue (USDOC, NMFS, 2011k).

Excluding inshore trot lines in Maryland (outside of the AOI), another commercial gear type that generated a relatively large amount of revenue was longlines. Of the total commercial landings for the seven primary gears, longline landings and associated revenue accounted for 1.2 and 5 percent, respectively. Longline gear was used to land an assortment of sharks, reef fishes, and coastal and highly migratory species from Florida to Maryland, with most of the revenue associated with landings in Florida (25 percent or $3.7 million) and North Carolina (24 percent or $3.6 million) (USDOC, NMFS, 2011k).

Landings associated with pound nets represented 2 percent of the total revenue, even though this gear was used only in Maryland, Virginia, and North Carolina to land a variety of fishes, e.g., striped bass, bluefish, and weakfish. Overall, most landings and revenue were evenly distributed between Maryland and Virginia, at around 46 percent and 37 percent, respectively (USDOC, NMFS, 2011k). It should be noted that pound net gear is a fixed, stationary, and semi-permanent (April-November) gear that is set inshore in shallow bay waters (3.6-6.1 m [12-20 ft]), which are not in the AOI.

4.2.7.1.3. Commercial Fishing Locations and Seasons

State and Federal agencies (NMFS and regional FMCs) manage fisheries by focusing on either individual species or mixed species groups having similar life-history characteristics and habitat-use patterns. The largest group managed by the SAFMC is the snapper-grouper complex, which includes 73 species. In general, many of the species grouped together by the SAFMC and the MAFMC are usually taken by commercial fisheries at similar locations (i.e., habitats), seasons, and sometimes with the same gear types. Regardless of what type of fishing gear is used to target or incidentally take a particular species, commercial fisheries within the AOI can be generally categorized into four zones according to where species can be found in the water column and distance from shore. In general, these zones are

- benthic: inshore (~5 km [3 mi]) to offshore (~32 km [20 mi]); species found within bottom sediments or along the seafloor;
- demersal: inshore (~5 km [3 mi]) to offshore (~32 km [20 mi]); species associated with the bottom (1-2 m [3.3-6.6 ft] above the seafloor) but that are not found within the bottom sediments;
- coastal pelagic: mid-water and surface, ~8-32 km (5-20 mi) from shore; and
- pelagic: mid-water (mesopelagic) and surface (epipelagic), >64 km (40 mi) from shore.

For example, commercial fishermen harvest fishes in the commercial snapper-grouper complex (demersal species) using four types of fishing gears (hook-and-line, traps, trawls, and bottom longline), but these types of fishes, classified under the “demersal” group, are usually associated with reefs (natural and artificial), live bottom, rocky hard bottom, ledges, limestone outcroppings, or some other type of hard bottom community (SAFMC, 1983, 2011a). Another example of a demersal species (reef-dwelling) in the snapper-grouper complex that is associated with hard bottom is the black sea bass; commercial fisheries harvest black sea bass with traps/pots, hook-and-line, and bottom longlines.

Although the terminology and definitions for benthic and demersal species has often been used synonymously in much of the scientific literature, a distinction was made for the purpose of this assessment.

Benthic Fisheries

Benthic species are those species (fishes and invertebrates) classified as either found within the bottom sediment substrates (e.g., clams and scallops) or along the seafloor. Many of these benthic species are mollusks and crustaceans, but they also can include skates, rays, and fishes such as summer, witch, and southern flounders. Depending on the species, benthic species are found either in soft bottom habitats (e.g., shrimps, clams, and scallops) or hard bottom substrates. Many of the commercial benthic fisheries (e.g., golden tilefish, scallops, and clams) are found in the northern section (North Carolina to Delaware) of the AOI, but there are important benthic commercial fisheries (shrimp) in the southern section (Georgia and Florida). The horseshoe crab fishery is primarily conducted in the Delaware Bay region with trawls and dredge gear. The fishery is conducted year-round, prohibited only from May-June, except in Maryland, which recently imposed a closed season from January-June for the next 2 years. In general, horseshoe crabs are found in water depths of less than 30 m (98 ft); they can be found in bays and along coastal nearshore areas.

The sea scallop fishery is among the most valuable commercial fisheries along the Atlantic coast; it is found in coarse sand, gravel, and cobble sediments at depths ranging from 18 to 111 m (59 to 364 ft) (MAFMC and NEFMC, 2007). Although the majority (63%) of the scallop landings occur outside of the AOI (MAFMC and NEFMC, 2007), some commercial landings do occur in the northern section of the AOI off Virginia through Delaware. The primary commercial fishing gears are scallop dredges and trawls. The fishery is conducted year-round, but many of the landings in Virginia occurred from March-August in 2009 (USDOC, NMFS, 2011k). Orphanides and Magnusson (2007) reported that the distribution of effort in days fished and number of hauls relative to bottom depth for bottom and mid-water trawl fisheries was in waters from 0 to 50 m (0 to 164 ft) in 1996, but it is now primarily from 50 to 100 m (164 to 328 ft); 90 percent of the fishing effort was concentrated where the bottom slope was 0°-0.5° (Orphanides and Magnusson, 2007). The fishing season is year-round, but many of the landings occur during the winter and spring.

Another important benthic commercial fishery is the summer flounder fishery. Summer flounder are found in bottom sediments and are usually taken with trawl gear. The summer flounder fishery is conducted year-round, but summer flounder migrate from nearshore to offshore during the winter, and some movement occurs from northern to southern waters, depending on the water temperature. As such, the commercial fishery adjusts accordingly. The commercial season is generally set by the availability of annual commercial quota by individual state, so the commercial fishing season in each state can vary from year to year. In 2009, most of the summer flounder commercial landings in Virginia occurred from December-March (USDOC, NMFS, 2011k).

The South Atlantic commercial fishery for shrimp is among the most important fisheries in the region; the majority of the commercial landings occur within nearshore waters. The commercial fishery for various species of shrimp is conducted year-round in the southeast. In 2009 in Florida, the primary commercial landings of white shrimp occurred in January, while rock shrimp landings peaked in July (USDOC, NMFS, 2011k).

Demersal Fisheries

Demersal species are those species that are associated with the bottom (e.g., snapper and groupers) but that are not found within the bottom sediments. In general, demersal species are usually more mobile than benthic species and display seasonal movements. In the South Atlantic region, commercial fishermen target hard bottom demersal species (snapper-grouper complex) at nearshore (37-73 m [121-240 ft]) to offshore (91-219 m [299-719 ft]) hard bottom locations. Commercial fishermen often target black sea bass in much shallower waters (12-30 m [39-98 ft]) during the winter (SAFMC, 1983, 2011a). Black sea bass are mostly caught with traps, whereas snappers and groupers are caught with hook-and-line and bottom longline gear. There are many hard bottom and reef communities scattered throughout the SAB (Cape Canaveral, Florida, to Cape Hatteras, North Carolina) that are used by commercial fishermen to target reef fishes, such as those in the snapper-grouper complex; most hard bottom communities occur in Federal waters. Although most reef communities are found south of North Carolina, there are also numerous ledges, rocks, and outcropping between North Carolina and Delaware that are used by commercial fishermen to target demersal species such as black sea bass. In the South Atlantic region, the commercial fishing season for demersal species (snapper-grouper complex) is determined by Federal regulations that are complex and constantly evolving. Depending on the species, there are various fishing seasonal regulations and annual commercial quotas; thus, the fishery can temporarily close at different times each year. For example, there is an annual seasonal closure for the recreational and commercial harvest of all shallow-water groupers (gag grouper, black grouper, red grouper, scamp, rock hind, red hind, coney, graysby, yellowfin grouper, yellowmouth grouper, and tiger grouper) from January-April (SAFMC, 2011a). Another example is the recent (January 31, 2011) closure prohibiting the harvest and retention of snowy grouper, blueline tilefish, yellowedge grouper, misty grouper, queen snapper, and silk snapper beyond 73-m (240-ft) depths in Federal waters of the South Atlantic (*Federal Register*, 2010k).

The bottom longline shark fishery is another important commercial fishery (demersal) in the South Atlantic region that targets small and large coastal sharks along the coastline within the AOI. In the South Atlantic (Florida to Virginia) during 1994 through 2003, and more recently in 2008, commercial fishermen primarily targeted sharks at water depths ranging from 20 to 30 m (66-98 ft) (40%) and 30 to 40 m (98-131 ft) (24%) (Hale et al., 2009; Morgan et al., 2009). Morgan et al. (2009) reported that commercial fishing effort for sharks with bottom longline gear (1994−2003) was distributed along the coastline (<100 m [328 ft]) within the AOI (Virginia to Florida), but most of the fishing effort was off North Carolina (Cape Hatteras) and Florida (Daytona Beach). Like the snapper-grouper complex, the commercial fishing season for the bottom longline shark fishery is determined by Federal regulations that are adaptive and frequently changing. The commercial fishing seasons for all shark species generally opens on or around January 1 every year, contingent upon available quota. The season would not open until NMFS publishes in the *Federal Register* the opening date and available quota. Once NMFS estimates that 80 percent of an individual species/complex's quota has been caught, the season would be closed within 5 days of filing with the *Federal Register* (USDOC, NMFS, 2010d).

Coastal Migratory Pelagic Fisheries

Commercial species classified as coastal pelagic species are those species that are usually found in nearshore marine environments (surface to mid-water [0-20 m; 0-66 ft]) within the continental shelf. Coastal pelagic species can display seasonal and annual movements along the coastline, but they do not make transoceanic migrations. Seasonal migrations are generally trigged by changes in water temperature, so in winter these species are found in the southern part of their range and in summer in the northern part of their range (SAFMC, 1983). Coastal pelagic species in the South Atlantic and Mid-Atlantic regions are Spanish and king mackerels, bluefish, cobia, little tunny, and bluefish. In general, coastal pelagic species are found from North Carolina to Florida, but they can also be found north of Cape Hatteras, North Carolina, depending on the water temperatures. In the northern section of the AOI, bluefish are an important commercial fishery. Prime fishing locations within the AOI are in the coastal waters off Florida where king and Spanish mackerels are the target species. The primary commercial fishing gears that fishermen use to harvest coastal pelagic species are gillnets, trammel nets, automatic (electric) reel, handline, and hook-and-line (trolling). Commercial fishing for coastal pelagic species is conducted along coastal beaches and is sometimes associated with bottom habitats such as artificial reefs and hard bottom features. In addition to the closed areas that are described below, the fishing season is open year-round in all locations, but the fishery does close according to the commercial quota limits (annual or trip) for individual species. In the Mid-Atlantic region, squid and butterfish are other important commercial fisheries that are managed in conjunction with Atlantic mackerel. Although many landings occur outside of the AOI (New Jersey to Massachusetts), some landings occur in the northern section of the AOI (Virginia to Delaware). The primary commercial fishing gear to target these schooling species is bottom or mid-water otter trawls. Commercial fishing is year-round (butterfish), but the prime fishing season for Atlantic mackerel is from January–April and from October–April for squid (MAFMC and NEFMC, 2007).

Another coastal pelagic species, Atlantic menhaden, dominates commercial landings in Virginia and contributes significantly to overall commercial landings in Maryland and Delaware. Commercial landings occur year-round, with most of the landings in Virginia and Maryland during 2009 occurring from June through October (USDOC, NMFS, 2011k). The primary commercial fishing grounds are inshore waters such as the Virginia State waters of Chesapeake Bay (Smith, 1999), but Atlantic menhaden are also caught in nearshore waters (0-4.8 km; 0-3 mi) off Delaware Bay, Virginia, and North Carolina.

Highly Migratory Pelagic Fisheries

Commercial species classified as highly migratory species (HMS) are those species that are generally found in the offshore pelagic environment (surface to mid-water [0-400 m; 0-1,312 ft]) beyond the continental shelf. HMS display daily, seasonal, or annual migratory behavior and can make transoceanic migrations. Commercial fisheries for HMS are conducted throughout the AOI with pelagic longline fishing gear, but other fishing gears used to harvest HMS species include purse seines, handgear (handlines and harpoons), and gillnets (i.e., for sharks). The primary species taken in HMS fisheries include wahoo, dolphin, swordfish, eight tuna species (albacore [*Thunnus alalunga*], Atlantic bluefin tuna, bigeye tuna [*Thunnus obesus*], blackfin tuna [*Thunnus atlanticus*], bonito [*Sarda sarda*], little tunny (*Euthynnus alletteratus*), skipjack tuna [*Katsuwonus pelamis*], and yellowfin tuna [*Thunnus albacares*]), and various species of pelagic sharks (e.g., shortfin mako shark [*Isurus oxyrinchus*]) and coastal sharks (tiger shark). Commercial fishing vessels set pelagic longline gear to target swordfish at sunset and retrieve gear around sunrise, while the opposite pattern is followed for tuna; gear is set at sunrise and retrieved in the afternoon before sunset. The longline fishery for tuna and swordfish is active year-round in the AOI, but most of the commercial fishing effort is in the spring through fall, when the weather is better. However, there are two time/area closures for pelagic longline gear within the AOI (Charleston Bump and East Florida), as described below. Commercial fishermen targeting HMS fisheries with pelagic longline gear generally set their gear in association with the Gulf Stream; pelagic longline sets can be made on the east or west side of the Gulf Stream current, which varies daily. Pelagic longline fishing vessels are mobile, so commercial fishing activity can occur either relatively close (80-161 km; 50-100 mi) or far away (322-483 km; 200-300 mi) from their respective ports of call.

4.2.7.1.4. Time and Area Closures and Gear Restrictions

One method that FMCs use to control commercial fishing effort or protect specific habitats is by designating closed areas (space) or closing fisheries (time: temporary, seasonal, or permanent). Permanent fishery or area closures are year-round, whereas seasonal and rolling closures are usually only at certain times of the year. To notify the public of fishery or site closures, NMFS publishes the regulations in the *Federal Register*, which are usually associated with an FMP amendment or FMP management action. When a closure has been approved, FMCs, in cooperation with NMFS, announce these closures through their website, sending emails and faxes, or holding public meetings. In addition to closing fisheries or areas for fish conservation management reasons, regulatory agencies also use closed areas to protect marine mammals or sea turtles (e.g., from entanglement in discarded fishing gear). Permanent commercial fishing closures can also consist of prohibiting various types of commercial fishing gears or fishing techniques.

Table 4-30 summarizes areas where certain commercial fishing activities are prohibited or where gear restrictions apply during all or part of the year. **Figure 4-23** shows the locations of most of these closure areas. Areas where the Atlantic Large Whale Take Reduction Plan (USDOC, NMFS, 2010e) mandates trap/pot and gillnet restrictions are shown in **Figures 4-24** and **4-25**, respectively.

4.2.7.2. Impacts of Routine Events

This section discusses the potential impacts of routine activities associated with Alternative A on commercial fisheries. As discussed in **Chapter 4.1.1**, IFPs that may affect commercial fisheries include (1) active acoustic sound sources (e.g., airguns, bottom profilers, depth sounders, side-scan sonar), (2) vessel traffic, (3) vessel exclusion zones, and (4) seafloor disturbance (**Table 4-2**).

4.2.7.2.1. Significance Criteria

Negligible impacts to commercial fisheries would include those where little to no measurable impacts are observed or expected. There would not be any interruption of commercial fishing activities, gear damage, or detectable impacts to commercial fish resources.

Minor impacts to commercial fisheries would include those that are detectable but neither severe nor extensive. Minor impacts to commercial fisheries would include localized, short-term interruption of commercial fishing activities or localized gear damage with no detectable effect on commercial fish landings. Minor impacts would also include localized, minor impacts on fish resources with no detectable effect on commercial fisheries landings.

Moderate impacts to commercial fisheries would be detectable, short-term, extensive but not severe; or severe but localized. Moderate impacts to commercial fisheries would include extensive but infrequent interruption of commercial fishing activities and/or damage to fishing gear sufficient to result in detectable decreases in commercial fisheries landings, and/or extensive but not severe impacts on fish resources (i.e., not sufficient to result in sizable decreases in commercial fisheries landings).

Major impacts to commercial fisheries would be detectable, extensive, and severe. Major impacts to commercial fisheries would include extensive, frequent interruption of commercial fishing activities and/or damage to fishing gear sufficient to result in sizable decreases in commercial fisheries landings, and/or extensive, severe impacts on fish resources (i.e., sufficient to result in sizable decreases in commercial fisheries landings).

4.2.7.2.2. Evaluation

Active Acoustic Sound Sources

Under Alternative A, active acoustic sound sources would be used in support of all BOEM program areas – oil and gas exploration and development, renewable energy, and marine minerals. However, there are significant differences in the spatial and temporal characteristics of seismic survey activity by program. Whereas active acoustic sound sources working under the oil and gas program may occur throughout the entire AOI (from shore [excluding State waters] to 648 km [403 mi]) and may work continuously for weeks or months to complete, active acoustic sound sources for renewable energy and marine minerals activities would only occur close to shore and would be of shorter survey duration. For example, wind facility siting studies are currently limited to about 46 km (25 nmi) from shore or 100 m (328 ft) water depth and would require 3 days or less to complete, while marine minerals activities (i.e., sand source mining, existing borrow areas) are typically located in water depths between 10 and 30 m (33 and 98 ft), are restricted to a half dozen locations in the AOI, and would be only day-long survey efforts. Therefore, proposed G&G activities include various types of seismic airgun surveys that could potentially affect economically valuable commercial fisheries and commercial fishing operations throughout the AOI, with appropriate caveats. The spatial characteristics of each commercial fishery are important qualifiers to determining impact; temporal aspects (e.g., seasonal fishing activity) should also be considered.

Sound is used by fishes in a variety of ways (Zelick et al., 1999; Fay and Popper, 2000), as summarized in **Appendix J**. A detailed discussion of direct effects of sound on fishes is presented in **Chapter 4.2.5.2**. In general, fishes use sound to obtain an instant image of their surroundings both in terms of biotic (living) and abiotic (environmental) sources (Fay and Popper, 2000; Popper et al., 2003; Slabbekoorn et al., 2010). Besides having the ability to acquire biological and environmental information from sound, many bony fishes can communicate with sound; some fishes use sound during mating and territorial interactions (Zelick et al., 1999). Given these abilities, sound produced from anthropogenic sources (e.g., airguns, depth sounders) can affect fishes in a variety of ways including (but not limited to) changes in behavior, an impact that can affect the catchability of commercial fish stocks.

For the purposes of these analyses, an injury is defined as an effect on the physiology of the animal (e.g., burst swim bladder and massive internal bleeding) caused by an anthropogenic sound source that leads to immediate or potential death. A behavioral effect is anything that impedes (auditory masking) the ability of fishes to hear biologically relevant sounds, such as those produced by anthropogenic sound sources that could interfere with normal behaviors or the survival of individuals or populations, or alters the normal behavior (e.g., feeding) of exposed fishes (see **Appendix J**).

More specifically related to fisheries, anthropogenic sound can cause fishes to alter their movements or avoid certain areas. Fish exposed to seismic sound typically exhibit an initial startle response, followed by habituation to the sound source and, after a period of time, resumption of normal behavior.

Exposure to seismic sounds can cause short-term effects such as temporary avoidance of or movement out of specific areas, with an increased potential for subsequent changes to commercial fishery landings and associated revenue. Løkkeborg and Soldal (1993) studied the influence of seismic exploration noise on behavior and catch rates of Atlantic cod (*Gadus morhua*) by investigating data on reported conflicts between fishing and seismic operations derived from fishing vessel log books and seismic survey log books. The catch rates were reduced 55 to 85 percent for longline and trawl fisheries at distances up to 9.2-18.5 km (5-10 nmi). These observed effects lasted for about 24 hr. The bottom trawl catch results were variable.

Engås et al. (1996), assessing haddock and Atlantic cod commercial fisheries, indicated a significant decline in catch rate of both species that lasted for several days following airgun exposure. Results suggest that fishes probably moved into deeper water, away from the fishing grounds. Catch rate subsequently returned to normal after cessation of seismic activity when fishes presumably moved back into their preferred water depths. These behavioral changes and associated declines in catch rates were also observed in other species exposed to seismic and other sound sources (e.g., Skalski et al., 1992; Slotte et al., 2004, both using seismic sound sources; Sarà et al., 2007, assessing pelagic species effects using boat noise). In several study results, however, available data regarding reduced catch rates for marine fisheries exposed to seismic survey noise was qualified by uneven or low fish concentrations present or the inability to distinguish the possible effects of other sources of disturbance, further complicating a definitive determination of reduced catch rates (e.g., see Dalen and Raknes, 1985; Dalen and Knutsen, 1986; Løkkeborg, 1991, all using seismic sound sources). Several studies also suggest that the spatial displacement of fishes is limited (e.g., ~9.2 km [~5 nmi] from an active seismic source) and that fishes move back into their preferred areas after cessation of seismic survey activity (e.g., within one to several days).

Limited scientific information is available that describes the impacts to fish behavior from seismic sound because it is difficult to study such behavior in the field; some study results suggest that fishes do not respond to sounds that are not biologically produced. In other words, if the sound was not recognized as being biologically important, then fishes did not react, regardless of the sound level (Doksaeter et al., 2009). Plachta and Popper (2003) have demonstrated that fishes respond to biologically relevant sounds, but only at certain sound levels. In the absence of a solid scientific database regarding sound effects, it is difficult to predict if anthropogenic sound from seismic activity would seriously affect fishes; impacts are expected to be related to exposure level and frequency of occurrence. The potential effect could also be related to water depth, suggesting that inshore fishes could be impacted to a greater extent than offshore fishes.

Given this type of observational information, it is possible that anthropogenic noise associated with the use of seismic equipment could influence pelagic fish behavior or their prey and thereby affect pelagic longline fisheries within the AOI, although studies conducted to date fail to universally support this hypothesis. Wardle et al. (2001) observed the behavior of Scotland fishes exposed to airgun noise, observing that several fish species showed virtually no response to the airgun firing beyond an initial, transient startle response that did not change their pattern of movement.

Depending on the amount of seismic activity, the location of the surveys, and species present, short-term effects that could temporarily affect pelagic longline fisheries in certain areas within the AOI could occur. For example, considering the single largest source of active acoustic sound (i.e., 2D high-resolution seismic survey activity for the period 2012-2020; **Table 3-9**), several spatially-based impact determinations can be made. Impacts to benthic, demersal, and coastal pelagic commercial fisheries would be (1) limited off Delaware, Virginia, and North Carolina within 32 km (20 mi) of shore given the relatively low level of 2D survey activity predicted for this portion of the AOI; and (2) higher off South Carolina, Georgia, and Florida within 32 km (20 mi) of shore because of higher projected 2D survey levels in these areas. Further offshore, impacts to the pelagic commercial fishery from 2D surveys are expected to be higher off Virginia, South Carolina, and Georgia, decreasing with distance, again attributed to the higher level of survey activity expected in these areas.

The limited information available on the effects of active acoustic sounds generated by G&G activities on economically important invertebrates suggests that behavioral changes would be minimal (**Chapter 4.2.1.2**). Accordingly, it is highly unlikely that commercial fisheries that use pots/traps, dredges, and otter trawls to target invertebrates would be significantly affected. However, there is a potential that commercial fisheries that use longlines, gillnets, and purse seines could be negatively impacted by active acoustic sound from seismic equipment.

Given the spatial and temporal characteristics of active acoustic sound source use under the activity scenario, and the results of limited seismic sound exposure studies on fishes, it is likely that potential impacts to commercial fisheries resources would be **minor**, with no population level effects. Impacts, including behavioral changes and avoidance, are expected at a few locations, with likely impacts being intermittent, temporary, and short-term. There would be an increased potential for a localized and temporary decrease in catchability of one or more commercial fish species. Overall, impacts associated with active acoustic sound generated from G&G activities under Alternative A are not expected to adversely affect commercial fishery landings. Impacts to commercial fisheries from active acoustic sound sources would be **minor**.

Vessel Traffic and Vessel Exclusion Zones

Vessel traffic associated with G&G activities would increase in specific areas, thereby increasing the potential for interference with commercial fishing operations, especially dredges, otter trawls, longlines, and purse seines. These types of commercial fisheries could be adversely affected because an increase in vessel traffic (and associated vessel exclusion zones) throughout the fishing grounds may prevent commercial fishing operators from properly setting their gear (see **Chapter 4.2.7.1.2**). The G&G seismic airgun surveys would also attempt to maintain a vessel exclusion zone to protect airgun arrays and towed streamers. The size of the vessel exclusion zone would be dependent upon the equipment being employed and the extent of the streamers. A typical vessel exclusion zone has been estimated to cover 1,021 ha (2,520 ac) of the sea surface. With the source vessel moving at speeds of about 4.5 kn (8.3 km/hr), the length of time that any particular point would be within the vessel exclusion zone would be about 1 hour. As discussed in **Chapter 3.5.1.5**, the vessel exclusion zone is simply an area monitored by a seismic survey operator and has no formal status or designation by the USCG. However, a Local

Notice to Mariners would be issued that would specify the survey dates and locations and the recommended avoidance requirements.

Generally, most commercial fishing operators set their gear according to specific habitats (e.g., bottom profile) or water conditions (e.g., Gulf Stream current). Thus, if there are numerous seismic vessels conducting surveys through the fishing grounds, it may prevent fishermen from setting their gear in a matter that maximizes fishing effort. Vessel exclusion zones around survey vessels may also affect the setting of gear. Catch rates are dependent not only upon the numbers of fishes and location, but also upon fishing techniques (deployment).

Several commercial fishery gears are classified as passive gears. These types of gears are usually set and go unattended for hours or days, such as pots/traps, gillnets, and longlines. Therefore, an increase in vessel traffic and towed survey gear (e.g., streamers) could increase the chances that fishing gear would be disturbed or accidently hit (buoys and lines cut) by seismic vessels conducting surveys, especially those operating at night. The G&G survey activities would be expected to produce a minor increased risk for entanglement, particularly during May-October in nearshore waters (<4.8 km [<3 mi] from shore) off the coasts of Virginia, Maryland, and North Carolina where the benthic and demersal inshore fisheries are prominent.

The primary direct effect of a vessel exclusion zone is the short-term, temporary loss of access to fishing grounds and lost fishing time. Given the small area occupied by the exclusion zone for these vessels and the short duration of the impact at any given location, there is only a limited potential for space-use conflicts between G&G activities and commercial fishing operations within the AOI. Vessel exclusion zones associated with G&G activities may require commercial fishing entities to retrieve nets or lines earlier than usual to avoid seismic vessels conducting surveys, or cause them to stand-off until the seismic vessel and its associated safety zone have moved past the fishing grounds. If commercial fishermen temporarily lose access to fishing grounds or are required to terminate or change their fishing techniques, this may reduce catch and affect quality of catch, which could ultimately affect annual or regional revenue. Under Alternative A, G&G activities and associated vessel exclusion zones would not be expected to have any indirect effects on commercial fishery operations unless these activities cause commercial fishermen to concentrate their fishing efforts on other fishing activities. Commercial fisheries are continuing to evolve, so it difficult to gauge whether these restrictions would cause some fishermen to engage in other fisheries. Most commercial fishermen already participate in various commercial fisheries, so it is unlikely that vessel exclusion zones would cause any other significant changes in fishing effort distribution.

Marine space-use issues are a continuing problem and an important element in marine spatial planning (Crowder and Norse, 2008; Douvere and Ehler, 2009). Marine space conflicts are already an issue between many competing fisheries in some regions (e.g., pelagic longline fisheries; deepwater crab fisheries). Vessel exclusion zones resulting from proposed G&G seismic activity under Alternative A have the potential to directly affect a limited amount of commercial fishing activity within the AOI. Although it is difficult to estimate the economic impacts at the regional level, it is possible that these activities would produce minor impacts to specific fisheries or individuals. Vessel traffic issues related to G&G survey activities under Alternative A have the potential to directly and indirectly affect some commercial fishing activities within the AOI. Although it difficult to estimate the economic impacts at the regional level, it is possible these activities would affect specific fisheries or individuals. Based on the predicted activity levels and AOI, G&G vessel traffic and vessel exclusion zones are expected to produce minor impacts, with no population level or regional effects. Impacts are expected at a few locations and would be intermittent, temporary, and short-term. Impacts to commercial fisheries landings arising from vessel traffic and vessel exclusion zones are expected to be **minor**.

Seafloor Disturbance

Seafloor disturbance could potentially affect commercial fisheries operations within the AOI, specifically the potential for damage to bottom-founded fishing gear. Most passive gears such as traps, pots, and bottom longlines are generally well marked by surface buoys. For longlines and groups of traps, the buoys may mark only the terminal ends of much longer deployments. Such situations would be susceptible to interference from G&G bottom sampling operations. Under Alternative A, seafloor disturbance caused by bottom sampling activities has the potential to affect unmarked gear or segments of gear deployments used by bottom-oriented commercial fishing operations.

Bottom fisheries (i.e., dredges, otter trawls, and bottom longlines) in the AOI are among the most important commercial fisheries in terms of value. The main indirect effect associated with seafloor disturbance is long-term change in benthic community structure. There are several G&G activities that could cause seafloor disturbance, including geological and geochemical samplings (e.g., bottom sampling, shallow coring), placement and removal of equipment on the seafloor (e.g., ocean bottom cables, anchors), and the installation of up to three COST wells and up to five shallow test wells. Proposed activities under Alternative A include bottom sampling in all three program areas. These include 50-300 core or grab samples in the oil and gas program, 3,106-9,969 core or grab samples in the renewable energy program, and 1-8 geologic cores, 60-320 grab samples, and 90-600 vibracores in the marine minerals program. Collection of each sample is estimated to disturb an area of approximately 10 m^2, although the actual area of the core or grab extracted may be much smaller. The maximum total area disturbed by core or grab sampling is expected to be about 11 ha (27.7 ac), which represents 0.00001 percent of the AOI. Sampling for renewable energy projects would occur at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Offshore Delaware, Maryland, and Virginia, the likely sampling locations would be within designated WEAs (USDOI, BOEM, 2011e) (**Chapter 4.2.12.1.4**). North Carolina has identified 56 OCS blocks of interest, but it is likely that sampling would occur within only a small subset of these blocks. Specific AOIs have not been identified for the South Atlantic states. Sampling activities for marine minerals would be conducted at specific borrow sites in water depths less than 30 m (98 ft). Much of the marine minerals activity is expected to occur within existing borrow sites offshore the Mid-Atlantic and South Atlantic states (**Chapter 4.2.12.2**). Depending on the amount and frequency of G&G survey effort that could disturb the seafloor in a specific area, these activities have the potential to change biodiversity, cause habitat fragmentation, and reshape benthic community structure (albeit on very small spatial scale), which could adversely affect bottom commercial fisheries. This phenomenon has already been documented in trawling and dredging operations (Barnette, 2001). Benthic communities have been affected by commercial and recreational fishing activities, the latter of which have been estimated to affect approximately 53 percent of the world's continental shelf (Watling and Norse, 1998).

Direct impacts to commercial fisheries include entanglement issues with bottom fisheries (i.e., fish traps [black sea bass], bottom longline, and bottom and mid-water gillnets). Indirect impacts associated with G&G activities that disturb the seafloor may include destruction and/or alteration of habitat, and disturbance of benthic communities (e.g., fishes and invertebrates such as flounders, shrimps, and crabs and their habitat). In many locations within the AOI, benthic habitat has already been severely impacted by commercial fishing operations (i.e., bottom trawling and dredging); any additional impacts arising from G&G activities on the seafloor could further reduce available habitat for bottom fishes and invertebrates (Barnette, 2001).

Seafloor disturbance issues related to G&G activities under Alternative A have the potential to directly and indirectly affect some commercial fishing activities within the AOI. Although it is difficult to estimate the economic impacts at the regional level (if any), it is still possible these activities would impact some specific commercial fisheries in the AOI. It is likely that intermittent, temporary, and short-term changes in benthic communities would occur as a result of G&G benthic sampling and coring activity (**Chapter 4.2.1.2**). However, these types of G&G activities would be conducted on a very limited basis. Bottom sampling is expected for all three program areas (**Chapter 3**), as summarized previously; however, the total area affected represents a very small fraction of the AOI. In addition, BOEM would require site-specific information concerning potential sensitive benthic communities (including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI.

The total areal extent of seafloor disturbance expected under the proposed action scenario represents a very small fraction of the seafloor in the AOI (**Chapter 4.2.1.2**). Seafloor disturbance and its impact to commercial fishing operations and potential effects on commercial fishery landings under Alternative A are expected to be limited and localized and therefore are expected to be **negligible**.

4.2.7.3. Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel, but such an event has a remote probability of occurring. For the purposes of this analysis, it is assumed that a vessel collision may release between 1.2 and 7.1 bbl of diesel fuel.

In the event of a fuel spill from a seismic vessel, it may be possible that commercially important fishes could be exposed to water soluble fractions of spilled diesel. Surface feeding fishes are most likely to be exposed. For example, dolphin (fish) often consume small fishes associated with floating *Sargassum*. Tuna and swordfish are another important commercial fish group that is sometimes associated with *Sargassum* habitat or surface waters. Given the size of the diesel spill, the extent of surface fouling would be limited. Under the expected spill scenario developed in **Chapter 3.5.2.1**, a diesel fuel spill would be expected to remain in surface waters, subjected to evaporation and dispersion; a portion of the spill may adhere to particulates and sink. It is unlikely that a small release of diesel fuel would have any direct impact to commercial fishery landings throughout the AOI. Impacts to commercial fisheries resources from an accidental fuel spill would be **negligible**.

Spill vessel response activity also has the potential to adversely affect commercial fishing operations. However, given the size of the potential spill, a large-scale spill response involving multiple vessels is not expected. Small diesel spills (500-5,000 gal.) usually evaporate and disperse within a day or less, even in cold water (USDOC, NOAA, 2006); thus, seldom is there any oil on the surface for responders to recover. Therefore, impacts to commercial fisheries resources from a small diesel fuel spill are expected to be **negligible**.

4.2.7.4. Cumulative Impacts

The cumulative impacts scenario is discussed in detail in **Chapter 3.6** and includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs for these cumulative activities that have the potential to affect commercial fisheries include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, and other active sound sources; (2) vessel traffic and vessel exclusion zones; (3) seafloor disturbance; and (4) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Five sources of potential impact to commercial fisheries have been identified in association with proposed G&G activities, including (1) active acoustic sound sources; (2) vessel traffic; (3) exclusion zones; (4) seafloor disturbance; and (5) accidental fuel spills. Impact analyses presented in **Chapters 4.2.7.2** and **4.2.7.3** determined that activities projected to occur under Alternative A would result in **negligible** or **minor** impacts to commercial fisheries, depending upon the IPF. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Underwater Noise Including Active Acoustic Sound Sources

With the cumulative activities scenario, the primary underwater noise sources that could adversely affect commercial fisheries include those arising from military operations (i.e., sonars, explosives, and other active sound sources). A sizeable portion of the AOI includes military range complexes and civilian space program use areas (i.e., five operating areas, one National Aeronautics and Space Administration [NASA] restricted area, multiple unexploded ordnance disposal areas; see **Chapter 4.2.12.1.2**) that, in total, extend almost the entire length of coast within the AOI. These military range complexes and civilian space program use areas include designated danger areas, restricted areas, and closure areas that limit access by vessel traffic, including commercial fishing, during specific times or prior to/during specific activities or operations; in some instances, areas may be completely closed to all vessel traffic. Impacts from sound-producing military operations, including behavioral changes and avoidance by commercial fish species, are expected at select military range complexes and civilian space program use locations, with likely impacts being intermittent, temporary, and short-term. Because of the spatial and temporal characteristics of military exercises that produce active acoustic sound and the nature of the sound sources (e.g., explosion, single pulse, limited multiple pulses), coupled with the exclusion of commercial fishing vessels from areas where military operations are planned or being conducted, impacts to commercial fisheries from military range complexes and civilian space program uses under the cumulative scenario are expected to be negligible.

Because there are no significant noise impacts evident from the cumulative activities scenario, and there is no evidence of ambient noise levels approaching a threshold level where commercial fisheries might be significantly affected, it is expected that there would be a minor incremental increase in impact to commercial fisheries from active acoustic sound sources under Alternative A under the cumulative scenario.

Vessel Traffic and Vessel Exclusion Zones

Vessel traffic would increase under the cumulative scenario to support most of the activities. As discussed in **Chapter 4.2.7.2**, generally, most commercial fishing operators set their gear according to specific habitats (e.g., bottom profile) or water conditions (e.g., Gulf Stream current). Thus, if there are numerous vessels transiting through the fishing grounds, it may prevent fishermen from setting their gear in a matter that maximizes fishing effort. However, the additional vessel traffic from the cumulative scenario would not be a significant increase to existing vessel traffic. Most vessels would be able to avoid commercial fishing vessels with gear in the water as they transit to an offshore location, and therefore impacts to commercial fisheries from vessel traffic associated with the cumulative scenario are expected to be negligible.

Military range complexes and civilian space program use areas already restrict commercial fishing activities, and the proposed action would cause additional vessel exclusion zones. Because the additional vessel exclusion zones caused by the proposed action would be intermitternt, temporary, and short-term, impacts to commercial fisheries arising from vessel exclusion zones are expected to be **negligible**.

Cumulative scenario activities including oil and gas exploration, renewable energy, geosequestration, and LNG import terminals potentially may include the presence of structures within the AOI. However, there is already an area in the AOI that is unavailable for trawl or longline fishing, which is a very small fraction of 1 percent of total OCS. The introduction of surface and bottom obstructions from oil and gas or renewable energy structures under the cumulative impacts scenario would not be greater than 1 percent of the available surface or bottom area in the AOI in water <200 m deep. Therefore, these additional structures would add to the exclusion areas already required by the proposed action and reduce the commercial fishing areas. As discussed in **Chapter 4.2.7.2**, marine space-use issues are an important element in marine spatial planning (Crowder and Norse, 2008; Douvere and Ehler, 2009). Marine space conflicts are already an issue between many competing fisheries in some regions (e.g., pelagic longline fisheries; deepwater crab fisheries). Vessel exclusion zones resulting from the proposed activities under Alternative A and the additional ones from the cumulative scenario activities have the potential to directly affect a limited amount of commercial fishing activity within the AOI. Although it is difficult to estimate the economic impacts at the regional level, it is possible that these activities would produce impacts to specific fisheries or individuals. However, based on the activities anticipated in the time period evaluated in the Programmatic EIS, impacts are expected at a few locations (**Chapter 4.2.7.2**). Incremental impacts to commercial fisheries arising from the presence of structures and the associated vessel exclusion zones are expected to be negligible.

Seafloor Disturbance

As discussed in **Chapter 4.2.7.2**, one of the biggest issues with the cumulative activities scenario is impacts from additional seafloor appurtenances (e.g., drilling rigs, bottom-founded meteorological buoys, wind turbines, and cables) to bottom fisheries (i.e., fish traps [black sea bass], bottom longline, and bottom and mid-water gillnets). Other seafloor activities would result in the destruction and/or alteration of habitat and disturbance of benthic communities (e.g., fishes and invertebrates such as flounders, shrimps, and crabs and their habitats). In many locations within the AOI, benthic habitat has already been severely impacted by commercial fishing operations; any additional impacts arising from additional seafloor-disturbing activities could further reduce available habitat for bottom fishes and invertebrates

(Barnette, 2001). A number of cumulative action scenario activities would result in additional seafloor disturbance (e.g., oil and gas exploration and development, marine minerals use, geosequestration, LNG terminals).

The BOEM would require site-specific information regarding seafloor and fishing resources prior to approving most of the cumulative scenario activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. The BOEM would use this information to ensure that impacts to benthic communities are avoided and impacts to fisheries resources are evaluated; therefore, benthic communities would be protected from impacts from oil and gas development, marine minerals use, renewable energy development, geosequestration, and LNG import terminals.

The area of the seafloor that would potentially be impacted by the proposed action activities is extremely small when compared to the total area of the AOI (0.00025%). Further, the level of activity in the time period analyzed in the Programmatic EIS for cumulative scenario activities is not anticipated to cause significant, extensive seafloor disturbance when compared to the entire AOI; therefore, the incremental impacts to commercial fisheries from seafloor-disturbing activities are expected to be negligible.

Accidental Fuel Spills

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to fisheries would occur via direct contamination of fishes and preclusion of commercial fishing operations within spill response areas would depend on the location and size of the spill. However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Therefore, potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prepared prior to the drilling of any wells. The EA would require site-specific information regarding fisheries and mitigation measures taken to minimize impacts to fisheries from drilling activities and a potential accidental crude oil spill. In addition, with the required mitigation measures in place and with oversight of these activities by the BSEE, an accidental crude oil spill from an exploratory well is not anticipated; however, a spill still could occur. However, with these measures in place, impacts to commercial fisheries from the cumulative scenario activities would be negligible.

The likelihood of a fuel spill during seismic airgun surveys or other G&G activities is expected to be remote and the associated impacts are expected to be **negligible** (**Chapter 4.2.7.3**). The potential for a fuel spill from vessels involved in the cumulative activities scenario would have similar likelihood and resulting impacts. Consequently, it may be possible that commercially important fishes could be exposed to water soluble fractions of spilled diesel. Spill effects on commercial fishes, as well as spill response vessel operations, would have a direct effect on commercial fishing operations. Surface-feeding fishes are most likely to be exposed to a diesel fuel spill and weathered or dissolved fuel components. However, given the size of the potential spill, a large-scale spill response involving multiple vessels is not expected. Small diesel spills (500-5,000 gal.) usually evaporate and disperse within a day or less, even in cold water (USDOC, NOAA, 2006); thus, seldom is there any oil on the surface for responders to recover. Therefore, the incremental impacts to commercial fisheries activities associated with a fuel spill from vessels under the cumulative activities scenario would be negligible.

4.2.8. Recreational Fisheries

4.2.8.1. Description of the Affected Environment

Recreational fishing is an important social and economic activity. Nationally, saltwater recreational angler expenditures in 2006 were estimated to have generated $82.3 billion in total sales, $38 billion in value-added (i.e., contribution to Gross Domestic Product [GDP]), and $24 billion in income, and supported 533,813 jobs (Gentner and Steinback, 2008). Saltwater recreational fisheries in states adjacent to the AOI are among the most valuable in the U.S. In 2006, Florida ranked first and North Carolina ranked fifth nationally for total expenditures and durable good expenditures related to recreational fishing (Gentner and Steinback, 2008). Among states adjacent to the AOI, sales, income, and employment impacts created by party/charter boat fishing and private/rental boat fishing were the highest in Florida, while the impacts generated from shore-based fishing were the highest in North Carolina (Genter and Steinback, 2008). Overall, angler trip expenditures in Florida generated more sales, income, and employment impacts than any other coastal state in 2006 (Genter and Steinback, 2008). In 2006, Federal taxes generated by angler purchases ranged from $15 million (Georgia) to $1.2 billion (Florida), while revenue received by State/local governments ranged from $11 million (Georgia) to $867 million (Florida) (Genter and Steinback, 2008).

The most recent comprehensive national analysis of recreational fishing estimated that saltwater fishing accounted for about 4 percent of the total marine fish landed in 2002 (Coleman et al., 2004). However, recreational fishing accounts for a much larger percentage of the total landings in some areas such as in the South Atlantic (38%) (Coleman et al., 2004). In 2009, commercial landings of red snapper along the South Atlantic coast (from North Carolina to the Florida east coast) were valued at $1.3 million, but recreational fisheries of red snapper along the Florida east coast alone accounted for $17 million (Genter Consulting Group, 2011). Worldwide, increases in recreational fishing activity also may threaten some already overfished populations (Cooke and Cowx, 2004); in 2002, recreational fishing activities landed about 23 percent of the overfished stocks in the U.S. (Coleman et al., 2004).

4.2.8.1.1. Recreational Fishing Effort

The annual number of recreational angler trips is a measure of recreational fishing effort that is monitored by NMFS. The most recent data are from the period from 2006-2009 (USDOC, NMFS, 2011l). During this period, the mean number of trips for the seven states adjacent to the AOI was 4.4 million, with the smallest mean in Georgia (962,495) and the largest in Florida (12.4 million) (**Figure 4-26**). In 2009, the number of angler trips in Florida was 10.1 million, followed by North Carolina (5.7 million), Virginia (2.9 million), Maryland (2.8 million), South Carolina (2.4 million), Delaware (919,745), and Georgia (851,462).

Recreational fishing is a year-round activity throughout the AOI, but it shows distinct seasonal patterns (**Figure 4-27**). During 2006-2009, the number of trips increased from winter to summer and peaked in July and August (USDOC, NMFS, 2011l).

Recreational fishing can be classified as nearshore or offshore effort, depending on the size of the vessel and its fishing location (distance from shore). Nearshore recreational fishing (<4.8 km [3.0 mi]) consists of anglers fishing from private vessels and along beaches, marshes, or manmade structures (e.g., jetties, docks, and piers), while offshore fishing consists of anglers fishing from larger vessels (private, rental, charter, or party) in offshore waters (>4.8 km [3.0 mi]). In total, recreational saltwater anglers made a total of 123.1 million trips in the AOI during 2006-2009. According to USDOC, NMFS (2011l), recreational fishing trips that caught fish in the AOI during 2006-2009 were primarily fishing from private/rental (31%), charter (23%), and party vessels (23%); a considerable number of fish were also caught by onshore anglers (22%). The primary recreational fishing effort in the AOI (Mid-Atlantic and South Atlantic states) during 2006-2009 was by anglers fishing from private or rental vessels (63.8 million trips), followed by shore (55.8 million trips) and charter (2.6 million trips) and party (868,149 trips) vessels (USDOC, NMFS, 2011l).

4.2.8.1.2. Recreational Fishing Locations

Marine fishes depend upon and utilize many different types of habitats (e.g., seagrass, salt marsh, soft bottom, hard bottom) for feeding, spawning, and nursery grounds. Given the importance of these areas to the local fish fauna, recreational anglers have many options to target various species in these habitats. For example, anglers targeting reef fishes (groupers and snappers) target offshore structure (natural and artificial reefs or ledges), while anglers pursuing inshore fishes (spotted seatrout and redfish) target seagrass habitat. Locations of natural and artificial reefs are discussed and plotted for the AOI in **Chapter 4.2.1**. Overall, 85 percent of the recreational fishing effort in the Mid-Atlantic states (Delaware, Maryland, and Virginia) during 2006-2009 was conducted in inland waters (27.4 million trips), followed by ocean waters less than 4.8 km (3 mi) from shore (4 million trips), and ocean waters greater than 4.8 km (3 mi) from shore (919,785 trips) (USDOC, NMFS, 2011l) (**Figure 4-28**). In the South Atlantic states (North Carolina, South Carolina, Georgia, and Florida), recreational fishing effort during 2006-2009 was also primarily conducted in inland waters (41.1 million trips), followed by ocean waters less than 4.8 km (3 mi) from shore (40.1 million trips), and ocean waters greater than 4.8 km (3 mi) from shore (9.6 million trips) (USDOC, NMFS, 2011l) (**Figure 4-28**).

4.2.8.1.3. Recreational Catch Characteristics

The choice of fish species targeted by recreational anglers depends on the season, fishing location, and seasonal movement of that particular species. For example, one of the best times to target highly migratory species such as marlin and sailfish off the coast of Florida is during winter. Other species such as grouper and snappers are found off North and South Carolina year-round, but reef fishes do migrate to deeper offshore waters during winter. Recreational fishing is a year-round activity, but many anglers target specific species at certain times, and recreational fishing effort is often weather-dependent; more recreational fishing effort occurs during spring through summer when the weather is ideal for anglers fishing from small watercraft.

The types and numbers of fishes caught by recreational anglers vary by state within the AOI (USDOC, NMFS, 2011l). Some of the primary species landed by recreational anglers in the Mid-Atlantic states (Delaware, Maryland, and Virginia) during 2006-2009 were Atlantic croaker, spot, and summer flounder (**Figure 4-29**). In the South Atlantic states, anglers primarily landed herring, kingfish, mullet, spotted seatrout, and spot (**Figure 4-30**). Spot, bluefish, and kingfish were landed primarily in North and South Carolina, and spotted seatrout were landed mainly in Georgia and Florida. Anglers also landed kingfish and sharks in Georgia, and a considerable number of herring and mullet in Florida; schooling fishes are often caught and used as baitfish for larger species (USDOC, NMFS, 2011l). Overall, there were more fishes landed in the Mid-Atlantic States than in the South Atlantic states during 2006-2009.

4.2.8.1.4. Recreational Fishing Tournaments

Organized saltwater fishing tournaments are popular amateur and professional events that are held throughout the AOI from Delaware to Florida. Recreational fishing tournaments are held year-round, but most take place in summer during weekends. In general, many fishing tournaments are held at the same time and place each year; the local community often relies upon fishing tournaments to stimulate the local economy (e.g., restaurants, hotels, fuel, and supplies). Some of these tournaments are large enough to have corporate sponsors who donate prizes. Depending on the fishing tournament and its rules, participants have the option to target inshore (e.g., red drum, spotted seatrout, snook) or offshore (dolphin, wahoo, kingfish) categories, or enter both categories. Every fishing tournament has its own set of rules for classes of eligible fish, size limits, time limits, and specific geographical boundaries. Based on the tournament's rules and eligible fish, participant teams choose fishing sites and tactics according to their fishing experience and local knowledge. Throughout the AOI, there are many fishing tournaments that are annual events; however, it is difficult to identify every possible tournament given that some tournaments are only one-time events and sponsorships can change from year to year. In general, saltwater fishing tournaments in the AOI have become such a local tradition and social activity that there is at least one tournament every weekend somewhere between Delaware and Florida from April through November (**Table 4-31**). Many of these fishing tournaments are held in conjunction with seafood and other local festivals within the community.

4.2.8.2. Impacts of Routine Events

This section discusses the potential impacts of routine G&G activities associated with Alternative A on recreational fishing activities in the AOI. As discussed in **Chapter 4.1.1**, IPFs for recreational fisheries include (1) active acoustic sound sources (i.e., airguns, subbottom profilers, depth sounders, side-scan sonar), (2) vessel traffic, and (3) vessel exclusion zones (**Table 4-2**). In general, the potential impacts to recreational fisheries are similar to those identified for commercial fisheries (**Chapter 4.2.7**).

4.2.8.2.1. Significance Criteria

Negligible impacts to recreational fisheries would include those where little to no measurable impacts are observed or expected.

Minor impacts to recreational fisheries would include those that are detectable but are neither severe nor extensive. Minor impacts to recreational fisheries would include localized, short-term interruption of recreational fishing activities. Minor impacts would also include localized, less than severe impacts on fish resources with minimal decreases in recreational fisheries landings.

Moderate impacts to recreational fisheries would be detectable and extensive but not severe. Moderate impacts to recreational fisheries would include extensive but infrequent interruption of recreational fishing activities and/or extensive, but not severe impacts on fish resources (i.e., not sufficient to result in sizable decreases in recreational fisheries landings).

Major impacts to recreational fisheries would be detectable, extensive, and severe. Major impacts to recreational fisheries would include extensive, frequent interruption of recreational fishing activities and/or extensive, severe impacts on fish resources (i.e., sufficient to result in sizable decreases in recreational fisheries landings).

4.2.8.2.2. Evaluation

Active Acoustic Sound Sources

Active acoustic sound sources would be used in support of all BOEM program areas – oil and gas exploration and development, renewable energy, and marine minerals. Active acoustic sound sources employed under the oil and gas program may occur throughout the entire AOI (from shore [excluding State waters] to 648 km [403 mi]), with broad areas being surveyed continuously for extended periods of time (i.e., weeks, months). Active acoustic sound sources for renewable energy and marine minerals activities would only occur close to shore and would be of shorter survey duration. Under the renewable energy program, wind facility siting studies would be limited to about 46 km (25 nmi) from shore or 100 m (328 ft) water depths and would require 3 days or less to complete. Marine minerals activities (i.e., sand source mining, existing borrow areas) are typically located in water depths between 10 and 30 m (33 and 98 ft), are restricted to a half dozen locations in the AOI, and would be only day-long survey efforts.

Depending on the equipment and technique, airgun seismic pulses are typically fired from one or two vessels and are emitted at intervals of 5-60 s, and occasionally at shorter or longer intervals. In addition to airguns, several electromechanical sources can produce underwater noise – sonar and depth sounders. Under the activity scenario, surveys using these types of equipment would be conducted throughout the AOI, ranging from 2,600 hr (off Delaware) to 9,000 hr (off Florida).

Sound is used by fishes in a variety of ways, as outlined previously in **Chapter 4.2.5**. In general, fishes use sound to obtain an instant image of their surroundings both in terms of biotic (living) and abiotic (environmental) sources. Many bony fishes can communicate with sound; some fishes use sound during mating and territorial interactions. Anthropogenic sound (e.g., airguns, depth sounders) can affect fishes via behavioral changes, injury, and mortality (**Chapter 4.2.5.2** and **Appendix J**).

Reef Fishes: In the southern region (North Carolina to Florida) of the AOI, snappers, groupers, and other reef fishes are usually targeted by recreational anglers at coral and hard/live bottom fishing sites. In the northern region (Delaware to North Carolina) of the AOI, recreational anglers usually target black sea bass and other reef fishes at hard bottom habitat communities. Under Alternative A, seismic operations would be avoided within the North Atlantic right whale critical habitat on a seasonal basis (November 15-April 15), effectively eliminating potential for impact to recreational fishes present in this region during this period. It is also unlikely that sounds generated from G&G equipment would cause any mortality to bottom reef fishes such as groupers and snappers because Alternative A includes the use of ramp-up as an existing survey protocol. Research results also suggest that seismic noise exposure would not produce serious injury or mortality to reef fishes. Only a few studies have documented the impacts of exposure to high intensity sound on fishes. Kane et al. (2010) and Song et al. (2008) both found that sound generated from sonar and seismic devices showed no tissue damage to fishes, while Halvorsen et al. (2011a,b) reported that Chinook salmon was affected by sounds generated from simulated pile driving procedures. Although Halvorsen's results documented initial negative effects, specimens showed complete recovery after a short period following exposure. Enger (1981) and McCauley et al. (2003) also reported that Atlantic cod and pink snapper exhibited small losses of sensory cells after being exposed to high intensity sounds, but fishes recovered shortly thereafter. Based on these studies, it is unlikely that the G&G activities under Alternative A would cause serious injury or mortality to reef-type fishes such as groupers and snappers. Impacts on reef fishes, as a component of recreational fisheries, would be **negligible**.

Coastal Fishes: Fishes found along coastal beaches and inlets are among the most popular fishes pursued by recreational anglers. In general, most of the time anglers fish inshore and outside of the AOI (USDOC, NMFS, 2011l,m); however, approximately 50 percent of the fishing activity occurs along nearshore coastal areas (i.e., <4.8 km (<3 mi) from shore) that may be affected by sound generated by seismic equipment. Popular recreational fishes harvested along coastal beaches and nearshore waters include bluefish, striped bass, cobia, wahoo, king mackerel, Spanish mackerel, and Atlantic croaker. Despite the fact that these inshore fishes are found in much shallower waters than bottom fishes (e.g., groupers and snappers), there is no scientific evidence to suggest that these species are more vulnerable to active acoustic sound generated from seismic equipment. Therefore, it is unlikely that the G&G activities under Alternative A would cause significant impacts leading to the mortality of inshore and coastal fishes. Impacts to coastal fishes, as a component of recreational fisheries, would be **negligible**.

Pelagic Fishes: Recreational anglers also target pelagic species such as tuna, billfishes, and sharks throughout the offshore waters of the AOI. In general, anglers usually troll along the Gulf Stream current (eastern and western edge) that flows from south (Florida) to north (Delaware) through the AOI. Assuming that G&G seismic airgun surveys would be conducted inshore, within, and offshore of the Gulf Stream, it is possible that seismic sounds may affect recreational anglers pursuing these offshore fishes. It is very unlikely that these types of sounds would cause mortality to tuna, billfishes, and pelagic sharks. In general, these types of fishes display highly migratory behavior and are adapted to continuously swim. Therefore, the chance of these fishes being exposed to seismic sounds at a level that could cause mortality is extremely unlikely, especially since the seismic vessel and these fishes are continually moving. Ramp-up procedures are also expected to minimize any potential impacts to migratory fishes. Currently, there is no scientific evidence that suggests that these types of fishes are adversely affected by anthropogenic sound generated from seismic activity. Therefore, it is unlikely that the G&G activities under Alternative A would cause significant impacts leading to the mortality of pelagic fishes such as tuna and billfishes. Impacts to pelagic fishes, as a component of recreational fisheries, would be **negligible**.

Recreational Fishing Activity: Anthropogenic sound generated from seismic activity under Alternative A has the potential to directly and indirectly affect some recreational fishing activities within the AOI. There is little scientific evidence to suggest that this type of sound would cause immediate mortality or physiological effects causing long-term injury. Nevertheless, localized, short-term interruptions of recreational fishing activities may be expected, and slight decreases in recreational fisheries landings may occur. A determination of economic impact of active acoustic sound exposure on recreational fish landings is problematic. Given the absence of serious injury or mortality to recreational fishes and the potential for behavioral changes from active acoustic sound exposure, it is likely that potential impacts would be intermittent, temporary, and short-term in terms of duration or frequency. Exposure to active acoustic sound sources from G&G activities under Alternative A is expected to produce **minor** impacts to recreational fisheries activities.

Vessel Traffic

Under Alternative A, vessel traffic could increase in specific areas, thereby potentially interfering with recreational fishing, especially to those engaged in amateur and professional fishing tournaments. Recreational fisheries could be affected because an increase in G&G vessel traffic throughout the fishing grounds may prevent or limit access by recreational fishermen. Generally, most recreational anglers fish (usually trolling or drifting) according to specific habitats (bottom profile) or water conditions (Gulf Stream current). Catch rates may also be adversely affected, as they are not only dependent upon the numbers of fishes and location, but also on fishing techniques. Temporary loss of access to fishing grounds or lost fishing time could affect the success of recreational landings, with potential for economic impact to local businesses. Since recreational anglers are generally in small maneuverable boats using rod-and-reel or electric reels with only easily retrievable lengths of line in the water, avoiding large survey vessels would be easy. Vessel traffic or vessel disturbance issues have the potential to affect several recreational fishing activities within the AOI, although a precise determination of the economic impacts is problematic. Vessel traffic disturbance and how it relates to recreational fishing activities would be expected to produce impacts ranging from **negligible** to **minor**.

A secondary impact associated with increased G&G vessel traffic is the potential for entanglement. Entanglement of recreational fishing gear would be limited to fishing line or possibly small numbers of crab traps cast or set in areas of increased vessel traffic such as from the jetty of a coastal inlet. To receive and record data, hydrophones are towed on streamers behind seismic vessels or positioned on the seafloor as autonomous nodes or cables, or, in rare instances, spaced at various depths in vertically positioned cables. In general, each type of G&G survey has its own special method of deploying equipment and collecting data. Depending on the method, each deployment approach can potentially impact recreational fishing activities in different ways. However, entanglement with towed seismic gear is much less likely for recreational fishing than described for commercial operations (**Chapter 4.1.4**). It is most likely that recreational anglers fishing from small boats would be able to actively avoid large seismic vessels towing hydrophone strings. In addition, public announcements such as Notice to Mariners played on marine VHF radio channel 16 would broadcast the timing and coordinates of any planned activity.

Inshore fisheries (i.e., estuaries and bays) are not expected to be affected by vessel traffic and entanglement issues because they are outside of the AOI. The exception would be coastal inlets, as mentioned above. Recreational anglers in coastal and offshore waters use a variety of fishing techniques, including trolling and bottom fishing throughout the AOI. It is estimated that G&G vessel activity and the associated vessel traffic would produce **negligible** to **minor** impacts to recreational fisheries. Effects are likely to be localized at a several locations, intermittent in frequency of occurrence, temporary, and short-term in nature.

Vessel Exclusion Zones

During seismic airgun surveys, operators typically attempt to maintain a vessel exclusion zone to protect towed streamers. The vessel exclusion zone would be maintained around the source vessel and arrays. The extent of the vessel exclusion zone would be dependent upon the equipment and number of streamers. A typical vessel exclusion zone for a 2D or 3D survey involving a towed array would be approximately 8.5 km (4.6 nmi) long and 1.2 km (0.6 nmi) wide, covering a total of 1,021 ha (2,520 ac) of the sea surface. The length of time that any particular point would be within the vessel exclusion zone would be about 1 hr, assuming a seismic vessel speed of 4.5 kn (8.3 km/hr). As discussed in **Chapter 3.5.1.5**, the vessel exclusion zone is simply an area monitored by a seismic survey operator and has no formal status or designation by the USCG. However, a Local Notice to Mariners would be issued that would specify the survey dates and locations and the recommended avoidance requirements.

If one or more seismic vessels are conducting a survey through a fishing ground, it may prevent recreational anglers from attempting to fish at specific fishing sites. The primary direct effect of an vessel exclusion zone to recreational fisheries would be loss of access to fishing grounds and time. Given the amount of area occupied by the exclusion zones for these vessels there is a potential for very short-term, temporary space-use conflicts between G&G activities and recreational fishing operations within the AOI. Because of these vessel exclusion zones, recreational fishermen may have to retrieve lines earlier than usual to avoid seismic vessel surveys (exclusion or safety zone), or stand off until the seismic vessel and its associated safety zone have moved past the fishing grounds. Under this Alternative, G&G activities and the associated vessel exclusion zones are expected to have no indirect effects on recreational fishery operations unless these activities cause recreational fishermen to concentrate their fishing efforts on other species or areas.

Impacts to recreational fisheries associated with vessel exclusion zones under Alternative A are expected to be **negligible**.

4.2.8.3. Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes a diesel spill ranging from

1.2 to 7.1 bbl. Spills occurring at the ocean surface would disperse and weather. Volatile components of the fuel would evaporate. Fuel and diesel used for operation of survey vessels is light and would float on the water surface. There is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink. Particulate matter contaminated with diesel fuel could eventually reach the seafloor either within or outside the AOI, depending upon spill location, water depth, ambient currents, and sinking rate.

Recreational fishing activity is not expected to be precluded from the area around the fuel source; spilled diesel would evaporate and disperse within a day or less. Given the relatively small size of the spill and the rapid loss of most spilled fuel through evaporation and dispersion, a small diesel fuel spill at the surface would have little to no effect on recreational fisheries. An accidental fuel spill would be expected to result in **negligible** impacts to recreational fisheries.

4.2.8.4. Cumulative Impacts

The cumulative impacts scenario discussed in detail in **Chapter 3.6** includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The potential IPFs for these cumulative activities that have the potential to affect recreational fisheries include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, and other active sound sources; (2) vessel traffic; (3) vessel exclusion zones; and (4) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Among the IPFs identified above for the cumulative impacts scenario, four sources of potential impact to recreational fisheries have been identified in association with proposed G&G activities, including (1) active acoustic sound sources; (2) vessel traffic; (3) exclusion zones; and (4) accidental fuel spills. Seismic sound, vessel traffic, and vessel exclusion zone effects of G&G activities in the AOI may result in fish behavior changes, reduction in access to recreational fishing grounds, and loss of income for some businesses. Impact analyses presented in **Chapters 4.2.8.2** and **4.2.8.3** determined that activities projected to occur under Alternative A would result in **negligible** or **minor** impacts to recreational fisheries, depending upon the IPF. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Underwater Noise Including Active Acoustic Sound Sources

Primary underwater noise sources that could adversely affect recreational fisheries include those arising from military operations (i.e., sonars, explosives, and other active sound sources). A sizeable portion of the AOI includes military range complexes and civilian space program use areas (i.e., five operating areas, one NASA restricted area, multiple unexploded ordnance disposal areas; see **Chapter 4.2.12.1.2**) that, in total, extend almost the entire length of coast within the AOI. These military range complexes and civilian space program use areas include designated danger areas, restricted areas, and closure areas that limit access by vessel traffic, including recreational fishing activity, during specific times or prior to/during specific activities or operations; in some instances, areas may be completely closed to all vessel traffic. Impacts from sound-producing military operations, including behavioral changes and avoidance by recreationally important fish species, are expected at select military range complexes and civilian space program use locations, with likely impacts being intermittent, temporary, and short-term. Because of the spatial and temporal characteristics of military exercises that produce active acoustic sound and the nature of the sound sources (e.g., explosion, single pulse, limited multiple pulses), coupled with the exclusion of recreational fishing vessels from areas where military operations are planned or being conducted, impacts to recreational fisheries from military range complexes and civilian space program uses under the cumulative scenario are expected to be negligible.

Vessel traffic noise from the remaining cumulative scenario sources (e.g., oil and gas exploration and development, commercial fishing, shipping and marine transportation) would also contribute to ambient noise levels throughout the AOI. Under the cumulative activities scenario, these vessel and equipment noise sources are expected to produce a negligible impact to recreational fisheries.

Under Alternative A, active acoustic sound sources would be used in support of all BOEM program areas – oil and gas exploration and development, renewable energy, and marine minerals. Active acoustic sound sources employed under the oil and gas program may occur throughout the entire AOI, with broad areas being surveyed continuously for extended periods of time (i.e., weeks, months). Active acoustic sound sources for renewable energy and marine minerals activities only would occur close to shore and would be of shorter survey duration. Overall, exposure to active acoustic sound sources from G&G activities under Alternative A is expected to produce **negligible** to **minor** impacts to recreational fisheries.

Because there are no significant noise impacts evident from the cumulative activities scenario, and there is no evidence of ambient noise levels approaching a threshold level where recreational fisheries might be significantly affected, it is expected that there would be a minor incremental increase in impacts from active acoustic sound sources associated with the proposed action under the cumulative scenario.

Vessel Traffic

Vessel traffic within the AOI is expected to increase under the cumulative scenario. Over the past several years, documented increases in commercial vessel activity in U.S. east coast ports have been noted. Other cumulative activities including oil and gas development, marine minerals use, renewable energy development, geosequestration, LNG import terminals, commercial fishing, military range complexes and civilian space program use, and dredged material disposal are also expected to contribute to increases in total vessel activity levels in the AOI. Impacts from vessel traffic associated with the cumulative scenario are expected to produce negligible to minor impacts to recreational fisheries.

Under Alternative A, vessel traffic is expected to increase in specific areas, particularly where amateur and professional recreational fishing tournaments are being conducted. Vessel traffic or vessel disturbance issues have the potential to affect several recreational fishing activities within the AOI, although a precise determination of the economic impacts is problematic. Vessel traffic disturbance and how it relates to recreational fishing activities is expected to produce impacts ranging from **negligible** to **minor**.

In spite of the increasing levels of commercial vessel activity within the AOI, there are no significant vessel traffic impacts evident from the cumulative activities scenario. In addition, there is no evidence of vessel traffic levels approaching a threshold level where recreational fisheries might be significantly affected. Therefore, it is expected that there would be a small incremental increase in vessel traffic impacts associated with the proposed action under the cumulative scenario.

Vessel Exclusion Zones

Several activities expected to occur under the cumulative impacts scenario may utilize vessel exclusion zones. Drilling operations to be conducted as part of oil and gas development, vessel approach and departure fairways used as part of LNG import terminals, and shipping and marine transportation vessel traffic corridors would exclude private vessel operations within prescribed distances from transiting vessels or operations. Impacts to recreational fisheries from the cumulative activities scenario are expected to be negligible.

During seismic airgun surveys, the operator would typically attempt to maintain a vessel exclusion zone to protect towed streamers. Impacts to recreational fisheries associated with vessel exclusion zones under Alternative A would be expected to be **negligible**. Therefore, it is expected that there would be a minor incremental increase in impacts to recreational fisheries associated with the proposed action under the cumulative scenario.

Accidental Fuel Spills

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to recreational fisheries would vary depending on the location and size of the spill. However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prior to any wells being drilled. In addition, a project-specific EA would require an analysis of site-specific information and mitigation measures taken to minimize impacts from drilling activities and potential accidental crude oil spills. In addition, with the required mitigation measures in place and with oversight of these activities by the BSEE, an accidental crude oil spill from an exploratory well is not anticipated; however, a spill still could occur. However, with these mitigation measures in place, the impacts to recreational fisheries from exploratory drilling operations would be negligible.

A sizeable amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations and commercial fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The impact of accidental fuel spills arising from a vessel collision under the cumulative scenario is expected to be negligible.

The potential for fuel spills from vessels involved in the cumulative activities scenario is considered to be remote. In the event of a small diesel fuel spill from one or more of the cumulative activities, recreationally important fishes could be exposed to water soluble fractions of spilled diesel. Spill effects on recreational fishes, as well as spill response vessel operations, would have a direct but limited effect on recreational fishing activities. Given the size of the potential spill, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts to recreational fisheries activities associated with a fuel spill from vessels under the cumulative activities scenario would be **negligible**.

The likelihood of a fuel spill during seismic airgun surveys or other G&G activities is considered to be remote, and the associated impacts would be expected to be **negligible** (**Chapter 4.2.8.3**). Therefore, only a negligible incremental increase in impacts to recreational fisheries from accidental fuel spills under Alternative A is expected under the cumulative scenario.

4.2.9. Recreational Resources

Coastal and marine habitats within and adjacent to the AOI make the Mid-Atlantic and South Atlantic coasts popular destinations for visitors from local communities and around the globe. An overview of the recreational resources, popular activities, and the economic contribution of recreation-related industries is provided in the following chapters. With the exception of recreational fishing, which is discussed separately in **Chapter 4.2.8**, most recreational activities in the region occur either along the coast or in nearshore (State) waters.

4.2.9.1. Description of the Affected Environment

The Mid-Atlantic and South Atlantic coasts offer a diverse range of marine and coastal habitats, including sandy beaches and barrier islands, estuarine bays and sounds, inland water bodies, maritime forests, and marshland. Shorelines and features adjacent to the AOI include Cape Henlopen at the mouth of Delaware Bay; Chesapeake Bay, with shorelines along Delaware, Maryland, and Virginia; the Outer Banks of North Carolina; the beaches, barrier islands, and coastal marshlands of South Carolina; the Georgia sea islands; extensive beaches and lagoon systems in northeastern Florida; and the Cape Canaveral region in east-central Florida. The purpose of this chapter is to provide an overview of the types of recreational resources within the AOI and the types of activities associated with each of these types of resources. Examples are provided, but the descriptions are not all-inclusive.

Public lands are intermingled with developed areas throughout the region. There are five National Seashores along the coast, occupying a combined area of more than 80,000 ha (198,000 ac): Assateague Island in Maryland and Virginia, Cape Hatteras and Cape Lookout in North Carolina, Cumberland Island in Georgia, and Canaveral in Florida. National Wildlife Refuges (NWRs) containing marine habitats occupy more than 84,000 ha (207,000 ac) of the Mid- and South Atlantic Coasts. These areas are further described in **Chapter 4.2.11**, which includes a complete listing of national and State parks, seashores, marine sanctuaries, wildlife refuges, and other protected marine areas. **Table 4-32** lists selected recreational areas along the coast of each state, including national and State parks, seashores, recreation areas, and wildlife refuges. **Table 4-33** summarizes the types of recreational activities that occur in various offshore and coastal areas.

Barrier island systems with associated recreational beaches exist along much of the coast. These barrier systems consist of sandy strands (barrier islands) that provide recreational beaches open to the Atlantic Ocean, with a protected lagoon and marshlands between the barrier island and the mainland. The sandy beaches are popular destinations for swimming, sunbathing, and surfing. The lagoons provide a low energy environment for fishing, kayaking, boating, and wildlife viewing.

Fishing piers and boat landings are located on both the lagoon and beach sides of the barrier systems. Public beach facilities are typically located on the ocean side of the barrier island. Golf courses are popular, especially along the South Atlantic coast, and are typically located on the mainland, although some are located on barrier islands (e.g., Hilton Head, South Carolina; Amelia Island, Florida).

Natural harbors and bays of varying sizes are located in the AOI. These serve as centers of recreational boating and fishing and support activities in the coastal, nearshore, and offshore areas. Boat-based activities include fishing, diving, sailing, and natural resource viewing. Diving is most popular at the many shipwrecks and artificial reefs in nearshore and, to a lesser extent, offshore waters. Natural hard bottom areas such as Gray's Reef NMS offshore Georgia are also a destination for divers (Gray's Reef National Marine Santuary, 2011a). Additional information regarding Gray's Reef NMS and the other marine sanctuaries located in the AOI is included in **Chapter 4.2.11**.

Table 4-34 shows the contribution of marine-based tourism and recreation to state economies in 2004, as represented by employment and wages. Data are based on the Bureau of Labor Statistics Quarterly Census of Employment and Wages, and marine-based tourism and recreation data were obtained from establishments in selected sectors (amusement and recreation services, boat dealers, eating and drinking places, hotels and lodging places, marinas, recreational vehicle parks and campsites, scenic water tours, sporting goods retailers, and zoos and aquaria) and zip codes (areas adjacent to the ocean) (Kildow et al., 2009). Marine-based tourism and recreation represent between 0.51 percent (Georgia) and 3.52 percent (Florida) of state employment and a slightly lesser share of wages, showing that tourism and recreation sectors tend to be an important source of employment for less qualified labor.

Table 4-35 shows that in the case of counties adjacent to the coast, the leisure and hospitality sector (defined by the Bureau of Labor Statistics as the sum of North American Industry Classification System codes 71 [arts, entertainment and recreation] and 72 [accommodation and food services]) can employ up to 19.31 percent (South Carolina) of the total employment of those counties.

4.2.9.2. Impacts of Routine Events

Potential impacts of routine G&G activities involved in Alternative A on recreational resources are evaluated in this section. The scope of G&G survey activity, equipment types, and geographic coverage were summarized in **Chapter 3**. Preliminary screening has identified the following IPFs related to G&G activities as potential sources of impact to recreational resources: (1) vessel exclusion zones, and (2) trash and debris (**Table 4-2**). All of these IPFs are associated with all types of G&G activities, as described in **Chapter 3.5**.

Activities related to G&G investigations would take place both offshore and in nearshore and coastal waters close to the shoreline. The G&G activities would include various types of surveys (e.g., deep penetration seismic, electromechanical), deep stratigraphic and shallow test drilling, and various types of bottom sampling. These surveys would occur under all three OCS programs (oil and gas, renewable energy, and marine minerals) and would include those areas where site characterization surveys are required for potential transmission lines or pipelines that might come onshore as part of future offshore projects. Thus, recreational activities in the offshore and nearshore environment (e.g., diving, fishing, boating, sightseeing) and along the coastline (e.g., swimming and other beach activities) could be located in proximity to G&G survey areas and could be affected by vessel exclusion zones and trash and debris. Even though in lagoons, along the mainland coastline behind the barrier islands, and embayments and harbors are not included in the AOI, recreational activities in these areas could be affected to a lesser extent from trash and debris associated with offshore or nearshore G&G activities that is carried into inland waters by tides.

4.2.9.2.1. Significance Criteria

Negligible impacts to recreational resources would include those where little to no measurable impacts are observed or expected. The G&G activities would neither interfere with nor diminish the use of recreational resources.

Minor impacts to recreational resources would include those that are detectable but are of short-term duration and are neither severe nor extensive. Minor impacts to recreational resources would include interference with the use of, or diminishment to, recreational resources for a short period of time (i.e., days).

Moderate impacts to recreational resources would be detectable and extensive but not severe or detectable, short-term or long-lasting, localized and severe. Moderate impacts to recreational resources would include those where G&G activities prohibit the use of recreational resources for up to a period of weeks.

Major impacts to recreational resources would be detectable, long-lasting in duration, spatially extensive, and severe in nature. Major impacts to recreational resources would include those where G&G activities prohibit the long-term use of recreational resources over a large area (i.e., for a period of months to years).

4.2.9.2.2. Evaluation

Vessel Exclusion Zones

Vessel exclusion zones would exclude recreational and commercial vessels as well as diving or other activities within an established zone surrounding the G&G activity. The vessel exclusion zones would be temporary, with the duration and areal extent dependent on the type of activity. The activities that involve towing equipment through the water column, such as the seismic airgun surveys, would require an extensive vessel exclusion zone; activities occurring over a single point, such as a drilling or benthic sampling activity, would also have to be avoided. However, the vessel exclusion zone for a seismic airgun survey would be larger but would move with the survey vessel, while drilling activity would require avoidance of a smaller area for a longer period of time. As an example, a typical vessel exclusion zone for a 2D or 3D survey involving a towed array would be approximately 8.5 km (4.6 nmi) long and 1.2 km (0.6 nmi) wide, covering a total of 1,021 ha (2,520 ac) of the sea surface. The length of time that any particular point would be within the vessel exclusion zone would be approximately 1 hour. Thus, all impacts would be of short duration (i.e., hours to days). As discussed in **Chapter 3.5.1.5**, the vessel exclusion zone is simply an area monitored by a seismic airgun survey operator and has no formal status or designation by the USCG. However, a Local Notice to Mariners would be issued that would specify the survey dates and locations and the recommended avoidance requirements for both vessels and divers.

Impacts on recreational activities could be more extensive if the vessel exclusion zone was established over a critical sport fishing period. For example, if a vessel exclusion zone were established in a fishing ground or along a species' migration route during the time when a recreationally important species was present, recreational users would have limited access to these resources. However, any vessel exclusion zone would be of short duration (i.e., hours to days), thus minimizing these types of impacts; therefore, impacts are expected to range from no impact to **negligible**.

Trash and Debris

Survey, sampling, and drilling operations generate trash comprising paper, plastic, wood, glass, and metal. Most trash is associated with galley and offshore food service operations. Offshore operators have developed and implemented trash and debris reduction and improved handling practices to reduce the amount of offshore trash that could potentially be lost into the marine environment. All survey vessels performing work within U.S. jurisdictional waters are expected to comply with Federal regulations, which include the requirements of MARPOL 73/78 Annex V, Regulations for the Control of Pollution by Garbage from Ships, as implemented by 33 CFR 151, which is designed to protect the marine environment from various types of garbage generated onboard vessels. In addition, all authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012). Therefore, with required compliance with Federal regulations and the requirements of MARPOL, the amount of trash and debris dumped offshore would be minimal, as only accidental loss of trash and debris is anticipated. As discussed in **Chapter 3.5.1.7**, USCG and USEPA have regulations requiring programs to minimize accidental loss of solid waste. The BOEM has also developed guidance instructing operators to exercise caution in the handling and disposal of small items and packaging materials, requiring the posting of placards at prominent locations on offshore vessels and structures, and mandating a yearly marine trash and debris awareness training and certification process.

Trash and debris accidentally released from vessels during survey activities could wash up on beaches and into harbors, embayments, and coastal salt marshes. Trash and debris on beaches would constitute aesthetic degradation of the recreational resource and adversely affect the current recreational use of the beach. Further, the presence of trash and debris could also result in a long term loss of reputation as a pristine tourist destination. Trash and debris can also present a safety hazard, both on beaches and in boating and fishing areas, where it could foul boat engines and fishing gear. However, since all survey vessels performing work within the U.S. jurisdictional waters are expected to comply with Federal regulations, which implement MARPOL 73/78. Within MARPOL Annex V, Regulations for the Control of Pollution by Garbage from Ships, as implemented by 33 CFR 151, are regulations designed to protect the marine environment from various types of garbage generated on board vessels. Therefore, the amount of trash and debris dumped offshore would be expected to be minimal, as only accidental loss of trash and debris is anticipated that could interfere with recreational use and is expected to result in a **negligible** to **minor** impact, depending on location.

4.2.9.3. Impacts of Accidental Fuel Spills

Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes diesel spill volumes in the range of 1.2-7.1 bbl. Accidental events resulting from a vessel collision and subsequent diesel fuel release would have limited impacts on recreational resources, based on the small amounts of fuel released. The potential does exist for any diesel fuel released to be carried to recreational areas by waves and currents (i.e., if the accident occurs close to shore) which could cause a sheen on the water. However, diesel fuel spilled on the ocean surface is expected to float and disperse via wind and wave activity and weather (i.e., light aromatic fractions would evaporate). Spill prevention and response measures would also be available to contain the small quantities that would be discharged. Given the small quantities of potential discharge and dispersal processes, the resultant impact is expected to be a sheen on water, which is very unlikely to reach beaches.

As described in **Chapter 3.5.2.1**, the risk of accidental fuel spills is expected to be remote. The impacts would depend on the size and location of the spill, in addition to the meterological conditions, which would affect the rate of weathering and transport. If a spill were to occur, which would likely involve a collision with fuel release, it would limit the access of recreational uses and limit the full use of the recreational resource for a short period of time. Given the very low probability of a sufficient release to impact recreational resources, the impact of a diesel fuel spill on recreational resources is expected to be **negligible** to **minor** depending on location of the spill.

Spill vessel response activity also has the potential to adversely affect recreational resources. However, given the size of the potential spill, a large-scale spill response involving multiple vessels is not expected. Small diesel spills (500-5,000 gal.) usually evaporate and disperse within a day or less, even in cold water (USDOC, NOAA, 2006); thus, seldom is there any oil on the surface for responders to recover. Therefore, impacts to recreational resources from a small accidental fuel spill are expected to be **negligible** to **minor**, depending on the location of the spill.

4.2.9.4. Cumulative Impacts

The cumulative impacts scenario discussed in detail in **Chapter 3.6** includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs for these cumulative activities that have the potential to affect recreational resources are vessel exclusion zones, trash and debris, and accidental events (smaller accidental events or low-probability large scale catastrophic events). Four IPFs are associated with all types of G&G activities including (1) exclusion zones; (2) trash and debris; and (3) accidental fuel spills.

Impact analyses presented in **Chapters 4.2.9.2** and **4.2.9.3** determined that activities projected to occur under Alternative A would result in **negligible** or **minor** impacts to recreational resources. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Vessel Exclusion Zones

Several activities expected to occur under the cumulative impacts scenario may utilize vessel exclusion zones. Drilling operations to be conducted as part of oil and gas development, vessel approach and departure fairways used as part of LNG import terminals, and shipping and marine transportation vessel traffic corridors would exclude private vessel operations within prescribed distances from transiting vessels or operations. In addition, G&G seismic survey activities would employ a vessel exclusion zone to protect towed streamers. The vessel exclusion zone would be maintained around the source vessel and arrays during seismic airgun surveys.

A sizeable portion of the AOI includes military range complexes and civilian space program use areas that include designated danger areas, restricted areas, and closure areas that limit access by vessel traffic, including recreational activities, during specific times or prior to/during specific activities or operations; in some instances, areas may be completely closed to all vessel traffic. Establishment of additional vessel exclusion zones under Alternative A would be temporary, with the duration and areal extent dependent on the type of activity. Because there are no significant impacts evident from the cumulative activities scenario, and a vessel exclusion zone's primary impact is a short-term displacement of use of a recreational resource, it is expected that the impacts associated with the proposed action would result in a small incremental increase in potential impact to recreational resources under the cumulative scenario.

Trash and Debris

Companies operating offshore have developed and implemented trash and debris reduction and improved handling practices over the last several years to reduce the amount of offshore trash that could potentially be lost to the marine environment. These improved practices would also apply to all activities included under the cumulative scenario. With improved trash handling practices and the required compliance with Federal regulations, which include MARPOL and Annex V requirements, the amount of trash and debris dumped offshore would be minimal; only accidental loss of trash and debris is anticipated. In addition, BOEM would develop guidance similar BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012), which would include guidance for marine debris awareness (**Appendix C**). This guidance would instruct operators to exercise caution in the handling and disposal of small items and packaging materials, require the posting of placards at prominent locations on offshore vessels and structures, and mandate a yearly marine trash and debris awareness training and certification process.

Within the cumulative activities scenario, the operation of survey vessels presents the potential for an incremental increase in the release of trash and debris in the coastal marine environment. All authorizations for shipboard surveys would include guidance for marine debris awareness. The guidance would be similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012). However, with the protective measures in place for commercial vessel operating offshore to minimize trash and debris discharges offshore, from looking at the types of debris that is typically found along beaches, it is expected that much of this trash is not generated from the activities included in the cumulative scenario (Ocean Conservancy, 2011). Since there are no significant impacts evident from the cumulative activities scenario and there are protective measures in place to prevent trash and debris from being dumped offshore, it is expected that the impacts associated with the proposed action would result in a small incremental increase in potential impact to recreational resources under the cumulative scenario. Impacts from trash and debris under Alternative A would not produce time or space crowding, would not result in significant synergistic (compounding) impacts, would not produce widespread exceedance of exposure thresholds, and would not result in the progressive loss of recreational resources in the AOI.

Accidental Fuel Spills

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to recreational resources would vary depending on the location and size of the spill. However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prior to any wells being drilled. In addition, a project-specific EA would require an analysis of site-specific information and mitigation measures taken to minimize impacts from drilling activities and potential accidental crude oil spills. With the required mitigation measures in place and with oversight of these activities by the BSEE, an accidental crude oil spill from an exploratory well is not anticipated; however, a spill still could occur. With these mitigation measures in place, the impacts to recreational resources from exploratory drilling operations would be expected to be negligible to minor, depending on the location, timing, and size.

A significant amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. Spill effects on recreational resources, as well as spill response vessel operations, would have a direct but limited effect on recreational activities. Therefore, the risk of accidental fuel spills arising from a vessel collision under the cumulative scenario is expected to range from negligible to minor, depending on the location.

The likelihood of a fuel spill during seismic airgun surveys or other G&G activities is expected to be remote, and the associated impacts would be expected to be **negligible** to **minor**, depending on location (**Chapter 4.2.9.3**). Given the size of the potential spill (1.2-7.1 bbl), a large-scale spill response involving multiple vessels is not expected. Small diesel spills (500-5,000 gal.) usually evaporate and disperse within a day or less, even in cold water (USDOC, NOAA, 2006); thus, seldom is there any oil on the surface for responders to recover. The impacts to recreational resources from spill response and cleanup activities associated with fuel spills from vessels under the cumulative activities scenario are expected to be negligible to minor depending on location. The G&G activities expected under Alternative A and the associated accidental fuel spills, should it occur, would produce a minor incremental increase in spill impacts.

4.2.10. Archaeological Resources

4.2.10.1. Description of the Affected Environment

Submerged cultural resources within the AOI include shipwrecks that date from early exploration and settlement of North America by Europeans as early as the 16th and 17th centuries. Submerged prehistoric sites dating between 30,000 and 3,000 B.P. may also be present within the AOI, depending on regional landform variation.

The AOI includes State and Federal waters (outside of estuaries) from Delaware Bay south to approximately Cape Canaveral, Florida, extending 648 km (350 nmi) seaward from the MHW line. In this discussion, "nearshore" refers to waters from the shoreline to the 100-m isobath, which is the outer depth limit for most renewable energy and marine minerals projects. "Offshore" refers to the zone extending from the 100-m isobath to the outer boundary of the AOI.

4.2.10.1.1. Historic Shipwrecks

European voyagers have been exploring the Atlantic seaboard since A.D. 1000, but it was not until the 16th century that expeditions reached the Mid-Atlantic and South Atlantic regions. Shipwrecks within the AOI date from the 16th century until modern times.

Estimates regarding the volume of shipwrecks and obstructions in the AOI were calculated utilizing various databases including the NOAA AWOIS, the NOAA Aids to Navigation (NavAids), the USCG Hazards to Navigation, and the Global Maritime Wrecks Database (GMWD). Information from the AWOIS database includes position (latitude/longitude), feature description, and any known historic and or descriptive details. Position accuracy of AWOIS wrecks and/or obstructions is highly variable and can be as much as a full kilometer from the actual wreck and/or obstruction. The NOAA NavAids database identifies wreck locations, obstructions, platforms, submerged pilings, navigational aids, and light/channel markers. The USCG Hazards to Navigation database identifies obstructions, wreck locations, buoys, and unidentified target locations. The GMWD provides a range of information for each site including wreck name, wreck nationality, date of sinking, depth of wreck, vessel category, gross tons, sinking agent, nominal accuracy of wreck location, source of wreck, nationality of the vessel that sunk the wreck, and more.

A variety of secondary sources relative to shipwrecks within the AOI were also reviewed, including Lytle and Holdcamper (1975), Marx (1987), and Berman (1973). Lytle and Holdcamper (1975) (also known as the Lytle-Holdcamper List) was originally compiled in 1952 and reprinted in 1975 and is a comprehensive register of most steam vessels in the U.S. from 1790 to 1868. The primary sources, compiled by William M. Lytle, include abstracts of registers, licenses, and enrollment documents sent or surrendered to the Bureau of Navigation. The list also includes a section titled "Losses of United States Merchant Vessels, 1790–1868" that provides vessel name, tonnage, year built, nature of wreck, date, place, and lives lost. Over 3,800 vessels are listed as lost during the time period in question. Careful attention was given to location of a specific wreck site (Charleston, South Carolina; off Charleston; etc.). While the reference is general in nature and only covers American steam vessels through the Civil War, it can offer an indication of potential losses within the AOI. Berman's work includes approximately 13,000 shipwrecks within American waters (excluding vessels less than 50 gross tons). The encyclopedia covers vessels dating from the pre-Revolutionary era to modern times, from coastal waters to inland waterways.

It should be noted that many of the shipwreck databases and secondary sources overlap, generating repetitiveness in data. Additionally, these primary and secondary sources are far from comprehensive. They tend to focus on large merchant vessels and omit the smaller coastal trading, fishing, and other locally produced vernacular watercraft that may be present in the nearshore zone of the AOI. By omitting smaller coastal watercraft, the potential for shipwrecks in the nearshore zone would certainly be underestimated.

Review of all databases and secondary sources identified 4,676 known wrecks, obstructions, archaeological sites, occurrences, or sites marked as "unknown" in the AOI (**Figure 4-31**). Of these sites, 4,266 (91%) are within the 100-m depth contour (nearshore zone) and 410 (9%) are in deeper waters (offshore zone). Even though diver investigation of many obstructions identified as "unknown" are eventually identified as modern debris, they cannot be ruled out as potential submerged cultural resources. A study by TRC Environmental Corporation (TRC) (TRC, 2011) reports there are approximately 7,900 wrecks located within the Federal portion of the Atlantic OCS that borders the seven states in the AOI (includes all of Florida), and the distribution of these wrecks appears to be closely correlated to vessel traffic, especially in the vicinity of port approaches and navigational hazards.

4.2.10.1.2. Prehistoric Resources

Submerged cultural resources also include prehistoric archaeological sites. Based on current research, sea levels were approximately 70 m (230 ft) lower than at present at the start of the Paleo-Indian period (30,000 B.P.) and were approximately 30 m (98 ft) lower than at present around 10,000 B.P., rising to nearly 10 m (33 ft) below present by 6,000 B.P. (TRC, 2011). Over the past 2,500 years in

Florida, sea level has risen at an average rate of about 3.8 cm (1.5 in) per century. However, since 1932 (when tide-gauge monitoring stations were installed), Florida has incurred a 22.9 cm (9-in) relative rise in sea level. It has been postulated that this accelerated rise is the result of warming (and expansion) of water in the western North Atlantic Ocean (Broward County Climate Change Task Force, 2009).

The possibility of locating submerged prehistoric sites would be greatest in the nearshore zone (less than 100-m (328-ft) water depth) because some of this area would have been exposed land during the period of human occupation. In a recent study regarding submerged prehistoric cultural resources on the Atlantic OCS, TRC (2011) identified high sensitivity zones extending from depths of 0-70 m (0-230 ft) offshore the Mid-Atlantic and Georgia Bight and from depths of 0-60 m (0-197 ft) offshore Florida. Low sensitivity zones were from depths of 70-120 m (230-394 ft) offshore the Mid-Atlantic, 70-110 m (230-361 ft) offshore the Georgia Bight, and 60-120 m (197-394 ft) offshore Florida. Areas deeper than 120 m (394 ft) offshore the Mid-Atlantic and Florida (or deeper than 110 m [361 ft] in the Georgia Bight) can be expected as having no sensitivity (TRC, 2011).

Along the Mid-Atlantic and as far south as the border between Georgia and Florida, rapid sea level rise may have increased the potential for preservation of Paleo-Indian and Archaic sites located in the vicinity of paleochannels. Off the coast of Florida, within the sensitivity areas identified by TRC (2011), there is low potential for Paleo-Indian and early Archaic sites in water depths greater than 10 m (33 ft).

Limited information regarding late Pleistocene/early Holocene sites and settlement patterns make it difficult to accurately predict the location of submerged prehistoric cultural resources. As a result, information from Archaic coastal terrestrial sites and research on paleolandscapes have enabled researchers to identify which sort of land forms (seen using high-resolution remote sensing equipment) are likely to yield evidence of submerged prehistoric cultural resources. The most commonly seen and widely distributed on the Atlantic OCS are relict river channels found off the coast of Virginia, South Carolina, Georgia, and Florida. As depicted by TRC (2011), these geographic features tend to have higher concentrations of submerged prehistoric sites (**Figure 4-32**).

Until recently, the earliest material culture that has been identified in the Paleo-Indian period in the U.S., called Clovis, is represented by distinctly basal fluted projectile points that date as far back as 12,500 B.P. This Paleo-Indian settlement pattern is described as semi-nomadic within a defined territory, reliant on reliable fresh water sources and cryptocrystalline raw material sources, exploiting large and small game along with wild plants. As a result of a semi-nomadic settlement pattern, Paleo-Indian sites that are most visible in the archaeological record would most likely be located in proximity to fresh water sources that would have been visited repeatedly. Material related to Clovis culture can be found throughout most of the U.S.

Recently, there have been sites discovered that could potentially pre-date Clovis culture. Sites such as Cactus Hill and Saltville in Virginia show evidence of Clovis and what appears to be pre-Clovis occupation. Along the South Carolina side of the Savannah River, ongoing excavations at the Topper Site appear to be revealing a distinct assemblage of multifaceted flake tools that may indicate a pre-Clovis occupation (Waters et al., 2009). It has been hypothesized that the original routes taken to populate the U.S. might have followed a coastal migration. Based on bathymetric research, it is likely that land beneath the Chesapeake Bay contains Paleo-Indian sites (Blanton, 1996).

Conditions necessary for preservation of intact Paleo-Indian sites along the Atlantic OCS are variable and depend on geomorphological conditions and the speed of sea level rise. Current research on regional geology, relative sea level changes, and marine transgression are providing useful data concerning the possibility that there may be intact Paleo-Indian sites submerged along the Atlantic OCS. These submerged Paleo-Indian sites would most likely be found in the vicinity of paleochannels or river terraces that offer the highest potential of site preservation.

4.2.10.2. Impacts of Routine Events

Routine events in the oil and gas, renewable energy, and marine minerals programs were discussed in **Chapter 3**. Those activities that do not impact the seafloor (e.g., seismic survey activity) should have no effect on submerged cultural resources. Preliminary screening has identified the following IPFs related to G&G activities as potential sources of impact to archaeological resources: (1) seafloor disturbance, and (2) drilling discharges (**Chapter 4.1.1**, **Table 4-2**). Oil and gas program activities that have been identified in association with seafloor disturbance include anchor placement (i.e., 3D controlled source electromagnetic anchors with bottom receivers, 4D time lapse surveys, and MT survey anchors with bottom receivers), coring (i.e., geologic coring), and drilling (i.e., COST wells, shallow test drilling, and VSP). Within the renewable energy development program, seafloor disturbance includes PCPT, anchoring (i.e., bottom-founded monitoring buoys), coring, and grab sampling. In the marine minerals program, seafloor disturbance is expected from coring.

4.2.10.2.1. Significance Criteria

The NHPA (16 U.S.C. 470 et seq.) established a national program to preserve the country's historical and cultural resources. Section 106 of the NHPA requires Federal agencies to consider the effects of their actions on historic properties and provide the President's Advisory Council on Historic Preservation an opportunity to comment on a proposed action before it is implemented. Regulations for implementing the Section 106 process are provided in 36 CFR 800. Both State and Federal guidelines for cultural resources recognize that buildings, structures, objects, districts, archaeological sites, and cultural landscapes can be historically significant. Under NHPA Section 106 (36 CFR 800.16), a historic property is "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places." Districts include the property types known as cultural landscapes (historic, rural, designed, etc.). To be eligible for the National Register of Historic Places (NRHP), these property types must be over 50 years old and meet at least one of the NRHP significance evaluation criteria (36 CFR 60.4) to be considered a historic property, and the property must also possess integrity. Specific aspects or types of integrity include location, design, setting, materials, workmanship, feeling, and association. The NRHP historic properties meet one or more of the following evaluation criteria:

- the property is associated with events that have made a significant contribution to the broad patterns of our history (Criterion A);
- the property is associated with the lives of persons significant in our past (Criterion B);
- the property embodies the distinctive characteristics of a type, period, or method of construction; represents the work of a master; possesses high artistic values; or represents a significant and distinguishable entity whose components may lack individual distinction (Criterion C); and/or
- the property has yielded, or may be likely to yield, information important to prehistory or history (Criterion D).

In consideration of the NRHP criteria noted above and the sensitivity of submerged cultural resources to disturbance, the following significance criteria are utilized in this analysis.

Negligible impacts to archaeological resources would include those where little to no measurable impacts are observed or expected. Negligible impacts would also include any effects upon suspected archaeological resources on the seafloor that are determined to be modern debris.

Minor impacts to archaeological resources would include those that are detectable but are neither severe nor extensive. Minor impacts to archaeological resources would include impacts arising from any activity that results in the alteration of, or causes a change to, stable environmental conditions for a significant submerged cultural resource. Further, such alteration or change would not change the significance of a submerged cultural resource or directly or indirectly result in the loss of diagnostic features or research potential of a submerged cultural resource.

Moderate impacts to archaeological resources would be detectable and extensive but not severe. Moderate impacts to archaeological resources would include impacts arising from any activity that results in the alteration of, or causes a change to, stable environmental conditions for a significant submerged cultural resource. However, in contrast to minor impacts, such alteration or change has the potential to change the significance of a submerged cultural resource or directly or indirectly result in the loss of diagnostic features or research potential of a submerged cultural resource.

Major impacts to archaeological resources would be detectable, extensive, and severe. Major impacts to archaeological resources would include any G&G activity that results in the permanent loss or damage to diagnostic features or research potential of a submerged cultural resource, disturbance of human remains associated with identified submerged cultural resources, adverse change in the significance of a submerged cultural resource, or exposure of previously buried features to harmful environmental conditions.

4.2.10.2.2. Evaluation

Seafloor Disturbance

Placement of equipment (e.g., anchors, nodes, cables, sensors, bottom-founded monitoring buoys) on the seafloor has the potential to damage any significant archaeological resources present. The renewable energy program would include 7-38 bottom-founded monitoring buoys and is expected to have an impact as large as 129 ha (319 ac), if all proposed monitoring buouys are installed. Conducting 3D control source electromagnetic surveys and MT surveys would impact the seafloor where anchors and receivers are deployed. The affected area would be spread out but would typically be less than one OCS block in size.

Bottom sampling activities have the potential to affect both historic and prehistoric archaeological resources via physical damage. Geologic coring, grab sampling, and the use of a piezocene penetrometer are expected to impact approximately 10 m^2 (108 ft^2) of the seafloor for each sample collected. Sampling activities are expected in all three program areas.

COST wells and shallow test drilling that is associated with exploration activities are expected to impact the seafloor over an area greater than or equal to 2 ha (5 ac) per well, primarily through the physical coring of the sediment. Secondarily, deposition of drill muds and cuttings may bury artifacts, making their future detection more difficult.

The depth distribution of submerged cultural resources is an important consideration when evaluating the potential for impact. While historic shipwrecks may occur at any water depth within the AOI, prehistoric resources are depth-limited by region, as outlined in **Chapter 4.2.10.1.2**. Further, highest probabilities for encountering submerged prehistoric sites vary within the AOI, primarily by depth (e.g., 0-70 m [0-230 ft] offshore the Mid-Atlantic and within the Georgia Bight; 0-60 m [0-197 ft] offshore Florida) and location (i.e., higher probability of sites within relict paleochannels). In general, areas deeper than 120 m (394 ft) offshore the Mid-Atlantic and Florida or deeper than 110 m (361 ft) in the Georgia Bight can be expected as having no sensitivity for the presence of and no potential for impact to prehistoric resources. Additionally, any seafloor disturbance in water depths >110-120 m (>361-394 ft) would likely have no potential for impact to submerged prehistoric resources but would have impact potential for historic shipwrecks. In shallower depths, it is most likely that submerged prehistoric resources would likely be found in the vicinity of paleochannels or similar geomorphic features that posess a higher potential for preservation relative to other areas.

Because of the rich maritime history and potential for submerged prehistoric resources in the AOI, all activities that disturb the seafloor have potential to impact previously unrecorded cultural resources. The potential areas of impact for survey operations are limited to small widely dispersed areas caused by coring, nodes and ocean bottom cable surveys, vertical cable surveys, and anchor deployments associated with each of these activities. The potential for impacts to archaeological resources resulting from G&G surveys would be further reduced through predisturbance survey plan reviews provided by BOEM. The seafloor disturbance associated with these survey activities would likely result in **negligible** impacts to archaeological resources If, during the course of G&G activity, it is determined that a potential shipwreck or prehistoric site has been located, the operator would immediately halt operations and take the necessary steps to ensure that the site is not disturbed further. The BOEM must also be notified within 48 hr of the discovery.

The BOEM would require site-specific information regarding potential archaeological resources and sensitive benthic communities (including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. The BOEM would use this information to ensure that physical impacts to archaeological resources or sensitive benthic communities are avoided.

For the renewable energy program, BOEM has issued *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 585* (USDOI, BOEM, 2011d). The guidelines specify that a site characterization survey must reliably cover any portion of the site that would be affected by seafloor-disturbing activities. The guidelines recommend avoidance as a primary mitigation strategy for objects of historical or archaeological significance.

Drilling Discharges

It is unlikely that archaeological resources would be affected by drilling discharges in the AOI during the time period of the Programmatic EIS. The oil and gas scenario for the Mid- and South Atlantic Planning Areas predicts that as many as three COST wells and five shallow test drilling activities would occur during the time period covered by the Programmatic EIS. Anticipated impacts to archaeological resources from drilling include discharge of drilling fluids, cuttings, and localized accumulation of cement slurry. Based on the limited impacts of these activities to benthic communities as discussed in **Chapter 4.2.1.2**, it is likely that the impact to archaeological resources would also be **negligible**. Avoidance of archaeological resources and immediate reporting of unanticipated discoveries to BOEM are expected to prevent a serious impact to archaeological resources. Given the BOEM requirement for site-specific information regarding archaeological resources, impacts from drilling discharges in the AOI are expected to be **negligible**.

4.2.10.3. Impacts of Accidental Fuel Spills

An accidental event could result in release of fuel or diesel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes a diesel spill ranging from 1.2 to 7.1 bbl. Spills occurring at the ocean surface would disperse and weather. Volatile components of the fuel would evaporate. Fuel and diesel used for operation of survey vessels is light and would float on the water surface. There is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink. Particulate matter contaminated with diesel fuel could eventually reach the seafloor, either within or outside the AOI, depending upon spill location, water depth, ambient currents, and sinking rate. However, given the relatively small size of the spill and the loss of most spilled fuel through evaporation and dispersion, a small diesel fuel spill at the surface would have no effect on the seafloor and would not require seafloor cleanup activity. An accidental diesel fuel spills would be expected to result in **negligible** impacts to archaeological resources.

4.2.10.4. Cumulative Impacts

The cumulative impacts scenario discussed in detail in **Chapter 3.6** includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs identified under Alterntive A that have the potential to affect archaeological resources include (1) seafloor disturbance; (2) drilling discharges; and (3) accidental fuel spills.

Impact analyses presented in **Chapters 4.2.10.2** and **4.2.10.3** determined that activities projected to occur under Alternative A would result in negligible impacts to archaeological resources. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Seafloor Disturbance

Within the cumulative activities scenario, the placement of equipment (e.g., anchors, nodes, cables, sensors, bottom-founded monitoring buoys) on the seafloor has the potential to damage archaeological resources present. Submerged cultural resources may be impacted by activities related to any of the nine cumulative activities that involve bottom-disturbing operations. For those activities under their purview, BOEM has existing regulations in place (NTLs) regarding submerged cultural resources and their preservation. Because of the rarity of non-renewable submerged cultural resources and the high potential for information loss and damage, cumulative impacts to submerged archaeological resources are potentially significant. However, all activities under BOEM purview that have the potential to disturb the seafloor would be subject to an avoidance survey as outlined by BOEM's *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 285* (USDOI, BOEM, 2011d) in order to ensure that historic and prehistoric submerged cultural resources are not affected. Areas identified with potential historic shipwreck or prehistoric archaeological resources should be assigned an avoidance zone for all cumulative activities. If, during the course of G&G activity, it is determined that a potential shipwreck or prehistoric site has been located, the operator must immediately halt operations and take the necessary steps to ensure that the site is not disturbed further. The BOEM must also be notified within 48 hr of the discovery. If existing protective measures and lease stipulations are followed, then no adverse impacts to submerged cultural resources are anticipated, and impacts to archaeological resources from seafloor disturbance associated with the cumulative activities scenario would be negligible. However, BOEM requirements do not protect the resources from activities outside of BOEM jurisdiction (i.e., commercial and recreational fishing and dredged material disposal).

Similarly, G&G activities would be conducted with similar information gathering, avoidance, and reporting requirements. As with the cumulative scenario, if existing protective measures and lease stipulations are followed, then no adverse impacts to submerged cultural resources are anticipated, and impacts to archaeological resources from seafloor disturbance associated with Alternative A would be negligible.

Because there are strict protective measures in place to protect undiscovered artifacts, and there is no evidence that cumulative G&G activities would damage archaeological resources, it is expected that there would be a minor incremental increase in impacts to archaeological resources from seafloor disturbance under the cumulative scenario. Cumulative impacts to archaeological resources from G&G related seafloor disturbance are expected to be negligible.

Drilling Discharges

Cumulative scenario activities that would include discharges of drilling fluids, drill cuttings, and other effluents from drilling rigs (e.g., oil and gas development, geosequestration) would require BOEM authorization and the submittal and agency review of site-specific information regarding archaeological resources prior to activity approval. It is expected that BOEM's review would ensure that physical impacts to sensitive archaeological resources are avoided and that these resources are protected from impacts from cumulative scenario activities.

Anticipated impacts to archaeological resources from drilling include discharge of drilling fluids, cuttings, and localized accumulation of cement slurry. Based on the limited impacts of these activities to benthic communities as discussed in **Chapter 4.2.1.2**, it is likely that the impact to archaeological resources would also be **negligible**. Avoidance of archaeological resources and immediate reporting of unanticipated discoveries to BOEM are expected to prevent a serious impact to archaeological resources.

Because impacts to archaeological resources associated with drilling discharges from the cumulative activities scenario are expected to be negligible, the proposed action would add an extremely small area of seafloor disturbance to the cumulative area affected. Therefore, the impacts associated with Alternative A would result in a negligible incremental increase in seafloor impacts associated with drilling discharges.

Accidental Fuel Spills

A significant amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The impacts of an accidental fuel spill arising from a vessel collision under the cumulative scenario are expected to range from negligible to minor.

The likelihood of a fuel spill during seismic airgun surveys or other G&G activities is considered to be remote, and the associated impacts are expected to be **negligible** (**Chapter 4.2.10.3**). Given the size of the potential spill, a large-scale spill response involving multiple vessels is not expected. Seafloor-disturbing activities associated with spill cleanup are not expected. Minor incremental impacts toarchaeological resources from spill response and cleanup activities associated with a fuel spill from vessels are expected under the cumulative activities scenario.

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, no impacts to archaeological resources would be expected. Before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any Exploration Plan submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prior to any wells drilled. In addition, a project-specific EA would require an analysis of site-specific information regarding submerged archaeological resources and mitigation measures taken to minimize impacts from drilling activities and potential accidental crude oil spills. An accidental crude oil spill from an exploratory well is not anticipated with the required mitigation measures in place and with oversight of these activities by BSEE as included in CFR Title 30 Chapter II, Part 250; however, a spill could potentially still occur. However, with these mitigation measures in place, the impacts to archaeological resources from exploratory drilling operations would be negligible.

4.2.11. Marine Protected Areas

An MPA is defined by EO 13158 as "any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." A National System of Marine Protected Areas was established in 2009 as a nationwide program for the effective stewardship, conservation, restoration, sustainable use, understanding, and appreciation of marine resources. The national system currently includes 254 Federal, State, and territorial MPAs covering an area of 453,250 km^2 (175,000 mi^2) (National Marine Protected Areas Center, 2008).

Section 5 of EO 13158 specifies that "each Federal agency whose actions affect the natural or cultural resources that are protected by an MPA shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each Federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA."

4.2.11.1. Description of the Affected Environment

The MPAs within and adjacent to the AOI are listed in **Table 4-36**, and their locations are shown in **Figures 4-33** to **4-35**. The following text focuses on MPAs within the AOI (i.e., in nearshore or offshore waters), followed by a brief summary of coastal MPAs.

4.2.11.1.1. National Marine Sanctuaries

Two NMSs have been established in the AOI: the Monitor NMS, located off the coast of North Carolina, and Gray's Reef NMS, located off the coast of Georgia (**Table 4-36**; **Figure 4-33**). They are administered by NOAA's ONMS.

Monitor National Marine Sanctuary

The Monitor NMS is located 26 km (14 nmi) off Cape Hatteras, North Carolina. The *USS Monitor* was a Civil War ship and the Navy's first ironclad warship. The Monitor NMS is closed to the public with access restricted to scientific research and managing officials. The *USS Monitor* sank off Cape Hatteras during a storm in December 1862, and its location was unknown until 1973 when the ship was found 30 km (14 nmi) off Cape Hatteras in 70 m (230 ft) of water. In 1975, the *Monitor* was named the nation's first NMS (Monitor NMS, 2011). Federal regulations (15 CFR 922) prohibit certain activities in the Monitor NMS, including anchoring, diving (except as authorized), cable laying, coring, dredging, drilling, detonating explosives, conducting salvage operations, trawling, or discharging wastes in violation of Federal regulations.

Gray's Reef National Marine Sanctuary

Gray's Reef NMS is located 32 km (17 nmi) east of Sapelo Island, Georgia, and encompasses an area of 57.4 km^2 (22.2 mi^2) (Gray's Reef National Marine Sanctuary, 2011b). It was designated in 1981 as the nation's fourth marine sanctuary to protect the unique hard bottom habitat that supports a variety of sessile organisms (e.g., sponges, corals, sea fans, and barnacles). Gray's Reef NMS has been recognized as a unique bioregion by the United Nations. Invertebrates constitute the live hard bottom and support reef fishes (e.g., black sea bass, snappers, groupers, and mackerels) as well as the threatened loggerhead sea turtle. Gray's Reef is within the winter calving ground for the endangered North Atlantic right whale, which is occasionally seen in the sanctuary. The reef is also a popular dive site and the largest nearshore live bottom habitat available to recreational fishermen in the Georgia region. Federal regulations (15 CFR 922, Subpart I) prohibit certain activities in Gray's Reef NMS, including anchoring; dredging, drilling, or altering submerged lands; constructing, placing, abandoning any structure, material or other matter on submerged lands; discharging or depositing any material; injuring, catching, harvesting or collecting marine organisms; using explosives or devices that produce electric charges; and breaking, cutting, damaging, taking, or removing any bottom formation or sanctuary historical resource. Further information on Gray's Reef NMS is provided in **Chapter 4.2.1.2.**

4.2.11.1.2. Deepwater Marine Protected Areas

The SAFMC (2011b) defines MPAs within its jurisdiction as a network of specific areas of marine environments reserved and managed for the primary purpose of aiding in the recovery of overfished stocks and to ensure the persistence of healthy fish stocks, fisheries, and associated habitats. Such areas may include naturally occurring or artificial bottom and water column habitats, and may include prohibition of harvest on seasonal or permanent time periods to achieve desired fishery conservation and management goals.

Eight deepwater MPAs have been established in the South Atlantic region through implementation of Amendment 14 to the Snapper Grouper Fishery Management Plan (SAFMC, 2007). Six of these deepwater MPAs are within the AOI (**Table 4-36**; **Figure 4-34**). The MPAs are designed to protect a portion of the long-lived, deepwater snapper-grouper species such as blueline tilefish, snowy grouper, and speckled hind. In these deepwater MPAs, fishing for or possession of any snapper-grouper complex species (73 species) and shark bottom longline gear are prohibited. Vessels (both commercial and recreational) may transit (direct, non-stop progression) through the MPAs with snapper-grouper complex species on board with fishing gear appropriately stowed. Trolling for pelagic species such as tunas, dolphin, mackerels, and billfishes is allowed within the MPAs. The following paragraphs describe the six deepwater MPAs in the AOI, from north to south, based on the SAFMC website (SAFMC, 2011b).

Snowy Grouper Wreck Marine Protected Area

The Snowy Grouper Wreck MPA has an area of 514 km^2 (150 nmi^2) and is located approximately 102 km (55 nmi) southeast of Southport, North Carolina (east of Cape Fear). It includes a wreck site known to have once held spawning aggregations of snowy grouper and may also contain smaller wrecks. Substantial hard bottom habitat is present and has the potential to protect a portion of deepwater snapper-grouper species, as well as some mid-shelf species, from directed fishing pressure. Bottom fishes known to frequent the area include gag grouper, graysby, hogfish, red grouper, red porgy, snowy grouper, and speckled hind. Prior to the MPA designation, the Snowy Grouper Wreck site was mostly fished by commercial snapper-grouper fishermen out of Little River, South Carolina, and the ports of Carolina Beach and Southport, North Carolina. This area was also heavily fished by fishermen who troll for dolphin, marlins, tunas, and wahoo during certain times of the year. After discovery of the wreck in 1990's, the area was quickly fished down.

Northern South Carolina Marine Protected Area

The Northern South Carolina MPA has an area of 171 km^2 (50 nmi^2) and is approximately 100 km (54 nmi) from Murrells Inlet, South Carolina. It contains areas of low relief and hard bottom habitat consisting of eroded rock in shelf edge water depths where vermilion snapper is found. Prior to the MPA designation, fishing focused on deepwater species like snowy grouper, speckled hind, and yellowedge grouper as well as gag grouper, red porgy, and triggerfish. The site has the potential of protecting several species of deepwater snappers and groupers, mid-shelf species, and associated habitat.

Edisto Marine Protected Area

Located 83 km (45 nmi) southeast of the Charleston, South Carolina harbor, the 50 nmi^2 Edisto MPA was heavily fished by both commercial and recreational fishermen prior to the MPA designation. Species such as black sea bass, blueline tilefish, gag, scamp, juvenile snowy grouper, red porgy, speckled hind, and vermilion snapper reside in this shelf-edge habitat.

Charleston Deep Reef Marine Protected Area

The Charleston Deep Reef MPA is a 6.5 by 11 km (3.5 by 6 nmi) area proposed as an experimental artificial reef site located about 93 km (50 nmi) southeast of Charleston Harbor, South Carolina. There is no hard bottom in the area. Any biological benefits to deepwater species would accrue after artificial reef material (such as sunken ships, tanks, or highway materials) is added to improve habitat and attract fishes. Long-term study of this site may provide important biological information about deepwater snapper-grouper species and the effectiveness of deepwater artificial reefs.

Georgia Marine Protected Area

The Georgia MPA is located 128 km (69 nmi) southeast of the mouth of Wassaw Sound, Georgia, and covers a area of 343 km^2 (100 nmi^2). Although most fishing in the area is for pelagic species such as tunas and dolphin, species such as snowy grouper and golden tilefish were often caught prior to the MPA designation. This area lies east of an area called the "Triple Ledge" that is an important area for commercial fishermen and was occasionally fished commercially for snapper-grouper species.

North Florida Marine Protected Area

Located 111 km (60 nmi) off the mouth of the St. Johns River near Jacksonville, Florida, the 343-km^2 (100-nmi^2) North Florida MPA has some mud bottom habitat and shelf-edge reef of slab pavement, blocked boulders, and buried blocked boulders. Snowy grouper and speckled hind have been caught in the area, and the mud bottom may also be habitat for golden tilefish. Some mid-shelf species that that are also likely to inhabit the area include vermilion snapper, hogfish, scamp, red porgy, and tomtate.

4.2.11.1.3. Other Federal Fishery Management Areas

Numerous other Federal fishery management areas have been designated by NMFS, the SAFMC, or the MAFMC (**Table 4-36**). These areas have restrictions on certain types of fishing activities that, although not directly relevant to the proposed action, are important because of the protected resources and the types of activities that are prohibited. See **Chapter 4.2.7.1.4** for a discussion of commercial fishing closures and restrictions.

4.2.11.1.4. Coastal Marine Protected Areas

National Park System (National Seashores)

There are five national seashores along the coast adjacent to the AOI that are administered by the National Park Service: Assateague Island National Seashore, Cape Hatteras National Seashore, Cape Lookout National Seashore, Cumberland Island National Seashore, and Canaveral National Seashore (**Figure 4-33**) (National Park Service, 2011).

Cape Hatteras was the first national seashore (1953), and Canaveral is the newest (1975). National seashores are coastal areas federally designated as being of natural and recreational significance as a preserved area. All national parks are required to have an approved General Management Plan that provides a framework to guide decisions for natural and cultural resource protection, appropriate types and levels of visitor activities, and appropriate facility development (National Park Service, 2011).

National Estuarine Research Reserves and National Estuary Program

The National Estuarine Research Reserves System is a partnership between NOAA and the coastal states that protects more than 1.3 million coastal and estuarine acres in a network of 28 reserves located in 22 states and Puerto Rico. The reserves consist of relatively pristine estuarine areas that contain key habitat for purposes of long-term research, environmental monitoring, education, and stewardship and are protected from significant ecological change or developmental impacts (National Estuarine Research Reserve System, 2011).

There are several National Estuarine Research Reserve (NERR) sites in Atlantic coastal states, but the Guana Tolomato Matanzas NERR is the only one that extends into open ocean waters. Located near St. Augustine, Florida, it includes 10,117 ha (25,000 ac) of open ocean as well as a range of other habitats including mangrove forests, lagoons, and upland habitats (**Figure 4-35**). Several protected bird species (e.g., bald eagle, rosette spoonbill, and peregrine falcon) and the Florida manatee are found in the reserve, and the offshore waters are considered breeding grounds for the endangered North Atlantic right whale (Frazel, 2009). The NERR supports 16 species that are fished or harvested commercially and 18 species that are fished recreationally (Florida Department of Environmental Protection, 2011).

Although not designated as MPAs, four National Estuary Program (NEP) sites occur along the Mid-Atlantic and South Atlantic coasts (NEP, 2011): Delaware Inland Bays, Maryland Coastal Bays, Albermarle-Pamlico Sounds (North Carolina), and Indian River Lagoon (Florida). Also, the Chesapeake Bay Program encompasses Chesapeake Bay waters from Virginia, Maryland, Delaware, and Pennsylvania (Chesapeake Bay Program, 2011).

National Wildlife Refuges

Ten NWRs are located along the coast adjacent to the AOI (USDOI, FWS, 2011f). They are Chincoteague NWR (Maryland/Virginia), Fisherman Island NWR (Virginia), Back Bay NWR (Virginia), Currituck NWR (North Carolina), Pea Island NWR (North Carolina), Cape Romain NWR (South Carolina), Blackbeard Island NWR (Georgia), Wassaw NWR (Georgia), portions of the Archie Carr NWR (Florida), and Merritt Island NWR (Florida) (**Figure 4-33**). All land within the NWR system is managed toward the goal of conserving and restoring the nation's fish and wildlife habitat. Management approaches and conservation methods differ among NWRs but typically include managing and rehabilitating wildlife habitat, controlling invasive species, and assisting in the recovery of rare wildlife species (USDOI, FWS, 2011g).

State Designated Marine Protected Areas

There are numerous State-designated MPAs representing state parks, resource conservation areas, (e.g., nature preserves, aquatic preserves, natural areas, wildlife management area), sanctuaries, water quality protection areas, and historical areas located along the coast adjacent to the AOI (**Figure 4-35**). In addition, there are also areas where fishery activities are prohibited or controlled in State-designated MPAs (**Table 4-36**). Except for sanctuaries and historical areas (shipwrecks) that are located seaward of the shoreline, most of the State-designated MPAs are on land.

4.2.11.2. Impacts of Routine Events

This section discusses the potential impacts of routine events associated with Alternative A on MPAs. Preliminary screening of potential impacts or IPFs relative to resources is summarized in **Chapter 4.1.1**. As outlined in **Table 4-2**, IPFs for MPAs include (1) active acoustic sound sources (e.g., airguns; electromechanical sources including subbottom profilers, depth sounders, and side-scan sonar), (2) trash and debris, (3) seafloor disturbance, and (4) drilling discharges.

4.2.11.2.1. Significance Criteria

Negligible impacts to MPAs would include those where little to no measurable impacts are observed or expected. Negligible impacts to MPAs would include those where G&G activities would produce little to no damage to natural communities, would not reduce the multiple resource uses within MPAs, and would not alter the physical, chemical, or biological environment within MPAs.

Minor impacts to MPAs would include those that are detectable but are neither severe nor extensive. Minor impacts to MPAs would include impacts arising from any activity that results in low levels of damage to the ecological function or reduction in the biological productivity of natural communities or multiple resource uses within MPAs.

Moderate impacts to MPAs would be detectable and extensive within the MPA, but not severe or localized within the MPA and severe. Moderate impacts to MPAs would include impacts arising from any activity that results in moderate damage to the ecological function or reduction in the biological productivity of natural communities or multiple resource uses within MPAs.

Major impacts to MPAs would be detectable, extensive within the MPA, and severe. Major impacts to MPAs would include any G&G activity that results in any destruction of, or damage to, key biological resources in MPAs; or severe, extensive damage to the ecological function or reduction in the biological productivity of natural communities or multiple resource uses within MPAs.

4.2.11.2.2. Evaluation

Active Acoustic Sound Sources

Airgun noise frequency output ranges from 10 to 200 Hz, with sound source (pressure) levels from 225 to 260 dB re 1 μPa. Airgun sounds are also pulsed and have a rapid rise time. Electromechanical sources typically are mid- or high-frequency narrow-band sources having highly directed very narrow beam widths. Broadband source levels range from 194.8 to 242 dB re 1 μPa at 1 m (**Table 3-11**). Because seismic airgun surveys are expected to cover the entire AOI, all marine (offshore) MPAs could be exposed to noise produced by seismic survey activity.

The G&G activity under the oil and gas program would account for most of the airgun and electromechanical sources and have the largest potential for affecting MPAs. Additionally, Because of the nature of renewable energy and marine mining projects (i.e., their limited spatial distribution), activities associated with the oil and gas program have a greater potential to affect MPAs through noise. For example, G&G activities such as 2D seismic airgun surveys account for majority of the activities under Alternative A, with nearly double the 2D survey line length projected in the Mid-Atlantic Planning Area (396,400 km) compared to the South Atlantic Planning Area (221,374 km), where most of the offshore MPAs are located. In contrast, HRG surveys have slightly greater projected activity in the South Atlantic (91,770 km) relative to the Mid-Atlantic (83,695 km), while projected VSP activity in the South Atlantic is double (800 km) that of the Mid-Atlantic (400 km). The projected levels of 3D and WAZ survey activity are similar in both planning areas. However, it is not clear how close these various G&G activities may come to MPAs.

National Marine Sanctuaries

Grays's Reef NMS offshore Georgia and the Monitor NMS offshore Cape Hatteras are located within areas planned for 2D seismic airgun surveys with moderate to high survey line density. While seismic airgun surveys employing airguns and hydrophone streamers are not likely precluded from conducting surveys over deepwater MPAs, these activities may not be allowed over an NMS located in shallow waters. While an NMS may be avoided so no airguns and streamers directly transit within its bounds, noise from 2D seismic and other types of surveys may still reach receptors within an NMS at a distance.

Depending on the distance from seismic survey project areas to an NMS and sensitive species and habitats contained therein, noise-generating activities from G&G surveys could potentially affect benthic communities (**Chapter 4.2.1.2**), marine mammals (**Chapter 4.2.2.2**), sea turtles (**Chapter 4.2.3.2**), marine and coastal birds (**Chapter 4.2.4.2**), and fisheries resources and EFH (**Chapter 4.2.5.2**), any of which may be present within an NMS. Cultural or archaeological resources would also be present, however, no impacts to these resources from noise sources is expected (**Chapter 4.2.10.2**). Recreational resources within an NMS may also be affected by seismic noise (**Chapter 4.2.9.2**). Seismic airgun surveys conducted at the border of an NMS may generate noise that would be projected into NMS waters. Although a buffer zone or exclusion area around an NMS would reduce noise levels within a sanctuary, it may not be warranted as outlined in the following resource-specific summaries.

Benthic Communities: Impacts to benthic organisms from noise generated from G&G surveys are not likely to occur except in the unlikely event of airgun use at very close range (e.g., in very shallow water), where sufficient acoustic energy reaches the seafloor to cause physiological damage. At the depths where each NMS occurs, only limited impacts to benthic communities from G&G survey noise are expected. Based on study results of invertebrate communities following airgun exposure, detectable impacts on hard/live bottom, coral, or chemosynthetic communities are not expected from active acoustic sound sources. Further, only limited, localized impacts to soft bottom benthic organisms are expected, and no overall changes in species composition, community structure, and/or ecological functioning of soft bottom communities is expected. Impacts to benthic communities, including those found within each NMS of the AOI, from active acoustic sound sources would be **negligible**.

Marine Mammals: Marine mammals would be affected by seismic survey and other noise as discussed in **Chapter 4.2.2.2.2**. While no mortality or injury is expected from seismic noise exposure, behavioral impacts may occur. Calculated radial distances to threshold level for behavioral impacts are dependent upon the size and orientation of the airgun array and physical characteristics of the marine environment and sediments (e.g., water column stratification, water depth, and nature of the seafloor). Seismic survey protocols include the use of ramp-up in conjunction with clearance of a safety zone, visual (and possibly passive acoustic) monitoring, and shutdown procedures if marine mammals are detected within the safety zone. With these mitigation measures, it is not expected that the impacts of noise from the proposed action would adversely affect either listed or protected marine mammal species that may be present in an NMS. Impacts from noise associated with active acoustic sound sources are expected to be **moderate** for airguns and **minor** for electromechanical sources.

Sea Turtles: Sea turtles have exhibited avoidance behavior from seismic noise exposure at received levels of 166-179 dB re 1 μPa (Moein et al., 1995; McCauley et al., 2000a). The potential range of behavioral effects would be similar to that anticipated for marine mammals as discussed in **Chapter 4.3.2.2.2**. The seismic survey protocols previously outlined within the context of marine mammal mitigation are also applicable to sea turtles. With these mitigation measures, it is not expected that the impacts of noise from the proposed action would adversely affect any listed sea turtles. Impacts of seismic noise on sea turtles may result in individual short-term behavioral reactions if they are present in proximity to the airgun array; this impact is expected to range from **negligible** to **minor** within NMSs. As discussed in **Chapter 4.3.2.2.2**, acoustic signals from electromechanical sources other than the boomer are not likely to be detectable by sea turtles. Therefore, impacts from HRG surveys using boomer subbottom profilers on sea turtles are expected to range from **negligible** to **minor**, based on the distance of the individual sea turtle from the sound pulse..

Marine and Coastal Birds: With only a few exceptions, marine and coastal birds would not be impacted within NMSs since they are benthic sites located in deep water. Therefore, impacts to marine and coastal birds, including those few species that may use the NMSs of the AOI, from active acoustic sound sources would be **negligible**.

Fisheries and EFH: The effects of active acoustic sound sources (e.g., airgun noise) on fishes include behavioral responses, masking of biologically important sounds, temporal threshold shifts (hearing loss), physiological effects, and mortality. Seismic survey (airgun) noise has the potential to disrupt normal activities of sensitive species and, in rare instances, inflict physiological damage. Direct effects may include pathological (i.e., injury), physiological (e.g., stress), and behavioral changes. Given sufficient exposure within an NMS, affected fish species would either vacate the area, experience short-term threshold shift (hearing loss), experience masking of biologically relevant sounds, or be completely unaffected. The mobile nature of the seismic airgun surveys as well as the temporary surveying of small areas of the seafloor relative to the overall area, and the propensity of fishes to move away from noise that is affecting them, suggest that the impacts would be **minor**.

Archaeological Resources: The Monitor NMS is closed to the public with access restricted to scientific research and managing officials. Federal regulations (15 CFR 922) prohibit certain activities in the Monitor NMS, including anchoring, diving (except as authorized), cable laying, coring, dredging, drilling, detonating explosives, conducting salvage operations, trawling, or discharging wastes in violation of Federal regulations. With these access restrictions in place for the Monitor NMS, there would be no impacts from active acoustic sources to the Monitor NMS.

Recreational Resources: In an NMS that may allow multiple uses such as recreational fishing or diving, such activities would not be affected by noise from G&G activities except for potential impacts to target recreational fish species in close proximity to noise sources that could result in a localized, temporary displacement and/or disruption of feeding. However, these potential impacts to target recreational fish species is unlikely to occur because recreational fishing activities and water sports such as diving are likely to be precluded from the survey area in advance of a seismic survey for safety purposes since operators would be expected to provide information to the USCG regarding survey activities and location to issue a Notice to Mariners (**Chapter 3.5.1.5**), and if marker buoys need to be removed, they would be expected to coordinate with the NMS manager (**Chapter 2.1.2.7**). The transient noise from survey vessels conducting seismic airgun surveys with streamers would have **negligible** impacts to recreational fishing and diving in Gray's Reef NMS, where fishing and diving is allowed. The Monitor NMS is closed to the public, with access restricted to scientific research and managing officials.

In summary, the extent of impacts to sensitive receptors in NMSs would depend largely on their distance from the noise sources associated with G&G surveys. Overall, such impacts from transient activities would be expected to be negligible in terms of potential impacts on sensitive populations within each NMS. Seismic survey airgun and electromechanical source noise intruding into an NMS would likely have no more than temporary effects on those protected resources that are characteristic of each NMS. **Negligible** impacts are expected for most NMS resources, including benthic communities, marine and coastal birds, and recreational resources, while **minor** impacts are expected for fisheries resources and EFH. Impacts to marine mammals would range from **negligible** to **moderate** and from **negligible** to **minor** for sea turtles. Impacts to each NMS from G&G sound sources, including airguns and electromechanical sources, are expected to range between **negligible** and **minor**.

Deepwater Marine Protected Areas

Six federally designated offshore/deepwater MPAs located south of Cape Hatteras are within the planned 2D seismic survey areas. Four deepwater MPAs are located in areas with the highest survey densities: Georgia, Edisto, Charleston Deep Artificial Reef, and Northern South Carolina MPAs. Fishes in the Federal fishery management areas along with sea turtles and marine mammals that may be present potentially may be affected by noise from G&G activities. The extent of impacts from noise emanating from seismic activities on fishes in these MPAs would depend largely on their distance from the noise sources associated with G&G surveys. As seismic airgun surveys are not precluded from deepwater MPAs, airgun and electromechanical noise may affect fishes within deepwater MPAs. Noise generated from G&G activities is expected to produce minor impacts on fishes in deepwater MPAs if surveys are conducted within the bounds of each MPA. While fishes are the primary resources for which these deepwater MPAs were established, other resources such as benthic organisms, marine birds, and marine mammals are also present; these are unlikely to be significantly affected by airgun and electromechanical noise from survey activities, as discussed previously (i.e., impacts to each NMS are expected to range between **negligible** and **minor**, depending upon the resource of concern).

Coastal Marine Protected Areas

Coastal/State-designated MPAs are located mostly outside or inshore of areas planned for 2D seismic airgun surveys and would not be impacted, although there are some whose seaward boundaries may fall within the planned 2D seismic survey areas. The boundaries of the Assateague Island and Cape Canaveral National Seashores and the Guana Tolomato Matanzas NERRs overlap with the AOI. State-designated MPAs that overlap with the AOI include the Blue Crab Sanctuary at the mouth of the Chesapeake Bay in Virginia, the North Carolina Crab Spawning Sanctuaries, the North Carolina Sea Turtle Sanctuaries, the *Queen Anne's Revenge* site, the Ft. Clinch State Park Aquatic Preserve, the Nassau River-St. Johns River Aquatic Preserve, the Guana River Marsh Aquatic Preserve, and the Cape Canaveral National Seashore Outstanding Florida Water. Noise from G&G surveys also could potentially affect fishes (**Chapter 4.2.5.2**), marine mammals (**Chapter 4.2.2.2**), and sea turtles (**Chapter 4.2.3.2**) in these coastal MPAs. The extent of impacts to fishes and marine mammals in MPAs would depend largely on their distance from the noise sources associated with G&G surveys. Impacts to sea turtles in coastal MPAs are expected to range from **negligible** to **moderate**, depending on the timing and location of the survey. Heavily used nesting beaches within some coastal MPAs are located in the southern portion of the AOI (e.g., Archie Carr NWR, Merrit Island NWR). The northern segment of the Archie Carr NWR borders the AOI, and it has been estimated that 25 percent of all loggerhead nesting in the U.S. occurs there (USDOI, FWS, 2011a). During the 2010 nesting season, there were over 31,000 loggerhead nests in Brevard County, where the Archie Carr NWR is located. It is likely that large numbers of sea turtles would be present in nearshore and inner shelf waters of Brevard County during the nesting season from May 1 through October 31. Seismic airgun surveys performed in these inner shelf waters during nesting season could temporarily displace breeding and nesting adult turtles and potentially disrupt time-critical activities and result in **moderate** impacts. Therefore, depending on the location of the surveys and the time of year, impacts to sea turtles could be **negligible** to **moderate**. Impacts to benthic organisms, primarily invertebrates, in these coastal MPAs from noise generated from G&G surveys are expected to be **negligible**, except in the unlikely event of use of airguns in very shallow water. Overall, such impacts would be expected to range between **negligible** and **minor** at the population level. Noise emanating from G&G survey activities is unlikely to affect biological, cultural, or archaeological resources contained in coastal/State-designated MPAs (e.g., shipwrecks such as the *Queen Anne's Revenge* and in artificial reefs).

Trash and Debris

Most trash generated offshore during G&G activities is mainly associated with galley and offshore food service operations. Although companies operating offshore have developed and implemented trash and debris reduction and improved handling practices in recent years to reduce the amount of offshore trash that could potentially be lost into the marine environment, trash and debris would be generated during G&G activities that could be accidentally lost overboard. A discussion of the effects of debris lost overboard from offshore drilling operations is provided in **Chapter 4.2.1.2**. The available information indicates that debris from exploratory drilling results in minimal (i.e., **negligible**) impact to the benthic environment. Debris deposited in areas of extensive soft bottom provided artificial hard substrate that resulted in epifaunal colonization and attracted fishes.

As guidance similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012) would be required for all survey vessels performing work within U.S. jurisdictional waters (i.e., they are expected to comply with Federal regulations including MARPOL 73/78 and all authorizations for shipboard surveys would include guidance for marine debris awareness), only accidental loss of trash and debris is anticipated. Impacts from trash and debris as generated by seismic survey vessels, sampling, shallow or COST well drilling, and other G&G-related activities on MPAs and the resources within would be **negligible**.

Seafloor Disturbance

G&G sampling, drilling, and anchor placement may disturb the seafloor. Activities with the potential for seafloor disturbance include sampling by vibracoring, geologic core, and grab; use of jet probes and piezonecone penetrometers; the laying of ocean bottom nodal, ocean bottom cable, and vertical cable; the drilling of shallow test and COST wells; and the placement and retrieval of bottom-founded monitoring buoys. Proposed activities under Alternative A include bottom sampling, drilling, and anchoring. Bottom sampling would be conducted in all three program areas. Total area disturbed by core or grab sampling is expected to affect 11 ha (27.7 ac), which represents 0.00001 percent of the AOI. Seafloor disturbance from the drilling of COST wells and shallow test wells would average about 2 ha (5 ac) per well. If all of the COST wells and shallow test wells in the proposed action scenario were drilled, the total seafloor disturbance would be about 16 ha (40 ac), or about 0.00002 percent of the AOI. Anchoring would include installation of 7-38 bottom-founded monitoring buoys as part of the renewable energy program. Similarly, the placement and removal of bottom cables and anchors would produce localized sediment disturbance to soft bottom communities. Total footprint area would range from 3.85 to 20.9 m^2 (42 to 228 ft^2) for the anchors, while the sweep area would range from 23.8 to 129.2 ha (59.5 to 323 ac). If all of the monitoring buoys in the proposed action scenario were installed, the total seafloor disturbance would be about 129 ha (319 ac), or about 0.0002 percent of the AOI and 0.047 percent of the identified wind energy areas.

The BOEM would require site-specific information regarding potential sensitive benthic communities prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. The BOEM has not designated specific benthic locations for avoidance in the AOI. However, deepwater MPAs, Gray's Reef NMS, and other known hard/live bottom areas, deepwater coral areas, and chemosynthetic community sites are likely areas for avoidance. All authorizations for G&G surveys proposed within or near these areas would be subject to review to facilitate avoidance (**Chapter 2.1.2.6.2**). The BOEM would use this information to ensure that physical impacts to sensitive benthic communities are avoided. Therefore, seafloor-disturbing impacts to sensitive benthic communities within MPAs are expected to be avoided (i.e., **negligible**).

National Marine Sanctuaries

Federal regulations (15 CFR 922, Subpart I) prohibit certain activities in the Gray's Reef NMS, including anchoring; dredging, drilling, or altering submerged lands; constructing, placing, abandoning any structure, material or other matter on submerged lands; discharging or depositing any material; injuring, catching, harvesting or collecting marine organisms; using explosives or devices that produce electric charges; and breaking, cutting, damaging, taking, or removing any bottom formation or sanctuary historical resource within the Gray's Reef NMS. Bottom-disturbing activities proposed within the boundaries of an NMS would not be permitted, whereas bottom-disturbing activities proposed near the boundaries of an NMS would be assigned a setback distance (to be determined at the time the action is before BOEM and in consultation with the Sanctuary Manager) as a condition of permit approval. Given these restrictions, no seafloor-disturbing G&G activities would occur within NMS waters. No direct impacts to benthic communities or archaeological/cultural resources in either NMS are expected from G&G activities.

Under the renewable energy program, BOEM has issued *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 285* (USDOI, BOEM, 2011d). The guidelines specify that a site characterization survey must reliably cover all portions of the site that would be affected by seafloor-disturbing activities. The guidelines recommend avoidance as a primary mitigation strategy for objects of historical or archaeological significance. The applicant has the option to demonstrate through additional investigations that an archaeological resource either does not exist or would not be adversely affected by the seafloor/bottom-disturbing activities. While site characterization activities covered by these guidelines could identify other resource types such as benthic communities, recommendations for conducting and reporting the results of other baseline collection studies (e.g., biological) would be provided by BOEM in separate guidelines. Impacts to NMSs from G&G-based seafloor disturbance would be **negligible**.

Deepwater Marine Protected Areas

G&G activities that result in seafloor disturbance can potentially affect deepwater MPAs. However, as discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information regarding potential sensitive benthic communities and archeological resources prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. In addition, as discussed in **Chapter 2.1.2.6.2**, setbacks from sensitive bottom communities and archaeological resources similar to those currently required for the Gulf of Mexico would be applied to activities within the AOI. Impacts would be minimized with implementation of these requirements for site characterization for G&G activities from BOEM. Overall, impacts from seafloor disturbance would be expected to be **negligible** for potential impacts on submerged archaeological resources, benthic communities, fisheries resources and EFH, sea turtles, and marine mammals from such seafloor-disturbing G&G activities in deepwater MPAs.

Other Federal Fishery Management Areas

If G&G activities that result in seafloor disturbance are not precluded in other federally designated fishery management areas (**Table 4-36**) where there are restrictions on certain types of fishing activities, such G&G activities would potentially affect resources in these fishery management areas. Seafloor disturbance from G&G activities could result in temporary and negligible impacts from sediment resuspension that could result in turbidity and suspension/mobilization of sediment trace metals and organics. Benthic communities also may be subject to direct physical impacts resulting in displacement, injury, or mortality within very limited areas of the seafloor. Seafloor disturbance could affect archaeological/cultural resources such as shipwrecks. However, as discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information regarding potential sensitive benthic communities and archeological resources prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. With implementation of guidelines for site characterization for G&G activities from BOEM, impacts from seafloor disturbance would be minimized. Overall, impacts from seafloor disturbance would be expected to be **negligible** for potential impacts on submerged archaeological resources, benthic communities, fisheries resources and EFH, sea turtles, and marine mammals.

Coastal Marine Protected Areas

For most coastal MPAs (e.g., National Seashores, the NEP and NERR areas, and coastal NWRs) located inshore of the AOI, the resources located therein would not be subject to impact from seabottom disturbance. Some National Seashores, NERRS sites, and State designated MPAs extend into shallow marine waters that overlap with the AOI where they could be directly or indirectly be affected by G&G activities. The boundaries of the Assateague Island and Cape Canaveral National Seashores and the Guana Tolomato Matanzas NERRs overlap with the AOI. State-designated MPAs that overlap with the AOI include the Blue Crab Sanctuary at the mouth of the Chesapeake Bay in Virginia, the North Carolina Crab Spawning Sanctuaries, the North Carolina Sea Turtle Sanctuaries, the *Queen Anne's Revenge* site, the Ft. Clinch State Park Aquatic Preserve, the Nassau River-St. Johns River Aquatic Preserve, the Guana River Marsh Aquatic Preserve, and the Cape Canaveral National Seashore Outstanding Florida Water. However, as discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information regarding potential sensitive benthic communities and archaeological resources prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. Seafloor disturbance from G&G survey activities is unlikely to be allowed in coastal MPAs; and therefore, seafloor disturbances are not likely to affect these coastal MPAs.

Drilling Discharges

Drilling discharges may occur during drilling of COST wells or shallow test wells; however, as discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information prior to approving any G&G activities involving seafloor-disturbing activities, including drilling, in the AOI. In addition, an NPDES permit would be required from the USEPA prior to any drilling activities. The installation of COST wells or shallow test wells associated with G&G survey activities is unlikely to be allowed in MPAs. An extensive discussion of impacts of drilling discharges from oil and gas operations is provided in **Chapter 4.2.1.2**. During the drilling process, drilling fluid and cuttings discharged would accumulate on the seafloor, causing changes in sediment grain size, and would affect the benthic community by burial and smothering, anoxia, and sediment toxicity. Excess cement slurry released at the seafloor during casing installation would also cause burial and smothering of benthic organisms around the wellbore. Soft bottom sediments disturbed by cuttings, drilling fluids, and cement slurry would eventually be recolonized through larval settlement and migration from adjacent areas. The areal extent of impacts from drilling discharges during the proposed action would be small; a typical effect radius of 500 m (1,640 ft) would be expected.

National Marine Sanctuaries

Federal regulations (15 CFR 922) prohibit certain activities in the Monitor NMS, including drilling and discharging wastes in violation of Federal regulations. Federal regulations also prohibit discharging wastes other than effluent from marine sanitation units, vessel cooling water, and fish parts within the Gray's Reef NMS (15 CFR 922.92). Bottom-disturbing activities proposed within the boundaries of an NMS would not be permitted, whereas bottom-disturbing activities proposed near the boundaries of an NMS would be assigned a setback distance (to be determined at the time the action is before BOEM and in consultation with the Sanctuary Manager) as a condition of permit approval. Given these restrictions, no discharges of drilling fludis and cuttings would occur within NMS waters, and no impacts in either NMS are expected from drilling discharges.

Deepwater Marine Protected Areas

As discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information prior to approving any G&G activities involving seafloor-disturbing activities, including drilling, in the AOI. In addition, an NPDES permit would be required from the USEPA prior to any drilling activities. The installation of COST wells or shallow test wells associated with G&G survey activities is unlikely to be allowed in deepwater MPAs. Therefore, no impacts from drilling discharges would be expected on benthic communities, submerged archaeological resources, fisheries resources and EFH, sea turtles, and marine mammals are expected from drilling discharges in deepwater MPAs.

Other Federal Fishery Management Areas

If drilling is not precluded in other federally designated fishery management areas where there are restrictions on certain types of fishing activities, drilling discharges would potentially affect resources in these fishery management areas. Because of the small footprint relative to the total area of fishery management areas, impacts from drilling discharges would be expected to be **negligible** in terms of potential impacts on benthic communities, while no impacts to submerged archaeological resources, fisheries resources and EFH, sea turtles, and marine mammals are expected from drilling discharges in these fishery management areas.

Coastal Marine Protected Areas

As discussed in **Chapter 3.5.1.8**, BOEM would require site-specific information prior to approving any G&G activities involving seafloor-disturbing activities, including drilling, in the AOI. In addition, an NPDES permit would be required from the USEPA prior to any drilling activities. The installation of COST wells or shallow test wells associated with G&G survey activities is unlikely to be allowed in MPAs. Therefore, drilling discharges would not affect coastal MPAs.

4.2.11.3. Impacts of Accidental Fuel Spills

An accidental event such as a ship collision could result in release of diesel fuel. Such spills are not expected to be extensive, would dissipate rapidly, and would likely affect only organisms in the immediate location of the accident. Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes a diesel spill ranging from 1.2 to 7.1 bbl. Spills occurring at the ocean surface would disperse and weather. Volatile components of the fuel would evaporate. Fuel and diesel used for operation of survey vessels is light and would float on the surface of the water.

The likelihood of a fuel spill during seismic airgun surveys or other G&G activities in proximity to MPAs is expected to be remote. The potential for impacts from a diesel fuel spill would depend greatly on the size and location of a spill, the meteorological conditions at the time, and the speed with which cleanup plans and equipment could be employed. Such small spills are unlikely to significantly affect biota, habitats, and submerged cultural resources within each NMS, other Federal fishery management areas (deepwater MPAs), and coastal MPAs. Adult fishes within an MPA would be less susceptible to the effects of spilled fuel or oil than would eggs and larvae. Limited spills of fuel are unlikely to affect benthic communities, sea turtles, and marine mammals in MPAs. Marine and coastal birds could possibly contact spilled fuel, which could cause injury or mortality. However, while individual birds may be oiled during a diesel spill, such impacts would be unlikely to affect marine and coastal birds at a population level. Impacts are expected to range between **negligible** and **minor**. In terms of all biological, recreational, and archaeological resources potentially affected, accidents involving G&G survey vessels and resulting in a fuel spill would range between **negligible** and **minor**.

4.2.11.4. Cumulative Impacts

The cumulative impacts scenario discussed in detail in **Chapter 3.6** includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development;

(3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs for these cumulative activities that have the potential to affect MPAs include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, and other active sound sources; (2) seafloor disturbance; (3) trash and debris; (4) drilling discharges; and (5) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Under Alternative A, IPFs identified for MPAs included (1) active acoustic sound sources; (2) trash and debris; (3) seafloor disturbance; (4) drilling discharges; and (5) accidental fuel spills. Impact analyses presented in **Chapters 4.2.11.2** and **4.2.11.3** determined that activities projected to occur under Alternative A would result in **negligible** or **minor** impacts for most of the resources that constitute MPAs, including benthic communities, marine mammals, marine and coastal birds, fisheries and EFH, and recreational resources. One resource, sea turtles, had the potential for **negligible** to **moderate** impacts, depending upon the IPF. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Active Acoustic Sound Sources

Under the cumulative activities scenario, the only active acoustic sound sources that could adversely affect MPAs would be from military activities (i.e., sonars, explosives, and other active sound sources) that could occur throughout any of the military operational areas. For the purposes of this analysis and in consideration of the documented increases in marine transportation volumes along the U.S. Atlantic coast, it is assumed that underwater noise from vessel traffic and other anthropogenic sources within the AOI is increasing. Most ambient noise is broadband and encompasses virtually the entire frequency spectrum, with vessel traffic recognized as a major contributor to ocean noise in the low frequency bands between 5 and 500 Hz. Naturally occurring noise (e.g., spray and bubbles from breaking waves) is also a major contributor to ambient noise in the 500-100,000-Hz range.

Noise from G&G operations would be survey- or activity-based and would occur on a transient and intermittent basis over the period of interest. The G&G activity, especially the use of active acoustic sources such as airguns, under the oil and gas program would account for most of the active acoustic noise and have the largest potential for affecting MPAs. Impacts to MPAs from underwater noise produced from sound sources associated with proposed G&G activities range from **negligible** to **minor** for most of the IPFs, with one exception. **Moderate** impacts were identified for active acoustic sound sources (seismic airgun surveys) operating off of heavily used nesting beaches during the nesting season (i.e., beaches of southeast Florida), with subsequent temporary displacement of breeding and nesting adult turtles and potential disruption of time-critical activities.

National Marine Sanctuaries, Deepwater Marine Protected Areas, and Other Federal Fishery Management Areas

As with the proposed alternative G&G survey activities, the impacts from active acoustic noise to NMSs, deepwater MPAs, and other Federal fisheries management areas from the cumulative scenario would depend on the distance between the activities and the MPAs. As stated above, the only source of active acoustic noise under the cumulative scenario is from military activities (i.e., sonars, explosives, and other active sound sources). Grays's Reef NMS offshore Georgia, the Monitor NMS offshore Cape Hatteras, six federally designated offshore/deepwater MPAs located south of Cape Hatteras, and several federally designated fishery management areas are located within military operating areas and could be exposed to active acoustic noise from either direct use of sonar or from noise propagation through the water that has the potential to impact resources within the MPA. All other MPAs are located along the shore, mostly outside or inshore of military range complexes and civilian space program use areas; however, during ingress and egress from the military areas, vessels may pass by these MPAs. As discussed in **Chapter 4.2.12.2**, there are six primary resources that could be impacted by active acoustic noise: benthic communities, marine mammals, sea turtles, marine and coastal birds, fisheries and EFH, and recreational resources. However, with the use of available mitigation measures (e.g., observation and clearance of safety zones), impacts from active acoustic sources associated with specific military activities (e.g., sonars, explosives, and other active sound sources) under the cumulative activities scenario are expected to fall predominantly within the negligible impacts category; localized, short-term **minor** noise impacts might be realized for all resources. Therefore, because only **negligible** to **minor** noise impacts are expected from the cumulative activities scenario, and there is no evidence to suggest that noise from G&G activities would push ambient noise levels above a threshold level where resources within these MPAs might be significantly affected, the impacts associated with the proposed action would result in a minor incremental increase in noise-related impacts to MPAs under the cumulative scenario.

Coastal Marine Protected Areas

As with the proposed alternative G&G survey activities, the impacts from active acoustic noise to the coastal MPAs from the cumulative scenario would depend on how close these various activities may come to them. As stated above, the only source of active acoustic noise from the cumulative scenario is from military activities (i.e., sonars, explosives, and other active sound sources). Coastal/State-designated MPAs are located inshore of military range complexes and civilian space program use areas; however, during ingress and egress from the military range complexes and civilian space program use areas, vessels may pass by coastal MPAs. Therefore, the impacts from active acoustic sources associated with specific military activities (e.g., those involving use of sonars, explosives, and other active sound sources) under the cumulative activities scenario are predicted to fall predominantly within the **negligible** impacts category. The impacts from the proposed action are expected to result in negligible to moderate impacts to coastal MPAs; impacts associated with the proposed action would result in an incremental increase in ambient noise levels under the cumulative scenario.

Trash and Debris

The accidental release of trash and debris can potentially occur from any of the nine activities identified in the cumulative impacts scenario. Vessel operators would be expected to comply with Federal laws and regulations that implement the requirements of MARPOL 73/78, including Annex V. Most trash generated offshore during G&G activities is mainly associated with galley and offshore food service operations. Although companies operating offshore have developed and implemented trash and debris reduction and improved handling practices in recent years to reduce the amount of offshore trash that could potentially be lost into the marine environment, trash and debris would be generated during G&G activities that could be accidentally lost overboard. A discussion of the effects of debris lost overboard from offshore drilling operations is provided in **Chapter 4.2.1.2**.

As guidance similar to BSEE's NTL 2012-G01 ("Marine Trash and Debris Awareness and Elimination") (USDOI, BSEE, 2012) would be required for all survey vessels performing work within U.S. jurisdictional waters (i.e., they are expected to comply with Federal regulations including MARPOL 73/78 and all authorizations for shipboard surveys would include guidance for marine debris awareness), only accidental loss of trash and debris is anticipated. Impacts from trash and debris on MPAs and their resources arising from G&G-related activities would be **negligible**. Only negligible impacts to benthic communities associated with the accidental release of trash and debris are expected under the cumulative activities scenario. The proposed action would potentially add a very small amount of accidentally released trash and debris, resulting in a negligible incremental increase in impacts to MPAs under the cumulative scenario.

Seafloor Disturbance

Seafloor disturbance potentially may occur from activities associated with the cumulative scenario including oil and gas development, marine minerals use, renewable energy development, geosequestration, LNG import terminals, dredged material disposal, and the installation of bottom-founded equipment or structures in the AOI. The BOEM would require site-specific information prior to approving the activities under their jurisdiction, which includes most cumulative scenario activities. However, BOEM requirements do not protect the resources from activities outside of BOEM jurisdiction (e.g., commercial and recreational fishing, dredged material disposal).

National Marine Sanctuaries

Grays's Reef NMS offshore Georgia and the Monitor NMS offshore Cape Hatteras are located in deep water and in areas where cumulative scenario activities could occur. All other NMSs are located along the shore and would not be subject to seafloor-disturbing activities associated with the cumulative scenario. Federal regulations (15 CFR 922) prohibit certain activities in the Monitor NMS, including drilling and detonating explosives. Federal regulations also prohibit breaking, damaging, or removing any bottom formation, constructing structures, and discharging wastes other than effluent from marine sanitation units, vessel cooling water, and fish parts within the Gray's Reef NMS (15 CFR 922.92). In addition, bottom-disturbing activities proposed within the boundaries of an NMS would not be permitted, whereas bottom-disturbing activities proposed near the boundaries of an NMS would be assigned a setback distance (to be determined at the time the action is before BOEM and in consultation with the Sanctuary Manager) as a condition of permit approval. Given these restrictions, seafloor disturbance within NMS from the cumulative scenario as well as the proposed action would not occur.

Deepwater Marine Protected Areas

Impacts to federally designated fishery management areas such as deepwater MPAs would be minimized with the BOEM requirement for site-specific information prior to seafloor-disturbing activities within their jurisdiction. Therefore, the impacts from the cumulative scenario from these activities would be negligible. Impacts associated with Alternative A would result in a negligible incremental increase in seafloor disturbance under the cumulative scenario.

Other Federal Fishery Management Areas

Seafloor-disturbing commercial fishing activities are restricted in other Federally designated fishery management areas; therefore, the impacts from these activities would be negligible. Establishment of dredged material disposal areas is under the jurisdiction of the USEPA. Site-specific information is required prior to placement of new disposal areas, and these federally designated fishery management areas would be precluded from use; therefore, impacts from these activities would not occur. As discussed in **Chapter 4.2.11.2**, the impacts from seafloor disturbance associated with the proposed action would result in **negligible** impacts; therefore, the impacts associated with the proposed action would result in no incremental increase in impacts associated with seafloor disturbance under the cumulative scenario.

Coastal Marine Protected Areas

Seafloor disturbance resulting from cumulative scenario activities is unlikely to be allowed in most coastal MPAs such as National Seashores, NEP and NERR areas, and NWRs located inshore of the AOI; therefore, seafloor disturbances are not likely to affect biological and archaeological resources in these coastal MPAs. However, seafloor disturbance could occur in some coastal MPAs that include shallow marine waters where benthic organisms could be affected by seafloor disturbance. The coastal MPAs with boundaries that overlap with the AOI and could be affected by G&G activities are discussed in **Chapter 4.2.11.2**. Impacts from seafloor disturbance from G&G in these areas would be expected to be **negligible**. The impacts associated with the proposed action would result in no incremental increase in seafloor disturbance to MPAs under the cumulative scenario.

Drilling Discharges

Cumulative scenario activities that would include discharges of drilling fluids, drill cuttings, and other effluents from drilling rigs (e.g., oil and gas development, geosequestration) would also require the submittal and agency review of site-specific information regarding benthic communities and submerged cultural resources prior to activity approval. In addition, setbacks from sensitive benthic communities would be implemented for all bottom-disturbing activities. These measures would ensure that physical impacts to sensitive benthic communities and submerged cultural resources within MPAs are avoided and that resources within MPAs are protected from impacts from cumulative scenario activities.

Drilling discharges from proposed G&G activities (i.e., COST wells) have been shown to cause a **negligible** impact to benthic communities (**Chapter 4.2.1.2**) and submerged cultural resources (**Chapter 4.2.10.2**). The proposed action would add an extremely small area of seafloor disturbance to the cumulative area affected and would not include MPAs. Impacts associated with the proposed action are expected to result in a no incremental increase in impacts to MPAs under the cumulative scenario.

Accidental Fuel Spills

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to MPAs would vary depending on the location and size of the spill, if the survey and drilling activities were located near an MPA. However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prior to the drilling of any wells. In addition, a project-specific EA would require an analysis of site-specific and mitigation measures taken to minimize impacts from drilling activities and potential accidental crude oil spills. With the required mitigation measures in place and with oversight of these activities by the BSEE, an accidental crude oil spill from an exploratory well is not anticipated; however, a spill still could occur. However, with these mitigation measures in place, the impacts to MPAs from exploratory drilling operations would be expected to be negligible.

The cumulative scenario considers a significant volume of overall vessel traffic, particularly around ports along the U.S. eastern seaboard. Military operations and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision or grounding with a subsequent loss of fuel into offshore or nearshore waters. The impacts arising from an accidental fuel spill from a vessel collision under the cumulative scenario for NMSs, other Federal fishery management areas (deepwater MPAs), and coastal MPAs are expected to range from negligible to minor. The likelihood of an accidental fuel spill during seismic airgun surveys or other G&G activities in proximity to MPAs is considered to be remote, and the associated impacts to MPAs are expected to be **negligible** to **minor** (**Chapter 4.2.11.3**). Therefore, the incremental increase in impacts from an accidental fuel spill arising from vessel collision during G&G activities would be considered extremely small. The impacts associated with the proposed action and the low probability of a G&G activity-related fuel spill would result in a negligible to minor incremental increase in impacts to MPAs under the cumulative scenario.

4.2.12. Other Marine Uses

4.2.12.1. Description of the Affected Environment

Other existing marine uses in the AOI include shipping and marine transportation, military range complexes supporting exercises and testing, sand and gravel mining; renewable energy development, oil and gas exploration, dredged material disposal, research activities from bottom-founded structures, and known sea bottom obstructions. Commercial and recreational fishing have been described in **Chapters 4.2.7** and **4.2.8**, respectively. As of May 2011, there are no existing deepwater LNG ports or pending applications for such ports within the Mid-Atlantic or South Atlantic Planning Areas (USDOT, Maritime Administration, 2011a). There are no petroleum platforms, pipeline production systems, or active leases for oil and gas activities in the U.S. Atlantic planning areas (USDOI, BOEM, 2011j). An oil and gas lease sale was planned offshore Virginia in the Mid-Atlantic Planning Area for June 2012 that has since been cancelled. There are no current plans for oil and gas exploration, although permits for geophysical surveying that generally precede exploration have been submitted to BOEM.

The Multipurpose Marine Cadastre (2011), a web-based tool developed by BOEM, the NOAA Coastal Services Center, and other partners, was used as the main basis for identifying uses of the AOI. The Multipurpose Marine Cadastre is an integrated marine information system that provides legal, physical, ecological, and cultural information in a common GIS framework. This tool is used by Federal regulatory agencies and others who are screening renewable energy sites and other offshore activities, as well as people working on regional and State coastal and marine spatial planning efforts. At its core, this data viewer contains the official U.S. marine cadastre, and it is the only place where users can see all of the official U.S. boundaries on one map. Similar to the nation's land-based parcel system, a marine cadastre describes the spatial extent, rights, restrictions, and responsibilities of U.S. waters. All data come from the appropriate authoritative source; these organizations are responsible for data upkeep. In addition, data from BOEM and the Naval Facilities Engineering Command (NAVFAC) was used for other uses within the AOI.

4.2.12.1.1. Shipping and Marine Transportation

Six commercial deepwater ports are located along the coast adjacent to the AOI, as listed below and shown on **Figure 4-36**:

- Norfolk, Virginia (Port of Virginia);
- Wilmington, North Carolina;
- Charleston, South Carolina;
- Savannah, Georgia;
- Brunswick, Georgia; and
- Jacksonville, Florida.

These ports (excluding Brunswick) are discussed further in **Chapter 4.2.13**. In addition, Delaware Bay provides access to Delaware River ports and terminals in the Wilmington, Delaware, and Philadelphia, Pennsylvania, area. Chesapeake Bay provides access to the Port of Baltimore and numerous smaller ports in Maryland and Virginia.

Large commercial vessels (cargo ships, tankers, and container ships) use these ports to access overland rail and road routes to transport goods throughout the U.S. Other vessels using these ports include military vessels, commercial business craft (tug boats, fishing vessels, and ferries), commercial recreational craft (cruise ships and fishing/sight-seeing/diving charters), research vessels, and personal craft (fishing boats, house boats, yachts and sailboats, and other pleasure craft).

The USCG designates shipping fairways and establishes traffic separation schemes that control the movement of vessels as they approach ports (**Figure 4-36**) (33 CFR 166). Each of the ports is serviced by a navigation channel maintained by the COE. Traffic fairways and the buoys and beacons that serve as aids to navigation are identified on NOAA's Office of Coast Survey's navigation charts.

4.2.12.1.2. Military Range Complexes and Civilian Space Program Use

Military range complexes and civilian space program use areas, including restricted areas and danger zones, are established in areas off U.S. coastlines to allow military forces to conduct training and testing activities. Most of the AOI is within military range complexes and civilian space program use areas, as shown in **Figure 4-37**. Military activities can include various air-to-air, air-to-surface, and surface-to-surface naval fleet training, submarine and antisubmarine training, and Air Force exercises.

Portions of the area are further defined as danger zones, which can be closed or subject to limited public access during intermittent periods. Danger zones and restricted areas are defined at 33 CFR 334.2, as described below:

(a) *Danger Zone:* A defined water area (or areas) used for target practice, bombing, rocket firing or other especially hazardous operations, normally for the armed forces. The danger zones may be closed to the public on a full-time or intermittent basis, as stated in the regulations.

(b) *Restricted Area:* A defined water area for the purpose of prohibiting or limiting public access to the area. Restricted areas generally provide security for Government property and/or protection to the public from the risks of property damage or injury arising from the Government's use of that area.

The five military-related restricted areas operated by DOD within the AOI extend from the Chesapeake Bay to Jacksonville, Florida (**Figure 4-37**). The Atlantic Fleet training Virginia Capes (VACAPES) Range Complex extends along the coastlines of Delaware, Maryland, and North Carolina (U.S. Fleet Forces, 2009). Within VACAPES, the NASA, GSFC's WFF owns and operates the launch range at the WFF which is located on Virginia's eastern shore. The WFF serves as a flight test site for aerodynamic research and NASA conducts science, technology, and educational flight projects from WFF aboard rockets, balloons, and UAV's, using the Atlantic waters for operations on almost a daily basis. The WFF is also home to several critical DOD programs. The Cherry Point Complex extends along the coastline of central North Carolina, and the Charleston Complex extends along the coastline of southern North Carolina and South Carolina. The Jacksonville complex extends along the coastlines of Georgia and north Florida to the Merritt Island National Wildlife Refuge. The fifth military area is Cape Canaveral OPAREA, which is located along the coastline of Merritt Island (**Figure 4-37**). Training exercises include mine, surface, amphibious, and strike warfare involving bombing and missile exercises and mine neutralization. Airborne, surface, and submarine activities are involved. Within the VACAPES Range Complex, five mission impact areas are present that are the debris cones for rocket test and detonations between 2005 and 2007 (**Figure 4-37**). These areas were showered with debris ranging in size from golf balls to the size of a small automobile.

Military range complexes and civilian space program use areas are designated for Joint Base Charleston, a combined Air Force and Navy installation in South Carolina, and Parris Island, a marine training facility also in South Carolina. A Danger Zone is also designated offshore Camp Lejeune, North Carolina.

Three military facilities are located at the Port of Jacksonville: the Naval Submarine Base Kings Bay, Naval Air Station Jacksonville, and Naval Station Mayport; together, these facilities represent the third largest concentration of the U.S. Naval fleet in the U.S. (World Port Source, 2011). These facilities also make use of offshore military range complexes and civilian space program use areas.

Military and civilian uses of the offshore sea and air areas are compatible, with Navy ships accounting for 3 percent of the total ship presence out to 371 km (200 nmi) (U.S. Fleet Forces, 2009). Where naval vessels and aircraft conduct operations that are not compatible with commercial or recreational transportation, they are confined to OPAREAs away from commercially used waterways and inside Special Use Airspace (U.S. Fleet Forces, 2009). Hazardous operations are communicated to all vessels and operators by use of Notices to Mariners issued by USCG and Notices to Airmen issued by the FAA.

The NASA also has designated danger zones and restricted areas for rocket testing and shuttle launches. The NASA restricted areas within the AOI include offshore Wallops Island in Virginia and offshore of the Kennedy Space Center at Cape Canaveral. The limits of the areas are established offshore of the facilities and have restricted access during rocket and shuttle launch activities (33 CFR 334.525).

4.2.12.1.3. Sand and Gravel Mining

The BOEM may offer and enter into a noncompetitive, negotiated lease for sand, shell, or gravel resources following 1994 amendments to the OSCLA (P.L. 103-426) for certain types of projects funded in whole or part by, or authorized by, the Federal Government. The Shore Protection Provisions of the Water Resource Development Act of 1999 amended P.L. 103-426 prohibited charging State and local governments a fee for using OCS sand. For all other uses, a competitive bidding process is required under Section 8(k)(1) of the OCSLA. The Marine Minerals Program administered by BOEM is dominated by the identification and use of OCS sand for beach nourishment and coastal restoration projects (USDOI, BOEM, 2011g). **Figure 4-38** shows the past and recent locations of OCS sand and gravel borrow areas within the AOI. Locations are as follows:

- Great Gull Bank Borrow Area (offshore Ocean City, Maryland);
- Sandbridge Shoal Borrow Area (offshore Virginia Beach, Virginia);
- Little River Borrow Area (offshore North Myrtle Beach, South Carolina);
- Cane South Borrow Area (offshore Myrtle Beach, South Carolina);
- Surfside Borrow Area (offshore Garden City, South Carolina);
- Jacksonville Borrow Area (offshore Jacksonville, Florida); and
- Canaveral Shoals Borrow Area (offshore Brevard County, Florida).

To date, BOEM has conveyed rights to about 30 million cubic yards of OCS sand for 23 coastal restoration projects in five states. Some of these projects were done on an emergency basis, where imminent breaching of barrier islands was prevented by the rapid placement of OCS sand. Most of these projects used sand that was previously identified by the BOEM through its cooperative sand evaluation program with coastal states (USDOI, BOEM, 2011g).

4.2.12.1.4. Renewable Energy Development

The USDOI (2011) has identified four WEAs offshore the Mid-Atlantic coast, including three within the AOI offshore Delaware, Maryland, and Virginia (**Figure 4-39**). In July 2011, BOEM issued a Draft EA for these areas that included changes to the extent of the Maryland and Virginia WEAs (USDOI, BOEM, 2011k,l,m,n). The revised WEAs are as follows:

- *Delaware*: The proposed Delaware WEA rests between the incoming and outgoing shipping routes for Delaware Bay and is made up of 11 whole OCS blocks and 16 partial blocks. The closest point to shore is 18.5 km (10 nmi) due east from Rehoboth Beach, Delaware. The area is approximately 122 nmi^2 (103,323 ac or 41,813 ha).
- *Maryland*: The Maryland WEA is defined as 9 whole OCS blocks and 11 partial blocks. The western edge of the WEA is located approximately 18.5 km (10 nmi) from the Ocean City, Maryland coast, and the eastern edge is approximately 50 km (27 nmi) from Ocean City, Maryland. The area is approximately 94 nmi^2 (79,706 ac or 32,256 ha).
- *Virginia*: The Virginia WEA consists of 22 whole OCS blocks and 4 partial blocks. The western edge of the area is approximately 33.4 km (18 nmi) from Virginia Beach, and the eastern edge is approximately 68.5 km (37 nmi) from Virginia Beach. The area is approximately 164 nmi^2 (138,788 ac or 56,165 ha).

Identification of the WEAs is part of the agency's "Smart from the Start" approach announced in November 2010 that uses appropriate designated areas, coordinated environmental studies, large-scale planning and expedited approval processes to speed offshore wind energy development.

In 2009, USDOI issued four limited leases authorizing wind resource data collection on lease blocks offshore Delaware and New Jersey (USDOI, MMS, 2009f). One of the lease blocks is offshore Delaware and is within the AOI for this Programmatic EIS (**Figure 4-39**).

In May 2011, the State of North Carolina completed a screening exercise of offshore regions for wind energy development, identifying 506 OCS lease blocks meeting their criteria for wind facility development (Thrive in North Carolina, 2011). The screening exercise examined potential environmental suitability, and the area is not proposed for wind development at this time. It is the expert judgment of BOEM staff that all 506 blocks would not be proposed for leasing or actually leased to begin site assessment activities within the period covered by the Programmatic EIS. The USDOI expects to identify WEAs offshore North Carolina in 2011 (USDOI, 2011a).

Atlantic Grid Holdings LLC has proposed to develop a high-voltage direct current transmission cable offshore the Atlantic coast running from northern New Jersey to Virginia in five phases (Atlantic Wind Connection, 2011a,b). The company has requested a right-of-way that is approximately 1,320 km (820 mi) in length, with as many as a dozen offshore platforms (substations).

4.2.12.1.5. Ocean Dredged Material Disposal Sites

There are 11 final dredged material disposal sites designated on the Atlantic OCS (40 CFR 228.15). These sites range in size from 3.4 to 40.5 km^2 (1 to 11.8 nmi^2) and are used for the disposal of dredged material from the maintenance dredging of commercial and military ports. The locations are offshore of the following areas (**Figure 4-40**):

- Dam Neck, Virginia;
- Norfolk, Virginia;
- Morehead City, North Carolina;
- Wilmington, North Carolina;
- Georgetown Harbor, South Carolina;
- Charleston, South Carolina;
- Savannah, Georgia;
- Brunswick Harbor, Georgia;
- Fernandina Beach, Florida;
- Jacksonville, Florida; and
- Canaveral Harbor, Florida.

There are two additional ocean dredged material disposal sites (ODMDSs) located in the AOI: New Wilmington, North Carolina, and Port Royal, South Carolina. These two areas are 32.2 and 3.4 km^2 (9.4 and 1 nmi^2), respectively (USEPA, 2011a).

The COE is the permitting authority for dredged material disposal. However, when issuing a permit, COE must obtain USEPA's concurrence, use USEPA developed dumping criteria, and use USEPA-designated ocean disposal sites to the maximum extent feasible. Virtually all ocean dumping in the U.S. today comprises dredged material (USEPA, 2011b).

4.2.12.1.6. Oil and Gas Exploration

The BOEM manages the leasing program for the 1.76-billion-ac OCS, under the authority of the OCSLA. These Federal lands are organized into 26 planning areas, approximately 80 percent of which have been unavailable for leasing because of Congressional moratoria and administrative withdrawals enacted over the years, including the Mid- and South Atlantic Planning Areas.

There are currently no active oil and gas leases or oil and gas exploration, development, or production activities on the Atlantic OCS. Ten oil and gas lease sales were held in the Atlantic between 1976 and 1983. Fifty-one wells were drilled in the Atlantic OCS between 1975 and 1984, including one well in the Mid-Atlantic Planning Area and seven wells in the South Atlantic Planning Area (**Figure 4-41**). At least one drillable prospect was identified during early Atlantic activity in the 1980s, Manteo, approximately 45 mi (72 km) northeast of Cape Hatteras, North Carolina, in water approximately from 820 m (2,700 ft) deep (USDOI, MMS, 1998). As a result of leasing during Sales 56 and 78 in September 1981 and September 1983, respectively, a 21 OCS block unit was approved by MMS in 1990 for this prospect. A 1998 review of the status of the Manteo project is contained in this OCS Report (USDOI, MMS, 1998).

In April 2007, this agency approved a 5-year leasing program for the OCS that included a contingent sale on the Atlantic OCS offshore the Commonwealth of Virginia. Contingent defined a condition that would be obtained if the Atlantic drilling moratoria imposed by executive order and the U.S. Congress for the Mid-Atlantic and South Atlantic Planning Areas in 1990 and 1991, respectively, were lifted at some point within the 5-Year Program. On July 14, 2008, by executive order President Bush announced a modification of the Presidential Withdrawal imposed on the Atlantic OCS. On September 30, 2008, the Congress let expire the previous USDOI appropriations measure that had imposed an Atlantic leasing ban. One oil and gas lease sale on the Atlantic OCS was scheduled in a Program Area of the Mid-Atlantic Planning Area in June 2012. This Agency began preparation of an EIS for the proposed sale.

After the administrative bans and Congressional moratoria were lifted, this Agency began preparation for special interest Lease Sale 220 off the coast of Virginia. The Program Area for proposed Sale 220 consisted of 593 whole and partial OCS blocks encompassing approximately 2.9 million ac.

Water depths in the program area range from 100 to 11,500 ft (30 to 3,500 m). The program area was roughly triangular in shape with the apex pointed east. The entire program area was located more than 50 statute miles from the boundary between the Commonwealth of Virginia and Federal waters, and extended seaward to 183 statute miles (**Figure 4-41**).

Scoping for the EIS in accordance with CEQ regulations implementing NEPA (40 CFR 1500) was conducted in two stages. The scoping process began November 13, 2008, with the publication of a combined Call for Information and NOI to Prepare an EIS in the *Federal Register* (*Federal Register*, 2008d), and public notices were printed in newspapers, announced on the MMS website, and e-mailed to a list serve of interested parties. A 45-day comment period was initially announced. In response to several requests, this agency extended the comment period to 60 days on January 7, 2009. The comment period closed on January 13, 2009. The public meetings required for scoping were deferred to a subsequent *Federal Register* notice. The MMS received comments from nearly 27,000 sources; of these, 58 percent were basically opposed to the proposed lease sale and 42 percent were basically in support of it.

Scoping was reopened with a new NOI published in the *Federal Register* on April 29, 2010 (*Federal Register*, 2010l), with scheduled public meetings in Ocean City, Maryland; Norfolk, Virginia; and Elizabeth City, North Carolina. Scoping was set to close May 17, 2010. After the *Deepwater Horizon* event and oil spill on April 20, 2010, the Secretary of the Interior re-evaluated the decision to hold Lease Sale 220 and decided on May 7, 2010 (*Federal Register*, 2010m) to postpone the comment period and cancel the public meetings that had been scheduled. This OCS lease sale offshore Virginia stands as cancelled.

4.2.12.1.7. Communication and Research Activities from Bottom-Founded Structures

Beginning in the early 1980's, the U.S. Navy constructed eight offshore towers in the Georgia Bight to support its Tactical Aircrew Combat System (**Figure 4-42**). The system consists of six perimeter towers arranged in a rectangle over the mid- to outer shelf, with two master stations in the center of the northern and southern halves of the range. The grid area covers an area of 115 by 50 km (71 by 31 mi), roughly 6,000 km^2 (2,317 mi^2), in waters from 25 to 45 m (82 to 147 ft) deep. The platforms are similar in appearance to small oil platforms. There are two platform styles, both of which are unmanned: (1) four-legged master platforms; and (2) three-legged remotes. This system exists to provide rapid (real-time) tracking of military combat aircraft in offshore military range complexes and civilian space program use areas to permit instructors onshore to observe and interact with pilots during exercises. The two master towers, R4 and R6, and R2 are four-legged platforms. These towers reach 52 m (170 ft) over the ocean surface and have two decks; the instrument deck is approximately 21 m (70 ft) above water and holds a large environmentally-controlled room, a diesel generator, a photovoltaic cell array, and small wind turbines. The helicopter deck is 6 m (20 ft) above the instrument deck, and extends 15 m (50 ft) beyond the instrument deck to the north. A 30-m (100 ft) tall communications tower is on the south end of the helicopter deck, where two 6 m (20 ft) poles hold small wind generators. The other towers are three-legged platforms with smaller instrument decks and only the photovoltaic array. Electrical components are housed in a large shed on the helicopter deck, but there are no wind generators on the three-legged towers, and the communications tower is 15 m (50 ft) tall.

Since 1998 the Navy towers have been instrumented to participate in the SABSOON, managed by Skidaway Institute of Oceanography. The program carries out long-term and real-time monitoring of a number of parameters including barometric pressure, precipitation, humidity, and dew point; air and water temperature; water salinity, density, light levels, chlorophyll, and dissolved organic matter; and velocity of currents and sea states that are useful for tracking movements of water masses offshore.

4.2.12.1.8. Known Sea Bottom Obstructions

The NOAA AWOIS database identifies the location of problematic bottom obstructions that include confirmed or suspected shipwrecks. Shipwrecks and obstructions are discussed in **Chapter 4.2.10**, and known locations are mapped in **Figure 4-31**. Artificial reefs are also widely distributed along the Atlantic coast, where they are used to improve or enhance the productivity of bottom conditions and fish habitat. Artificial reefs are discussed in **Chapter 4.2.1.1.3**, and locations are shown in **Figure 4-6**.

4.2.12.2. Impacts of Routine Events

This section discusses the potential impacts of routine G&G activities associated with Alternative A on other marine uses in the AOI. As discussed in **Chapter 4.1.1**, IPFs for other marine uses include (1) vessel traffic, (2) aircraft traffic and noise, (3) vessel exclusion zones, and (4) seafloor disturbance. Vessel traffic is related to all types of G&G activities; vessel exclusion zones relate to G&G activities for oil and gas exploration; and seafloor disturbances relate to all types of G&G activities. For the purpose of this discussion, vessel traffic and vessel exclusion zones will be dealt with together since they are interrelated and result in impacts of a similar nature.

4.2.12.2.1. Significance Criteria

Negligible impacts to other marine uses would include those where little to no measurable impacts on other marine uses are observed or expected.

Minor impacts to other marine uses would include those that are detectable but are neither severe nor extensive. Minor impacts to other marine uses would include limited, localized, and short-term disruptions of other marine uses (from vessel traffic, vessel exclusion zones and space use conflicts, and seafloor disturbance).

Moderate impacts to other marine uses would be detectable and extensive but not severe or detectable, localized, and severe. Moderate impacts to other marine uses would include detectable disruptions of other marine uses (from vessel traffic, vessel exclusion zones and space use conflicts, and seafloor disturbance).

Major impacts to other marine uses would be detectable extensive, and severe. Major impacts to other marine uses would include any G&G activity that results in (1) a substantial increase in the volume of vessel traffic for an extended period over a large area resulting in an interruption of other marine uses; (2) broad scale long-term vessel exclusion zones resulting in long-term space use conflicts with other marine uses; and/or (3) severe and extensive disturbance to the seafloor.

The significance criteria noted above have been developed as broad impact definitions. On a resource-specific basis, they are further defined for significant impacts as follows:

- *Shipping and Marine Transportation*: a minor impact would include short-term, localized disruption of marine vessel activities and movements; a moderate impact would include long-term or widespread detectable changes in vessel activity patterns but without severe consequences; and a major impact would include extensive interference with shipping and marine transportation resulting from G&G activities occurring in shipping channels, increased accident risks for other vessels and/or their equipment from towed G&G equipment, extensive hinderance (i.e., access) for other vessels, and/or extensive interference with normal port operations from G&G vessel traffic exceeding port capacity.
- *Military Range Complexes and Civilian Space Program Use*: a major impact would include extensive interference with military operations by G&G activities occurring within these areas. For ODMDSs, a major impact would include extensive disturbance to dredged disposal sites by intrusive boring or towed geophysical equipment.
- *Communication and Research Activities from Bottom-Founded Structures*: a major impact would include extensive damage to bottom-founded structures from seafloor-disturbing G&G activities (e.g., bottom-towed equipment or cabling).
- *Known Sea-Bottom Obstructions*: a major impact would include destruction of historical context or intrusive seafloor-disturbing G&G activities.

4.2.12.2.2. Evaluation

Vessel Traffic and Vessel Exclusion Zones

Vessel traffic generated by the G&G activities within all three program areas is discussed in detail in **Chapter 3.5.1.3**. Depending on the type of G&G survey being performed, the number of survey vessels typically would be one to three vessels. Vessel size can range from 20 m (65 ft) to 80-90 m (200-300 ft) and the vessels typically move at speeds of 4.5 kn (8.3 km/hr). The level of vessel traffic related to G&G activities would not represent a significant increase in total vessel traffic when compared to existing vessel traffic in offshore waters. Vessels performing surveys are slow moving, which allows for other vessels to easily move out of the way. In addition, survey efforts related to renewable energy and marine minerals are typically on the order of 5 days or less and are site-specific. Survey durations for oil and gas exploration can continue for weeks or months based on the size of the survey area and can occur anywhere within the AOI. In all three cases, local ports would be used for either supply vessels or as ports of operation.

The proposed action includes extensive 2D and 3D surveys involving towed streamer arrays requiring vessel exclusion zones within the AOI (**Chapter 3.5.1.5**). The scenario for the 2012-2020 timeframe includes 617,775 line km of 2D streamer surveys, 2,500 blocks of 3D streamer surveys, and 900 line km of 3D WAZ surveys. For each of these surveys, the establishment of a vessel exclusion zone around the source vessel and its towed streamer arrays is required. The size of the vessel exclusion zone varies depending on the array configuration and the radius from the ship that marine mammal observers can effectively observe, but a typical zone would be approximately 8.5 km (4.6 nmi) long and 1.2 km (0.6 nmi) wide, covering a total of 1,021 ha (2,520 ac) of the sea surface. Since survey vessels move at speeds of 4.5 kn (8.3 km/hr), the length of time that any particular point would be within an vessel exclusion zone would be approximately 1 hour. As discussed in **Chapter 3.5.1.5**, the vessel exclusion zone is simply an area monitored by a seismic survey operator and has no formal status or designation by the USCG. However, a Local Notice to Mariners would be issued that would specify the survey dates and locations and the recommended avoidance requirements.

All of the vessels involved in G&G activities would operate out of onshore support bases (**Chapter 3.5.1.10**). Five ports in the AOI have been identified as potential support bases (as well as numerous smaller ports for the smaller vessels). Ports and service bases would be used as launching points for the structures, equipment, supplies, and crew that serve in addition to providing products and services to the vessels.

Seismic airgun surveys for oil and gas exploration are conducted by large ships that are likely to remain offshore for most of their survey duration. However, it is expected the vessels would return to an onshore support base a total of 125 times under the proposed action scenario. Survey vessels for renewable energy or marine minerals programs would be relatively small and are expected to make daily round trips to their shore base. The renewable energy scenario would require 4,255 vessel round trips for HRG surveys and 3,106-9,969 vessel round trips for geotechnical surveys. The marine minerals scenario would require 180 vessel round trips for HRG surveys and 93-615 vessel round trips for geotechnical surveys. These G&G vessel traffic estimates are for the entire period under consideration in this Programmatic EIS (i.e., 2012-2020).

Shipping and Marine Transportation

Six commercial deepwater ports are located along the coast adjacent to the AOI (**Chapter 4.2.12.1.1**). Vessels using these ports include large commercial vessels, military vessels, commercial business craft, commercial recreational craft, research vessels, and personal craft. Current levels of shipping and marine transportation occurring along the entire U.S. Atlantic coast amount to nearly 30,000 arrivals for 2002-2004 (USDOC, NMFS, 2008) for vessels of 150 gross registered tons (GRT) or more.

Shipping and maritime vessel activity in the six major commercial ports of the AOI is substantial, with several thousand vessel arrivals per port per year noted. Actual vessel movements consider both vessel approach/arrival and departure from a port facility, indicating that vessel transits levels through the region are approximately twice the vessel arrival levels. Based on 2004 USCG data, more than 54,000 vessel transits (involving commercial vessels of at least 150 GRT) occur at U.S. east coast ports per year, a significant proportion of which either use ports of the AOI or may traverse waters of the AOI during inbound or outbound transit.

Based on the vessel traffic expected under G&G activities (**Chapter 3.5.1.3**), impacts to shipping and marine transport are expected to be **negligible** since the number of G&G-related vessel trips involved (approximately 4,250) and the duration of these surveys is small in relation to the existing vessel traffic throughout the AOI. There would not be a sufficient increase in vessel traffic to impact shipping and marine transportation.

Impacts from G&G activities on shipping and marine transportation would result from limited access to routes when vessel exclusion zones (**Chapter 3.5.1.5**) are in place. Impacts would be of relatively short duration with the time and extent dependent on the type of G&G activity; all impacts would be of short duration, on the order of days for surveys related to renewable energy and marine minerals and up to months with surveys related to oil and gas exploration; however, vessel exclusion zones would move with the investigation equipment, so one specific location would not be impacted for an extended period of time. Furthermore, the lease areas to be surveyed would not be located within maintained navigation channels and would not disrupt primary commercial ship traffic routes.

Preclusion of commercial ships from shipping lanes constitutes a space-use conflict. Seismic research vessels conducting G&G activities would operate under a ”restricted ability to maneuver” designation, which means other vessels in the path of the survey vessel must give way. All vessels operating with restricted maneuverability are required to carry the lights and signals described in Rule 27 of International Regulations for Preventing Collisions at Sea (COLREGS). Towed streamers are required to be marked with an orange buoy equipped with a quick flashing light and radar reflector. In addition, because of the length of the streamer arrays, the survey vessel requires considerable turning room between tracklines. Thus, the shipping lanes precluded to commercial ships could extend beyond the planned survey areas when appropriate allowances are made for maneuvering the vessel. However, proposed seismic airgun surveys would use from one to three vessels for a survey that would operate for a limited duration. Moreover, commercial shipping vessels would be notified of G&G activities through the “Notice to Mariners” process in advance of any seismic airgun surveys. The Notice to Mariners would specify the survey dates and locations and the recommended avoidance requirements.

While all of the vessels involved in G&G activities would operate out of onshore support bases (ports), the number of vessels and the number of anticipated round trips to the support bases is small when compared to the existing daily vessel traffic and usage of onshore support bases in the AOI. If the larger vessels used for oil and gas seismic surveying are operating out of large ports with extensive capacity, each port would be able to accommodate the increased vessel traffic without interference with existing marine traffic. If smaller ports are used for the smaller vessels (approximately 20 m [66 ft]) deployed for the types of surveys required for renewable energy and the marine minerals programs, there could be limited effects from the increased vessel traffic on both port capacity and port access (e.g., navigation into and out of port, within port maneuvering). Impacts to large ports from G&G vessel traffic are expected to be **negligible**. Large seismic survey vessels would not be using smaller ports. Impacts on smaller ports are expected to range from **negligible** to **minor** and should be evaluated on a project-specific basis.

Overall, impacts to shipping and marine transportation would be of relatively short duration with the time and extent dependent on the type of G&G activity and are expected to be **negligible** to **minor**.

Military Range Complexes and Civilian Space Program Use

Military range complexes and civilian space program use areas, including restricted area and danger zones, are discussed in **Chapter 4.2.12.1.2**. Most of the AOI is within military range complexes and civilian space program use areas, and G&G activities would be subject to restrictions imposed by military and NASA needs, rules, and regulations. Vessel traffic levels and vessel exclusion zones associated with G&G activities are small and of limited duration but could be an obstruction to surface use by military units, depending upon their location. Potential impacts of G&G activities to military range complexes and civilian space program use would be **negligible** and avoidable when coordinated with DOD and NASA prior to commencement. The use of the sea surface by vessels in support of the proposed action would occur within areas also belonging to various military range complexes or NASA’s Wallops Flight Facility, the latter of which can be affected by launch debris (see **Figure 4-38**). Conflicts between G&G activities and scheduled military operations can be largely avoided by assigning military coordination mitigation measures as a condition of permit approval (i.e., similar to NTL 2009-G06, the military coordination lease stipulation in effect in the Gulf of Mexico) (**Chapter 2.1.2.8**). Mitigation of this type would require the G&G operator to contact designated DOD or NASA personnel identified for the purpose to be notified of the nature and schedule for any pending G&G activity planned within military range complexes or NASA’s use areas. Such notification and communication would ensure that authorities are aware of pending G&G activities and would provide a mechanism to avoid scheduling conflicts, should the need arise.

Sand and Gravel Mining

There are currently seven OCS sand and gravel borrow area location within the AOI (**Chapter 4.2.12.1.3**). Impacts to sand and gravel mining from G&G vessel traffic and exclusions zones (resulting from oil and gas exploration and renewable energy surveys) would be **negligible**. As previously stated, both vessel traffic and vessel exclusion zones are small and of limited duration; similarly, sand and gravel mining occurs over a relatively short time period, decreasing the chance for any overlap of activities. Furthermore, G&G activities associated with marine mineral surveys (**Chapter 3.5.1.3**) are in support of sand and gravel mining.

The marine minerals scenario includes a maximum activity level estimated at 12,100 km or approximately 1,450 hr of surveying across 180 8-hour operational survey days for all geophysical survey activities. The marine minerals G&G activities are to be conducted in support of identification and use of OCS sand for beach nourishment and coastal restoration projects (USDOI, BOEM, 2011g) through BOEM's cooperative sand evaluation program with coastal states in the AOI. Since a portion of the G&G activities are in support of sand and gravel mining, impacts are expected to be **negligible** as there is no potential for use conflicts.

Renewable Energy Development

Renewable energy development within the AOI includes three WEAs, one limited lease block area, and four environmentally suitable areas for use in the near future (**Chapter 4.2.12.1.4**). Impacts to renewable energy development from G&G vessel traffic and exclusions zones (resulting from oil and gas exploration and marine minerals surveys) would be **negligible**, since both vessel traffic and vessel exclusion zones are small and of limited duration. Furthermore, G&G activities associated with renewable energy surveys (**Chapter 3.5.1.3**) are to be conducted in support of renewable energy development.

Vessel traffic and vessel exclusion zones (established as part of renewable energy surveys) would occur on new, undeveloped lease areas and would not affect current or future renewable energy development projects within the AOI. Therefore, since there are no conflicts of use within renewable energy development areas, impacts to renewable energy development from vessel traffic and vessel exclusion zones are expected to be **negligible**.

Ocean Dredged Material Disposal Sites

There are 11 final dredged material disposal sites on the Atlantic OCS and two additional ODMDSs in the AOI (**Chapter 4.2.12.1.5**). Impacts from vessel traffic and exclusions zones associated with the proposed action are expected to be **negligible** since the number of vessels involved and the duration of the surveys is small. Impacts on ODMDSs would result from limited access to routes when vessel exclusion zones (**Chapter 3.5.1.5**) are in place. Impacts would be of relatively short duration, with the time and extent dependent on the type of G&G activity; all impacts would be of short duration, on the order of days for surveys related to renewable energy and marine minerals and up to months with surveys related to oil and gas exploration, however vessel exclusion zones would move with the investigation equipment so that one specific location is not impacted for an extended duration.

Preclusion of vessels using the disposal sites would constitute a space-use conflict. Seismic vessels conducting G&G activities operate under a "restricted ability to maneuver" designation, which means other vessels in the path of the survey vessel must give way. In addition, because of the length of the streamer arrays, the survey vessel requires considerable turning room between tracklines. Thus, the disposal sites precluded to vessels could extend beyond the planned survey areas when appropriate allowances are made for maneuvering the vessel. However, proposed seismic airgun surveys would use one to three vessels that would operate for a limited duration. Moreover, as part of the normal seismic airgun survey planning process, areas where "restricted ability to maneuver" may exist would be identified and accounted for during planning. All vessels operating within an area planned for a seismic airgun survey would be notified of G&G activities in advance via the "Notice to Mariners" process. Overall, impacts to ODMDSs from G&G activities are expected to be **negligible**.

Oil and Gas Exploration

There are currently no active oil and gas leases or oil and gas exploration, development, or production activities on the Atlantic OCS (**Chapter 4.2.12.1.6**). The G&G activities under the proposed action would occur on undeveloped lease areas and would not affect current or future oil and gas exploration projects. Impacts to oil and gas exploration from G&G activities are expected to be **negligible**.

Communication and Research Activities from Bottom-Founded Structures

The U.S. Navy has constructed eight offshore towers in the Georgia Bight arranged within an area of 115 by 50 km (71 by 31 mi), roughly 6,000 km^2 (2,317 mi^2) (**Chapter 4.2.12.1.7**) used in support of the Tactical Aircrew Combat System to provide tracking of military aircraft in offshore military range complexes and civilian space program use areas. The G&G activities occurring within the vicinity of the Tactical Aircrew Combat System structures would be subject to restrictions imposed by military needs, rules, and regulations and require coordination with the DOD or NASA prior to commencement. Vessel traffic levels and vessel exclusion zones related to G&G activities are small and of limited duration but could be an obstruction to surface use by military units depending upon their location. Potential impacts would be avoidable with proper coordination including developing mitigation measures similar to NTL 2009-G06, the military coordination lease stipulation in effect in the Gulf of Mexico (**Chapter 2.1.2.8**). Overall, impacts to communication and research activities from G&G activities are expected to be **negligible**.

Known Sea Bottom Obstructions

A review of all databases and secondary sources has identified 4,676 known wrecks, obstructions, archaeological sites, occurrences, or sites marked as "unknown" in the study area. Shipwrecks and obstructions are discussed in **Chapter 4.2.10**, within the context of archaeological resources. In addition, artificial reefs are also widely distributed along the Atlantic coast (**Chapter 4.2.1.1.3**). Vessel traffic and vessel exclusion zones relate to surface-based activities and so do not pose a threat to sea bottom obstructions. Therefore, impacts to known sea bottom obstructions from vessel traffic and vessel exclusion zones are **negligible**.

Aircraft Traffic and Noise

Remote sensing surveys associated with oil and gas exploration and development activities would include aeromagnetic surveys (**Chapter 3.2.2.6.5**) and helicopter support during drilling of COST wells and shallow test wells (**Chapter 3.2.4**). The BOEM anticipates that one or two aeromagnetic surveys may be conducted in the AOI during the time period covered by the Draft Programmatic EIS. As discussed in detail in **Chapter 3.5.1.4**, the surveys would be conducted by fixed-wing aircraft flying at speeds of about 250 km/hr (135 kn) (Reeves, 2005). Most offshore aeromagnetic surveys are flown at altitudes between 61-152 m (200-500 ft). Line spacing varies depending on the objectives, but typical grids are 0.5 by 1.0 mi or 1.0 by 1.0 mi. It is expected that a typical aeromagnetic survey may require 1-3 months to complete. In addition, helicopters are a potential source of aircraft noise during drilling of COST wells and shallow test wells. The oil and gas scenario assumes that up to three COST wells and up to five shallow test wells would be drilled in the Mid- or South Atlantic Planning Areas during the time period of the Programmatic EIS. It is expected that drilling activities would be supported by a helicopter making one round-trip daily between the drilling rig and onshore support base. Noise generated by aircraft is associated with engines, which may be either reciprocating engines or turbine (turboprop) engines, airframe, and propellers (Richardson et al., 1995). Not considering harmonic tones, the dominant tones from fixed-wing aircraft are generally below 500 Hz. Because of the expected airspeed (135 kn), noise generated by survey aircraft is expected to be brief in duration for receptors on the ground or at the ocean surface.

All aircraft flights would originate from existing shore-based facilities and would file flight plans with the FAA before departure. These flights would not interfere with normal commercial traffic, which flies at much higher altitudes, nor are the number of G&G-related flights anticipated to be large enough to add stress to the air traffic control system.

Aircraft traffic and noise resulting from G&G activities would have no effect on most of the other marine uses, including shipping and marine transportation, sand and gravel mining, renewable energy development, oil and gas exploration, dredged material disposal, research activities from bottom-founded structures, and known sea bottom obstructions. Aircraft traffic has the potential to interfere with military aircraft operations to be conducted within and between existing military range complexes supporting exercises and testing. As was noted for surface-based G&G activities to be operating within existing military range complexes and civilian space program use areas, G&G aircraft activities would be subject to restrictions imposed by military and NASA needs, rules, and regulations. Military range complexes and civilian space program use areas, including those restricted area and danger zones discussed in **Chapter 4.2.12.1.2**, include most of the AOI. Aircraft traffic levels and the duration of airborne surveys associated with G&G activities are very limited both in terms of survey area and duration. Potential impacts of G&G activities to military range complexes and civilian space program use would be **negligible** and avoidable when coordinated with DOD and NASA prior to commencement.

Seafloor Disturbance

Activities with the potential for seafloor disturbance include sampling by vibracoring, geologic core, and grab; use of jet probes and piezonecone penetrometers; the laying of ocean bottom nodal, ocean bottom cable, and vertical cable; the drilling of shallow test and COST wells; and the placement and retrieval of bottom-founded monitoring buoys. Proposed activities under Alternative A include bottom sampling, drilling, and anchoring. Bottom sampling would be conducted in all three program areas. The total area disturbed by core or grab sampling is expected to affect 11 ha (27.7 ac), which represents 0.00001 percent of the AOI. Drilling of COST wells and shallow test wells would average about 2 ha (5 ac) per well. If all of the COST wells and shallow test wells in the proposed action scenario were drilled, the total seafloor disturbance would be about 16 ha (40 ac), or about 0.00002 percent of the AOI. Anchoring would include installation of 7-38 bottom-founded monitoring buoys as part of the renewable energy program. Similarly, the placement and removal of bottom cables and anchors would produce localized sediment disturbance to soft bottom communities. Total footprint area would range from 3.85 to 20.9 m^2 (42 to 228 ft^2) for the anchors, while the sweep area would range from 23.8 to 129.2 ha (59.5 to 323 ac). If all of the monitoring buoys in the proposed action scenario were installed, the total seafloor disturbance would be about 129 ha (319 ac), or about 0.0002 percent of the AOI and 0.047 percent of the identified wind energy areas.

Shipping and Marine Transportation

Six commercial deepwater ports are located along the coast adjacent to the AOI (**Chapter 4.2.12.1.1**). Vessels using these ports include large commercial vessels, military vessels, commercial business craft, commercial recreational craft, research vessels, and personal craft. Seafloor disturbance resulting from G&G activities would have no impact upon shipping and marine transportation.

Military Range Complexes and Civilian Space Program Use

Military range complexes and civilian space program use areas including restricted area and danger zones are discussed in **Chapter 4.2.12.1.2**. Most of the AOI is within military range complexes and civilian space program use areas, and G&G activities would be subject to restrictions imposed by military and NASA needs, rules, and regulations. Given that the DOD and NASA would require prior approval of any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures (including requiring site-specific information), impacts to military range complexes and civilian space program use areas are expected to be **negligible** and avoidable with proper coordination.

Sand and Gravel Mining

There are currently seven OCS sand and gravel borrow area locations within the AOI (**Chapter 4.2.12.1.3**). Sampling activities for marine minerals would be conducted at specific borrow sites in water depths less than 30 m (98 ft). Much of the marine minerals activity is expected to occur within existing borrow sites offshore the mid- and south Atlantic states (**Figure 4-38**). The G&G

activities that could cause seafloor disturbance are consistent with the ongoing use of sand and gravel mining areas and do not present a conflict of use, therefore, impacts to sand and gravel mining uses would be **negligible**.

Renewable Energy Development

Renewable energy development within the AOI includes three WEAs, one limited lease block area, and four environmentally suitable areas for use in the near future (**Chapter 4.2.12.1.4**). Sampling for renewable energy projects would occur at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. The G&G activities that could cause seafloor disturbance are consistent with the ongoing use of renewable energy development areas and do not present a conflict of use, therefore impacts to renewable energy development areas would be **negligible**.

Ocean Dredged Material Disposal Sites

There are 11 final dredged material disposal sites on the Atlantic OCS and two additional ODMDSs in the AOI (**Chapter 4.2.12.1.5**). The G&G activities that could cause seafloor disturbance are expected to avoid these disposal sites, given that placement of bottom-founded equipment or bottom sampling could be compromised by subsequent or prior dredge spoil deposition, respectively. Activities associated with G&G-related bottom sampling or placement of bottom-founded equipment would not interfere with ocean dredged material disposal operations nor adversely affect any ODMDSs. As a result, G&G activities that could cause seafloor disturbance would not impact ODMDSs.

Oil and Gas Exploration

There are currently no active oil and gas leases or oil and gas exploration, development, or production activities on the Atlantic OCS (**Chapter 4.2.12.1.6**). The earliest that an OCS oil and gas lease sale could take place in the Mid- or South Atlantic Planning Area is 2018, and only if these planning areas were included as part of the BOEM's 2018-2023 5-year leasing program. Oil and gas exploration and development activities that could occur before 2018 would be limited to the prelease G&G activities that are analyzed in this Programmatic EIS. These surveys could take place as soon as BOEM completes the NEPA evaluation and publishes an ROD for G&G work in the AOI and the environmental consultations required by law are completed, as projected to happen in the first quarter of 2013. After these conditions are satisfied, a submitted permit application would be processed within 45-60 days. If a lease sale were held in 2018, oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020 (the end of the time period analyzed in the Programmatic EIS) would be prelease and postlease G&G surveys and possibly drilling of a few exploration wells. Sampling for oil and gas exploration would be conducted at specific lease blocks where structures (e.g., drilling rigs) may be installed. The G&G activities that could cause seafloor disturbance are consistent with the potential future use of oil and gas exploration areas and do not present a conflict of use, therefore impacts to oil and gas exploration areas would be **negligible**.

Communication and Research Activities from Bottom-Founded Structures

The U.S. Navy has constructed eight offshore towers in the Georgia Bight arranged within a 115 by 50 km (71 by 31 mi) area, roughly 6,000 km^2 (2,317 mi^2) (**Chapter 4.2.12.1.7**), used in support of the Tactical Aircrew Combat System to provide tracking of military aircraft in offshore military range complexes and civilian space program use areas. The BOEM would require coordination with DOD prior to any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures (including requiring site-specific information), it is expected that impacts to communication and research activities from bottom-founded structures would be very limited, a **negligible** impact.

Known Sea Bottom Obstructions

A review of all databases and secondary sources has identified 4,676 reported wrecks, obstructions, archaeological sites, occurrences, or sites marked as "unknown" in the study area. Shipwrecks and obstructions are discussed in **Chapter 4.2.10**. In addition, artificial reefs are also widely distributed along the Atlantic coast (**Chapter 4.2.1.1.3**).

The BOEM would require site-specific information regarding potential archaeological resources and sensitive benthic communities (including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. The BOEM would use this information to ensure that there are no physical impacts to archaeological resources and other sea bottom obstructions. Therefore, impacts to known sea bottom obstructions would be **negligible**.

In the event that bottom-founded G&G activities (such as 4D seismic airgun surveys and intrusive boring) are conducted in an area containing no previously known archaeological resources or sensitive benthic communities and such obstructions are discovered during operations, operations would be suspended immediately. If it is determined that a potential shipwreck or prehistoric site has been located, the operator must halt operations and take the necessary steps to ensure that the site is not disturbed further. The BOEM must also be notified within 48 hr of the discovery.

4.2.12.3. Impacts of Accidental Fuel Spills

An accidental event could result in release of diesel fuel by a survey vessel. Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes a diesel spill ranging from 1.2 to 7.1 bbl. Spills occurring at the ocean surface would disperse and weather. Volatile components of the fuel would evaporate. Fuel and diesel used for operation of survey vessels is light and would float on the water surface. There is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink. Particulate matter contaminated with diesel fuel could eventually reach the benthos either within or outside the AOI, depending upon spill location, water depth, ambient currents, and sinking rate. However, given the relatively small size of the spill and the loss of most spilled fuel through evaporation and dispersion, a small diesel fuel spill at the surface would have no effect on benthic communities. As described in **Chapter 3.5.2.1**, the risk of accidental fuel spills is expected to be remote. The impacts would depend on the size and location of the spill, in addition to the meteorological conditions at the time. If a small diesel spill were to occur, it would have **negligible** impact on other marine uses, since it would only prohibit full use of a small area by other marine users for a very limited amount of time.

4.2.12.4. Cumulative Impacts

The cumulative impacts scenario discussed in detail in **Chapter 3.6** includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The potential IPFs for these cumulative activities that have the potential to affect other marine uses include (1) vessel traffic and vessel exclusion zones; (2) seafloor disturbance; (3) presence of structures; and (4) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Among the IPFs identified above for the cumulative impacts scenario, all four sources of potential impact to other marine uses have been identified in association with proposed G&G activities. However, the activities included in other marine uses include seven of the nine activities included in the cumulative scenario: (1) oil and gas development; (2) marine minerals use; (3) renewable energy development; (4) commercial and recreational fishing; (5) military range complexes and civilian space program use; (6) shipping and marine transportation; and (7) dredged material disposal. Under Alternative A, IPFs identified for other marine uses included (1) vessel traffic; (2) exclusion zones; (3) aircraft traffic and noise; (4) seafloor disturbance; and (5) accidental fuel spills, as presented in **Chapters 4.2.12.2** and **4.2.12.3**. Based on the prior impact analysis, it was determined that activities projected to occur under Alternative A would result in **negligible** or **minor** impacts to other marine uses, depending on the IPF. Only geosequestration and LNG import terminals were not addressed previously under other marine uses; these two cumulative activities are expected to be very limited in spatial extent. The cumulative analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Vessel Traffic and Vessel Exclusion Zones

Vessel traffic would increase under the cumulative scenario to support most of the activities. Commercial vessels can range across the entire OCS, but higher traffic areas are generally self-restricted to transit corridors (**Figure 4-36**). Recent trends for increases in marine transportation and shipping levels at U.S. east coast ports are expected to continue, and overall vessel traffic volume within the AOI would increase during the period of interest. Impacts to other marine uses from the cumulative scenario are expected to range from negligible to minor, with the highest impact level expected in the vicinity of U.S. east coast ports where the majority of commercial vessel visits are documented.

As discussed in **Chapter 4.2.12.2**, the G&G vessel activity levels expected under the three program areas would not be sufficient to impact navigation, port capacity, or shipping and marine transportation; impacts were determined to be **negligible** to **minor**. Elevated impact levels could result from increased vessel traffic if several G&G investigations were conducted simultaneously. This effect would be most acute if smaller ports were used. Vessel operations must follow USCG vessel regulations and standards that include the use of vessel traffic schemes, other navigation tools, and observing vessel exclusion zones (**Figure 4-36**). Additional vessel traffic from proposed G&G operations would not represent a significant increase to existing vessel traffic from cumulative activities and operations within the AOI. In addition, G&G vessel traffic occurring under the cumulative action scenario would be transiting to and from offshore locations (i.e., support vessels; short duration survey activity) or would be operating offshore (i.e., extended seismic airgun surveys). Therefore, G&G activities would produce only a negligible incremental increase in impacts to other marine uses under the cumulative scenario.

Military range complexes and civilian space program use areas already restrict a number of activities on a spatial and/or temporal basis. The Mid- and South Atlantic Planning Areas include all or parts of five major DOD range complexes and NASA's Wallops Island Flight Facility downrange hazard area (**Figure 4-37**). Under the proposed action, additional vessel exclusion zones would occur, however these zones would be temporary (i.e., duration of activity) and may be either transitory (i.e., moving with a survey vessel) or fixed (e.g., surrounding a drilling operation). Vessel traffic within military range complexes and civilian space program use areas would also increase. Increased vessel traffic and the establishement of vessel exclusion zones caused by the proposed action would result in negligible incremental increases in impacts to military range complexes and civilian space program uses.

Under the cumulative activities scenario, oil and gas exploration, renewable energy, geosequestration, and LNG terminals all potentially may include the presence of structures within the AOI. These additional structures would add to the exclusion areas already required by the proposed action. Marine space-use issues are an important element in marine spatial planning (Crowder and Norse, 2008; Douvere and Ehler, 2009). However, all vessel operations must adhere to USCG regulations and other vessel operations requirements, which include the avoidance of structures. Marine space conflicts would have to be evaluated prior to structure placements. Based on the activities anticipated in the time period evaluated in the Programmatic EIS, impacts are expected at a few locations. Therefore, only negligible incremental increases to impacts to other marine uses are expected from G&G activities.

Cumulative impacts would also result if multiple G&G activities were occurring simultaneously within close proximity of each other. Vessel exclusion zones established for multiple projects could result in a larger cumulative area excluded and may result in a longer time period where other marine uses are prohibited from certain areas. This type of cumulative impact could be most acute where exclusion zones and an increase in vessel traffic occur in the approach to a commercial harbor. For each G&G investigation, planning should include review of scheduled activities within a given area. However, the level of increased vessel traffic would not increase significantly with the cumulative action scenario; therefore, only minor incremental increases in impacts to other marine uses are expected from vessel exclusion zones associated with G&G activities.

Aircraft Traffic and Noise

Aircraft traffic adjacent to and within the AOI would increase in association with G&G activities. All aircraft flights would originate from existing shore-based facilities. Flights would not interfere with the nornal commercial traffic. The number of G&G-related flights is not expected to be large enough to add stress to the air traffic control system. As noted in **Chapter 4.2.12.2**, aircraft traffic and noise resulting from G&G activities would have no effect on most of the other marine uses, including shipping and marine transportation, sand and gravel mining, renewable energy development, oil and gas exploration, dredged material disposal, research activities from bottom-founded structures, and known sea bottom obstructions. The G&G-related aircraft traffic does, however, have the potential to interfere with military aircraft operations associated with existing military range complexes.

Aircraft traffic levels and the duration of airborne surveys associated with G&G activities are very limited both in terms of survey area and duration. Potential impacts of G&G activities on military range complexes and civilian space program use area was determined to be **negligible** and avoidable when coordinated with DOD and NASA prior to commencement. The incremental increase in aircraft traffic and noise expected under Alternative A would produce a negligible incremental increase in total aircraft activity and associated impacts expected under the cumulative scenario.

Seafloor Disturbance

Several activities under the cumulative scenario would include seafloor disturbance, including oil and gas development, marine minerals use, renewable energy development, geosequestration, LNG import terminals, commercial fishing, and dredged material disposal. As discussed in **Chapter 4.2.12.2**, several proposed action activities could cause seafloor disturbance, including geological and geochemical sampling, placement and removal of equipment on the seafloor, and the installation of COST and shallow test wells, and the impacts were determined to be **negligible**.

One of the biggest issues with the cumulative scenario activities is additional seafloor disturbance from appurtenances (e.g., drilling rigs, bottom-founded meteorological buoys, wind turbines, cables, and LNG terminals). The seafloor area that potentially would be impacted by the proposed action activities is extremely small when compared to the total area of the AOI (0.00025%). Further, seafloor disturbances as part of the level of activity or installations of additional appurtenances are not anticipated to be significant when compared to the entire AOI.

Commercial fishing activities under the cumulative activities scenario would result in seafloor disturbance. However, the level of activity in the time period analyzed in the Programmatic EIS for cumulative scenario activities is not anticipated to cause significant, extensive seafloor disturbance when compared to the entire AOI. Therefore, only negligible incremental increases in impacts from G&G-based seafloor disturbance are expected under the cumulative scenario.

Accidental Fuel Spills

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to other marine uses from the response activities would vary depending on the location and size of the spill. However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prior to any wells being drilled. In addition, a project-specific EA would require an analysis of site-specific information and mitigation measures taken to minimize impacts from drilling activities and potential accidental crude oil spills. With the required mitigation measures in place and with oversight of these activities by the BSEE, an accidental crude oil spill from an exploratory well is not anticipated; however, a spill still could occur. With these mitigation measures in place, the impacts to other marine uses from exploratory drilling operations are expected to be negligible.

A sizeable amount of vessel traffic is expected to occur under the cumulative scenario from non-G&G activities during the period of interest, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The impacts of an accidental fuel spill arising from a vessel collision under the cumulative scenario are expected to range from negligible to minor.

Each G&G activity that involves survey vessels has the potential to result in an accidental fuel spill. A survey vessel colliding with another vessel or structure could result in a diesel fuel spill ranging from 1.2 to 7.1 bbl (**Chapter 3.5.2.1**). The likelihood of such a spill is expected to be remote for the G&G activity scenario. Spilled diesel fuel would evaporate, disperse, and break down within a day, resulting in a **negligible** impact to other marine uses. Non-G&G activities at risk for spilled fuel include geosequestration, commercial and recreational fishing, military activity, and dredged material disposal. An accidental fuel spill associated with G&G activities would produce a negligible incremental increase in impacts under the cumulative scenario.

4.2.13. Human Resources and Land Use

4.2.13.1. Description of the Affected Environment

This chapter describes the human and land resources in and around five selected ports: Port of Virginia (Norfolk, Virginia), Wilmington (North Carolina), Charleston (South Carolina), Savannah (Georgia), and Jacksonville (Florida). The ports were selected based on their geographic proximity to the AOI, locations named in permit applications for G&G activities, and the availability of adequate support facilities that could be used by G&G survey vessels. Many smaller ports exist along the coast from Delaware to Florida that could be used as support bases for G&G activities associated with individual renewable energy or marine minerals projects. See **Chapter 3** for a discussion of port selection.

4.2.13.1.1. Land Use and Coastal Infrastructure

The CEQ regulations for implementing NEPA state that the discussion of environmental consequences in an EIS should include possible conflicts between the proposed action and existing land use plans (40 CFR 1502.16(c)) and proximity to areas with unique characteristics such as park lands and ecologically critical areas (40 CFR 1508.27(b)(3)). This chapter describes current land use and future land use plans for the selected ports and corresponding channels, harbors, and estuaries. **Chapter 4.2.11** presents a complete listing of NWRs, parks, and other protected coastal areas.

The Coastal Zone Management Act establishes that “each Federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone shall be carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved State management programs” (16 U.S.C. 1456 (c)), where “State management programs” refers to State Coastal Management Programs approved by the Federal government. A detailed description of State Coastal Zone Management Programs is included as **Appendix B** of this Programmatic EIS.

The Farmland Protection Policy Act (FPPA) (7 U.S.C. 4201 – 4209, 7 CFR 658) requires Federal agencies to “identify and take into account the adverse effects of Federal programs on the preservation of farmland” (7 U.S.C. 4202(b)). All five selected ports are located on developed land, in or adjacent to urban areas. Projects on land already in urban development are not subject to the FPPA (Natural Resources Conservation Service, 2011). Because of the small scale of onshore support operations for G&G activities, BOEM does not expect new facilities to be proposed on undeveloped rural lands, and no further consideration is given in this Programmatic EIS to lands subject to the FPPA.

The remainder of this chapter discusses land use and land use plans for the five ports.

All port terminals are situated in or adjacent to urban areas and are typically surrounded by residential and industrial zones. Harbors and channels leading to the sea typically contain a mix of residential, military, and undeveloped lands. Some channels cross or are adjacent to parks or wildlife refuges. In all ports, land use is dominated by berths, open and closed storage areas, facilities, and rail yards. The following paragraphs provide further details for each port.

Port of Virginia (Norfolk, Virginia)

The Port of Virginia has its largest terminal in Norfolk, with additional terminals in Portsmouth and Newport News (Virginia Port Authority, 2011). It is located at the mouth of the Hampton Roads natural harbor that opens to the mouth of the Chesapeake Bay. The Port of Virginia terminals are located in an urban area with a mix of industrial, commercial, and residential uses. There are also several small parks in the area. The mouth of the Chesapeake Bay, connecting the port terminals to the sea, is bordered to the south by urban beaches of the cities of Norfolk and Virginia Beach. To the north and south there are several NWRs, including the Eastern Shore of Virginia NWR, Fisherman Island NWR, Back Bay NWR, Mackay Island NWR, and Currituck NWR. The mouth of the harbor is over 3.2 km (2 mi) wide and borders urban residential areas in the cities of Hampton (to the north) and Norfolk (to the south).

The Virginia Port Authority Strategic Plan includes construction of a fourth terminal on Craney Island to accommodate port expansion. This expansion is deemed crucial to accommodate projected growth in import cargo in the long run (Virginia Port Authority, 2007).

Wilmington, North Carolina

The Port of Wilmington is located in New Hanover County, North Carolina, on the eastern banks of the Cape Fear River (North Carolina Ports, 2011). It is surrounded by industrial and residential areas of the City of Wilmington to the east and the Cape Fear River to the west (City of Wilmington, 2009). Across the river from the port is Eagle Island, most of it property of the COE, which manages a dredged material disposal facility there (U.S. Department of the Army [USDOA], COE, 2009). The port is connected to the sea by an approximately 42-km (26-mi) channel along the Cape Fear River. The lands to the west of the navigation channel are part of the County of Brunswick and are mostly undeveloped. They include the Brunswick Town State Historic Site, the Sunny Point Military Ocean Terminal and, close to the mouth of the river, the city of Southport. The lands to the east of the navigation channel are part of New Hanover County and are also mostly undeveloped, with some intermixed residential areas, Carolina Beach State Park, and Fort Fischer State Recreation Area. At the mouth of the river is the small village of Bald Head Island.

The Port of Wilmington is currently conducting a feasibility study weighing options for upgrading and for making the port more accessible to increased traffic and larger vessels (North Carolina Ports, 2011).

Charleston, South Carolina

The Port of Charleston consists of five terminals, four of them located on the western bank of the Cooper River and one on the eastern bank of the Wando River, all in Charleston County, South Carolina (South Carolina State Ports Authority, 2011). Land use around the port is a mix of industrial, commercial, and residential areas, with some undeveloped land along the Cooper and Wando River banks. The port terminals are located 8-16 km (5-10 mi) from the sea in a natural harbor along which there are several residential areas as well as the USS Yorktown State Park. The harbor leading to the sea is between 1.6-4.8 km (1-3 mi) wide, with residential piers, particularly on the north side. Most of the terminals face small undeveloped areas across the river.

A new container terminal is currently under construction at the Port of Charleston, with initial operations expected for 2018 (South Carolina State Ports Authority, 2011).

Savannah, Georgia

The Port of Savannah is located in Chatham County, Georgia, on the border with South Carolina. Its two terminals are on the west bank of the Savannah River, within the Savannah urban area (Georgia Ports Authority, 2009). Land use to the west of the port terminals is a mix of industrial and residential uses. To the east, the Savannah River waters are often no more than 275-m (900-ft) wide, with relatively undeveloped portions of Hutchinson Island and Kings Island on the opposite side. Part of the northern terminal faces the Savannah NWR. The Port is located approximately 24 km (15 mi) upstream from the mouth of the river. The banks along the river channel leading to the sea are mostly undeveloped and include recreational areas such as the McQueen's Island Historic Trail, the Fort Pulaski National

Monument, and the Tybee Island beaches at the mouth of the river. The Tybee NWR lies to the north of the river, in South Carolina. The Savannah historic district with its colonial buildings lies along the river banks to the south or the Port.

Several expansion projects are currently underway at the Port of Savannah aiming at more than doubling its throughout capacity by 2018 (Georgia Ports Authority, 2009).

Jacksonville, Florida

The Port of Jacksonville has three cargo terminals and one cruise terminal within the city of Jacksonville, Duval County, Florida (Jacksonville Port Authority, 2011). One cargo terminal is located next to the urban core of the city on the west bank of the St. Johns River, about 29 km (18 mi) from the estuary. The terminal is adjacent to residential and industrial areas. Another cargo terminal is located on Blount Island, approximately 13 km (8 mi) from the estuary, adjacent to the U.S. Marine Corps Blount Island Command. It is flanked to the north and south by the St. Johns River. The third cargo terminal and the cruise terminal are located on the north bank of the St. Johns River, just upstream from Blount Island, and are adjacent to mostly undeveloped lands. Approximately 10 km (6 mi) of the river channel and its banks, before it reaches its estuary, are part of the Timucuan Ecological and Historic National Preserve, the exceptions being a private and mostly residential area on Fanning Island and the Mayport Naval Station, on the southern tip of the estuary. There are light residential areas with piers at various parts of the channel to the sea, while other parts of the river banks are undeveloped and others contain military port and airport facilities.

The 2010 Jacksonville Port Authority Annual Report describes several projects currently underway to expand capacity and accommodate future growth, including improved infrastructure projects and increased container handling capacity (Jacksonville Port Authority, 2011).

4.2.13.1.2. Demographics

For the purpose of analyzing human resources, it is useful to look at the Metropolitan Statistical Areas (MSAs) in which each port is located. The MSAs are counties or groups of counties where commuting ties around an urbanized area of 50,000 people or more indicate the existence of strong social and economic integration. They are defined and revised by the Office of Management and Budget on a regular basis. Each of the five ports is part of an MSA.

The Port of Virginia is located in the Virginia Beach-Norfolk-Newport News MSA. This is a relatively large area including communities on both sides of the Hampton Roads Harbor, seven counties, and nine cities, including the cities of Norfolk, Virginia Beach, Portsmouth, Newport News, and Hampton. The Port of Wilmington is part of the Wilmington MSA, an area that includes the counties of New Hanover, Brunswick, and Pender. The Port of Charleston is part of the Charleston-North Charleston-Summerville MSA, which consists of the counties of Charleston, Berkeley, and Dorchester. The Port of Savannah is located within the Savannah MSA, which consists of Chatham, Bryan, and Effingham counties. The Port of Jacksonville is part of the Jacksonville MSA, formed by the counties of Baker, Clay, Duval, Nassau, and St. Johns (Executive Office of the President, Office of Management and Budget, 2009).

Table 4-37 shows population and population growth in the last decade in the MSAs of each port. Wilmington was the least populous MSA in 2000 but grew at a fast pace during the last decade and is now more populous than Savannah. The Virginia Beach-Norfolk-Newport News MSA, where the Port of Virginia is located, has the most population, but it is the area that grew the least among the five MSAs in the last decade.

4.2.13.1.3. Economic Factors

Table 4-38 shows the GDP for the MSAs of each port. There is considerable difference in the size of the economy of each of these areas, with the largest economy (Virginia Beach-Norfolk-Newport News MSA) being approximately six times larger than the smallest (Savannah). The Virginia Beach-Norfolk-Newport News MSA is also the area with largest per capita GDP growth between 2001 and 2009. The negative per capita GDP growth of Wilmington suggests its economic growth is slightly behind the strong growth in its population.

Table 4-39 shows the labor force and current unemployment for the five MSAs. The unemployment rate is currently lowest in those areas that enjoyed highest per capita GDP growth in the past years: the Virginia Beach-Norfolk-Newport News MSA and the Charleston-North Charleston-Summerville MSA.

The five ports are important contributors to their local economies, creating jobs, facilitating trade, and attracting businesses. A study done for the Virginia Port Authority estimated that the Port of Virginia supported 343,001 total jobs in fiscal year 2006 (Virginia Port Authority, 2008). A study commissioned by the North Carolina State Ports Authority Board of Directors estimates that 61,800 jobs are supported annually by the Port of Wilmington (North Carolina State University, 2011). A study for the South Carolina State Ports Authority estimates that the Port of Charleston affects an estimated 260,800 jobs across the state (Wilbur Smith Associates, Inc., 2008). The Georgia Ports Authority estimates the impact of its ports (Savannah and Brunswick) to be 295,443 annual jobs (Georgia Ports Authority, 2010). The Jacksonville Port Authority estimates a contribution of 65,000 jobs a year (Jacksonville Port Authority, 2010). These estimates typically include not only jobs generated directly by the Ports, but also by port clients and suppliers and jobs induced by local consumption of port and client employees.

4.2.13.1.4. Environmental Justice

EO 12898 requires Federal agencies to take appropriate steps to identify and avoid disproportionately high and adverse effects of Federal actions on the health and surrounding environment of minority and low-income populations. The CEQ guidance for implementation of EO 12898 in the context of NEPA (CEQ, 1997) identifies a minority population as an affected area where more than 50 percent of the population belongs to a minority group or where the percentage presence of minority groups is meaningfully greater than in the general population.

Table 4-40 shows the share of the population belonging to a minority group in 2010 in the five states and MSAs in which the ports are located. In the Virginia Beach-Norfolk-Newport News MSA, the Charleston-North Charleston-Summerville MSA, and the Savannah MSA, African Americans represent a share of the local population that is over twice the share that African Americans represent in the U.S. as a whole. In these MSAs, African Americans represent between 27 and 34 percent of the total population. For the purposes of this Programmatic EIS, BOEM considers the African American presence in these three MSAs to be meaningfully greater than in the country as a whole.

Table 4-41 shows the presence of low-income populations in the same MSAs. The presence of low-income populations is slightly higher in the MSAs of Wilmington and Charleston-North Charleston-Summerville than in the rest of the country. The BOEM does not consider this difference to be meaningful for purposes of environmental justice analysis in this Programmatic EIS.

Fishing communities in the affected area are of particular interest because they are often low-income communities. The NMFS notes that fishing communities in the Mid-Atlantic region have faced pollution from agriculture and urban expansion and that the commercial fishery production in one of the nation's traditionally most productive areas, the Chesapeake Bay, is in decline (USDOC, NMFS, 2009c). The same report notes how fishing communities in both the Mid-Atlantic and South Atlantic regions have suffered from the loss of fishing infrastructure to alternate uses and a process of gentrification, the influx of wealthy people creating increased pressure on the traditional livelihood of poorer communities, typically through increased costs of living and property prices (USDOC, NMFS, 2009c). Commercial fisheries are more fully discussed in **Chapter 4.2.7**. The USDOC, NMFS (2009c) has assembled fishing community profiles by state and includes information on minority presence and low-income presence based on the 2000 census.

Table 4-42 shows the share of the population in identified fishing communities belonging to a minority group in 2000. The communities included were those for all seven states along the Mid- and South Atlantic coasts from Delaware to Florida. Minority presence in those communities is comparable to or lower than minority presence in the general population, with the possible exception of Native Americans in South Carolina fishing communities, although it still represents a small share (4.1%) of the total fishing community population.

Table 4-43 shows information for poverty rates in fishing communities of the Mid-Atlantic and South Atlantic coasts. Rates vary considerably among communities and indicate that fishing communities of the affected area, when taken as a whole, are not necessarily low-income communities. However, individual fishing communities may present a meaningfully greater share of households in poverty when compared to the rest of their corresponding state, and therefore individual fishing communities could constitute low-income populations for the purpose of analyses of environmental justice impacts. Because identification of individual low-income fishing communities would not affect the environmental justice impact analysis at the programmatic level and would be relevant only in reviewing the potential impact of site-specific projects, no further detail is provided in this Programmatic EIS. Environmental reviews of site-specific projects would be expected to identify individual low-income fishing communities and assess any disproportionate human health and environmental effects that these communities could face.

4.2.13.2. Impacts of Routine Events

This section discusses the potential impacts of routine events associated with Alternative A on human resources and land use onshore of the AOI. As discussed in **Chapter 4.1.1**, through preliminary screening of the activities and affected resources, IPFs for human resources and land use include potential effects of onshore support activities (**Table 4-2**). The factors associated with G&G activities assessed in this section for their potential socioeconomic and land use impacts are restricted to those aspects on shore. Offshore factors such as vessel exclusion zones and noise impacts on fish catchability could also potentially result in impacts to human resources (e.g., recreational resources; commercial fishing) but are analyzed in other sections of this document. Assessment of potential impacts on minority and low-income populations includes all impacts to human resources, whether derived from onshore or offshore activities. Onshore routine events associated with G&G activities consist of the use of shore bases for deployment, support, and debarkation of vessels and the employment of personnel for work on each survey.

4.2.13.2.1. Significance Criteria

Negligible impacts to human resources and land use would include those where little to no measurable impacts are observed or expected, and there would be no disproportionately adverse human health and environmental effects on minority and low-income populations.

Minor impacts to human resources and land use would include those that are detectable but are neither severe nor extensive. Minor impacts would include limited, localized, and short-term disruption to onshore support facilities and the local community; a low level of disproportionate impact to minority or low-income populations present in shore base communities; or minimal adverse human health and environmental effects.

Moderate impacts to human resources and land use would be detectable and would be either extensive but not severe or localized and severe. Moderate impacts would include localized and severe (or extensive but not severe) disruption to onshore support facilities and the local community; a disproportionate impact to minority or low-income populations present in shore base communities; or visible adverse human health and environmental effects.

Major impacts to human resourcse and land use would be detectable, and would be long-lasting, extensive, and severe. Major impacts would include extensive and severe disruption to onshore support facilities and the local community; a high level of disproportionate impact to minority or low-income populations present in shore base communities; or significant adverse human health and environmental effects.

4.2.13.2.2. Evaluation

Survey vessels for renewable energy and marine minerals projects are expected to make daily round trips to their shore base, whereas the larger seismic vessels (working primarily under the oil and gas program) can remain offshore for weeks or months.

Oil and gas seismic airgun surveys represent over 90,000 hr (3,725 days) of vessel activity during the 2012-2020 time period (**Chapter 3.5.1.3**). Seismic survey vessels are likely to remain offshore for most of the survey duration, with supply vessel support originating from ports along the Atlantic coast. For this analysis, five potential support bases were identified in support of oil and gas program seismic survey activity – Norfolk, Virginia; Wilmington, North Carolina; Charleston, South Carolina; Savannah, Georgia; and Jacksonville, Florida.

Vessels conducting G&G surveys or sampling for renewable energy would operate mainly at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Typically, the vessel would return to its shore base daily. HRG survey vessels are expected to require 4,255 days and the same number of vessel round trips; additionally, the renewable energy scenario includes 3,106-9,969 geotechnical sampling locations, requiring approximately 3,106-9,969 vessel round trips **Chapter 3.5.1.3**. Vessel trips associated with renewable energy areas would be divided among several existing ports in Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. Depending on the location of the renewable energy area, the surveys could operate from one of the five larger ports in the AOI – Norfolk, Wilmington, Charleston, Savannah, or Jacksonville, or any of numerous smaller ports along the coast, depending on whatever is convenient.

For marine minerals survey activity, HRG surveys of sand source areas are likely to focus on prospective borrow sites (3-10 km^2 [714-2,471 ac]) or reconnaissance areas (on the order of one to three OCS blocks), and each survey is assumed to require 1-5 operational days for completion, with an estimated 180 vessel round trips. Vessels are assumed to operate on site during daylight hours and return to the shore base at the end of each day. There would be approximately 93-615 vessel round trips associated with marine minerals survey activity, with vessel traffic divided among several existing ports in Delaware, Maryland, Virginia, North Carolina, South Carolina, and Florida, exclusive of Georgia. Depending on the location of the renewable energy area, the surveys could operate from one of the larger ports – Norfolk, Wilmington, Charleston, Savannah, or Jacksonville – or any of numerous smaller ports along the coast, depending on whatever is convenient.

Onshore Support Activities

The use of existing ports and their associated shore bases is expected to have no or negligible land use conflicts with current land uses and land use plans. Shore bases would require the use of berthing space at existing ports. Because vessels would be expected to be between 20 and 100 m (66 and 328 ft) in length, they would require modest berthing space. All five major ports described previously can regularly accommodate much larger cargo vessels, and all have expansion plans in place. The larger survey vessels used for oil and gas seismic exploration could spend up to a year at sea; during surveys, crew changes and replenishment of supplies would be conducted on a regular basis using smaller service vessels. Larger seismic vessels may visit a shore base periodically (e.g., for repairs and equipment replacement that cannot be done at sea). Assuming a single visit every 30 days, a total of 125 port visits would occur based on the estimate of about 3,750 days of seismic survey vessel activity, as indicated in **Chapter 3.5.1.3**.

Smaller vessels used for renewable energy and marine mineral surveys and sampling would typically return to their shore bases daily, averaging less than 4 trips/day over the 10-year period and divided among ports in Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. In 2010, there were 12,446 calls by ocean-going vessels (larger ships typically over 400 ft) at U.S. Ports between Virginia and Florida, or approximately 34 calls per day (USDOT, Maritime Administration, 2011b). The increase in G&G-related traffic volume along the channels connecting ports to sea is expected to be insufficient to adversely affect the current use of such channels by commercial vessels. To the extent that specific projects include greater use of onshore bases and port channels, they would be subject to site-specific environmental reviews.

Larger seismic vessels (100 m [328 ft]) typically accommodate a crew of approximately 40 people, including survey engineers, technicians, and mariners. As described in **Chapter 3.5.1.10**, BOEM expects little or no local employment would be directly generated by G&G survey activity because of the specialized expertise required for these surveys. Survey crews aboard larger survey vessels would be expected to embark and disembark at shore bases about 125 times during the 2012-2020 time period, with associated purchases within those metropolitan areas around shore bases.

Much smaller crews, ranging from 10 to 20 people, would be required for renewable energy or marine minerals surveys or sampling activities involving smaller vessels. The current number of port-related jobs for the five major ports of the region range from 65,000 to more than 343,000 **Chapter 4.2.13.1.3**, further supporting the determination that local employment would not be affected by G&G survey crew demands. Because of the small number of workers directly employed in these surveys and the distribution of onshore support among several ports, the impact on local economies of increased expenditures associated with the use of shore bases, although positive, would be negligible. Given the size of the metropolitan areas surrounding the ports described in **Chapter 4.2.13.1**, supplies obtained locally to support the larger survey events would also be expected to have positive but negligible effects on the local economies surrounding shore base areas.

The potential for disproportionately high, adverse human health and environmental effects depends on the local presence of minority or low-income populations and the nature of the onshore activities resulting from G&G operations. **Chapter 4.2.13.1** identified potential environmental justice populations in the onshore area bordering the AOI, including African-American communities in the metropolitan areas around the Ports of Virginia, Charleston, and Savannah and low-income fishing communities distributed throughout the affected area. Because only negligible to minor impacts were identified on human resources, commercial fisheries (**Chapter 4.2.7**), and recreational resources (**Chapter 4.2.9**), no high and adverse human health and environmental effects would be expected on environmental justice populations, including African-American communities and low-income fishing communities. Site-specific environmental reviews would be expected to identify the specific minority and low-income populations in their affected areas and analyze the existence of disproportionately high and adverse human health or environmental effects from project-specific activities. Based on the projected level of G&G survey activity and associated demands for shore base space, supplies, and services, impacts from onshore activities on human resources and land use are expected to be **negligible**.

4.2.13.3. Impacts of Accidental Fuel Spills

Based on USCG spill statistics, a spill scenario was developed in **Chapter 3.5.2.1** that assumes a diesel spill ranging from 1.2 to 7.1 bbl (see **Chapter 3.5.2**). Because the incremental use of onshore bases would be small relative to the current utilization of these bases and other port facilities, the risk of damage or harm would not exceed current risk at shore base locations. In addition, any damage and harm done would be small relative to the size of local economies and populations. The accidental fuel spill of diesel (1.2-7.1 bbl) would be addressed via use of vessel and local spill response capabilities. An accidental diesel fuel spill would be expected to have minimal to no impact to either the local economies or populations of ports and surrounding communities. Based on the accidental diesel fuel release scenario, impacts on human resources and land use are expected to be **negligible**.

As outlined in **Chapter 4.2.13.1**, the impacts of accidental events on minority and low-income populations require identification of site-specific projects. Because impacts are dependent upon project scope and location, they cannot be analyzed at the programmatic level but would be considered in project-specific environmental assessments.

4.2.13.4. Cumulative Impacts

The cumulative impacts scenario discussed in detail in **Chapter 3.6** includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs for these cumulative activities that have the potential to affect human resources and land use include (1) potential effects of onshore support activities, and (2) accidental releases (smaller accidental events or low-probability large scale catastrophic events). The factors associated with G&G activities assessed in this section for their potential socioeconomic and land use impacts are restricted to those aspects on shore.

Impact analyses presented in **Chapters 4.2.13.2** and **4.2.13.3**, including analysis of (1) onshore support activities and (2) accidental fuel spills, determined that activities projected to occur under Alternative A would result in negligible impacts to human resources. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact.

Onshore Support Activities

Within the cumulative activities scenario, the use of existing ports and their associated shore bases by G&G survey support vessels has the potential to impact human resources, land uses, and land use plans. The vessels supporting G&G surveys fall into two categories: smaller vessels used for renewable energy and marine minerals surveys, and larger survey vessels used for oil and gas seismic exploration. The smaller vessels would typically return to their shore bases daily, while the larger survey vessels could spend up to a year at sea. As discussed in **Chapter 3** for the renewable energy program, there would be approximately 3,106-9,969 vessel round trips within the AOI over the period 2012-2020. There would be approximately 93-615 vessel round trips associated with marine minerals survey activity. A total of 125 port visits by survey vessels for the oil and gas seismic exploration program would occur during the surveying period. The berthing space requirements for all of these vessels should not tax berthing capabilities of the ports anticipated to be used (**Chapter 4.2.13.1**) for these operations since they are equipped for handling large vessels.

All five major ports adjacent to the AOI regularly accommodate much larger cargo vessels, and all have expansion plans in place (**Chapter 4.2.13.1**). The current number of port-related jobs for these ports range from 65,000 to more than 343,000 (**Chapter 4.2.13.1**) and would not be affected by G&G survey crew demands.

Because land use and socioeconomic impacts from G&G activities would be negligible, there would be no or negligible cumulative impacts with other simultaneous activities in the proximity of the shore bases. As outlined in **Chapter 4.2.13.2**, cumulative impacts on minority and low-income populations require identification of site-specific projects, and further discussion of such impacts is left for project-specific environmental reviews.

Accidental Fuel Spills

A significant amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The risk of accidental fuel spills arising from a vessel collision under the cumulative scenario is expected to range from negligible to minor.

The likelihood of a fuel spill during seismic airgun surveys or other G&G activities is considered to be remote, and the associated impacts are expected to be **negligible** (**Chapter 4.2.13.3**). Given the size of the potential spill, a large-scale spill response involving multiple vessels is not expected. The impacts to local economies or populations of the ports and surrounding communities from spill response and cleanup activities under the cumulative activities scenario are expected to range from negligible to minor

Chapter 3.6.1 outlined the oil and gas exploration activities that could reasonably be expected to occur between 2018 and 2020, the end of the time period analyzed in the Programmatic EIS. These activities would include prelease and postlease G&G surveys and the possible drilling of one to three exploration wells. However, it is highly unlikely that exploration wells would be drilled within the time period of the Programmatic EIS given the steps required by the OCSLA and NEPA and the length of time these steps are likely to take in a frontier area, based on BOEM's previous experience. If one or more exploratory wells are not drilled, the probability of a release of crude oil from an accidental well blowout is zero. In the event one or more exploratory wells are drilled and the remote probability of a blowout is realized, the severity of impacts to human resources and land use from the response activities would depend on the location and size of the spill. However, before exploration drilling could occur in the Atlantic OCS, impacts would be analyzed in a lease sale EIS, and an EA would be prepared for any EP submitted by an operator. Potential impacts from an accidental crude oil spill from a well blowout would be examined in the EA prior to any wells being drilled. In addition, a project-specific EA would require an analysis of site-specific information and mitigation measures taken to minimize impacts from drilling activities and potential accidental crude oil spills. An accidental crude oil spill from an exploratory well is not anticipated with the required mitigation measures in place and with oversight of these activities by the BSEE; however, a spill potentially still could occur. With these mitigation measures in place, the impacts to human resources and land use from exploratory drilling operations are expected to be negligible.

4.3. Alternative B – The Proposed Action with Additional Mitigation

As described in **Chapter 2.2**, Alternative B would authorize G&G activities in support of all program areas – oil and gas exploration and development, renewable energy, and marine minerals – throughout the entire AOI. It would include the same regulatory requirements and mitigation measures as Alternative A, but it would include additional time-area closures for North Atlantic right whales and sea turtles; establish a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and require the use of PAM as part of the seismic survey protocol.

4.3.1. Benthic Communities

Descriptions of the benthic communities present in the AOI were provided in **Chapter 4.2.1.1**. As discussed in **Chapter 4.2.1.2**, IPFs for benthic communities include (1) active acoustic sound sources (e.g., airgun noise); (2) trash and debris; (3) seafloor disturbance; and (4) drilling discharges (**Table 4-2**). Impacts to benthic communities under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.1.2**). The following discussion outlines the effects of the additional mitigation measures included in Alternative B on benthic communities.

4.3.1.1. Impacts of Routine Activities

4.3.1.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI.

The additional time-area closure for right whales under Alternative B would not change the extent, severity, or timing of seafloor disturbance or drilling discharge impacts. Benthic impacts of trash and debris are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance; therefore, impacts from seafloor disturbance, drilling discharges, and trash and debris would be unchanged under Alternative B (i.e., **negligible** or **minor**, depending upon the IPF).

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the additional 37-km (20-nmi) closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 37-km (20-nmi) closure area offshore Florida between November 15 and April 15. As discussed in **Chapter 4.2.1.2**, impacts of active acoustic sound sources on benthic communities are expected to be **negligible**. A change in survey timing in the additional closure areas would not alter the impacts of seismic airgun surveys on benthic communities.

Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization may include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. The case-by-case review could result in altered timing of G&G surveys, including those involving seafloor disturbance or drilling discharges, but would not be expected to change the extent or severity of benthic impacts, which are evaluated in **Chapter 4.2.1.2** as **negligible** or **minor**, depending upon the IPF.

4.3.1.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.1.2**, applicable routine IPFs for benthic communities are active acoustic sound sources, seafloor disturbance, drilling discharges, and trash and debris. The additional time-area closure for sea turtle nesting under Alternative B would not change the extent, severity, or timing of seafloor disturbance or drilling discharge impacts. Benthic impacts of trash and debris are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance; therefore, impacts from seafloor disturbance, drilling discharges, and trash and debris would be unchanged under Alternative B (i.e., **negligible** or **minor**, depending upon the IPF).

The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. As discussed in **Chapter 4.2.1.2**, impacts of active acoustic sound sources on benthic communities are expected to be **negligible**. A change in survey timing in the closure area would not alter the impacts of seismic airgun surveys on benthic communities.

Under the time-area closure for sea turtle nesting, other non-airgun surveys in the closure area would be reviewed on a case-by-case basis, and authorizations may include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles. The case-by-case review could result in altered timing of G&G surveys, including those involving seafloor disturbance or drilling discharges, but would not be expected to change the extent or severity of benthic impacts, which are evaluated in **Chapter 4.2.1.2** as **negligible** or **minor**, depending upon the IPF.

4.3.1.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.1.2**, applicable routine IPFs for benthic communities are active acoustic sound sources, seafloor disturbance, drilling discharges, and trash and debris. Limits on concurrent seismic airgun surveys would not change the extent, severity, or timing of seafloor disturbance or drilling discharge impacts. Benthic impacts of trash and debris are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance; therefore, impacts from seafloor disturbance, drilling discharges, and trash and debris would be unchanged by limits on concurrent seismic airgun surveys (i.e., **negligible** or **minor**, depending upon IPF).

Limits on concurrent seismic airgun surveys under Alternative B could change the timing of seismic airgun surveys in certain areas. The locations cannot be predicted in advance and would depend on the schedule and planned coverage of individual surveys. As discussed in **Chapter 4.2.1.2**, impacts of active acoustic sound sources on benthic communities are expected to be **negligible**. A change in survey timing because of limits on concurrent seismic airgun surveys would not alter the active acoustic sound impacts on benthic communities.

4.3.1.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any benthic community impacts analyzed in **Chapter 4.2.1.2**.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) active acoustic sound sources impacts would remain unchanged from Alternative A and would be **negligible**; (2) trash and debris – impacts would remain unchanged and would be **negligible**; (3) seafloor disturbance – impacts would remain unchanged and would be **negligible** to **minor**; and (4) drilling discharges – impacts would remain unchanged and would be **negligible**.

4.3.1.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on benthic communities would be very similar to those analyzed for Alternative A (**Chapter 4.2.1.3**). The analysis concluded that a small spill at the sea surface would be unlikely to have any effect on benthic communities.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Also, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on benthic communities would be the same as under Alternative A and would be **negligible**.

4.3.1.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.1.1** and **4.3.1.2** determined that activities projected to occur under Alternative B would result in impacts ranging from **negligible** to **minor** to benthic communities, depending on the activity, as a result of active acoustic sound sources, seafloor disturbance, drilling discharges, trash and debris, and accidental fuel spills. These IPFs would also contribute to the cumulative activities scenario under Alternative B. The cumulative activities scenario for benthic communities, as outlined in **Chapter 4.2.1.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified only negligible incremental increases in impacts from all IPFs under Alternative A.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys in certain areas. Overall, however, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A. Only minor incremental increases in ambient noise levels would occur as a result of G&G activities, however, the localized noise impacts within the time-area closure zones would be eliminated under Alternative B. Additional time-area closures would not change the extent, severity, or timing of seafloor disturbance or drilling discharge impacts under Alternative B and therefore would not affect the cumulative impacts identified under Alternative A. Benthic impacts of trash and debris are expected to be avoided through compliance with existing regulations and BSEE guidance; therefore, impacts would be unchanged under the cumulative scenario for Alternative B.

Limits on concurrent seismic airgun surveys would change the timing of seismic airgun surveys in certain areas, but would not alter the impacts of active acoustic noise from seismic airgun surveys on benthic communities. In addition, these concurrent survey limits would not change the extent, severity, or timing of seafloor disturbance or drilling discharge impacts. Benthic impacts of trash and debris are expected to be avoided through compliance with existing regulations and BSEE guidance. Cumulative impacts under Alternative B would be unchanged by limits on concurrent seismic airgun surveys.

The use of PAM in Alternative B would not change any benthic community cumulative impacts determined under Alternative A.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Spills from other survey vessels could also occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential cumulative impacts on benthic communities would be the same under Alternative B as determined under Alternative A.

4.3.2. Marine Mammals

Descriptions of the marine mammals present in the AOI were provided in **Chapter 4.2.2.1**. As discussed in **Chapter 4.2.2.2** and highlighted in **Table 4-2**, the IPFs from routine events that may impact marine mammals within the AOI include (1) active acoustic sound sources (i.e., airguns; electromechanical sources including subbottom profilers, multibeam depth sounders, and side-scan sonars); (2) vessel and equipment noise (from survey and support vessels and aircraft); (3) vessel traffic (i.e., physical disturbance to and risk of collisions with marine mammals); (4) aircraft traffic and noise; and (5) trash and debris (i.e., potential for entanglement and ingestion). Impacts to marine mammals under Alternative B would be very similar to those described for Alternative A (**Chapter 4.2.2.2**). The following discussion outlines the effects of additional mitigation measures included in Alternative B on marine mammals.

4.3.2.1. Impacts of Routine Activities

4.3.2.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, time-area closures of SMAs for North Atlantic right whales described under Alternative A would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure area would add 6,823,753 ac (27,615 km^2) to the SMA closure areas described under Alternative A, totaling 14,413,356 ac (58,329 km^2), representing 7 percent of the total AOI. Seismic airgun surveys would not be authorized in the additional closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional closure area offshore Florida between November 15 and April 15. The rationale for the expansion of these closure areas is to provide a continuous buffer for right whales from active acoustic sound along their seasonal migratory route and within their critical habitat off Georgia and northeast Florida. Historical sightings of right whales within their migratory corridor have occurred primarily within 37 km (20 nmi) of shore. However, these data also show that individual right whales may also be distributed at much greater distances from shore (Knowlton et al., 2002).

As discussed in **Chapter 4.2.2.2**, applicable routine IPFs for marine mammals include active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, and trash and debris. In the analysis of potential impacts under Alternative A, impacts of most active acoustic sound sources on marine mammals are expected to range from **minor** to **moderate**. It is expected that expansion of the time-area closure would effectively reduce or eliminate active acoustic sound source related impacts to right whales and other marine mammal species, primarily bottlenose dolphins that may occur within the closure area during the specified time frame. It is anticipated that the time-area closure would also reduce project-related vessel traffic within these areas, prompting a significant reduction in the likelihood of ship strike for right whales, of particular importance to calving females and calves of the highly endangered right whale population. The time-area closure mitigation measure would not affect the overall level of impacts from active acoustic sound sources on marine mammal species, including right whales outside of the closure area. Therefore, for this analysis, the expansion of the time-area closure of SMAs within the AOI would not be expected to reduce the anticipated level of impact from seismic survey activities from **moderate** for most species. It is expected that these measures would, however, reduce anticipated impacts to the North Atlantic right whale. Although incidental take was not modeled for Alternative B, it is estimated that the expanded time-area closure would avoid approximately 80 percent of the incidental takes of North Atlantic right whales over the period of the Programmatic EIS (as compared with no closures). In contrast, the Alternative A time-area closure would be expected to avoid about 67 percent of the right whale incidental takes. The estimate for Alternative B is based on the geographic and seasonal distribution of right whale densities used for modeling in **Appendix E**.

Under the additional time-area closure, other non-airgun G&G surveys, including surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. This review process could result in altered timing of G&G surveys but would not be expected to change the level of impacts to marine mammals within the AOI, which are evaluated in **Chapter 4.2.2.2** as ranging from **negligible** to **minor**.

Under the additional time-area closure, impacts from trash and debris and aircraft traffic and noise would remain unchanged from Alternative A.

4.3.2.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would also include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. In addition, non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on both marine mammals and sea turtles.

As discussed in **Chapter 4.2.2.2**, applicable routine IPFs for marine mammals include active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, and trash and debris. In the analysis of potential impacts under Alternative A, impacts of active acoustic sound sources on marine mammals are expected to range from **minor** to **moderate**. The time-area closure for nesting sea turtles under Alternative B would reduce the extent, severity, and/or timing of potential active acoustic noise-related impacts to marine mammals (primarily bottlenose dolphins) within inner shelf waters off Brevard County. In addition, seismic survey vessels would not be expected to pass through these waters during the time-area closure, which would remove the potential for noise-related impacts or vessel collision impacts to marine mammals during these periods. Although this mitigation measure would reduce potential impact levels to mammals within this isolated area, this mitigation measure would not change the evaluation of potential impacts from active acoustic sound sources, vessel traffic, and aircraft traffic to marine mammals within the remaining AOI. Impacts to marine mammals from discarded trash and debris are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance, and therefore impacts would be unchanged under Alternative B (**negligible**).

Under the time-area closure for sea turtle nesting, other non-airgun surveys in the closure area would be reviewed on a case-by-case basis and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on marine mammals. The case-by-case review could result in altered timing of G&G surveys but would not be expected to change the extent or severity of impacts to marine mammals, which are evaluated in **Chapter 4.2.2.2** as **negligible** to **minor**.

Under the additional time-area closure, impacts from trash and debris and aircraft traffic and noise would remain unchanged from Alternative A.

4.3.2.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.2.2**, applicable routine IPFs for marine mammals include active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, and trash and debris. Limits on concurrent seismic airgun surveys would not significantly change the extent or severity of active acoustic sound impacts. The limits are intended to restrict these surveys to discrete areas at any given time, providing marine mammals with areas to avoid active acoustic sounds, survey-related vessel traffic and related noise, and aircraft traffic and noise. Impacts to marine mammals from trash and debris are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance, and therefore impacts would be unchanged by limits on concurrent seismic airgun surveys.

Limits on concurrent seismic airgun surveys under Alternative B could change the timing of seismic airgun surveys in certain areas. The locations cannot be predicted in advance but would depend on the schedule and planned coverage of individual surveys. As discussed in **Chapter 4.2.2.2**, impacts of active acoustic sound sources on marine mammals are expected to range from **minor** to **moderate**. Overall, a change in survey timing because of limits on concurrent seismic airgun surveys would provide a practical means of avoidance of seismic survey-related noise for all marine mammal species and would further reduce potential injurious (Level A harassment) impacts. The mitigation measure is not likely to alter the overall level of non-injurious impacts, such as disruption of behavior (e.g., avoidance) of marine mammals within the AOI.

Under the additional time-area closure, impacts from trash and debris and aircraft traffic and noise would remain unchanged from Alternative A.

4.3.2.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. This is in contrast to Alternative A, in which the use of PAM is optional. The use of PAM prior to and during seismic survey mitigation monitoring surveys may assist or improve the detection of marine mammals within the 180-dB exclusion zone, particularly during periods when visual monitoring is not possible. In order to be effective, the method relies on repeated vocalizations by marine mammals. The effectiveness of PAM also depends on the ability to properly identify species-specific vocalizations (when those marine mammals are vocalizing) in the presence of ambient noise and other noise sources (Ward et al., 2011). McDonald and Fox (1999) proposed the application of PAM techniques to visually-based marine mammal density estimations and suggest that acoustic detection (via PAM) should provide measurable increases in marine mammal densities for several species (e.g., fin and blue whales). Mellinger et al. (2007), in their overview of PAM techniques, noted that acoustic surveys detect 1-10 times as many cetacean groups as visual ones (McDonald and Moore, 2002; Širovic et al., 2004; Barlow and Taylor, 2005; Rankin et al., 2007). Consequently, the effectiveness of PAM for detecting and locating marine mammals may vary significantly. In addition, because the use of PAM is optional under Alternative A, identification of when and where it might be employed as an option becomes problematic. Therefore, the required use of PAM prior to and during seismic airgun surveys within the AOI would not change any impacts to marine mammals analyzed in **Chapter 4.2.2.2**.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) active acoustic sound sources – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would range from **minor** to **moderate**; (2) vessel and equipment noise – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would range from **negligible** to **minor**; (3) vessel traffic – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **negligible**; (4) aircraft traffic and noise – impacts would remain unchanged and would range from **negligible** to **minor**; and (5) trash and debris – impacts would remain unchanged and would be **negligible**.

4.3.2.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on marine mammals would be very similar to those analyzed for Alternative A in **Chapter 4.2.2.3**. The analysis concluded that a small spill at the sea surface would result in **negligible** to **minor** impacts to marine mammals.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. The time-area closures may reduce the possibility of spilled fuel from reaching North Atlantic right whale adults and calves during periods of migration within their migratory corridor and during calving and nursing activities within their designated critical habitat. However, a fuel spill outside of the closure areas may drift into these closure areas during these periods or may occur within the closure areas outside the closure period. In addition, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. Consequently, a change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk to marine mammals from a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on marine mammals would remain the same as under Alternative A (**negligible** to **minor)**.

4.3.2.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.1.1** and **4.3.1.2** determined that activities projected to occur under Alternative B would result in impacts ranging from **negligible** to **minor** to marine mammals from active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills. These IPFs would also contribute to the cumulative activities scenario under Alternative B. The cumulative activities scenario for marine mammals, as outlined in **Chapter 4.2.2.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified negligible to significant incremental increases in impacts from all IPFs under Alternative A. The significant impact increase was issued for potential impacts resulting from an accidental well blowout with a release of crude oil.

Additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would limit seismic airgun surveys in certain areas and during certain time periods. The North Atlantic right whale time-area closure would significantly reduce the extent, severity, and/or timing of active acoustic sound source, vessel and equipment noise, and vessel collision impacts to right whales during seasonal migrations and calving-nursing periods within the SMAs and critical habitat, respectively, but these measures would not affect overall impacts to marine mammals in other areas of the AOI and would not appreciably change the cumulative impacts noted under Alternative A. Only negligible incremental increases in ambient noise levels would occur under the cumulative scenario. The time-area closure of inner shelf waters off Brevard County, Florida, during the sea turtle nesting period is not expected to reduce cumulative impact levels to marine mammals identified under Alternative A. Impacts to marine mammals from trash and debris are expected to be avoided through compliance with existing regulations and BSEE guidance; therefore, impacts would remain unchanged (**negligible**) under the cumulative scenario for Alternative B.

Limits on concurrent seismic airgun surveys would change the timing of these surveys in certain areas but would not alter the impacts of active acoustic noise from seismic airgun surveys on marine mammals. These concurrent survey limits would provide areas for marine mammals to escape active acoustic sounds. Impacts to marine mammals from trash and debris are expected to be avoided through compliance with existing regulations and BSEE guidance. Cumulative impacts under Alternative B would be unchanged (**negligible**) by limits on concurrent seismic airgun surveys.

The use of PAM in Alternative B may improve detection of marine mammals during mitigation monitoring surveys; however, it is not anticipated that the use of PAM would change any marine mammal cumulative impacts determined under Alternative A.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period, or spilled oil could move into the closure areas. Spills from other survey vessels could also occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential cumulative impacts on marine mammals would be the same under Alternative B as determined under Alternative A and would be **negligible** to **minor**.

4.3.3. Sea Turtles

Descriptions of the sea turtles present in the AOI were provided in **Chapter 4.2.3.1**. As outlined in **Chapter 4.2.3.2**, five IPFs from routine G&G activities may affect sea turtles, including (1) active acoustic sound sources; (2) vessel and equipment noise; (3) vessel traffic; (4) aircraft traffic and noise; and (5) trash and debris (**Table 4-2**). Impacts to sea turtles under Alternative B would be very similar to those described for Alternative A (**Chapter 4.2.3.2**). The following discussion outlines the effects of additional mitigation measures included in Alternative B on sea turtles.

4.3.3.1. Impacts of Routine Activities

4.3.3.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. Seismic airgun surveys would not be authorized in the additional 20-nmi closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 20-nmi closure area offshore Florida between November 15 and April 15.

As discussed in **Chapter 4.2.3.2**, applicable routine IPFs for sea turtles include active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, and trash and debris. In the analysis of potential impacts under Alternative A, impacts of most active acoustic sound sources on sea turtles are expected to be **negligible** or **minor** with one exception. Impacts from seismic airgun surveys conducted in inner shelf waters within the southern part of the AOI during sea turtle nesting season are expected to range from **minor** to **moderate** if nesting activities are substantially affected. Under Alternative B, no airgun surveys would be authorized within the closure area during the specified periods. As discussed in **Chapter 4.2.3.1**, inner shelf waters from North Carolina to Florida provide important winter habitat for loggerhead, Kemp's ridley, and green turtles. These areas also serve as a seasonal migration corridor for these species between their northern (summer) habitats and winter habitats. It is expected that this time-area closure would effectively reduce or eliminate active acoustic sound source related impacts to neritic juvenile, subadult, and adult sea turtles within the closure areas during the specified time frame. The time-area closure mitigation measure would not, however, change the overall level of impacts from active acoustic sound sources to all sea turtle species within the AOI.

Under the additional time-area closure, other non-airgun G&G surveys, including surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations may include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. This review process could result in altered timing of non-airgun G&G surveys, but it would not be expected to change the level of impacts to sea turtles within the AOI, which are evaluated in **Chapter 4.2.3.2** as **no effect**, **negligible**, or **minor**.

The effects of vessel and equipment noise on sea turtles, including behavioral changes and possibly auditory masking, would be eliminated in the closure zone for vessel operations associated with airgun surveys and possibly for HRG surveys but would remain in other portions of the AOI; impacts would remain **negligible** if a time-area closure for right whales was implemented. Drilling-related noises associated with the proposed activity would remain unchanged if a time-area closure for right whales was implemented under Alternative B (i.e., **negligible**). Vessel traffic-related impacts would be reduced in the closure zone for vessel operations associated with airgun surveys and possibly for HRG surveys but would remain elsewhere in the AOI; vessel traffic impacts would remain **negligible** under Alternative B. Aircraft operations would not be affected in the closure zone if a time-area closure for right whales was implemented under Alternative B; therefore, impacts of aircraft–related noise and physical disturbance to sea turtles would remain **negligible**. Impacts to sea turtles from accidentally lost trash and debris are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance, and therefore impacts would be unchanged (**negligible**) under Alternative B.

4.3.3.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would also include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1-October 31). No airgun surveys would be authorized within the closure area during this time. In addition, non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.3.2**, applicable routine IPFs for sea turtles include active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, and trash and debris. In the analysis of potential impacts under Alternative A, impacts of active acoustic sound sources on sea turtles are expected to be **negligible** to **moderate**. The time-area closure for nesting sea turtles under Alternative B would significantly reduce the extent, severity, or timing of potential active acoustic noise related impacts to nesting adults and hatchlings within inner shelf waters and nesting beaches of Brevard County, which is among the most important areas in the world for loggerhead turtle nesting (**Chapter 4.2.3.1**). In addition, seismic survey vessels would not be expected to pass through these waters during the time-area closure, which would reduce the potential for vessel collisions with turtles. Therefore, this mitigation measure would change the evaluation of potential impacts from active acoustic sound sources to sea turtles within the AOI, reducing impacts from **negligible** to **moderate** under Alternative A to **negligible** to **minor** under Alternative B, because of the sea turtle time-area closure.

It is important to note that there are other areas within the AOI that support relatively high levels of sea turtle nesting (consisting of primarily loggerhead and green turtle nests, with some leatherback turtle nests). During the 2010 nesting season, high density areas were documented in Volusia County, Florida (just north of Brevard County) and Charleston County, South Carolina. Each of these areas supported over 2,000 nests during this nesting season; by comparison, the number of loggerhead nests present along Brevard County beaches, within the area protected by the time-area closure, was estimated at >31,000 in 2010. The closure of Brevard County during the turtle nesting season would significantly reduce potential impact levels to nesting activities within the extremely important nesting areas in Brevard County, and would protect adult females lingering near the nesting beaches before and between nesting events, and adults and dispersing hatchlings following emergence, from possible auditory injury associated with seismic airguns. The sea turtle time-area closure would not mitigate potential impacts to other nesting beaches within the AOI. Based on criteria for potential impacts to sea turtles, the protection of near-coastal waters off Brevard County provides a significant reduction in potential impact to nesting sea turtles. The potential loss of loggerhead, green, or leatherback nests in the other areas of the AOI resulting from seismic airgun survey activities would constitute a little disruption of critical, time-senstive behaviors. Under the time-area closure for sea turtle nesting, other non-airgun surveys in the closure area would be reviewed on a case-by-case basis, and authorizations may include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles. The case-by-case review could result in altered timing of G&G surveys, but it would not be expected to change the extent or severity of impacts to sea turtles, which are evaluated in **Chapter 4.2.3.2** as ranging from **negligible** to **minor**.

The effects of vessel and equipment noise on sea turtles, including behavioral changes and possibly auditory masking, would be eliminated in the closure zone for vessel operations associated with airgun surveys and possibly for HRG surveys, but would remain in other portions of the AOI; impacts would remain **negligible** if a time-area closure for sea turtles was implemented under Alternative B. Drilling-related noises associated with the proposed activity would remain unchanged (i.e., **negligible**). Vessel traffic-related impacts would be reduced in the closure zone for vessel operations associated with airgun surveys and possibly for HRG surveys, but would remain elsewhere in the AOI; vessel traffic impacts would remain **negligible** if a time-area closure for sea turtles was implemented under Alternative-B. Aircraft operations would not be affected in the closure zone under Alternative B; therefore, impacts of aircraft–related noise and physical disturbance to sea turtles would remain **negligible**. Impacts to sea turtles from accidentally lost trash and debris are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance, and therefore impacts would be unchanged (**negligible**) if a time-area closure for sea turtles was implemented under Alternative B.

4.3.3.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.3.2**, applicable routine IPFs for sea turtles are active acoustic sound sources, vessel and equipment noise, vessel traffic (i.e., vessel collisions), aircraft traffic and noise, and trash and debris. Limits on concurrent seismic airgun surveys would not significantly change the extent or severity of active acoustic sound impacts. The limits are intended to limit these surveys to discrete areas at any given time to provide sea turtles with areas to avoid associated active acoustic sounds and survey-related vessel traffic. Limits on concurrent seismic airgun surveys under Alternative B could change the timing of these surveys in certain areas. The locations cannot be predicted in advance but would depend on the schedule and planned coverage of individual surveys. As discussed in **Chapter 4.2.3.2**, impacts of active acoustic sound sources on sea turtles are expected to range from **negligible** to **moderate**. A change in survey timing because of limits on concurrent seismic airgun surveys would not alter the overall level of impacts on sea turtles. Therefore, impacts to sea turtles from seismic airgun sources would remain **negligible** to **moderate** with a limit on concurrent surveys.

The effects of vessel and equipment noise on sea turtles would not be eliminated or reduced with a restriction on concurrent surveys; impacts would remain **negligible**. Drilling-related noises associated with the proposed activity would remain unchanged with a restriction on concurrent surveys; impacts to sea turtles would remain **negligible**. Vessel traffic-related impacts would also remain unchanged (i.e., **negligible**) with a restriction on concurrent surveys. Aircraft operations would not be affected by a restriction on concurrent surveys; impacts of aircraft–related noise and physical disturbance to sea turtles would remain **negligible**. Impacts to sea turtles from accidentally lost trash and debris are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance, and therefore impacts would be unchanged by limits on concurrent seismic airgun surveys (**negligible**).

4.3.3.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any impacts to sea turtles analyzed in **Chapter 4.2.3.2**. Impacts from active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, and trash and debris would range from **negligible** to **moderate**, depending upon the IPF.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) active acoustic sound sources – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would range from **negligible** to **minor**; (2) vessel and equipment noise – impacts would be reduced due to the sea turtle time-area closures, but overall impacts would remain unchanged from Alternative A and would be **negligible**; (3) vessel traffic – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **negligible**; (4) aircraft traffic and noise – impacts would remain unchanged and would be **negligible**; and (5) trash and debris – impacts would remain unchanged and would be **negligible**.

4.3.3.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on sea turtles would be very similar to those analyzed for Alternative A (**Chapter 4.2.3.3**). The analysis concluded that a small spill at the sea surface would result in **negligible** to **minor** impacts to sea turtles.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Likewise, spilled fuel could drift into the closure areas during the closure periods. In addition, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. Consequently, a change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk to sea turtles from a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on sea turtles would remain the same as under Alternative A (i.e., ranging from **negligible** to **minor**).

4.3.3.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.3.1** and **4.3.1.2** determined that activities projected to occur under Alternative B would result in impacts to sea turtles ranging from **negligible** to **moderate**, arising from active acoustic sound sources, vessel and equipment noise, vessel traffic, aircraft traffic and noise, trash and debris, and accidental fuel spills. These IPFs would also contribute to the cumulative activities scenario under Alternative B. The cumulative activities scenario, as outlined in

Chapter 4.2.3.4, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified **negligible** to **moderate** incremental increases in impacts from all IPFs under Alternative A. The significant impact increase was determined for potential impacts resulting from active acoustic sound sources (i.e., seismic sources) and potential nesting disruptions to sea turtles.

Additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would limit seismic airgun surveys in certain areas and during certain time periods. The North Atlantic right whale time-area closure would not appreciably change the cumulative impacts noted under Alternative A. Only negligible incremental increases in ambient noise levels would occur under the cumulative scenario. The time-area closure of inner shelf waters off Brevard County, Florida, during the sea turtle nesting period would significantly reduce the extent, severity, or timing of active acoustic sound sources, vessel and equipment noise, and vessel collision impacts to nesting adult and hatchling sea turtles within this area of the AOI but would not affect overall impacts to sea turtle nesting in other nesting areas within the AOI. Therefore, this mitigation measure is not expected to reduce cumulative impact levels identified under Alternative A. Impacts to sea turtles from trash and debris are expected to be avoided through compliance with existing regulations and BSEE guidance; therefore, impacts would remain unchanged (**negligible**) under the cumulative scenario for Alternative B.

Limits on concurrent seismic airgun surveys would change the timing of these surveys in certain areas but would not alter the impacts of active acoustic noise from seismic airgun surveys on sea turtles. These concurrent survey limits would provide areas for sea turtles to escape active acoustic sounds. Impacts to sea turtles from trash and debris are expected to be avoided through compliance with existing regulations and BSEE guidance. Cumulative impacts under Alternative B would be unchanged (**negligible**) by limits on concurrent seismic airgun surveys.

The use of PAM in Alternative B would not change any sea turtle cumulative impacts determined under Alternative A.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period or spilled oil could move into the closure areas. Spills from other survey vessels could also occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential cumulative impacts on sea turtles would be the same under Alternative B as determined under Alternative A and would be **negligible** to **minor**.

4.3.4. Marine and Coastal Birds

Descriptions of the marine and coastal birds present in the AOI were provided in **Chapter 4.2.4.1**. As discussed in **Chapter 4.2.4.2**, IPFs for marine and coastal birds include (1) active acoustic sound sources, (2) vessel and equipment noise, (3) vessel traffic, (4) aircraft traffic and noise, and (5) trash and debris (**Table 4-2**). Impacts to marine and coastal birds under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.4.2**). The following discussion outlines the effects of additional mitigation measures included in Alternative B on marine and coastal birds.

4.3.4.1. Impacts of Routine Activities

4.3.4.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI.

As discussed in **Chapter 4.2.4.2**, applicable routine IPFs for marine and coastal birds are active acoustic sound sources, vessel traffic and vessel and equipment noise, aircraft traffic and noise, and trash and debris. The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the additional 20-nmi closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 20-nmi closure area offshore Florida between November 15 and April 15. As discussed in **Chapter 4.2.4.2**, impacts of active acoustic sound sources on marine and coastal birds are expected to be **negligible** to **minor** depending on the location. A change in survey timing in the additional closure areas would not alter the impacts of active acoustic noise from seismic airgun surveys on marine and coastal birds since this additional closure would be outside of breeding and nesting periods.

Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization might include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. As discussed in **Chapter 4.2.4.2**, many of the surveys that would be performed for renewable energy and marine minerals sites would use equipment with frequency ranges that are outside the hearing range of birds (e.g., side-scan sonar, depth sounders) and should be inaudible to birds; therefore, these sources would not be expected to result in impacts to marine and coastal birds. The case-by-case review could result in altered timing of G&G surveys, but it would not be expected to change the extent or severity of impacts to marine and coastal birds, which are evaluated in **Chapter 4.2.4.2** as **negligible**.

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in certain areas and reduce the vessel traffic and associated vessel and equipment noise from these surveys in the coastal areas during certain times of the year when compared to Alternative A. As discussed in **Chapter 4.2.4.2**, impacts of vessel traffic and vessel and equipment noise on marine and coastal birds are expected to be **negligible** to **minor** depending on the location. A change in survey timing in the additional closure areas would potentially reduce the impacts of vessel traffic and noise from seismic airgun surveys on some groups of marine and coastal birds (e.g., shorebirds) since these surveys would not occur within the coastal waters for half of the year. However, the impacts to marine and coastal birds from vessel traffic and noise would still be expected to be **negligible** to **minor** for IBAs since the additional closure would occur outside of breeding and nesting periods.

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in certain areas but would not affect the potential for 1–2 aeromagnetic surveys to occur. Therefore, it is expected that the impacts from aircraft traffic and noise would remain unchanged (e.g., **negligible** to **minor**) for the additional time-area closure under Alternative B.

Impacts of trash and debris to marine and coastal birds are expected to be **negligible** through compliance with USCG and USEPA regulations and BSEE guidance, and therefore impacts would be unchanged under Alternative B.

4.3.4.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.4.2**, applicable routine IPFs for marine and coastal birds are active acoustic sound sources, vessel traffic and associated vessel and equipment noise, aircraft traffic and noise, and trash and debris. The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. As discussed in **Chapter 4.2.4.2**, impacts of active acoustic sound sources on marine and coastal birds are expected to be **negligible** to **minor**, depending on the location. A change in survey timing in the closure area would not alter the impacts of active acoustic noise from seismic airgun surveys on marine and coastal birds which would remain **negligible** to **minor**, depending on the location.

Under the time-area closure for sea turtle nesting, other non-airgun surveys in the closure area would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles. The case-by-case review could result in altered timing of G&G surveys in this area, but it would not be expected to change the extent or severity of impacts from active acoustic sound sources to marine and coastal birds, which are evaluated in **Chapter 4.2.4.2** as **negligible**.

Chapter 4.2.4.2 evaluated the impacts from vessel traffic and associated vessel and equipment noise as **negligible** to **minor**, depending on the location. The time-area closure for sea turtle nesting under Alternative B would change the timing of some G&G survey activities in certain areas. These additional mitigation measures would not alter the impacts of vessel traffic and the associated vessel and equipment noise to marine and coastal birds, which would remain as **negligible** to **minor**, depending on the location.

The additional time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in certain areas but would not affect the potential for one to two aeromagnetic surveys to occur. Therefore, it is expected that the impacts from aircraft traffic and noise would remain unchanged (e.g., **negligible** to **minor**) for the additional time-area closure under Alternative B.

As discussed in **Chapter 4.2.4.2**, impacts of trash and debris to marine and coastal birds are expected to be **negligible** through compliance with USCG and USEPA regulations and BSEE guidance, and impacts would be unchanged under Alternative B.

4.3.4.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.4.2**, applicable routine IPFs for marine and coastal birds are active acoustic sound sources, vessel traffic and associated vessel and equipment noise, aircraft traffic and noise, and trash and debris. Limits on concurrent seismic airgun surveys under Alternative B could change the timing of these surveys in certain areas. The locations cannot be predicted in advance, but this would depend on the schedule, planned coverage of individual surveys, and ports to be used for support activities. As discussed in **Chapter 4.2.4.2**, impacts of active acoustic sound sources, vessel traffic, and the associated vessel and equipment noise on marine and coastal birds are expected to be **negligible** to **minor**, depending on location. A change in survey timing because of limits on concurrent seismic airgun surveys would not alter the impacts from active acoustic sound, vessel traffic, vessel and equipment noise, or aircraft traffic and noise on marine and coastal birds, which would remain **negligible** to **minor**, depending on location. As discussed in **Chapter 4.2.4.2**, impacts of trash and debris on marine and coastal birds are expected to be **negligible** through compliance with USCG and USEPA regulations and BSEE guidance, and impacts would be unchanged by limits on concurrent seismic airgun surveys.

4.3.4.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any impacts to marine and coastal birds analyzed in **Chapter 4.2.4.2**.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) active acoustic sound sources – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would range from **negligible** to **minor**; (2) vessel and equipment noise while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would range from **negligible** to **minor**; (3) vessel traffic – impacts would be reduced due to time-area closures, overall impacts would be reduced compared to Alternative A and would be **negligible**; (4) aircraft traffic and noise – impacts would remain unchanged and would range from **negligible** to **minor**; and (5) trash and debris – impacts would remain unchanged and would be **negligible**.

4.3.4.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on marine and coastal birds would be very similar to those analyzed for Alternative A in **Chapter 4.2.4.3**. The analysis concluded that a small spill at the sea surface would result in **negligible** to **moderate** impacts, depending on the location of the spill and if threatened and endangered bird species found within the AOI were adversely affected.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Also, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on marine and coastal birds would be the same as under Alternative A and would range from **negligible** to **moderate**, depending on the location of the spill and if threatened and endangered bird species found within the AOI were affected.

4.3.4.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.4.1** and **4.3.4.2** determined that activities projected to occur under Alternative B would result in impacts ranging from **negligible** to **moderate** to marine and coastal birds, depending on the activity, as a result of active acoustic sound sources, vessel traffic and associated vessel and equipment noise, aircraft traffic and noise, trash and debris, and accidental fuel spills. The cumulative activities scenario for marine and coastal birds, as outlined in **Chapter 4.2.4.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs that would contribute to the cumulative activities scenario under Alternative B include underwater noise including active acoustic sound sources and vessel and equipment noise, presence of structures including vessel and helicopter traffic, trash and debris, and accidental fuel spills. The cumulative impact analysis identified negligible incremental increases in impacts from all IPFs under Alternative A except for accidental fuel spills, which was identified as having a minor to moderate incremental increase in impacts depending on the bird species affected (i.e., threatened and endangered). The cumulative scenario would remain unchanged for Alternative B, and the associated impacts would remain the same.

Alternative B would change the timing of seismic aigun surveys in certain areas, however, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A.

4.3.5. Fisheries Resources and Essential Fish Habitat

Descriptions of the fisheries resources and EFH present in the AOI were provided in **Chapter 4.2.5.1**. As outlined in **Chapter 4.2.5.2**, IPFs related to fisheries resources and EFH (**Table 4-2**) included (1) active acoustic sound sources (i.e., airguns, electromechanical sources [e.g., subbottom profilers, side-scan sonar, etc.]), (2) vessel and equipment noise, (3) seafloor disturbance; and (4) drilling discharges. Impacts to fisheries resources and EFH under Alternative B would be similar to those previously described for Alternative A (**Chapter 4.2.5.2**). The following discussion outlines the effects of the additional mitigation measures included in Alternative B on fisheries resources and essential fish habitat.

4.3.5.1. Impacts of Routine Activities

4.3.5.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI.

As discussed in **Chapter 4.2.5.2**, applicable routine IPFs for fisheries resources and EFH are active acoustic sound sources, vessel and equipment noise, seafloor disturbance, and drilling discharges.

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the additional 37-km (20-nmi) closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 37-km (20-nmi) closure area offshore Florida between November 15 and April 15. As discussed in **Chapter 4.2.5.2**, impacts of active acoustic sound sources and vessel and equipment noise on fisheries resources and EFH are expected to be **minor**. A change in survey timing in the additional closure areas would not alter the impacts of seismic airgun surveys or vessel and equipment noise on fisheries resources and EFH.

The additional time-area closure for right whales under Alternative B would not change the extent, severity, or timing of seafloor disturbance impacts. Given the minimal seafloor disturbance expected by projected G&G activities (**Chapter 3.5.1.8**), the impacts are expected to be **negligible**.

Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization might include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. The case-by-case review could result in altered timing of G&G surveys, including those involving seafloor disturbance, but would not be expected to change the extent or severity of impacts, which are evaluated in **Chapter 4.2.5.2** as **negligible**.

Drilling discharges from COST and shallow test wells would affect limited portions of the water column and seafloor surrounding individual wells. Because of the small areas affected by proposed G&G well drilling activities, the impacts to fisheries resources and EFH because of drilling discharges are expected to be **negligible**. The additional time-area closure for right whales under Alternative B would not change the extent, severity, or timing of drilling discharge impacts.

4.3.5.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.5.2**, applicable routine IPFs for fisheries resources and EFH are active acoustic sound sources, vessel and equipment noise, seafloor disturbance, and drilling discharges. Impacts of active acoustic sound sources and vessel and equipment noise on fisheries resources and EFH are expected to be **minor** (**Chapter 4.2.5.2**). The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. As discussed in **Chapter 4.2.5.2**, impacts of active acoustic sound sources on fisheries resources and EFH are expected to be **minor**. A change in survey timing in the closure area would not alter the impacts of seismic airgun surveys on fisheries resources and EFH.

The additional time-area closure for sea turtle nesting under Alternative B would not change the extent, severity, or timing of seafloor disturbance. Given the minimal seafloor disturbance expected by projected G&G activities (**Chapter 3.5.1.8**), the impacts are expected to be **negligible**.

Under the time-area closure for sea turtle nesting, other non-airgun surveys in the closure area would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles. The case-by-case review could result in altered timing of G&G surveys, including those involving seafloor disturbance, but would not be expected to change the extent or severity of vessel and equipment noise and benthic impacts, which are evaluated in **Chapter 4.2.5.2** as **negligible** (seafloor disturbance) to **minor** (vessel and equipment noise).

Drilling discharges from COST and shallow test wells would affect limited portions of the water column and seafloor surrounding individual wells. Because of the small areas affected by proposed G&G well drilling activities, the impacts to fisheries resources and EFH because of drilling discharges are expected to be **negligible**. The additional time-area closure for sea turtles under Alternative B would not change the extent, severity, or timing of drilling discharge impacts.

4.3.5.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.5.2**, applicable routine IPFs for fisheries resources and EFH are active acoustic sound sources, vessel and equipment noise, seafloor disturbance, and drilling discharges.

Limits on concurrent seismic airgun surveys under Alternative B could change the timing of these surveys and vessel and equipment noise in certain areas. The locations cannot be predicted in advance and would depend on the schedule and planned coverage of individual surveys. As discussed in **Chapter 4.2.5.2**, impacts of active acoustic sound sources and vessel and equipment noise on fisheries resources and EFH are expected to be **minor**. A change in survey timing because of limits on concurrent seismic airgun surveys would not alter the impacts on fisheries resources and EFH.

Limits on concurrent seismic airgun surveys would not change the extent, severity, or timing of seafloor disturbance or drilling discharge impacts to fisheries resource and EFH, as analyzed in **Chapter 4.2.5.2**, and are expected to be **negligible**.

4.3.5.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any fisheries resource and EFH impacts analyzed in **Chapter 4.2.5.2**, including those determined for active acoustic sound sources (**minor**), vessel and equipment noise (**minor**), seafloor disturbance (**negligible**), and drilling discharges (**negligible**).

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) active acoustic sound sources – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **minor**; (2) vessel and equipment noise – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **minor**; (3) seafloor disturbance – impacts would remain unchanged and would be **negligible**; and (4) drilling discharges – impacts would remain unchanged and would be **negligible**.

4.3.5.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on fisheries resources and EFH would be very similar to those analyzed for Alternative A (**Chapter 4.2.5.3**). The analysis concluded that a small spill at the sea surface could have an effect on the planktonic early life stages of fish and *Sargassum*, however the effects are expected to last for a day or less and have limited spatial extent; therefore, impacts of a small accidental diesel fuel spill from G&G activities would be **minor**.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Also, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on fisheries resources and EFH would be the same as under Alternative A and would be **minor**.

4.3.5.3. Cumulative Impacts

The cumulative impacts scenario (**Chapter 3.6**) includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. Impact analyses presented in **Chapters 4.2.5.2** and **4.2.5.3** determined that activities projected to occur under Alternative A would result in impacts ranging from **negligible** to **minor** to fisheries resources and EFH, depending on the activity. The IPFs identified in **Chapter 4.2.5.4** for the cumulative impacts scenario included (1) active acoustic sound sources; (2) vessel and equipment noise; (3) seafloor disturbance; (4) drilling discharges; and (5) accidental fuel spills. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact under Alternative B.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys and, therefore, vessel traffic in certain areas. Overall, however, these time-area closures would not appreciably change the small incremental increase in impacts (i.e., small incremental increase in ambient noise levels) noted under Alternative A. Ambient noise levels and vessel traffic would be reduced during the closures, but the reduction would be temporary under the cumulative scenario. Additional time-area closures would not change the extent, severity, or timing of seafloor disturbance impacts under Alternative B; therefore, there would be no change to the negligible incremental cumulative impacts identified under Alternative A.

Limits on concurrent seismic airgun surveys would change the timing of these surveys and vessel traffic in certain areas but would not alter the impacts of active acoustic noise or vessel traffic from seismic airgun surveys on fisheries resources and EFH. Cumulative impacts under Alternative B would be unchanged by limits on concurrent seismic airgun surveys.

The use of PAM in Alternative B would not change any of the incremental impacts identified for fisheries resources and EFH under Alternative A.

Cumulative scenario activities, including oil and gas exploration, renewable energy, geosequestration, and LNG terminals, have the potential for the emplacement of structures within the AOI and such structures would attract fishes. Most G&G activities would be of short duration and are not expected to cause permanent alteration of migratory, feeding, or breeding schedules in fishery species. Because of the small size of structures and the relatively short duration of deployments, the incremental increase in cumulative impacts on fisheries resources and EFH from the presence of structures is negligible under Alternative A. The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys but would not alter the impacts of structures within the AOI and therefore would not affect the cumulative impacts identified under Alternative A.

A significant amount of vessel traffic is expected to occur under the cumulative scenario for Alternative A. The impacts of accidental fuel spills arising from a vessel collision under the cumulative scenario are expected to be minor. Spilled diesel fuel would evaporate, disperse, and break down within a day, resulting in minor impacts to fisheries resources and EFH. Non-G&G activities at risk for spilled fuel include geosequestration, commercial and recreational fishing, military activity, and dredged material disposal. Assuming a similar spill scenario for non-G&G activity, the incremental increase in cumulative impacts for the AOI are expected to be minor. Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Spills from other survey vessels could also occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential incremental increase to cumulative impacts on fisheries resources and EFH would be the same under Alternative B as determined under Alternative A and would be minor.

4.3.6. Threatened and Endangered Fish Species

Descriptions of the threatened and endangered fish species present in the AOI were provided in **Chapter 4.2.6.1**. As outlined in **Chapter 4.2.6.2**, six IPFs from routine G&G activities may affect threatened and endangered fishes, including (1) active acoustic sound sources; (2) vessel and equipment noise; (3) vessel traffic; (4) trash and debris; (5) seafloor disturbance; and (6) drilling discharges (**Table 4-2**). Impacts to threatened and endangered fishes under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.6.2**). The following discussion outlines the effects of the additional mitigation measures included in Alternative B on threatened and endangered fishes.

4.3.6.1. Impacts of Routine Activities

4.3.6.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI.

Two endangered fish species (smalltooth sawfish and shortnose sturgeon), one proposed for endangered status (Atlantic sturgeon), and two proposed for threatened status (blueback herring and alewife) occur in the AOI. As discussed in **Chapter 4.2.6.2**, applicable routine IPFs for threatened and endangered fishes are active acoustic sound sources; vessel and equipment noise; vessel traffic; seafloor disturbance; drilling discharges; and trash and debris. Potential accidents were also considered in this impact analysis. The following subsections briefly discuss impacts resulting from these IPFs.

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the additional 37-km (20-nmi) closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 37-km (20-nmi) closure area offshore Florida between November 15 and April 15. As discussed in **Chapter 4.2.6.2**, impacts of active acoustic sound sources vessel and equipment noise on threatened and endangered fishes are expected to range from **negligible** to **minor**, depending on the species of fish. A change in survey timing in the additional closure areas as proposed in Alternative B would not alter the impacts of seismic survey or vessel and equipment noise on threatened and endangered fishes.

Impacts of vessel traffic, including mortality associated with vessel strike, are expected to be **negligible**. A change in survey timing in the additional closure areas as proposed in Alternative B would not alter the impacts of vessel traffic on threatened and endangered fishes. The additional time-area closure for right whales under Alternative B would not change the extent, severity, or timing of seafloor disturbance impacts (**negligible**). Impacts of trash and debris to threatened and endangered fish species are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance; therefore, impacts from trash and debris would be unchanged under Alternative B (**negligible**).

Impacts to bottom-feeding threatened and endangered fishes from drilling discharge deposition are expected to be **negligible**, as are impacts on blueback herring and alewives from drilling discharge-induced increases in turbidity. A change in survey timing in the additional closure areas as proposed in Alternative B would not alter the impacts of drilling discharges on threatened and endangered fishes.

Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization might include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. The case-by-case review could result in altered timing of G&G surveys, including those involving seafloor disturbance, but would not be expected to change the extent or severity of impacts, which are evaluated in **Chapter 4.2.6.2** as **negligible**.

4.3.6.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.6.2**, applicable routine IPFs for threatened and endangered fishes are active acoustic sound sources; vessel and equipment noise; vessel traffic; seafloor disturbance; drilling discharges; and trash and debris. The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. As discussed in **Chapter 4.2.6.2**, impacts of active acoustic sound sources on threatened and endangered fishes are expected to range from **negligible** (smalltooth sawfish and shortnose sturgeon) to **minor** (Atlantic sturgeon, blueback herring, and alewife), and impacts from vessel and equipment noise are expected to be **negligible**. A change in survey timing in the closure area would not alter the impacts of seismic airgun surveys on threatened and endangered fishes.

Impacts of vessel traffic are expected to be **negligible**. A change in survey timing in the additional closure areas as proposed in Alternative B would not alter the impacts of vessel traffic on threatened and endangered fishes.The additional time-area closure for sea turtle nesting under Alternative B would not change the extent, severity, or timing of seafloor disturbance impacts (**negligible**). Impacts of trash and debris to threatened and endangered fish species are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance; therefore, impacts would be unchanged under Alternative B (**negligible**).

Impacts to bottom feeding threatened and endangered fishes from drilling discharge deposition are expected to be **negligible**, as are impacts on blueback herring and alewives from drilling discharge-induced increase in turbidity. A change in survey timing in the additional closure areas as proposed in Alternative B would not alter the impacts of drilling discharges on threatened and endangered fishes.

Under the time-area closure for sea turtle nesting, other non-airgun surveys in the closure area would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles. The case-by-case review could result in altered timing of G&G surveys, including those involving seafloor disturbance, but would not be expected to change the extent or severity of impacts to threatened or endangered fishes, which are evaluated in **Chapter 4.2.6.2** as **negligible**.

4.3.6.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.6.2**, applicable routine IPFs for threatened and endangered fishes are active acoustic sound sources; vessel and equipment noise; seafloor disturbance; and trash and debris. Limits on concurrent seismic airgun surveys under Alternative B could change the timing of these surveys in certain areas. The locations cannot be predicted in advance and would depend on the schedule and planned coverage of individual surveys. As discussed in **Chapter 4.2.6.2**, impacts of active acoustic sound sources and vessel and equipment noise on threatened and endangered fishes are expected to range from **negligible** to **minor**. A change in survey timing because of limits on concurrent seismic airgun surveys under Alternative B would not alter the impacts on threatened and endangered fishes.

Limits on concurrent seismic airgun surveys would not change the extent, severity, or timing of vessel traffic impacts (**negligible**), seafloor disturbance impacts (**negligible**), or drilling discharges (**negligible**). Impacts of trash and debris to threatened and endangered fish species are expected to be avoided through compliance with USCG and USEPA regulations and BSEE guidance; therefore, impacts would be unchanged under Alternative B (**negligible**).

4.3.6.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any impacts to threatened and endangered fishes analyzed in **Chapter 4.2.6.2**.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) active acoustic sound sources – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would range from **negligible** to **minor**; (2) vessel and equipment noise – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would range from **negligible** to **minor**; (3) vessel traffic – impacts would be reduced, overall impacts would remain **negligible**; (4) trash and debris – impacts would remain unchanged and would be **negligible**; (5) seafloor disturbance – impacts would remain unchanged and would be **negligible**; and (6) drilling discharges – impacts would remain unchanged and would be **negligible**.

4.3.6.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on threatened and endangered fishes would be unchanged from those analyzed for Alternative A (**Chapter 4.2.6.3**). The analysis concluded that accidents involving G&G survey vessels and equipment are not expected to affect individuals or populations of threatened and endangered fish species. While Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys, spills may occur from other survey vessels. Spilled diesel fuel would generally remain in the surface waters and would evaporate, disperse, and break down within a day. Smalltooth sawfish give birth to live benthic young, and shortnose sturgeon, Atlantic sturgeon, blueback herring, and alewife are anadromous species with no pelagic life stage found in the AOI. Therefore, the expected impact of an accidental diesel fuel spill is expected to be **negligible** for all five of these species.

4.3.6.3. Cumulative Impacts

The cumulative impacts scenario (**Chapter 3.6**) includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. Impact analyses presented in **Chapters 4.2.6.2** and **4.2.6.3** determined that activities projected to occur under Alternative B would result in impacts ranging from **negligible** to **minor** to threatened and endangered fishes depending on the activity and species of fish. As discussed in **Chapter 4.2.6.4**, applicable routine IPFs for threatened and endangered fishes are (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, and other active sound sources and vessel and equipment noise; (2) vessel traffic; (3) seafloor disturbance; (4) trash and debris; (5) drilling discharges, and (6) accidental fuel spills. These IPFs would also contribute to the cumulative activities scenario under Alternative B. The following analysis considers whether those incremental impacts, when added to or acting synergistically with other impact sources from the cumulative impacts scenario, may result in a significant impact under Alternative B.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys and, therefore, anthropogenic noise and vessel traffic in certain areas. Overall, however, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A (**negligible** to **minor**). Ambient noise levels and vessel traffic would be reduced during the closures, but the reduction would be temporary under the cumulative scenario. Additional time-area closures would not change the extent, severity, or timing of seafloor disturbance impacts under Alternative B; therefore, only minor incremental increases in ambient noise and vessel traffic levels would occur.

Limits on concurrent seismic airgun surveys would change the timing of these surveys and vessel traffic in certain areas but would not alter the impacts of active acoustic noise or vessel traffic from seismic airgun surveys on threatened and endangered fishes. In addition, these concurrent survey limits would not change the extent, severity, or timing of seafloor disturbance impacts. Cumulative impacts under Alternative B would be unchanged (**negligible** to **minor**) by limits on concurrent seismic airgun surveys. Furthermore, additional time-area closures would not change the extent, severity, or timing of seafloor disturbance impacts under Alternative B; therefore, there would be no changes in the incremental increase in impacts identified under Alternative A.

Impacts to threatened and endangered fishes from trash and debris are expected to be avoided through compliance with existing regulations and BSEE guidance; therefore, impacts would be unchanged (**negligible**) under the cumulative scenario for Alternative B. The use of PAM in Alternative B would not change any cumulative impacts determined for threatened and endangered fishes in Alternative A.

A significant amount of vessel traffic is expected to occur under the cumulative scenario for Alternative A. The risk of accidental fuel spills arising from a vessel collision under the cumulative scenario is expected to range from **negligible** to **minor**. Alternative B would change the timing of certain surveys due to additional time-area closures and limits on concurrent seismic airgun surveys; however, a change in survey timing would not substantially change the risk of a small fuel spill. The greatest risk of a fuel spill, such as the one portrayed in the accidental scenario (**Chapter 3.5.2.1**), is to fishes at various life stages that occur near or at the surface. Direct exposure would occur only in the water column near the discharge point, thus pelagic adults and planktonic eggs and larvae are most susceptible. Smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, blueback herring, and alewives do not have pelagic life stages in AOI waters, therefore the impacts are expected to be **negligible**. The negligible incremental increases in potential accidental fuel spills from G&G activities identified for Alternative A under the cumulative scenario would remain unchanged.

4.3.7. Commercial Fisheries

Descriptions of the commercial fisheries present in the AOI were provided in **Chapter 4.2.7.1**. As discussed in **Chapter 4.2.7.2**, IFPs that may affect commercial fisheries include (1) active acoustic sound sources (e.g., airguns, bottom profilers, depth sounders, side-scan sonar); (2) vessel traffic; (3) vessel exclusion zones; and (4) seafloor disturbance (**Table 4-2**). Impacts to benthic communities under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.7.2**). The following discussion outlines the effects of the additional mitigation measures included in Alternative B on commercial fisheries.

4.3.7.1. Impacts of Routine Activities

4.3.7.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI. As discussed in **Chapter 4.2.7.2**, applicable routine IPFs for commercial fisheries are active acoustic sound sources, vessel traffic and vessel exclusion zones, and seafloor disturbance, with impacts ranging from **negligible** to **minor**, depending on the IPF.

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the additional 37-km (20-nmi) closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 37-km (20-nmi) closure area offshore Florida between November 15 and April 15.

As discussed in **Chapter 4.2.7.2**, impacts of active acoustic sound sources on commercial fisheries are expected to be **minor**. Among the seven states of the AOI, Virginia generated the most revenue in commercial landings, while North Carolina, Maryland, and Delaware ranked second, third, and seventh in total value based on 2009 landings data. Commercial landings and the associated value typically increase steadily from winter (February) to late summer and peak in August, indicating the importance of the period of overlap (February through April) between increasing commercial landings and the Alternative B additional time-area closure (November 15 through April 30). All of the commercial fishing activities discussed in **Chapter 4.2.7.2** could occur within the additional time-area closure area, with the exception of pelagic longlining. Therefore, during the additional time-area closure, any adverse effects from G&G active acoustic noise on commercial fisheries within the closure area in the four northern states would be eliminated under Alternative B. In addition, related impacts associated with vessel traffic and vessel equipment and noise would also be eliminated in the time-closure area, as discussed further below.

Under Alternative A, there is an existing time-area closure off the coast of South Carolina, Georgia, and Florida; therefore, impacts to commercial fisheries in this southern area would remain unchanged under Alternative B. Even though the impacts to commercial fisheries would be eliminated within the additional closure area for the northern states of the AOI and the impacts would remain unchanged within the southern AOI states, the additional time-area closure area is only approximately 6,823,753 ac, or only 3.2 percent of the total AOI, which is not a significant area impacted by this additional closure. Therefore, this additional closure area would not alter the impacts of active acoustic sound sources from seismic airgun surveys on commercial fisheries, which would remain **minor**.

Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization may include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. The case-by-case review could result in altered timing of G&G surveys but would not be expected to change the extent or severity of commercial fishing impacts from survey vessel traffic or vessel exclusion zones, which are evaluated in **Chapter 4.2.7.2** as **minor**.

As discussed in **Chapter 4.2.7.2**, vessel traffic associated with G&G activities would increase in specific areas, thereby increasing the potential for interference with commercial fishing operations, especially dredges, otter trawls, longlines, and purse seines. These types of commercial fisheries could be affected, albeit on a limited basis, because an increase in vessel traffic (and associated vessel exclusion zones) throughout the fishing grounds may prevent commercial fishing operators from properly setting their gear; however, the impacts were determined to be **minor** for vessel traffic and vessel exclusion zones for Alternative A. Under Alternative B, G&G seismic survey activities would be precluded from the additional 37-km (20-nmi) closure area for 6 months of the year, and other survey activity may be precluded on a case-by-case basis, which would decrease the vessel traffic and associated vessel exclusion zones from this area during the closure time period. Therefore, seasonal commercial fishing activities in this region of the AOI would no longer have the potential for additional vessel traffic and vessel exclusion zones associated with G&G survey activities during the closure period. However, since this additional closure area is only a very small portion of the AOI (3.2%), the impacts would remain the same (**minor**) for vessel traffic and vessel exclusion zones under Alternative B.

The additional time-area closure for right whales under Alternative B for all survey types would not change the extent, severity, or timing of seafloor disturbance impacts; therefore, impacts would remain **negligible** under Alternative B.

4.3.7.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles. As discussed in **Chapter 4.2.7.2**, applicable routine IPFs for commercial fisheries are active acoustic sound sources, vessel traffic and vessel exclusion zones, and seafloor disturbance.

The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in the additional time-area closure area. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. As discussed in **Chapter 4.2.7.2**, impacts of active acoustic sound sources on commercial fisheries are expected to be **minor**. Commercial fisheries landings from Florida ranked fourth among the seven states in the AOI. Any adverse effects from G&G active acoustic noise on commercial fisheries operating within the additional sea turtle time-area closure off Broward County, Florida, would be eliminated between May 1 and October 31 under Alternative B. However, the additional closure area is very small (312,785 ac, or 0.6%) when compared to the entire AOI; therefore, this change in survey timing in the closure area would not alter the impacts of active acoustic noise from seismic airgun surveys on commercial fisheries, which would remain **minor**.

As discussed in **Chapter 4.2.7.2**, vessel traffic associated with all G&G survey activities would increase in specific areas, thereby increasing the potential for interference with commercial fishing operations, especially dredges, otter trawls, longlines, and purse seines. These types of commercial fisheries could be affected, albeit on a limited basis, because an increase in vessel traffic (and associated vessel exclusion zones) throughout the fishing grounds may prevent commercial fishing operators from properly setting their gear; however, the impacts were determined to be **negligible** for vessel traffic and vessel exclusion zones under Alternative A. Under Alternative B, G&G seismic survey activities would be precluded from the additional 37-km (20-nmi) closure area for 6 months of the year and other survey activity may be precluded on a case-by-case basis, which would decrease the vessel traffic and associated vessel exclusion zones during this sea turtle nesting time-area closure. Therefore, seasonal commercial fishing activities in this region of the AOI would no longer have the potential for additional vessel traffic and vessel exclusion zones associated with G&G survey activities during the closure period. However, since this additional closure area is only a very small portion of the AOI (0.6%), the impacts would remain the same (**negligible**) for vessel traffic and vessel exclusion zones under Alternative B.

The additional time-area closure for sea turtle nesting under Alternative B would not change the extent, severity, or timing of seafloor disturbance impacts, which would remain **negligible**.

4.3.7.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time. As discussed in **Chapter 4.2.7.2**, applicable routine IPFs for commercial fisheries are active acoustic sound sources, vessel traffic and exclusion areas, and seafloor disturbance.

Limits on concurrent seismic airgun surveys under Alternative B could change the timing of these surveys in certain areas; the locations cannot be predicted in advance but would depend on the schedule and planned coverage of individual surveys. In addition, the limit on concurrent surveys has the potential to reduce impacts from active acoustic sound sources and vessel traffic and vessel exclusion zones to commercial fisheries. However, this reduction of impacts would occur only within areas where commercial fishing grounds are large enough to accommodate more than one survey at a time. Therefore, the impacts to commercial fishing from both active acoustic sound sources and vessel traffic and vessel exclusion zones would remain the same for Alternative B, **minor** and **negligible**, respectively.

Limits on concurrent seismic airgun surveys would not change the extent, severity, or timing of seafloor disturbance impacts; therefore, seafloor impacts under Alternative B would remain **negligible**.

4.3.7.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any commercial fisheries impacts analyzed in **Chapter 4.2.7.2**.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) active acoustic sound sources – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **minor**; (2) vessel traffic – impacts would be reduced due to time-area closures, overall impacts would remain **minor**; (3) vessel exclusion zones – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **minor**; and (4) seafloor disturbance – impacts would remain unchanged and would be **negligible**.

4.3.7.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on commercial fisheries would be very similar to those analyzed for Alternative A (**Chapter 4.2.7.3**). The Alternative A analysis concluded that a small spill at the sea surface would have **negligible** impacts to commercial fisheries.

Alternative B would change the timing of certain surveys due to additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Also, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing due to limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on commercial fisheries would be the same as under Alternative A and would be **negligible**.

4.3.7.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.7.1** and **4.3.7.2** determined that activities projected to occur under Alternative B would result in impacts ranging from **negligible** to **minor** to commercial fisheries, depending on the activity, as a result of active acoustic sound sources, vessel traffic and vessel exclusion zones, and seafloor disturbance. These IPFs would also contribute to the cumulative activities scenario under Alternative B. The cumulative activities scenario for commercial fisheries, as outlined in **Chapter 4.2.7.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified only negligible incremental increases in impacts from all IPFs under Alternative A.

As described in **Chapter 4.2.7.2**, because there are no significant noise impacts evident from the cumulative activities scenario, and there is no evidence of ambient noise levels approaching a threshold level where commercial fisheries might be significantly affected, it is expected that the cumulative impacts to commercial fisheries associated with Alternative A would result in a minor incremental increase in impacts. The additional time-area closures would decrease the active acoustic noise in the closure areas for portions of the year. However, the combined total area of the additional closure areas is only a very small portion of the entire AOI (6,823,753 ac, or 3.2%) where commercial fishing impacts would be reduced; therefore, when evaluating the cumulative impacts over the entire AOI, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A and would remain the same for active acoustic noise under Alternative B.

Vessel traffic would increase under the cumulative scenario to support most of the activities. As discussed in **Chapter 4.2.7.4**, most commercial fishing operators set their gear according to specific habitats (e.g., bottom profile) or water conditions (e.g., Gulf Stream current). Thus, if there are numerous vessels transiting through the fishing grounds, it may prevent fishermen from setting their gear in a manner that maximizes fishing effort. However, the additional vessel traffic from the cumulative scenario would not be a significant increase to existing vessel traffic. Most vessels involved in the cumulative scenario would be able to avoid commercial fishing vessels with gear in the water as they would be transiting to an offshore location. Therefore, impacts from vessel traffic associated with the cumulative scenario are expected to be negligible to commercial fisheries. With the additional time-area closures for the North Atlantic right whale and sea turtles, vessel traffic within the additional closure areas would be slightly reduced during portions of the year and the timing of seismic airgun surveys would change. However, these additional closure areas are very small when compared to the entire AOI and would still result in a negligible incremental increase in cumulative impacts to commercial fisheries from vessel traffic.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys in certain areas. Additional time-area closures would not change the extent, severity, or timing of seafloor disturbance impacts under Alternative B; therefore, additional time-area closures for North Atlantic right whales would not affect the cumulative impacts identified under Alternative A and would be unchanged for seafloor disturbance under Alternative B.

Limits on concurrent seismic airgun surveys would change the timing of these surveys in certain areas but would not alter the impacts of active acoustic noise from seismic airgun surveys on commercial fisheries. Therefore, cumulative impacts under Alternative B would be unchanged by limits on concurrent seismic airgun surveys.

The use of PAM in Alternative B would not change any cumulative impacts to commercial fisheries determined under Alternative A.

Alternative B would change the timing of certain surveys due to additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Spills from other survey vessels could also occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing due to limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential cumulative impacts on commercial fisheries would be the same under Alternative B as determined under Alternative A.

4.3.8. Recreational Fisheries

Descriptions of the recreational fisheries present in the AOI were provided in **Chapter 4.2.8.1**. As discussed in **Chapter 4.2.8.2**, IPFs for recreational fisheries include (1) active acoustic sound sources (i.e., airguns, subbottom profilers, depth sounders, side-scan sonar), (2) vessel traffic, and (3) vessel exclusion zones (**Table 4-2**). Impacts to recreational fisheries under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.8.2**). The following discussion outlines the effects of the additional mitigation measures included in Alternative B on recreational fisheries.

4.3.8.1. Impacts of Routine Activities

4.3.8.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI.

As discussed in **Chapter 4.2.8.2**, applicable routine IPFs for recreational fisheries are active acoustic sound sources (i.e., airguns, subbottom profilers, depth sounders, side-scan sonar), vessel traffic, and vessel exclusion zones, with impacts ranging from **negligible** to **minor**, depending on the IPF.

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the additional 37-km (20-nmi) closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 37-km (20-nmi) closure area offshore Florida between November 15 and April 15.

As discussed in **Chapter 4.2.8.2**, impacts of active acoustic sound sources on recreational fisheries are expected to range from **negligible** to **minor** as they have the potential to directly and indirectly affect some recreational fishing activities and recreational fisheries resources within the AOI. The additional time-area closure for right whales would change the timing of seismic airgun surveys in certain areas within the area where most recreational fishing takes place (within 3k-km [20-nmi] of the shore) during cetain portions of the year. However, during the months when the surveys would not take place in this area (November through April), the area is typically not heavily used by recreational fishers because of weather conditions. The abundance of recreational fishing takes place during the warmer, calmer months. Therefore, the additional time-area closure under Alternative B would not alter the impacts to recreational fisheries and would remain **negligible** to **minor**.

Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization might include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. The case-by-case review could result in altered timing of G&G surveys, which are typically short in duration, but would not be expected to change the extent or severity of recreational fishing impacts from survey vessel traffic or vessel exclusion zones, which are evaluated in **Chapter 4.2.8.2** as ranging from **negligible** to **minor**.

As discussed in **Chapter 4.2.8.2**, vessel traffic associated with G&G activities would increase in specific areas, thereby increasing the potential for interference with recreational fishing, especially those engaged in amateur and professional fishing tournaments. The additional survey vessels could temporarily prevent or limit access by recreational fishermen to portions of fishing grounds. However, the impacts were determined to be **negligible** to **minor** for vessel traffic under Alternative A. In addition, the vessel exclusion zones associated with survey vessels and towed equipment could result in loss of access to fishing grounds; however, the impact of vessel exclusion zones was determined to be **negligible** under Alternative A.

Under Alternative B, G&G seismic survey activities would be precluded from the additional 37-km (20-nmi) closure area for 6 months of the year, and other survey activity may be precluded on a case-by-case basis, which would affect vessel traffic, the potential for entanglements, and associated vessel exclusion zones from this area during the closure time period. Seasonal recreational fishing activities in this region of the AOI would no longer have the potential for additional vessel traffic and vessel exclusion zones associated with G&G survey activities during the closure period. However, since the additional closure period is not typically a high use time for recreational fisheries because of weather, the impacts would remain the same (**negligible** to **minor**) for vessel traffic and **negligible** for vessel exclusion zones under Alternative B.

4.3.8.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.8.2**, applicable routine IPFs for recreational fisheries are active acoustic sound sources, vessel traffic, and vessel exclusion zones.

The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in the additional time-area closure area. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. As discussed in **Chapter 4.2.8.2**, impacts of active acoustic sound sources on recreational fisheries are expected to range from **negligible** to **minor**. The exclusion of seismic airgun surveys within this area would reduce the potential impact to recreational fisheries within this time-area closure area from active acoustic noise during this period of high fishing activity. However, the additional closure area is very small (i.e., 312,785 ac, or 0.6 percent of the AOI) when compared to the entire AOI; therefore, this change in survey timing in the closure area would not alter the impacts of active acoustic noise from seismic airgun surveys on recreational fisheries and would remain **negligible** to **minor**.

As discussed in **Chapter 4.2.8.2**, vessel traffic associated with all G&G survey activities would increase in specific areas, thereby increasing the potential for interference with recreational fishing operations, especially those engaged in amateur and professional fishing tournaments. The additional survey vessels could prevent or limit access by recreational fishermen to portions of fishing grounds; the towing of long streamers behind seismic vessels may also result in entanglement of seismic gear with recreational fishing gears. The impacts were determined to be **negligible** to **minor** for vessel traffic under Alternative A. In addition, the vessel exclusion zones associated with survey vessels and towed equipment could result in loss of access to fishing grounds; however, the impact was determined to be **negligible** under Alternative A for vessel exclusion zones.

Under Alternative B, G&G seismic survey activities would be precluded from the additional 11-km (6.8-nmi) closure area for 6 months of the year and other survey activity may be precluded on a case-by-case basis, which would decrease the vessel traffic during this time-area closure for sea turtle nesting. Therefore, recreational fishing activities in this region of the AOI would no longer have the potential for additional vessel traffic, the potential for entanglement, and vessel exclusion zones associated with G&G survey activities during the closure period. However, since this additional closure area is only a very small portion of the AOI (0.6%), the impacts under Alternative B would remain the same as determined under Alternative A – **negligible** to **minor** for vessel traffic and **negligible** for vessel exclusion zones.

4.3.8.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.8.2**, applicable routine IPFs for recreational fisheries include active acoustic sound sources, vessel traffic, and vessel exclusion zones.

Limits on concurrent seismic airgun surveys under Alternative B could change the timing of seismic airgun surveys in certain areas, however, the locations cannot be predicted in advance and would depend on the schedule and planned coverage of individual surveys. In addition, the limit on concurrent surveys has the potential to reduce impacts to recreational fisheries from active acoustic sound sources, vessel traffic, and vessel exclusion zones. However, this reduction in impacts would occur only within areas where recreational fishing areas are large enough to accommodate more than one survey at a time; very few recreational fishing areas in the AOI are this large. Therefore, the impacts to recreational fishing from active acoustic sound sources, vessel traffic, and vessel exclusion zones would remain the same for Alternative B – **negligible** to **minor** for active acoustic sound sources, **negligible** to **minor** for vessel traffic, and **negligible** for vessel exclusion zones.

4.3.8.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any recreational fisheries impacts analyzed in **Chapter 4.2.8.2** (i.e., **negligible** to **minor**).

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) active acoustic sound sources – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would range from **negligible** to **minor**; (2) vessel traffic – impacts would be reduced due to time-area closures, overall impacts would range from **negligible** to **minor**; and (3) vessel exclusion zones – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **negligible**.

4.3.8.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on recreational fisheries would be very similar to those analyzed for Alternative A (**Chapter 4.2.8.3**). The analysis concluded that a small spill at the sea surface would have **negligible** impacts to recreational fisheries.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Also, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on recreational fisheries would be the same as under Alternative A and would be **negligible**.

4.3.8.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.8.1** and **4.3.8.2** determined that activities projected to occur under Alternative B would result in impacts ranging from **negligible** to **minor** to recreational fisheries, depending on the activity, as a result of active acoustic sound sources, vessel traffic, and vessel exclusion zones. These IPFs would also contribute to the cumulative activities scenario under Alternative B. The cumulative activities scenario for recreational fisheries, as outlined in **Chapter 4.2.8.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified only small incremental increases in impacts from all IPFs under Alternative A.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys in certain areas.

As described in **Chapter 4.2.8.2**, because there are no significant noise impacts evident from the cumulative activities scenario, and there is no evidence of ambient noise levels approaching a threshold level where recreational fisheries might be significantly affected, it is expected that the incremental increase in cumulative impacts to recreational fisheries associated with Alternative A would be negligible. The additional time-area closures would decrease the active acoustic noise in the closure areas, which are the highest primary use areas for recreational fishing (within 3k-km [20-nmi] from shore) for portions of the year. However, because of the weather, the time that the area is closed to seismic airgun surveys is not the high use season for recreational fishing in most of the closure area. In addition, the total additional closure areas are only a very small portion of the entire AOI (6,823,753 ac, or 3.2%) where recreational fishing impacts would be reduced. Therefore, when evaluating the cumulative impacts over the entire AOI, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A.

Vessel traffic would increase under the cumulative scenario to support most of the activities. As discussed in **Chapter 4.2.8.2**, most recreational fishing operators set their gear according to specific habitats (e.g., bottom profile) or water conditions (e.g., Gulf Stream current). Thus, if there are numerous vessels transiting through popular fishing grounds, it may prevent fishermen from setting their gear. However, there is no evidence of vessel traffic levels approaching a threshold level where recreational fisheries might be significantly affected. Most vessels involved in the cumulative scenario would be able to avoid recreational fishing vessels as they would be transiting to an offshore location; therefore, impacts from vessel traffic associated with the cumulative scenario are expected to range from negligible to minor for recreational fisheries. With the additional time-area closures for the North Atlantic right whale and sea turtles, vessel traffic within the additional closure areas would be slightly reduced during portions of the year and the timing of seismic airgun surveys would change. However, because of the weather, the additional closure time for the Atlantic right whale does not occur at a peak time for recreational fishers. Further, these additional closure areas are very small when compared to the entire AOI. Therefore, cumulative impacts to recreational fisheries would remain **negligible** to **minor** from vessel traffic and **negligible** for vessel exclusion zones.

Limits on concurrent seismic airgun surveys would change the timing of these surveys in certain areas but would not alter the impacts of active acoustic noise from seismic airgun surveys on recreational fisheries. Therefore, cumulative impacts under Alternative B would be unchanged by limits on concurrent seismic airgun surveys.

The use of PAM in Alternative B would not change any cumulative impacts to recreational fisheries determined under Alternative A.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Spills from other survey vessels could also occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential cumulative impacts on recreational fisheries would be the same under Alternative B as determined under Alternative A.

4.3.9. Recreational Resources

Descriptions of the recreational resources present in the AOI were provided in **Chapter 4.2.9.1**. As outlined in **Chapter 4.2.9.2**, the IPFs identified for recreational resources include (1) vessel exclusion zones and (2) trash and debris (**Table 4-2**). Impacts to recreational resources under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.9.2**). The following discussion outlines the effect of the additional mitigation measures included in Alternative B on recreational resources.

4.3.9.1. Impacts of Routine Activities

4.3.9.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI.

As discussed in **Chapter 4.2.9.2**, there are two applicable routine IPFs for recreational resources (vessel exclusion zones and trash and debris) which are expected to result in impacts ranging from **negligible** to **minor**, depending on the location. Impact of trash and debris on recreational resources is expected to be minimized through compliance with USCG and USEPA regulations and BSEE guidance; therefore, impacts would be unchanged under Alternative B (**negligible** to **minor**), depending on location.

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys and the associated exclusion zones in the time-closure areas, which total approximately 14,413,356 ac, or 6.8 percent of the total AOI. Seismic airgun surveys would not be authorized in the additional 20-nmi closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 37-km (20-nmi) closure area offshore Florida between November 15 and April 15.

Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization might include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. The additional time-area closure for right whales under Alternative B would not significantly alter the recreational opportunities since the closure times in most of the AOI are not high use times for recreational opportunities because of weather. Most recreational use within the AOI would occur during the warmer and calmer spring and summer months, which would not change under Alternative B; therefore, the impacts to recreational resources from exclusion zones would still be expected to be **negligible**.

4.3.9.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during that time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.9.2**, there are two applicable routine IPFs for recreational resources (vessel exclusion zones and trash and debris), which resulted in **negligible** to **minor** impacts. Impacts of trash and debris on recreational resources is expected to be minimized through compliance with USCG and USEPA regulations and BSEE guidance; therefore, impacts would be expected to remain unchanged under Alternative B (**negligible** to **minor**), depending on location.

The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys and the associated exclusion zones in the additional closure area. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. The additional time-area closure for sea turtles under Alternative B would reduce the potential for exclusion zones that limit recreational opportunities. However, this time-area closure is only 312,785 ac (126,579 ha), or only 0.6 percent of the total AOI; therefore, this minor reduction of impacts within this small area would not result in a change in the impact identified under Alternative A. Impacts to recreational resources under Alternative B would be expected to remain **negligible**.

4.3.9.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.9.2**, there are two applicable routine IPFs for recreational resources (vessel exclusion zones and trash and debris) that resulted in **negligible** to **minor** impacts, depending on location. Impact of trash and debris on recreational resources is expected to be minimized through compliance with USCG and USEPA regulations and BSEE guidance; therefore, impacts would be expected to remain unchanged under Alternative B (i.e., **negligible** to **minor**), depending on location.

As discussed in **Chapter 4.2.9.2**, a typical vessel exclusion zone for a 2D or 3D survey involving a towed array would be approximately 8.5 km (4.6 nmi) long and 1.2 km (0.6 nmi) wide, covering a total of 1,021 ha (2,520 ac) of the sea surface. The length of time that any particular point would be within the vessel exclusion zone would be about 1 hour. The limits on concurrent seismic airgun surveys would spread out the spatial extent of these vessel exclusion zones and would reduce the potential for an additive vessel exclusion zone within one area. However, the same vessel exclusion zone areas for recreational activities would still be present within the AOI. This potential small incremental decrease in impact from removal of the potential of an additive vessel exclusion zone in one area would remain unchanged under Alternative B; impacts to recreational resources from concurrent seismic survey limits would be expected to remain the same as identified under Alternative A (i.e., **negligible**), depending on location.

4.3.9.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. Since there are no exclusion zones associated with the use of PAM, the impact to recreational resources analyzed in **Chapter 4.2.9.2** (i.e., **negligible**) would not be expected to change.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) vessel exclusion zones – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **negligible**; and (2) trash and debris – impacts would remain unchanged and would range from **negligible** to **minor**.

4.3.9.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on recreational resources would be very similar to those analyzed for Alternative A (**Chapter 4.2.9.3**). In the event of a spill, the potential does exist for fuel released to be carried to recreational areas by waves and currents (i.e., if the accident occurs close to shore) resulting in the potential for a short-term interference with recreational opportunities would be expected to result in a **negligible** to **minor** impacts, depending on the location of the spill.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Also, spills from other vessels could occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on recreational resources from Alternative B would be the same as under Alternative A and would be expected to range from **negligible** to **minor**, depending on the location of the spill.

4.3.9.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.9.1** and **4.3.9.2** determined that activities projected to occur under Alternative B would result in **negligible** to **minor** impacts to recreational resources. The cumulative activities scenario for recreational resources, as outlined in **Chapter 4.2.9.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs that would contribute to the cumulative activities scenario under Alternative B include vessel exclusion zone, trash and debris, and accidental fuel spills. The cumulative impact analysis identified negligible incremental increases in impacts from these IPFs under Alternative A.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys in certain areas. Overall, however, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A. Therefore, impacts would be unchanged under the cumulative scenario for Alternative B for all IPFs.

Limits on concurrent seismic airgun surveys would change the timing of these surveys in certain areas but would not alter the impacts to recreational resources; therefore, the impacts would remain unchanged under the Alternative B cumulative scenario. Cumulative impacts under Alternative B would be unchanged by limits on concurrent seismic airgun surveys for all IPFs.

The use of PAM in Alternative B would not change cumulative impacts to recreational resources determined under Alternative A.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, as discussed in **Chapter 4.2.9.4**, a significant amount of vessel traffic is expected to occur under the cumulative scenario. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The risk of accidental fuel spills arising from a vessel collision under the cumulative scenario is expected to range from negligible to minor. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential cumulative impacts to recreational resources would be the same under Alternative B as determined under Alternative A and would result in a negligible incremental increase in risk of a collision-based fuel spill. Therefore, the impacts to recreational resources from spill response and cleanup activities associated with fuel spills from vessels under the cumulative activities scenario are expected to range from negligible to minor, depending on the location of the spill.

4.3.10. Archaeological Resources

Descriptions of the archaeological resources present in the AOI were provided in **Chapter 4.2.10.1**. As outlined in **Chapter 4.2.10.2**, IPFs for archaeological resources included (1) seafloor disturbance, and (2) drilling discharges (**Table 4-2**). Impacts to archaeological resources under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.10.2**). The following discussion outlines the effect of the additional mitigation measures included in Alternative B on archaeological resources.

4.3.10.1. Impacts of Routine Activities

4.3.10.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI.

As discussed in **Chapter 4.2.10.2**, there are two applicable routine IPFs for archaeological resources – seafloor disturbance and drilling discharges, both of which are expected to result in a **negligible** impact. This impact determination is based on the avoidance of archaeological resources, which is based on the protective measures outlined in **Chapter 4.2.10.2**.

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in the time-closure areas, which total approximately 6,823,753 ac (2,761,474 km^2), or only 3.2 percent of the total AOI. Seismic airgun surveys would not be authorized in the additional 37-km (20-nmi) closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 37-km (20-nmi) closure area offshore Florida between November 15 and April 15. The additional time-area closure for right whales under Alternative B would not change the extent, severity, or timing of seafloor disturbance or drilling discharges; therefore, the impacts to archaeological resources from seafloor disturbance and drilling discharges would still be expected to be **negligible**.

4.3.10.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during that time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.10.2**, there are two applicable routine IPFs for archaeological resources – seafloor disturbance and drilling discharges, both of which resulted in a **negligible** impact.

The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in the additional closure area. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. The additional time-area closure for sea turtles under Alternative B would not change the extent, severity, or timing of seafloor disturbance or drilling discharge impacts; therefore, impacts would remain the same as those analyzed in **Chapter 4.2.10.2** (**negligible**).

4.3.10.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.10.2**, there are two applicable routine IPFs for archaeological resources – seafloor disturbance and drilling discharges, both of which resulted in a **negligible** impact. The limit on concurrent seismic airgun surveys under Alternative B would not change the extent, severity, or timing of seafloor disturbance impacts, and therefore impacts would remain the same as those analyzed in **Chapter 4.2.10.2** for archaeological resources (**negligible**).

4.3.10.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any impacts to archaeological resources analyzed in **Chapter 4.2.10.2**. Impacts would remain **negligible**.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) seafloor disturbance – impacts would remain unchanged and would be **negligible**; and (2) drilling discharges – impacts would remain unchanged and would be **negligible**.

4.3.10.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on archaeological resources would be very similar to those analyzed for Alternative A in **Chapter 4.2.10.3**. Since there is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink, particulate matter contaminated with diesel fuel could eventually reach the seafloor; an accidental diesel fuel spill would be expected to result in **negligible** impacts to archaeological resources.

4.3.10.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.10.1** and **4.3.10.2** determined that activities projected to occur under Alternative B would result in **negligible** impacts to archaeological resources. The cumulative activities scenario and the potential for impact to archaeological resources, as outlined in **Chapter 4.2.10.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs that would contribute to the cumulative activities scenario under Alternative B include seafloor disturbance, drilling discharges, and accidental fuel spills. The cumulative impact analysis identified negligible to minor incremental increases in impacts from these IPFs under Alternative A.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys in certain areas. Overall, however, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A. Therefore, impacts would be unchanged under the cumulative scenario for Alternative B for all IPFs.

Limits on concurrent seismic airgun surveys would change the timing of these surveys in certain areas but would not alter the impacts to archaeological resources; therefore, the impacts would remain unchanged under the Alternative B cumulative scenario. Cumulative impacts under Alternative B would be unchanged by limits on concurrent seismic airgun surveys for all IPFs.

The use of PAM in Alternative B would not change cumulative impacts to archaeological resources determined under Alternative A.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, as discussed in **Chapter 4.2.10.4**, a significant amount of vessel traffic is expected to occur under the cumulative scenario. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The risk of accidental fuel spills arising from a vessel collision under the cumulative scenario is expected to range from negligible to minor. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential cumulative impacts to archaeological resources would be the same under Alternative B as determined under Alternative A and would result in a negligible incremental increase in risk of a collision-based fuel spill. Seafloor-disturbing activities associated with spill cleanup are not expected. Therefore, the impacts to archaeological resources from spill response and cleanup activities associated with fuel spills from vessels under the cumulative activities scenario are expected to range from negligible to minor.

4.3.11. Marine Protected Areas

Descriptions of the MPAs present in the AOI were provided in **Chapter 4.2.11.1**. As outlined in **Chapter 4.2.11.2**, IPFs for MPAs include (1) active acoustic sound sources (e.g., airguns; electromechanical sources including subbottom profilers, depth sounders, and side-scan sonar); (2) trash and debris; (3) seafloor disturbance; and (4) drilling discharges. These IPFs are based on potential impacts to the resources that are present with the MPAs, including benthic communities, marine mammals, sea turtles, marine and coastal birds, and fishery resources. As a consequence, the evaluation of impacts to MPAs reflects impact designations for these other resources. Impacts to MPAs under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.11.2**). The following discussion outlines the effects of the additional mitigation measures included in Alternative B on MPAs.

4.3.11.1. Impacts of Routine Activities

4.3.11.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI.

As discussed in **Chapter 4.2.11.2**, applicable routine IPFs for MPAs are active acoustic sound sources, trash and debris, seafloor disturbance, and drilling discharges.

The additional time-area closure for right whales under Alternative B would change the timing of seismic airgun surveys in the time-closure areas, which total approximately 6,823,753 ac (2,761,474 ha), or only 3.2 percent of the total AOI. Seismic airgun surveys would not be authorized in the additional 37-km (20-nmi) closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 37-km (20-nmi) closure area offshore Florida between November 15 and April 15. As discussed in **Chapter 4.2.11.2**, impacts of active acoustic sound sources from Alternative A on MPAs are expected to be **negligible**, **minor**, or **moderate**, depending on the resource present in the MPA. Impacts to benthic communities, marine and coastal birds, and recreational resources were all expected to be **negligible**, whereas impacts to marine mammals and fisheries resources and EFH were expected to be **minor**. Impacts on sea turtles are expected to be **negligible** or **minor**, except in inner shelf waters within the southern part of the AOI during sea turtle nesting season, where impacts may range from **negligible** to **moderate** depending on how severely nesting activities are affected. This additional time-area closure would preclude surveys in the coastal and nearshore waters that encompass the NMSs (e.g., Gray's Reef NMS and Monitor NMS) and the coastal MPAs for half of the year, which would reduce the impacts of active acoustic noise from seismic airgun surveys on MPAs and the resources present in particular marine mammals, sea turtles, and fishes and EFH. However, the impacts to MPAs from active acoustic sound sources would still be expected to be **negligible**, **minor**, or **moderate**, depending on the resource.

The additional time-area closure for right whales under Alternative B would not change the extent, severity, or timing of seafloor disturbance impacts. Impacts would still be expected to be avoided or limited in most MPAs, resulting in **negligible** to **minor** impacts to benthic communities, fisheries resources and EFH, sea turtles, marine mammals, and submerged archaeological or cultural resources.

No impacts to sea turtles and marine mammals are expected from seafloor-disturbing activities in deepwater MPAs or other Federal fishery management areas.

Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization might include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. The case-by-case review could result in altered timing of G&G surveys, but would not be expected to change the extent or severity of impacts to MPAs and the associated resources, which are evaluated in **Chapter 4.2.11.2** as **negligible** for most NMS resources, including benthic communities, marine and coastal birds, and recreational resources, while **minor** impacts are projected for marine mammals and fisheries resources and EFH, and **negligible**, **minor**, or **moderate** impacts are expected for sea turtles, depending upon location and season.

Under the additional time-area closure, impacts from trash and debris and drilling discharges would remain unchanged from Alternative A.

4.3.11.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.11.2**, applicable routine IPFs for MPAs are active acoustic sound sources, trash and debris, seafloor disturbance, and drilling discharges.

The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in the additional closure areas, which is only 312,785 ac (126,579 ha), or only 0.6 percent of the total AOI. While this represents a small percentage of the AOI, the time-area closure does focus on key sea turtle nesting locations along the northeast Florida coast. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. As discussed in **Chapter 4.2.11.2**, impacts from active acoustic sound sources for Alternative A would be expected to be **negligible, minor**, or **moderate**, depending on the resource. However, this mitigation measure would significantly reduce potential impact levels from seismic airguns within the important north Florida sea turtle nesting area, resulting in a decrease in the impacts to MPAs to **negligible** to **minor**. A change in survey timing in the closure area would reduce the impacts of active acoustic noise from seismic airgun surveys on MPAs and the associated resources (especially nesting sea turtles and hatchlings) within the Merritt Island NWR, Archie Carr NWR, and the Canaveral National Seashore.

Under the time-area closure for sea turtle nesting, other non-airgun surveys (e.g., electromechanical sources) in the closure area would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles. The case-by-case review could result in altered timing of G&G surveys in this area but would not be expected to change the extent or severity of impacts from electromechanical sound to MPAs or the associated resources, which are evaluated in **Chapter 4.2.11.2** as **negligible**to **minor**, depending on the resource.

The additional time-area closure for sea turtles under Alternative B would not change the extent, severity, or timing of seafloor disturbance impacts in MPAs, therefore impacts would remain the same as those analyzed in **Chapter 4.2.11.2**.

Under the additional time-area closure, impacts from trash and debris and drilling discharges would remain unchanged from Alternative A.

4.3.11.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.11.2**, applicable routine IPFs for MPAs are active acoustic sound sources, trash and debris, seafloor disturbance, and drilling discharges.

Limits on concurrent seismic airgun surveys under Alternative B could change the timing of these surveys in certain areas. The locations cannot be predicted in advance and would depend on the schedule, planned coverage of individual surveys, and ports to be used for support activities. As discussed in **Chapter 4.2.11.2**, impacts of active acoustic sound sources on MPAs are expected to range from **negligible** to **moderate**, depending on the resource. A change in survey timing because of limits on concurrent seismic airgun surveys would not alter the impacts from either active acoustic sound on MPAs or the associated resources present.

The limits on concurrent seismic airgun surveys under Alternative B would not change the extent, severity, or timing of seafloor disturbance impacts in MPAs, and therefore impacts would remain the same as those analyzed in **Chapter 4.2.11.2**.

4.3.11.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not be expected to change any impacts to MPAs or the resources present analyzed in **Chapter 4.2.11.2**.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) active acoustic sound sources – impacts would be reduced because of the sea turtle time-area closure, resulting in the overall impacts ranging from **negligible** to **minor**; (2) trash and debris – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **negligible**; (3) seafloor disturbance – impacts would remain unchanged and would be **negligible**; and (4) drilling discharges – impacts would remain unchanged and would be **negligible**.

4.3.11.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on MPAs and the associated resources present would be very similar to those analyzed for Alternative A (**Chapter 4.2.11.3**). The analysis concluded that a small spill at the sea surface would be unlikely to affect benthic communities, sea turtles, and marine mammals in MPAs; however, impacts to marine and coastal birds, recreational resources, and archaeological resources could range from **negligible** to **minor**, depending on the location of the spill.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Also, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on MPAs and the resources present would be the same as under Alternative A and would range from **negligible** to **moderate**, depending on the location of the spill and the resources affected.

4.3.11.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.11.1** and **4.3.11.2** determined that activities projected to occur under Alternative B would result in impacts ranging from **negligible** to **moderate** for MPAs and the associated resources present, depending on the activity, as a result of active acoustic sound sources, seafloor disturbance, and accidental fuel spills. The cumulative activities scenario for MPAs, as outlined in **Chapter 4.2.11.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs that would contribute to the cumulative activities scenario under Alternative B include active acoustic sound sources, seafloor disturbance, trash and debris, and accidental fuel spills. The cumulative impact analysis identified negligible to minor incremental increases in impacts from all IPFs under Alternative A.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys in certain areas. Overall, however, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A. Therefore, impacts would be unchanged under the cumulative scenario for Alternative B for all IPFs.

Limits on concurrent seismic airgun surveys would change the timing of these surveys in certain areas but would not alter the impacts of active acoustic noise from seismic airgun surveys on MPAs and the resources present. Therefore, the impacts to MPAs and the associated resources would remain unchanged under the Alternative B cumulative scenario. Cumulative impacts under Alternative B would be unchanged by limits on concurrent seismic airgun surveys for all IPFs.

The use of PAM in Alternative B would not change any MPA cumulative impacts determined under Alternative A.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Spills from other survey vessels could also occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential cumulative impacts to MPAs and the associated resources would be the same under Alternative B as determined under Alternative A and would result in a negligible incremental increase in risk of a collision-based fuel spill. Therefore, the cumulative impacts from a small spill at the sea surface would be unlikely to affect benthic communities, sea turtles, and marine mammals in MPAs; however, impacts to marine and coastal birds, recreational resources, and archaeological resources could range from negligible to minor, depending on the location of the spill.

4.3.12. Other Marine Uses

Descriptions of the other marine uses occurring within the AOI were provided in **Chapter 4.2.12.1**. As outlined in **Chapter 4.2.12.2**, IPFs for other marine uses include (1) vessel traffic; (2) aircraft traffic and noise; (3) vessel exclusion zones; and (4) seafloor disturbance. Impacts to other marine uses under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.12.2**). As with Alternative A, Alternative B would still include military coordination mitigation measures as a condition of permit approval (i.e., similar to NTL 2009-G06, the military coordination lease stipulation in effect in the Gulf of Mexico) (**Chapter 2.1.2.8**). Mitigation of this type would require the G&G operator to contact designated DOD or NASA personnel identified for the purpose to be notified of the nature and schedule for any pending G&G activity planned within military range complexes or NASA's use areas. The following discussion outlines the effects of the additional mitigation measures included in Alternative B on other marine uses.

4.3.12.1. Impacts of Routine Activities

4.3.12.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI.

As discussed in **Chapter 4.2.12.2**, applicable routine IPFs for other marine uses are vessel traffic and exclusion zones, aircraft traffic and noise, and seafloor disturbance. The additional time-area closure for right whales under Alternative B would not change the extent, severity, or timing of aircraft traffic and noise and seafloor disturbance impacts, therefore impacts would be unchanged under Alternative B.

The additional time-area closure for right whales under Alternative B would change the timing of vessel traffic and exclusion zones in certain areas. Seismic airgun surveys and therefore the vessel traffic and exclusion zones associated with the surveys would not be authorized in the additional 37-km (20-nmi) closure areas offshore Delaware, Maryland, Virginia, and North Carolina between November 1 and April 30, or in the additional 37-km (20-nmi) closure area offshore Florida between November 15 and April 15. As discussed in **Chapter 4.2.12.2**, impacts of vessel traffic and exclusion zones on other marine uses are expected to be **negligible** in all cases other than the potential for **minor** impacts from vessel traffic on small ports. The additional time-area closure for right whales under Alternative B described above would change the timing of seismic airgun surveys in certain areas and reduce the vessel traffic and exclusion zones related to these surveys in the coastal areas during certain times of the year when compared to Alternative A. A change in survey timing in the additional closure areas would potentially reduce the impacts of vessel traffic and exclusion zones from seismic airgun surveys on other marine uses since these surveys would not occur within the coastal waters for half of the year; therefore, the impacts to other marine uses would be expected to be **negligible**.

Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization may include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales. The case-by-case review could result in altered timing of G&G surveys but would not be expected to change the extent or severity of impacts to other marine uses, which are evaluated in **Chapter 4.2.12.2** as **negligible**.

4.3.12.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31), resulting in a change of the timing of seismic airgun surveys in certain areas. No airgun surveys would be authorized within the closure area during that time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.12.2**, applicable routine IPFs for other marine uses are vessel traffic and exclusion zones, aircraft traffic and noise, and seafloor disturbance. The additional time-area closure for sea turtles under Alternative B would not change the extent, severity, or timing of aircraft traffic and noise and seafloor disturbance impacts, therefore impacts would be unchanged under Alternative B.

Impacts of vessel traffic and exclusion zones on other marine uses are expected to be **negligible** in all cases other than the potential for **minor** impacts from vessel traffic to small ports. The additional time-area closure for sea turtle nesting under Alternative B described above would change the timing of seismic airgun surveys in certain areas and reduce the vessel traffic and exclusion zones related to these surveys in the coastal areas during certain times of the year when compared to Alternative A. A change in survey timing in the additional closure areas would potentially reduce the impacts of vessel traffic and exclusion zones from seismic airgun surveys on other marine uses since these surveys would not occur within the coastal waters for half of the year; therefore, impacts to other marine uses would be expected to be **negligible**.

Under the time-area closure for sea turtle nesting, other non-airgun surveys in the closure area would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles. The case-by-case review could result in altered timing of G&G surveys, including those involving seafloor disturbance, but it would not be expected to change the extent or severity of vessel traffic or exclusion zones, both of which are evaluated in **Chapter 4.2.12.2** as **negligible**.

The sea turtle time-area closure would overlap with the right whale time-area closure (November 15 through April 15 for right whales and May 1 through October 31 for sea turtles) and would change the timing of seismic airgun surveys in this closure area. This would result in a further reduction of vessel traffic and exclusion zones related to seismic airgun surveys in the coastal areas during certain times of the year when compared to Alternative A since these surveys would not occur within the coastal waters for half of the year in this small area. Overall, the impacts to other marine uses from vessel traffic and exclusion zones under Alternative B would be **negligible**.

4.3.12.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.12.2**, applicable routine IPFs for other marine uses are vessel traffic and exclusion zones, aircraft traffic and noise, and seafloor disturbance. Limits on concurrent seismic airgun surveys would not change the extent, severity, or timing of aircraft traffic and noise and seafloor disturbance.

Limits on concurrent seismic airgun surveys under Alternative B could change the timing of these surveys in certain areas. The locations cannot be predicted in advance but would depend on the schedule and planned coverage of individual surveys. As discussed in **Chapter 4.2.12.2**, impacts of vessel traffic and exclusion zones on other marine uses are expected to be **negligible** in all cases other than the potential for **minor** impacts from vessel traffic to small ports. A change in survey timing due to limits on concurrent seismic airgun surveys would potentially reduce the amount of vessel traffic and exclusion zones within a specific area. Additionally, the separation distance of 40 km (25 mi) may be large enough to reduce impacts from vessel traffic and exclusions zones by resulting in a further separation of G&G activities (i.e., the use of different ports).

4.3.12.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any impacts to other marine uses analyzed in **Chapter 4.2.12.2**.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include (1) vessel traffic – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would range from **negligible** to **minor**; (2) vessel exclusion zones – while impacts would be reduced due to time-area closures, overall impacts would remain unchanged from Alternative A and would be **negligible**; (3) aircraft traffic and nosie – impacts would remain unchanged and would be **negligible**; and (4) seafloor disturbance – impacts would remain unchanged and would be **negligible**.

4.3.12.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of accidental collisions or fuel spills on other marine uses would be very similar to those analyzed for Alternative A in **Chapter 4.2.13.3**. The analysis concluded that mitigation measures including planning and implementing vessel exclusion zones, vessel-to-vessel communication, and issuance of warnings to mariners would limit the likelihood of a vessel-to-vessel collision or another vessel becoming entangled in towed G&G equipment and that a small spill at the sea surface would be unlikely to have any effect on other marine uses.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Also, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of an accidental fuel spill and the potential impacts on other marine uses would be the same as under Alternative A and would be **negligible**.

4.3.12.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.3.12.1** and **4.3.12.2** determined that activities projected to occur under Alternative B would result in **negligible** impacts to other marine uses. The cumulative activities scenario for other marine uses, as outlined in **Chapter 4.2.12.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs that would contribute to the cumulative activities scenario under Alternative B include vessel traffic and vessel exclusion zones, aircraft traffic and noise, seafloor disturbance, and accidental fuel spills. The cumulative impact analysis identified negligible to minor incremental increases in impacts from all IPFs under Alternative A.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys in certain areas. Overall, however, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A. Under the cumulative scenario, vessel traffic and vessel exclusion zones would see a negligible incremental increase. This additional time-area closure would not change the extent, severity, or timing of seafloor disturbance impacts or the associated vessel traffic; therefore, the impacts to other marine uses from seafloor disturbance and vessel traffic would remain unchanged under the cumulative scenario for Alternative B. Impacts would be unchanged (negligible incremental increase) under the cumulative scenario for Alternative B for all IPFs except accidental fuel spills.

Limits on concurrent seismic airgun surveys would change the timing of these surveys in certain areas, and would likely reduce the impacts of vessel traffic and vessel exclusion zones related to seismic airgun surveys on other marine uses. In addition, these concurrent survey limits would not change the extent, severity, or timing of seafloor disturbance impacts, nor would they change associated vessel traffic; therefore, the impacts to other marine uses would result in a negligible impact under the Alternative B cumulative scenario. Cumulative impacts under Alternative B would be unchanged (**negligible**) by limits on concurrent seismic airgun surveys for all IPFs except accidental fuel spills.

The use of PAM in Alternative B would not change any other marine uses cumulative impacts as determined under Alternative A.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Spills from other survey vessels could also occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential cumulative impacts to other marine uses would be the same under Alternative B as determined under Alternative A and would result in a negligible incremental increase in risk and associated impacts of a collision-based fuel spill.

4.3.13. Human Resources and Land Use

Descriptions of the human resources and land use present adjacent to the AOI were provided in **Chapter 4.2.13.1**. As outlined in **Chapter 4.2.13.2**, IPFs for human resources and land use include potential effects of onshore support activities (**Table 4-2**). Impacts to human resources and land use under Alternative B would be very similar to those previously described for Alternative A (**Chapter 4.2.13.2**). The following discussion outlines the effects of the additional mitigation measures included in Alternative B on human resources and land use.

4.3.13.1. Impacts of Routine Activities

4.3.13.1.1. Expanded Time-Area Closure for North Atlantic Right Whales

Under Alternative B, the time-area closure for North Atlantic right whales would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of the AOI. The expanded closure zone would fill gaps in coverage between Delaware Bay and Wilmington, North Carolina, where the Mid-Atlantic SMA is discontinuous. It would also cover areas offshore Florida adjacent to the right whale critical habitat between the Southeast SMA and the southern boundary of the AOI. Under the additional time-area closure, non-airgun G&G surveys for renewable energy and marine minerals in right whale critical habitat area, in the SMAs, and the expanded 37-km (20-nmi) closure area would be reviewed on a case-by-case basis. Authorization might include additional mitigation and monitoring requirements to avoid or reduce impacts on right whales.

As discussed in **Chapter 4.2.13.2**, the only applicable routine IPF for human resources and land use is onshore support activities. The additional time-area closure for right whales under Alternative B and the case-by-case review would not change the projected demands for shore base space, supplies, and services related to G&G activities, and therefore impacts would be unchanged under Alternative B. The use of existing ports and their associated shore bases is expected to have no or negligible land use conflicts with current land uses and land use plans. Overall, the impacts to human resources and land use from onshore support activities from Alternative B would be **negligible**.

The additional time-area closure for right whales under Alternative B described above would change the timing of seismic airgun surveys in the coastal areas during certain times of the year when compared to Alternative A. A change in survey timing in the additional closure areas would not change the projected demands for shore base space, supplies, and services related to G&G activities, therefore the impacts to other human resources and land use would be expected to be **negligible**.

4.3.13.1.2. Time-Area Closure for Nesting Sea Turtles

Alternative B would include a time-area closure in near-coastal waters offshore Brevard County, Florida, during the sea turtle nesting season (May 1 through October 31). No airgun surveys would be authorized within the closure area during this time. Other non-airgun surveys in the closure area, including HRG surveys of renewable energy and marine minerals sites, would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles.

As discussed in **Chapter 4.2.13.2**, applicable routine IPFs for human resources and land use are potential effects of onshore support activities. The additional time-area closure for sea turtle nesting under Alternative B would not change the projected demands for shore base space, supplies, and services related to G&G activities.

The time-area closure for sea turtle nesting under Alternative B would change the timing of seismic airgun surveys in certain areas. Seismic airgun surveys would not be authorized in the closure area offshore Brevard County, Florida, from May 1 through October 31. As discussed in **Chapter 4.2.13.2**, impacts of onshore support activities on human resources and land use are expected to be **negligible**. A change in survey timing in the closure area would not alter the impacts of seismic airgun surveys on human resources and land use.

Under the time-area closure for sea turtle nesting, other non-airgun surveys in the closure area would be reviewed on a case-by-case basis, and authorizations might include additional mitigation and monitoring requirements to avoid or reduce impacts on sea turtles. The case-by-case review could result in altered timing of G&G surveys including those involving onshore support activities but would not be expected to change the projected demands for shore base space, supplies, and services, which are evaluated in **Chapter 4.2.13.2** as **negligible**.

4.3.13.1.3. Limits on Concurrent Seismic Airgun Surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating deep penetration seismic airgun surveys to limit ensonification of large areas of the AOI at the same time.

As discussed in **Chapter 4.2.13.2**, the only applicable routine IPF for human resources and land use is onshore support activities. Limits on concurrent seismic airgun surveys would not change the projected demands for shore base space, supplies, and services related to G&G activities. The use of existing ports and their associated shore bases is expected to have no or negligible land use conflicts with current land uses and land use plans, and therefore impacts would be unchanged by limits on concurrent seismic airgun surveys.

Limits on concurrent seismic airgun surveys under Alternative B could change the timing of these surveys in certain areas. The locations cannot be predicted in advance but would depend on the schedule and planned coverage of individual surveys. As discussed in **Chapter 4.2.13.2**, impacts of onshore support activities on human resources and land use are expected to be **negligible**. A change in survey timing because of limits on concurrent seismic airgun surveys would not alter the impacts on human resources and land use.

4.3.13.1.4. Required Use of Passive Acoustic Monitoring

Alternative B includes the required use of PAM in the seismic survey protocol to improve detection of vocalizing marine mammals. The use of PAM would not change any human resource and land uses analyzed in **Chapter 4.2.13.2**.

Summary

Alternative B includes four components that differentiate this alternative from Alternative A: (1) an additional time-area closure for North Atlantic right whales; (2) an additional time-area closure for sea turtles; (3) establishment of a 40-km (25-mi) separation distance between simultaneously operating deep-penetration seismic airgun surveys; and (4) required use of PAM as part of the seismic survey protocol. Impact determinations by IPF under Alternative B include onshore support activity – impacts would remain unchanged and would be **negligible**.

4.3.13.2. Impacts of Accidental Fuel Spills

Under Alternative B, impacts of an accidental fuel spill on human resources and land use would be very similar to those analyzed for Alternative A (**Chapter 4.2.13.3**). The analysis concluded that a small spill would be likely to have minimal to no impact to either the local economies or populations of ports and surrounding communities.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Also, spills from other survey vessels could occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on human resources and land use would be the same as under Alternative A and would be **negligible**.

4.3.13.3. Cumulative Impacts

Impact analyses presented in **Chapter 4.3.13.1** and **4.3.12.2** determined that activities projected to occur under Alternative B would result in impacts to human resources and land use ranging from **negligible** to **minor**, depending on the activity, as a result of potential effects of onshore support activities and accidental fuel spills. These IPFs would also contribute to the cumulative activities scenario under Alternative B. The cumulative activities scenario for human resources and land use, as outlined in **Chapter 4.2.13.4**, includes (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified no or negligible cumulative impacts associated from all IPFs under Alternative A.

The additional time-area closures for North Atlantic right whales and sea turtles included in Alternative B, as discussed above, would change the timing of seismic airgun surveys in certain areas. Overall, however, these time-area closures would not appreciably change the cumulative impacts noted under Alternative A. Additional time-area closures would not change the projected demands for shore base space, supplies, and services under Alternative B and therefore would not affect the cumulative impacts identified under Alternative A, so impacts would be unchanged (**negligible**) under the cumulative scenario for Alternative B.

Limits on concurrent seismic airgun surveys would not change the projected demands for shore base space, supplies, and services related to G&G activities. The use of existing ports and their associated shore bases is expected to have no or negligible land use conflicts with current land uses and land use plans, and therefore cumulative impacts under Alternative B would be unchanged (**negligible**) by limits on concurrent seismic airgun surveys.

The use of PAM in Alternative B would not change any human resource and land use cumulative impacts determined under Alternative A.

A significant amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. The impact of accidental fuel spills arising from a vessel collision under the cumulative scenario is expected to be **negligible**.

Alternative B would change the timing of certain surveys because of additional time-area closures and limits on concurrent seismic airgun surveys, which would result in a reduction of vessel traffic and onshore support activities related to these surveys in the coastal areas during certain times of the year when compared to Alternative A. However, spills from seismic survey vessels could occur in the closure areas during times outside the closure period. Spills from other survey vessels could also occur during the closure period if surveys were authorized on a case-by-case basis. A change in survey timing because of limits on concurrent seismic airgun surveys would not substantially change the risk of a small fuel spill. The impacts to local economies or populations of the ports and surrounding communities from spill response and cleanup activities would be the same under Alternative B as determined under Alternative A.

4.4. ALTERNATIVE C – NO ACTION FOR OIL AND GAS G&G ACTIVITY, STATUS QUO FOR RENEWABLE ENERGY AND MARINE MINERAL G&G ACTIVITY

Under Alternative C, no G&G activities associated with oil and gas exploration (except for remote sensing from satellites) would occur in the Mid- and South Atlantic Planning Areas. Oil and gas survey activity represents a significant proportion of the total line km of G&G activity under Alternative A, including 617,775 line km of 2D streamer surveys, approximately 120,000 line km of 3D streamer surveys, and 900 line km of 3D WAZ surveys; in total, oil and gas G&G surveys represent about 3,750 days of vessel activity over the 2012-2020 period. By comparison, the renewable energy program is expected to conduct 4,255 days of HRG survey vessel activity and as many as 9,969 vessel trips for coring operations between 2012 and 2020. Under the marine minerals program, HRG surveys would require 180 operational survey days while bottom sampling operations may utilize as many as 615 days during this period (**Chapter 3.5.1.3**).

Permitting and postlease G&G activities for renewable energy development and marine minerals use would continue to occur on a case-by-case basis under Alternative C. At a programmatic level, while there are no mitigation measures that apply to G&G activities conducted in support of renewable energy development, best management practices were documented in the Programmatic EIS for the renewable energy program, as outlined in **Chapter 2.3.2**. In addition, through the NEPA process (e.g., EIS or EA), BOEM may identify mitigation measures to avoid/minimize environmental impacts during G&G surveys. Mitigation measures may be implemented as a condition for OCS plan approval. Additional mitigation measures may be required as a result of consultations under the ESA or MMPA.

Similarly, at a programmatic level, there are no mitigation measures that apply to G&G activities under the marine minerals program. Under Section 11 of the OCSLA, BOEM may authorize G&G prospecting for non-energy marine minerals, except in the case that another Federal agency is performing the survey on the OCS. Before authorizing any proposed prospecting, BOEM undertakes the necessary environmental review, including preparation of a NEPA document and consultations for protected species. Through the NEPA process, BOEM may identify mitigation measures to avoid/minimize environmental impacts during G&G surveys. Mitigation measures may be implemented as a condition for survey authorization.

Additionally, the incremental contribution of the G&G surveys conducted under the oil and gas program (included under Alternative A) to cumulative effects would also be eliminated under Alternative C, while effects from other activities in the AOI would remain. Limited impacts would occur because of case-by-case permitting of postlease G&G activities for renewable energy development and marine minerals use.

Two general types of G&G site characterization surveys are expected to be conducted in support of renewable energy development: HRG surveys and geotechnical surveys (**Chapter 3.3.2**). The HRG surveys are conducted to obtain information about subseafloor conditions, shallow hazards, archaeological resources, and sensitive benthic habitats. Equipment typically used in HRG surveys for renewable energy includes single beam and/or multibeam depth sounders, magnetometers, side-scan sonars, and shallow or medium penetration subbottom profilers (electromechanical sources). The BOEM does not anticipate that airguns would be used for renewable energy site assessment activities. Geotechnical surveys, which involve seafloor-disturbing activities such as CPTs, geologic coring, and grab sampling, are conducted to obtain information about surface and subsurface geological and geotechnical properties. Another activity conducted as part of site characterization is the deployment of bottom-founded monitoring buoys in a lease area. These meteorological buoys would be anchored at fixed locations and regularly collect observations from many different atmospheric and oceanographic sensors. The buoys can vary in height, hull type, and anchoring method (**Chapter 3.3.2.3**).

The following discussion outlines the effects on the impact analysis of activities associated with renewable energy development and marine minerals use that would take place under Alternative C.

4.4.1. Benthic Communities

Under Alternative C, only activities for renewable energy development and marine minerals use would occur. Applicable routine IPFs for benthic communities from renewable energy development and marine minerals activities are active acoustic sound sources (such as underwater noise from subbottom profilers, side-scan sonar, and multibeam depth sounders), trash and debris, and seafloor disturbance. Drilling discharges are only associated with COST and shallow test well drilling operations exclusive to the oil and gas program and would not occur under Alternative C.

4.4.1.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would lessen the extent, severity, and timing of active acoustic sound sources, trash and debris, and seafloor disturbance impacts and remove impacts from drilling discharges.

Active Acoustic Sound Sources

The BOEM does not anticipate that airguns would be necessary for renewable energy site assessment activities. Under Alternative C, other non-airgun G&G surveys (HRG surveys and geotechnical surveys) as part of renewable energy and marine minerals actvities would still occur.

As presented in **Chapter 4.2.1**, the impacts to benthic communities from active acoustic sound sources are not well documented, and there are no known systematic studies of the effects of sonar sound on invertebrates. Most marine invertebrates do not have sensory organs that can perceive sound pressure, but many have tactile hairs or sensory organs that are sensitive to disturbances such as those caused by hydroacoustic equipment. The active acoustic sound sources associated with Alternative C are not anticipated to be detected by benthic communities or invertebrates; therefore, these sources would not be expected to result in impacts to benthic communities, and there would be **no impacts** to benthic communities from active acoustic sound sources under Alternative C.

Trash and Debris

All survey vessels performing work within U.S. jurisdictional waters would be expected to comply with Federal regulations, which include the requirements of MARPOL 73/78. In addition, all authorizations for shipboard surveys would be considered on a case-by-case basis. It remains to be determined if BSEE guidance for marine debris awareness would be developed under Alternative C. In spite of this unknown, required compliance with Federal regulations is expected to result in only minimal amounts of trash and debris being accidentally lost overboard. Portions of the trash and debris accidently lost could sink to the seafloor and potentially entangle or smother sessile organisms. However, because of the small anticipated amount of accidental loss of trash and debris and the very small potential for this debris to sink to the seafloor onto sensitive benthic communities, the impacts on benthic communities from trash and debris as generated by survey vessels and sampling activities would be reduced under Alternative C; impacts would remain **negligible**.

Seafloor Disturbance

Geotechnical surveys as part of renewable energy projects and sampling activities for marine minerals involve seafloor-disturbing activities such as CPTs, geologic coring, and grab sampling. Additionally, the placement and removal of equipment on the seafloor (e.g., monitoring buoys) may also cause seafloor disturbance and have impacts on both soft and hard/live bottom communities.

As discussed in **Chapter 4.2.1.2**, the impacts from seafloor-disturbing activities would range from **negligible** to **minor**. Most of the proposed activities under Alternative A that include bottom sampling are associated with the renewable energy and marine minerals program areas. The elimination of oil and gas exploration activities would only slightly reduce the overall number of bottom samples taken (50-300 samples) (**Table 3-4**) but would also eliminate the potential for COST well and shallow test well installation, the latter of which was the only activity that would produce **minor** impacts to benthic communities under Alternative A. All other seafloor-disturbing activities could still occur under Alternative C.

The BOEM would implement requirements, including setbacks from sensitive benthic resources, to ensure protection of sensitive benthic resources, including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities, prior to permitted activities. Given that BOEM would require prior approval of any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures (including requiring site-specific information), sensitive benthic resources would be avoided. Therefore, potential impacts to sensitive benthic communities from seafloor sampling under Alternative C would still be **negligible**.

Bottom sampling activities would primarily take place in soft bottom areas as most bottom sampling equipment cannot penetrate hard bottom substrate. Although several thousand cores may be collected under the renewable energy and marine minerals programs, sampling in soft bottom areas would produce only localized impacts to soft bottom benthos. Therefore, potential impacts to soft bottom benthic communities from seafloor sampling under Alternative C would not be detectable and would remain **negligible**.

Elimination of COST wells and shallow test wells under Alternative C would eliminate the **minor** impact identified under Alternative A for this source.

4.4.1.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on benthic communities would be very similar to those analyzed for Alternative A (**Chapter 4.2.1.3**). The analysis concluded that a small spill at the sea surface would be unlikely to have any effect on benthic communities.

Alternative C would reduce the number of surveys and vessels because of the elimination of G&G activities in support of oil and gas exploration, but this reduction would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on benthic communities would be the same as under Alternative A and would be **negligible**.

4.4.1.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.1.1** and **4.4.1.2** determined that activities projected to occur under Alternative C would result in either no impacts or negligible impacts to benthic communities, depending on the activity, as a result of active acoustic sound sources, seafloor disturbance, trash and debris, drilling discharges, and accidental events. These IPFs would also contribute to the cumulative activities scenario under Alternative C. The cumulative activities scenario for benthic communities, as outlined in **Chapter 4.2.1.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified only negligible to minor incremental increases in impacts from all IPFs under Alternative A (**Chapter 4.2.1.4**). Under Alternative C, there would be no G&G activities associated with oil and gas exploration; therefore, there would still be only a negligible incremental increase in impacts from all IPFs.

4.4.2. Marine Mammals

Under Alternative C, only activities for renewable energy development and marine minerals would occur. Applicable routine IPFs for marine mammals from renewable energy development and marine minerals activities are active acoustic sound sources (such as underwater noise from subbottom profilers, side-scan sonar, and multibeam depth sounders), vessel and equipment noise, vessel traffic, and trash and debris. Alternative C would not include any aeromagnetic surveys; therefore, there would be no impacts from aircraft traffic or noise.

4.4.2.1. Impacts of Routine Activities

As discussed in **Chapter 4.1.1**, the IPFs from routine events that may impact marine mammals within the AOI include active acoustic sound sources (i.e., electromechanical sources including subbottom profilers, multibeam depth sounders, and side-scan sonars); vessel and equipment noise (from survey and support vessels); vessel traffic (i.e., physical disturbance to and risk of collisions with marine mammals); and trash and debris (i.e., potential for entanglement and ingestion) (**Table 4-2**).

Active Acoustic Sound Sources

Under Alternative C, no seismic surveys using airguns associated with oil and gas exploration would take place; therefore, the impacts presented in **Chapter 4.2.2.2** for seismic airgun survey noise would not occur. Only the impacts associated with HRG surveys (e.g., electromechanical sources) for renewable energy and marine minerals sites would occur. The impacts presented in **Chapter 4.2.2.2** for HRG surveys would be the same for Alternative C (i.e., **minor**) as those presented for Alternative A.

Vessel and Equipment Noise

As described in **Chapter 4.2.2.2**, G&G activities in all three program areas would generate vessel traffic and associated noise. The dominant source of noise from vessels is from propeller operation, and the intensity of this noise is largely related to ship size and speed. Equipment noise would also be generated from G&G vessels. Under Alternative A, based on the proposed volume of vessel traffic within the AOI and the presumption that marine mammals within the AOI are familiar with various and common vessel-related noises, the effects of project-related vessel and equipment noise on marine mammals within the AOI was expected to be **negligible** to **minor**. Under Alternative C, no seismic airgun surveys for oil and gas exploration would occur, which would significantly decrease vessel traffic and the associated noise. Even with this decrease in vessel traffic and associated noise, the impact to marine mammals would still be **negligible** to **minor** under Alternative C.

Vessel Traffic

As described in **Chapter 4.2.2.2**, G&G activities in all three program areas would generate vessel traffic that could make marine mammals vulnerable to physical disturbance from or collisions (ship strike) with moving vessels. Most reports of collisions involve large whales, but collisions with smaller species also occur (van Waerebeek et al., 2007). Under Alternative A, the analysis indicated that a collision between a project-related survey vessel and any marine mammal within the AOI is unlikely; vessel traffic impacts would be **negligible**. Under Alternative C, vessel operators would still be expected to comply with NOAA's ship strike reduction requirements. In addition, under this alternative, no seismic airgun surveys for oil and gas exploration would occur, which would decrease vessel traffic. Even with the reduced vessel traffic under Alternative, C, the impacts to marine mammals from vessel traffic are anticipated to remain the same as those under Alternative A.

Trash and Debris

All survey vessels performing work within U.S. jurisdictional waters are expected to comply with Federal regulations, which include MARPOL 73/78. It remains to be determined if BSEE guidance for marine debris awareness would be developed under Alternative C. With required compliance of vessel operators with Federal regulations, including the requirements of MARPOL, the amount of trash and debris dumped offshore would be minimal as only accidental loss of trash and debris is anticipated. Taking into account existing laws and regulations regarding trash and debris disposal, it is unlikely that significant amounts of trash and debris from G&G activities would be released into the marine environment under Alternative C. Debris entanglement and ingestion impacts on marine mammals would be unchanged under Alternative C (**negligible**).

4.4.2.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on marine mammals would be very similar to those analyzed for Alternative A (**Chapter 4.2.2.3**). The analysis concluded that an accidental diesel fuel spill adjacent to or within the North Atlantic right whale critical habitat during the winter calving period may result in direct contact of the spilled fuel with both adult and new born whales. It is presumed but not substantiated that the animals would avoid areas with heavy fuel sheen, and the fuel would disperse and weather rapidly. Impacts from an accidental fuel spill are not likely to seriously injure individual whales and thus were expected to be **minor**. Fuel spills in other areas of the AOI are not expected to result in significant impacts to marine mammals. Impacts were expected to be to be **negligible**.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on marine mammals would be the same as those under Alternative A and would be **minor** if the spill occurred adjacent to or in the North Atlantic right whale critical habitat during the winter calving period and **negligible** if the spill occurred in other areas of the AOI.

4.4.2.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.2.1** and **4.4.2.2** determined that activities projected to occur under Alternative C would result in **negligible** impacts to marine mammals as a result of active acoustic sound sources (electromechanical sources), vessel traffic, and trash and debris. **Negligible** to **minor** impacts were expected for vessel equipment and noise and accidental events. No impacts were identified for active acoustic sound sources (i.e., airguns and aircraft traffic and noise). The cumulative activities scenario for marine mammals, as outlined in **Chapter 4.2.2.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs for these cumulative activities that may affect marine mammals include (1) increased anthropogenic noise in the ocean, including underwater noise from sonars, explosives, dredges, vessel traffic, and other active sound sources; (2) discharges of drilling fluid, produced water, and other effluents from drilling rigs; (3) the physical presence of offshore structures; (4) accidental releases of trash and debris; (5) vessel collisions; (6) depletion of prey species from fishing pressure; (7) interactive effects of climate change, including impacts on preferred habitats and food sources; and (8) a risk of a crude oil spill from a well blowout or accidental releases of fuel or other hazardous materials from accidents (smaller accidental events or low-probability large scale catastrophic events).

Among the IPFs identified above for the cumulative impacts scenario, several sources of potential impacts to marine mammals have been identified in association with Alternative C G&G activities, including (1) underwater noise; (2) vessel and equipment noise; (3) vessel traffic and collisions; (4) aircraft traffic and noise; (5) trash and debris; and (6) accidental events.

The cumulative impact analysis identified only negligible to minor incremental increases in impacts from underwater noise under Alternative A (**Chapter 4.2.2.4**). Under Alternative C there would be no activities associated with oil and gas exploration, which precludes seismic airgun surveys, a significant source of underwater noise, and significantly reduces the Level A and B take estimates. Therefore, underwater noise would be reduced under Alternative C and result in a negligible incremental increase under the cumulative scenario.

Under Alternative A (**Chapter 4.2.2.4**), it was expected that impacts would result in a negligible incremental increase in vessel collisions with marine mammals under the cumulative scenario because of the low number of G&G survey vessels in operation at a given time (relative to overall vessel traffic) and the low probability for a collision between a G&G vessel and a marine mammal (because of the relative slow operating speeds of G&G survey vessels, existing vessel strike avoidance regulations, and the requirements for mitigation monitoring prior to and during all seismic survey activities). Under Alternative C, there would be no seismic airgun surveys performed for oil and gas exploration, which would reduce the overall number of survey vessels; however, a negligible incremental increase in vessel collisions with marine mammals is still anticipated to result under the cumulative scenario.

Vessel operators are expected to comply with Federal regulations, including the requirements of MARPOL 73/78 and Annex V. Therefore, the amount of trash and debris intentionally dumped offshore would be very limited, and only accidental loss of trash and debris is expected. Impacts from cumulative activities within the AOI under Alternative C are expected to be negligible. The G&G activities under Alternative C would produce a negligible incremental impact to trash and debris impacts under the cumulative scenario.

A significant amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The likelihood of a diesel fuel spill during G&G activities is expected to be remote, and the associated impacts to marine mammals are expected to be **negligible** or **minor**, influenced by a series of factors, including whether spilled diesel fuel directly contacts individual animals, the quantity of fuel encountered, the degree of weathering to which the fuel has been exposed, and duration of contact. It is reasonable to assume that the potential for fuel spills from vessels involved in the cumulative activities scenario would be considerably higher than that expected from vessels associated with activities under Alternative C because of the relative magnitude of overall vessel activity in the AOI when compared to G&G activities. Therefore, the incremental increase in potential for accidental fuel spills arising from vessel collision during G&G activities would be considered to be extremely small. Based on the low probability of a G&G activity-related fuel spill during the period of interest, the incremental increase in diesel spill-related impacts to marine mammals under the cumulative scenario is expected to be negligible.

4.4.3. Sea Turtles

Under Alternative C, only activities for renewable energy development and marine minerals use would occur. Applicable routine IPFs for sea turtles from renewable energy development and marine minerals activities are active acoustic sound sources (such as underwater noise from subbottom profilers, side-scan sonar, and multibeam depth sounders), vessel and equipment noise, vessel traffic, and trash and debris. Alternative C would not include any aeromagnetic surveys; therefore, there would be no impacts from aircraft traffic or noise.

4.4.3.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would substantially lessen the extent, severity, and timing of active acoustic sound sources and slightly lessen the extent, severity, and timing of vessel and equipment noise, and vessel traffic.

Active Acoustic Sound Sources and Vessel and Equipment Noise

The BOEM does not anticipate that airguns would be necessary for renewable energy site assessment activities. Under Alternative C, other non-airgun G&G surveys (HRG surveys and geotechnical surveys) as part of renewable energy and marine minerals activities would still occur.

Detailed acoustic characteristics of electromechanical sources, including side-scan sonars, subbottom profilers, and depth sounders, are discussed in **Appendix D**. The HRG surveys of renewable energy and marine minerals sites would use predominantly electromechanical sources. Acoustic signals from electromechanical sources other than the boomer are not likely to be detectable by sea turtles. Boomer subbottom profilers emit frequencies that are within the presumed hearing range of sea turtles; however source levels are sufficiently low as to ensonify only a limited (5-m [16-ft]) radius around the source.

Any impacts from electromechanical sources being used by seismic surveys would be eliminated, leaving only electromagnetic sources employed in HRG and geotechnical surveys. Impacts from HRG and geotechnical surveys using boomer subbottom profilers on sea turtles are expected to be reduced to **negligible** under Alternative C.

Activities occurring under Alternative C would generate vessel and equipment noise that could disturb sea turtles or contribute to auditory masking. As discussed in **Chapter 3.5.1.2**, G&G vessels, including survey and support vessels, are expected to produce strong low-frequency sounds up to approximately 50 Hz (Richardson et al., 1995). Broadband source levels for most small ships, including survey vessels that could be used for renewable energy and marine minerals surveys, are in the range of 150-170 dB re 1 μPa (Richardson et al., 1995).

Vessels conducting G&G surveys or sampling for renewable energy would be smaller and operate mainly at specific sites (consisting of one or more OCS blocks) in water depths less than 100 m (328 ft) and along potential cable routes to shore. Similarly, vessels conducting G&G surveys or sampling for marine minerals would be operating mainly at specific borrow sites in water depths less than 30 m (98 ft). Survey vessels for renewable energy and marine minerals projects are expected to make daily round trips to their shore base.

The most likely effects of vessel and equipment noise on sea turtles would include behavioral changes and possibly auditory masking. The source levels are too low to cause death, injury, or threshold shifts. Because of the uncertain role of hearing in sea turtle ecology, it is unclear whether masking would realistically have any effect on sea turtles. Behavioral responses to vessels have been observed but are difficult to attribute exclusively to noise rather than to visual or other cues. It is conservative to assume that noise associated with survey vessels may elicit behavioral changes, including evasive maneuvers such as diving or changes in swimming direction and/or speed, in individual sea turtles near these vessels. This evasive behavior is not expected to adversely affect these individuals or the population, and so the impacts are expected to be **negligible**.

Vessel Traffic

G&G survey vessels could strike and injure or kill sea turtles. Propeller and collision injuries to turtles arising from their interactions with boats and ships are common (**Chapter 4.2.3**).

Under Alternative C, renewable energy and marine minerals surveys would continue to be reviewed and approved on a case-by-case basis. It remains to be determined if BOEM would provide vessel operators with appropriate guidance for vessel strike avoidance. All vessels would be expected to comply with NOAA's ship strike reduction requirements, the benefits of which would extend to sea turtles (i.e., reduced vessel speeds in designated areas), particularly for the numerous day trips expected. With these mitigation measures in place, G&G survey vessels are unlikely to strike sea turtles. Seismic vessels, which account for most of the project-related vessel traffic associated with Alternative A activities, would be eliminated with the elimination of oil and gas activities under Alternative C. With the removal of seismic survey vessels and the implementation of the mitigation measures for protected species observers, vessel traffic impacts are expected to be **negligible**.

Trash and Debris

All survey vessels performing work within U.S. jurisdictional waters are expected to comply with Federal regulations, which implement MARPOL 73/78. Therefore, the amount of trash and debris dumped offshore would be minimal as only accidental loss of trash and debris is anticipated, some of which could sink to the seafloor. Therefore, impacts on sea turtles from trash and debris as generated by survey vessels and sampling activities would be unchanged under Alternative C (**negligible**).

4.4.3.2. Impacts of Accidental Fuel Spills

Sea turtles could be affected by an accidental diesel fuel spill during G&G activities. Under Alternative C, impacts of an accidental fuel spill on sea turtles would be very similar to those analyzed for Alternative A (**Chapter 4.2.3.3**). The analysis concluded that a small spill at the sea surface would be unlikely to have any effect on sea turtles.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. Potential impacts to sea turtles within the AOI are expected to range from **negligible** (if the fuel does not contact individual turtles) to **minor** (if individual turtles encounter the dispersed windrows of the surface slick). It is unlikely that a small fuel spill in the ocean would reach turtle nests, which are usually positioned above the high tide line. A small diesel fuel spill is not likely to result in the death or life-threatening injury of individual turtles or hatchlings, or the long-term displacement of adult turtles from preferred feeding, breeding, or nesting habitats or migratory routes.

4.4.3.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.3.1** and **4.4.3.2** determined that activities projected to occur under Alternative C would result in **no impacts** or **negligible** to **minor** impacts to sea turtles, depending on the activity, as a result of active acoustic sound sources (including vessel and equipment noise), vessel traffic, aircraft traffic and noise, trash and debris, and accidental events. These IPFs would also contribute to the cumulative activities scenario under Alternative C. The cumulative activities scenario for sea turtles, as outlined in **Chapter 4.2.3.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified only **negligible** to **minor** incremental increases in impacts from all IPFs under Alternative A (**Chapter 4.2.3.4**). Under Alternative C there would be no activities associated with oil and gas exploration; therefore, there would still be only a negligible to minor incremental increase in impacts from all IPFs under Alternative C. Underwater noise and vessel traffic would be reduced under Alternative C, which would result in a negligible incremental increase in impacts under the cumulative scenario. Vessel operators would comply with Federal regulations, which include the requirements of MARPOL 73/78, including Annex V. With compliance, the amount of trash and debris intentionally dumped offshore would be very limited, and only accidental loss of trash and debris is expected; impacts from cumulative activities within the AOI are expected to be negligible. A significant amount of vessel traffic is expected to occur under the cumulative scenario, including high levels of vessel activity associated with shipping and marine transportation around ports along the U.S. eastern seaboard. Military operations and commercial and recreational fishing activity would also contribute to overall vessel activity. All vessel movements are associated with a risk of collision and subsequent loss of fuel. The risk of accidental fuel spill arising from a vessel collision under the cumulative scenario is expected to range from negligible to minor. The likelihood of a diesel fuel spill during the reduced G&G activities under Alternative C is considered to be remote, and the associated impacts to sea turtles are still expected to range from **negligible** to **minor**. It is also reasonable that the potential for fuel spills from vessels involved in the cumulative activities scenario would be considerably higher than that expected under Alternative C because of the magnitude of vessel activity in the AOI and the high number of vessel transits. Therefore, the incremental increase in potential for accidental fuel spills arising from vessel collision during Alternative C G&G activities would be considered extremely small. The impacts associated with Alternative C and the low probability of a G&G activity-related fuel spill would result in a negligible incremental increase in sea turtle impacts under the cumulative activities scenario.

4.4.4. Marine and Coastal Birds

Under Alternative C, only activities for renewable energy development and marine minerals use would occur. Applicable routine IPFs for marine and coastal birds from renewable energy development and marine minerals activities include active acoustic sound sources (such as underwater noise from subbottom profilers, side-scan sonar, and multibeam depth sounders), vessel and equipment noise, vessel traffic, and trash and debris. Alternative C would not include any aeromagnetic surveys; therefore, there would be no impacts from aircraft traffic or noise.

4.4.4.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would substantially lessen the extent, severity, and timing of active acoustic sound sources and slightly lessen the extent, severity, and timing of vessel traffic and the associated vessel and equipment noise.

Active Acoustic Sound Sources

The BOEM does not anticipate that airguns would be necessary for renewable energy site assessment activities. Under Alternative C, other non-airgun G&G surveys (HRG surveys and geotechnical surveys) as part of renewable energy and marine minerals activities would still occur. Electromechanical sources would be used during HRG surveys for renewable energy development and sand source evaluation, where a high-resolution boomer or chirp subbottom profiler is typically used to delineate near-surface geologic strata and features and typically includes single beam and multibeam depth sounders and side-scan sonar.

As presented in **Chapter 4.2.4.2**, the impacts to marine and coastal birds from Alternative A from active acoustic sound sources were determined to be **negligible** or **minor** depending on the location of the survey and the equipment being used. Under Alternative C, the use of airguns would be eliminated and only the electromechanical sound sources (e.g., subbottom profilers) would remain. Only a portion of the underwater noise would fall within the airborne hearing range of birds, whereas noise generated by other types of survey equipment (e.g., side-scan sonar, depth sounders) is outside of their airborne hearing range and should be inaudible to birds. Therefore, if birds can hear within the same range for underwater noise as their airborne hearing range, the survey activities included in Alternative C that have the potential to impact diving seabirds and waterfowl are HRG surveys for renewable energy and marine minerals surveys.

As explained in **Chapter 4.2.4**, some seabirds and waterfowl either rest on the water surface or shallow-dive for only short durations. Because of this behavior, the members of these families of marine and coastal birds would not come in contact with active acoustic sounds generated from side-scan and subbottom profilers, since these seismic pulses are highly directive and pointed downward; therefore, it would result in a **negligible** impact.

Diving seabirds and waterfowl could be susceptible to active acoustic sounds generated from side-scan sonar and subbottom profilers. However, these seismic pulses are highly directive, with beam widths as narrow as few degrees or narrower; the ramifications of this directionality include a lower risk of high level exposure to diving birds that may forage close to (but lateral to) a seismic vessel. Based on the directionality of the sound generated from side-scan sonars and subbottom profilers and the limited studies available, it is expected that there would be little disruption of behavioral patterns or other non-injurious effects to any diving seabirds or waterfowl, resulting in a **negligible** impact.

Vessel and Equipment Noise and Vessel Traffic

Similar to Alternative A, the primary potential impacts to marine and coastal birds from vessel traffic and noise are from underwater vessel and equipment noise, attraction to vessels and subsequent collision or entanglement, disturbance to nesting or roosting, and disturbance to feeding or modified prey abundance. Since all G&G survey activities included in Alternative C are performed from vessels in all programs, all survey activities have the potential to impact marine and coastal birds from vessel traffic and noise. However, the removal of G&G activities associated with oil and gas exploration (except for remote sensing) would reduce the amount of vessel traffic and associated vessel and equipment noise when compared to Alternative A (**Tables 3-2**, **3-3**, **3-5**, and **3-6**). While the remaining surveys associated with renewable energy and marine minerals activities would take place closer to shore, where the predominant impact to marine and coastal birds would occur, overall impacts from vessel traffic and vessel and equipment noise to marine and coastal birds under Alternative C are expected to be lower and would be **negligible**.

Underwater Noise

The sound generated from individual vessels can contribute to overall ambient noise levels in the marine environment on variable spatial scales. As stated above in **Chapter 4.2.4**, birds have a relatively restricted hearing range, and there are few data available regarding bird hearing range for underwater noise. The G&G survey vessels under Alternative C would contribute to the overall noise environment by transmitting noise through both air and water. Because of the dissipation of underwater noise from survey vessels prior to reaching the shore/beach habitat, it is expected that underwater noise would produce **negligible** impacts to shorebird species, including piping plover and red knot, as well as to marine and coastal birds using the nearshore BCRs within the AOI.

Some seabirds and waterfowl either rest on the water surface, skim the water surface, or shallow dive for only short durations. Because of such behaviors, these birds would not come in contact with underwater vessel noise generated from G&G survey vessels or equipment, or the contact would be for such a short time that it would result in little disruption of behavioral patterns or other non-injurious effects. Therefore, impacts to these seabirds and waterfowl (including the Bermuda petrel and roseate tern) from vessel and equipment noise would be a **negligible**.

Diving seabirds and waterfowl could be susceptible to underwater noise generated from G&G survey vessels and equipment. Renewable energy and marine minerals surveys typically involve a single vessel. This level of vessel activity per survey event would not significantly increase existing vessel and equipment noise, and noise levels would dissipate quickly with distance from the vessel and impact only a very small area of the AOI. Therefore, impacts to seabirds and waterfowl from the underwater noise from survey vessels and equipment are expected to be **negligible**.

There are three offshore IBAs off the coast of North Carolina. Because of the noise produced from G&G survey vessels, there is the potential for some diving seabirds and waterfowl that use these areas to come into contact with survey vessel and equipment noise. However, because of noise dissipation, only a very small area of IBAs would experience vessel and equipment noise. Therefore, impacts to those species of seabirds and waterfowl present within offshore IBAs from the underwater noise from survey vessels and equipment are expected to be **negligible**.

Vessel Attraction

Renewable energy and marine minerals surveys typically involve a single vessel, which would not result in a significant increase in vessel traffic when compared to existing vessel traffic in nearshore or offshore waters. In addition, vessels performing surveys are relatively slow moving (approximately 7.4-11.1 km/hr [4-6 kn]), allowing for marine and coastal birds to easily move out of their way.

The potential for bird strikes on a vessel is not expected to be significant to individual birds or their populations. However, a number of seabird species are generally attracted to offshore rigs and vessels. Survey equipment is typically towed behind vessels at varying water depths below the surface, and vessels are required to have down-shielded lighting to minimize the potential attraction of birds. There exists a very low potential for either vessel collision or entanglement since the vessels are moving relatively slowly (7.4-11.1 km/hr [4-6 kn]) and the gear is towed below the surface. Given the low potential for collision or gear entanglement, the impacts to individual birds or their populations are not expected to be significant, resulting in a **negligible** impact to these types of seabirds from vessel attraction. Shorebirds are not known to be attracted to vessels. Therefore, there would not be impacts to shorebirds from vessel attraction.

Disturbance to Nesting or Roosting

There is the potential for impact to marine and coastal birds from the potential disturbance of breeding colonies by airborne noise from vessels (**Chapter 4.2.4**). Survey vessels for renewable energy and marine minerals projects are expected to make daily round trips to their shore base.

Vessels could cause a disturbance to breeding birds, with the potential to adversely affect egg and nestling mortality, if a vessel approached too close to a breeding colony. The G&G surveys would not occur close enough to land to affect marine and coastal bird breeding colonies during survey activities. However, survey vessels for renewable energy and marine minerals projects would typically transit from a shore base to offshore and return daily. The expectation is that this daily vessel transit would occur at one of the shore bases identified or at other established ports, which have established transiting routes for ingress and egress in the coastal areas and existing vessel traffic. Because of this existing vessel traffic, it is not anticipated that marine and coastal birds would roost in adjacent areas, or if they did already roost nearby, the addition of G&G survey vessels would not significantly increase the existing vessel traffic. In addition, airborne noise generated from the survey vessels would typically dissipate prior to reaching the coastline and the nesting habitats of coastal birds. Impacts of airborne vessel and equipment noise to nesting or roosting marine and coastal birds under Alternative C would be **negligible**.

Disturbance to Feeding or Modified Prey Abundance

Survey vessel and equipment noise could cause pelagic bird species to be disturbed and relocate to alternative areas, which could result in a localized, temporary displacement and disruption of feeding. These alternative areas may not provide food sources (prey) or habitat requirements similar to that of the original (preferred) habitat and could result in additional energetic requirements expended by the birds and diminished foraging opportunity. However, the survey types included in Alternative C are typically of short duration, and it is expected that if these species temporarily moved out of the area it would be limited to a very small portion of a bird‘s foraging range, and it would be unlikely that this temporary relocation because of noise from survey vessels would affect foraging success. Impacts to pelagic birds from disturbance associated with vessel and equipment noise would be **negligible**.

Chapter 4.2.1.4 illustrated the importance of migration routes, habitat requirements for nesting/feeding, and the IBAs for marine and coastal birds in the AOI. Because of the noise produced from G&G survey vessels, there is the potential for modified prey abundance and distribution that migrating birds rely on for the accumulation of fat reserves to fuel their migration, which could result in additional energetic requirements for the migrating birds. However, under Alternative C it is unlikely that bird prey species would be affected by G&G survey vessels to a level that would affect foraging success, especially with the significantly reduced vessel traffic and survey activities. As noted previously, surveys would not take place within coastal nearshore areas or within bays. If prey species exhibit avoidance of the area in which a survey is performed, it is expected to be limited to a very small portion of a bird‘s foraging range and for a limited duration. Additionally, shorebirds that feed along the shoreline would not be impacted by vessel and equipment noise.

Trash and Debris

All survey vessels performing work within U.S. jurisdictional waters are expected to comply with Federal regulations, which include MARPOL 73/78. In addition, it remains to be determined if case-by-case review and approval of marine minerals and renewable energy surveys would include guidance for marine debris awareness. Therefore, with required compliance, the amount of trash and debris dumped offshore would be minimal as only accidental loss of trash and debris is anticipated, which could be ingested by marine or coastal birds. Therefore, impacts on marine and coastal birds from trash and debris as generated by seismic survey vessels and sampling activities under Alternative C would be unchanged (**negligible**).

4.4.4.2. Impacts of Accidental Fuel Spills

Marine and coastal birds could be affected by an accidental diesel fuel spill during G&G activities. Under Alternative C, impacts of an accidental fuel spill on marine and coastal birds would be very similar to those analyzed for Alternative A (**Chapter 4.2.4.3**), however, there would be a reduced potential for an accidental fuel spill because of the decreased number of survey vessels.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. An accidental fuel spill within nearshore waters would not be expected to result in significant impacts to these types of coastal and marine birds. Impacts to birds from accidents are unlikely; however, in the event that an accident occurs, there could possibly be impacts on their food supply. Impacts to shorebirds, waterfowl, and seabird species would range from **negligible** (if the fuel does not contact individual birds) to **minor** (if individual birds encounter the dispersed windrows of the surface slick). Since the populations of piping plover, roseate tern, and red knot are already in peril, any impact to these populations from an accidental fuel spill would result in a **moderate** impact to these species. Impacts to oceanic and pelagic birds from a spill incident involving survey vessels within offshore waters would range from **negligible** (if the fuel does not contact individual birds) to **minor** (if individual birds encounter the dispersed windrows of the surface slick). However, since populations of Bermuda petrel are already imperiled, if an accidental release occurred that affected the Bermuda petrel, there is the potential for a **moderate** impact.

Within IBAs, there is expected to be a greater presence of marine and coastal birds. If a diesel spill were to occur within or adjacent to the IBAs, there would be a greater potential for impact to oceanic and pelagic birds present in the IBA. Impacts from an accidental fuel spill within an IBA would be expected to range from **negligible** to **minor**.

4.4.4.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.4.1** and **4.4.4.2** determined that activities projected to occur under Alternative C would result in negligible to moderate impacts to marine and coastal birds, depending on the activity, location, and bird species, as a result of active acoustic sound sources (i.e., electromechanical sources), vessel and equipment noise, vessel traffic, aircraft traffic and noise, and trash and debris. The cumulative activities scenario for marine and coastal birds, as outlined in **Chapter 4.2.4.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The IPFs that would contribute to the cumulative activities scenario under Alternative C include underwater noise including active acoustic sound sources and vessel and equipment noise, presence of structures including vessel and helicopter traffic, trash and debris, and accidental fuel spills.

As presented in **Chapter 4.2.4.4**, the cumulative impacts under Alternative A are expected to be negligible for underwater noise, presence of structures including vessel and helicopter traffic, and trash and debris. Under Alternative C, there would be a reduced number of G&G surveys, which would not significantly modify the associated cumulative impacts. Therefore, impacts to marine and coastal birds from these IPFs under the cumulative activities scenario would remain the same (i.e. **negligible**). Alternative C would only slightly reduce the overall vessel traffic; and therefore, would not change the incremental risk from accidental fuel spills, which would still result in a **minor** to **moderate** impact to marine and coastal birds, depending on the size, location, and season under the cumulative scenario.

4.4.5. Fisheries Resources and Essential Fish Habitat

Under Alternative C, only activities for renewable energy development and marine minerals would occur. Applicable routine IPFs for fisheries resources and EFH from renewable energy development and marine minerals activities are active acoustic sound sources (such as underwater noise from subbottom profilers, side-scan sonar, and multibeam depth sounders), vessel and equipment noise, and seafloor disturbance. Drilling discharges are only associated with COST and shallow test well drilling operations, exclusive to the oil and gas program and would not occur under Alternative C.

4.4.5.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would slightly reduce the extent, severity, and timing of active acoustic sound sources, vessel and equipment noise, and seafloor disturbance impacts, and remove drilling discharge impacts. Therefore, impacts would be incrementally decreased under Alternative C.

Active Acoustic Sound Sources

The BOEM does not anticipate that airguns would be used for renewable energy site assessment activities. Of the various types of active acoustic sound sources discussed in **Chapter 3**, due the nature of their sound output, airguns have the greatest potential to affect fishes physiologically. Under Alternative C, other non-airgun G&G surveys (HRG surveys and geotechnical surveys) would still occur as part of renewable energy and marine minerals activities, however, **minor** impacts associated with airguns would be eliminated.

As presented in **Chapter 4.2.5.1.4** and **Appendix J**, findings showed that many fishes cannot detect sounds above approximately 3-4 kHz, and most are only able to detect sounds to 1 kHz or below; however, a few species of cartilaginous fishes can only detect sounds that are around 600 or 800 Hz. The highest frequency detected for some commercially important fish families is around 1,000 Hz, but some can detect higher frequencies that are around 4,000 Hz (some important baitfishes) and others can detect some very high frequencies that are greater than 120,000 Hz (shad and menhaden) (**Appendix J**). In general, commercial fish species would be most susceptible to the low-frequency sound sources such as some subbottom profilers (e.g., boomers).

Under Alternative C, routine surveys would generate noise through electromechanical sources and vessels, since no seismic airgun surveys using airguns would be performed. During surveying activities, the sound source is constantly moving, and intense sounds would rarely be close enough to individuals to inflict physiological or anatomical damage. Various sonar units emit semi-continuous noise that would not inflict physical damage to individuals except at very close range.

As presented in **Chapter 4.2.5.2**, affected species would either vacate the survey area, experience TTS (hearing loss), experience masking of biologically relevant sounds, or be completely unaffected. Overall background noise would increase during surveys of particular pre-plotted areas of seafloor such as renewable energy buoy sites and sand borrow areas. Ambient noise levels would return once the survey ends and the noise source is terminated. The mobile nature of the surveys as well as the temporary surveying of small areas of the seafloor relative to the overall area and the propensity of fishes to temporarily move away from noise that is affecting them suggest that the impacts from Alternative A would be **minor**. Therefore, with the reduction in active acoustic seismic noise under Alternative C, the impacts would be reduced to **negligible**.

Vessel and Equipment Noise

G&G HRG survey and geotechnical survey activity occurring under Alternative C would be conducted from vessels. Ships, barges, and platforms powered primarily by diesel engines produce sound that is below levels that can cause TTS or mortality in fishes. Presently there are few areas within the AOI that do not experience vessel noise of some kind; regional fishes are likely to have habituated to this noise (**Appendix J**). While vessel and equipment noise would increase in the AOI as a result of the Alternative C scenario, impacts of vessel and equipment noise are expected to be lower than under Alternative A, and would be **negligible**.

Seafloor Disturbance

Sources of seafloor disturbance that may result from G&G activities are bottom sampling (cores and grabs); placement of anchors, nodes, cables, or other bottom-founded equipment; and placement of anchored monitoring buoys (**Table 3-10**). Placement of equipment on the seafloor can damage areas where direct contact with the seafloor occurs. Many well known hard bottom areas that have been designated as exclusionary zones or HAPCs would be avoided during G&G survey activities. Soft bottom areas where deployments are made would lose benthic organisms (because of burial and crushing), and bottom-feeding fishes would be temporarily displaced from feeding areas.

The proposed action scenario indicates that individual grab samples, core samples, and bottom-founded meteorological buoys would affect a relatively small portion of the seafloor within the AOI (**Chapter 3.5.1.8**). As discussed in **Chapter 4.2.1.2**, the impacts from seafloor-disturbing activities are expected to be **negligible** under Alternative A. Most of the proposed activities under Alternative A that include bottom sampling are associated with the renewable energy and marine minerals program areas. The removal of the oil and gas exploration activities would only slightly reduce the overall number of bottom samples taken (50-300 samples) (**Table 3-4**), and all other seafloor-disturbing activities could still occur under Alternative C. Given the estimates of minimal seafloor disturbance by projected G&G activities, impacts to fisheries resources and EFH are expected to be **negligible**.

Drilling Discharges

Discharges from COST and shallow test wells would not occur under Alternative C. Therefore, the impacts to fisheries resources and EFH from drilling discharges under Alternative A (i.e., **negligible**) would be eliminated. No impacts to fisheries resources and EFH from drilling discharges are expected.

4.4.5.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on fisheries resources and EFH would be very similar to those analyzed for Alternative A (**Chapter 4.2.5.3**). The analysis concluded that a small spill at the sea surface would be likely to produce a **minor** impact to fisheries resources and EFH.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. For the duration of a spill, species and life stages residing in the upper water column are most at risk for contact with the spilled fuel. Coastal pelagic and epipelagic adults that forage at the ocean surface would be most likely to encounter a surface spill but would likely swim away from a small diesel spill. Planktonic early life stages would be less able to avoid a spill and therefore are most vulnerable. The EFH most at risk from a small diesel spill would be pelagic *Sargassum*, which supports numerous fishes and invertebrates including the young of several federally managed species. Because the effects on early life stages and *Sargassum* are expected to last for a day or less and have limited spatial extent, the impacts of a small accidental diesel fuel spill from G&G activity would be **minor**.

4.4.5.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.5.1** and **4.4.5.2** determined that activities projected to occur under Alternative C would result in **negligible** impacts to fisheries resources and EFH as a result of active acoustic sound sources (i.e., electromechanical sources), vessel and equipment noise, seafloor disturbance, and accidental events. Impacts from drilling discharges would be eliminated. The IPFs contributing to the cumulative activities scenario under Alternative C include active acoustic sound sources, vessel and equipment noise, the presence of structures, seafloor disturbance, and accidental events. The cumulative activities scenario for fisheries and EFH, as outlined in **Chapter 4.2.5.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified only small to minor incremental increases in impacts from all IPFs under Alternative A. Under Alternative C there would be no activities associated with oil and gas exploration; therefore, there would still be only a small to minor incremental increase in impacts from all IPFs, depending on the IPF. Underwater noise and vessel traffic would be reduced under Alternative C, resulting in a negligible incremental increase under the cumulative scenario. While permanent and temporarily moored structures including barges, buoys, wind turbines, and other structures would attract fishes, the small size of the structures and the relatively short duration of deployments would result in only a small incremental increase in cumulative impacts on fisheries resources and EFH. The small footprint associated with activities resulting in seafloor disturbance would be minimal, and the impacted seafloor area would account for only a small fraction of the total seafloor area of the AOI; therefore, the incremental increase in cumulative impacts is expected to be negligible. Vessel traffic would not be significantly reduced under Alternative C; therefore, the incremental increase in cumulative impacts from an accidental fuel spill would remain small.

4.4.6. Threatened and Endangered Fish Species

Under Alternative C, only activities for renewable energy development and marine minerals would occur. Applicable routine IPFs for threatened and endangered species from renewable energy development and marine minerals activities are active acoustic sound sources (such as underwater noise from subbottom profilers, side-scan sonar, and multibeam depth sounders), vessel and equipment noise, trash and debris, and seafloor disturbance. Drilling discharges are only associated with COST and shallow test well drilling operations, exclusive to the oil and gas program and would not occur under Alternative C. Two endangered species (smalltooth sawfish and shortnose sturgeon), one candidate species proposed for threatened status (Atlantic sturgeon), and two proposed for threatened status (blueback herring and alewife) occur in the AOI and may be affected by activities under Alternative C.

4.4.6.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would slightly reduce the extent, severity, and timing of impacts resulting from active acoustic sound sources, vessel and equipment noise, trash and debris, seafloor disturbance impacts, and remove drilling discharge impacts. Therefore, impacts would be incrementally decreased under Alternative C.

Active Acoustic Sound Sources and Vessel and Equipment Noise

The BOEM does not anticipate that airguns would be used for renewable energy site assessment activities. Of the various types of seismic equipment discussed in **Chapter 3**, due to the nature of their sound output, airguns have the greatest potential to affect fishes physiologically; under Alternative C, this impact would be removed. However, under Alternative C, other non-airgun G&G surveys (HRG surveys and geotechnical surveys) would still occur as part of renewable energy and marine minerals activities. As was the case with Alternative A, because of the low numbers of smaltooth sawfish in the AOI, effects of active acoustic sound sources are expected to be **negligible** under Alternative C. Shortnose sturgeon are also rare within the AOI, preferring estuaries and rivers inshore of the coastline; therefore, the effect of active acoustic sound sources on this species is likely to be **negligible** under Alternative C. The proposed species, Atlantic sturgeon, is more prevalent in the shelf AOI and could be affected by active acoustic noise. Atlantic sturgeon possess poor underwater hearing sensitivity and are most susceptible to low-frequency noise sources. The active acoustic sound sources associated with Alternative C produce mid- and high-frequencies that are not anticipated to be detected by Atlantic sturgeon; therefore, these sources would be expected to result in **no impact** to Atlantic sturgeon. Blueback herring and alewife are sensitive to very high-frequency sounds such as those produced by some electromechanical sources and may exhibit behavioral response from such sources. However, electromechanical sources would be used under Alternative C during individual surveys that are temporary and spatially limited, the impacts on blueback herring individuals and populations are expected to be **negligible**. Because of the limited spatial and temporal components of proposed Alternative C G&G surveys relative to alewife distribution in the AOI, impacts are expected to be **negligible**.

Although Alternative C would result in reduced vessel traffic and therefore less overall vessel and equipment noise in the AOI, the other non-oil and gas G&G activities would still represent a source of noise that could affect coastal populations of Atlantic sturgeon. Impacts of vessel and equipment noise on Atlantic sturgeon are expected to be **negligible**. Because of limited geographic coverage, relative abundance, or distribution, the impacts of vessel and equipment noise on smalltooth sawfish, shortnose sturgeon, blueback herring, and alewife individuals in the AOI would be **negligible**.

Vessel Traffic

Similar to Alternative A, vessel traffic has the potential to affect endangered and threatened fish species through interaction (i.e., vessel strikes) with motor vessels, particularly those operating in shallow water (relative vessel draft). However, vessel traffic would be reduced under Alternative C and vessel strike mortality from increased vessel traffic associated with the Alternative C would be reduced; but still expected to be **negligible**.

Trash and Debris

All survey vessels performing work within U.S. jurisdictional waters are expected to comply with Federal regulations, which implement MARPOL 73/78. In addition, it remains to be determined if case-by-case review and approval of marine minerals and renewable energy surveys would include guidance for marine debris awareness. Therefore, with required compliance, the amount of trash and debris dumped offshore would be minimal, as only accidental loss of trash and debris is anticipated. Therefore, impacts on smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon from trash and debris as generated by seismic survey vessels and sampling activities under Alternative C would be unchanged (**negligible**).

Seafloor Disturbance

Sources of seafloor disturbance that may result from G&G activities are bottom sampling (cores and grabs); placement of anchors, nodes, cables, or other bottom-founded equipment; and placement of anchored monitoring buoys (**Table 3-10**).

The Alternative A scenario indicates that individual grab samples, core samples, and bottom-founded meteorological buoys would affect a relatively small portion of the seafloor within the AOI (**Chapter 3.5.1.8**). As discussed in **Chapter 4.2.6.2**, the impacts from seafloor-disturbing activities were determined to be **negligible** under Alternative A. Most of the seafloor-disturbing activities under Alternative A are associated with the renewable energy and marine minerals program areas. The removal of the oil and gas exploration activities would only slightly reduce the overall number of bottom samples taken (50-300 samples) (**Table 3-4**), and all other seafloor-disturbing activities could still occur under Alternative C. Seafloor disturbance would not greatly affect the smalltooth sawfish or shortnose sturgeon. Of concern would be destruction of habitat; in the case of Atlantic sturgeon, it would be soft bottom areas where feeding occurs. These impacts would be **negligible** for smalltooth sawfish and shortnose sturgeon because of their scarcity in the AOI. Effects on Atlantic sturgeon would be **negligible** because of the small footprint of sampling and bottom tending operations. Because blueback herring and alewife are pelagic species with no particular affinity of dependence on the seafloor, **no impacts** are expected for either species.

4.4.6.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on threatened and endangered species would be very similar to those analyzed for Alternative A (**Chapter 4.2.6.3**). The analysis concluded that a small spill at the sea surface would be unlikely to have any effect.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. However, smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon are demersal species with no pelagic life stage found in the AOI. Blueback herring and alewife, as pelagic species, would be more likely to come in contact with dispersed diesel fuel. Because both species are anadromous, their sensitive egg and larval stages occur in coastal rivers and would be separated from any accidental spill occurring in the AOI. Given the relatively small spill size and its expected rapid dispersion, impacts to blueback herring and alewife would be **negligible**. Therefore, the expected impact of an accidental diesel fuel spill is expected to be **negligible** for all five of these species.

4.4.6.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.6.1** and **4.4.6.2** determined that activities projected to occur under Alternative C would result in **negligible** impacts to threatened and endangered species as a result of active acoustic sound sources (i.e., electromechanical sources), vessel and equipment noise, vessel traffic, seafloor disturbance, trash and debris, and accidental events. Impacts from drilling discharges would be eliminated. The same IPFs would contribute to the cumulative activities scenario under Alternative C, with the exception of drilling discharges. The cumulative activities scenario for threatened and endangered species, as outlined in **Chapter 4.2.6.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified only **negligible** to **minor** incremental increases in impacts from all IPFs under Alternative A. Under Alternative C, there would be no activities associated with oil and gas exploration; therefore, there would be a sizeable decrease in G&G activities. This decrease would not change the cumulative impacts determined under Alternative A and would still result in negligible impacts to threatened and endangered species from active acoustic noise (i.e., electromechanical sources), vessel and equipment noise, seafloor disturbance, vessel traffic, trash and debris; and from accidental events.

4.4.7. Commercial Fisheries

Under Alternative C, only activities for renewable energy development and marine minerals would occur. Applicable routine IPFs for commercial fisheries from renewable energy development and marine minerals activities are active acoustic sound sources (such as underwater noise from subbottom profilers, side-scan sonar, and multibeam depth sounders), vessel traffic and seafloor disturbance.

4.4.7.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would reduce the extent, severity, and timing of active acoustic sound sources, vessel traffic and vessel exclusion zones, and seafloor disturbance, therefore, impacts would be incrementally decreased or eliminated under Alternative C.

Active Acoustic Sound Sources

The BOEM does not anticipate that airguns would be used for renewable energy site assessment activities. Under Alternative C, other non-airgun G&G surveys (HRG surveys and geotechnical surveys) would still occur as part of renewable energy and marine minerals activities.

Whereas active acoustic sound sources used under the oil and gas program may occur throughout the entire AOI and may work continuously for weeks or months, active acoustic sound sources for renewable energy and marine minerals activities would only occur closer to shore, and surveys would be of shorter duration (**Chapter 3**). For example, studies related to renewable energy are currently limited to about 46 km (25 nmi) from shore or 100 m (328 ft) water depth and would require 3 days or less to complete, while marine minerals activities (i.e., sand source mining, existing borrow areas) are typically located in water depths between 10 and 30 m (33 and 98 ft), are restricted to a half dozen locations in the AOI, and would be only day-long survey efforts.

Given the spatial and temporal characteristics of active acoustic sound source use under Alternative C (single beam and/or multibeam depth sounders, side-scan sonars, and shallow or medium penetration subbottom profilers [electromechanical sources]) and the results of limited sound exposure studies on fishes, it is likely that potential impacts to commercial fisheries resources would be **negligible**, with no population-level effects. Impacts, including behavioral changes and avoidance, are expected at a few locations, with likely impacts being intermittent, temporary, and short-term. There would be an increased potential for a localized and temporary decrease in catchability of one or more commercial fish species. Overall, impacts associated with active acoustic sound generated from G&G activities under Alternative C are expected to be **minor**.

Vessel Traffic

Total vessel traffic associated with G&G activities under Alternative C would decrease compared to Alternative A. Renewable energy and marine minerals surveys would generally be limited to day-long surveys relatively close to port. Although oil and gas seismic surveys would be eliminated under Alternative C, renewable energy and marine minerals surveys represent the potential for interference with commercial fishing operations, especially dredges, otter trawls, longlines, and purse seines. These types of commercial fisheries could be adversely affected because vessel traffic throughout the fishing grounds may prevent commercial fishing operators from properly setting their gear. Under Alternative C, airguns would not be utilized, thus eliminating the vessel exclusion zones associated with airgun arrays and towed streamers.

Under Alternative C, G&G activities and associated vessel traffic levels would be reduced, effectively reducing the potential for interactions with commercial fishery operations. Impacts are expected at a few locations and would be intermittent, temporary, and short-term. Impacts to commercial fisheries arising from vessel traffic are expected to be **negligible**.

Seafloor Disturbance

Sources of seafloor disturbance that may result from G&G activities are bottom sampling (cores and grabs); placement of anchors, nodes, cables, or other bottom-founded equipment; and placement of anchored monitoring buoys (**Table 3-10**), which has the potential to damage to bottom-founded fishing gear such as bottom longlines, bottom and mid-water gillnets, and pots and traps.

The proposed action scenario indicates that individual grab samples, core samples, and bottom-founded meteorological buoys would affect a relatively small portion of the seafloor within the AOI (**Chapter 3.5.1.8**). As discussed in **Chapter 4.2.7.2**, the impacts from seafloor-disturbing activities were determined to be negligible. Most of the proposed activities under Alternative A that include bottom sampling are associated with the renewable energy and marine minerals program areas. The removal of the oil and gas exploration activities would only slightly reduce the overall number of bottom samples taken (50-300 samples) (**Table 3-4**), and all other seafloor-disturbing activities could still occur under Alternative C. It is likely that intermittent, temporary, and short-term changes in benthic habitats would occur as a result of G&G benthic sampling and coring activity. However, these types of G&G activities would be conducted on a very limited basis. Seafloor disturbance and its impacts to commercial fishing operations under Alternative C are expected to be limited and localized, and therefore would be a **negligible** impact.

4.4.7.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on commercial fisheries resources would be very similar to those analyzed for Alternative A (**Chapter 4.2.7.3**). The analysis concluded that a small spill at the sea surface would be unlikely to have any effect.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. A small diesel spill is expected to disperse and weather rapidly, with evaporation of volatile components. It is unlikely that a small release of diesel fuel would have any direct impact to commercial fisheries throughout the AOI. Spill vessel response activity also has the potential to adversely affect commercial fishing operations. However, given the size of the potential spill, a large-scale spill response involving multiple vessels is not expected. Therefore, impacts to commercial fisheries resources from a small diesel fuel spill are expected to be **negligible**.

4.4.7.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.7.1** and **4.4.7.2** determined that activities projected to occur under Alternative C would result in **no impact**, **negligible**, or **minor** impacts to commercial fisheries resources, depending on the IPF, as a result of active acoustic sound sources (i.e., electromechanical sources), vessel traffic, seafloor disturbance, and accidental events. The same IPFs would contribute to the cumulative activities scenario under Alternative C. The cumulative activities scenario for commercial fisheries, as outlined in **Chapter 4.2.7.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis under Alternative A identified negligible incremental increases in impacts from vessel traffic, seafloor disturbance, and accidental events, and minor incremental increase in impacts from active acoustic noise. Under Alternative C there would be no activities associated with oil and gas exploration, which would eliminate the impacts from most active acoustic sound sources (i.e, airguns) and vessel exclusion zones. All other IPFs under the Alternative C cumulative scenario would remain the same.

4.4.8. Recreational Fisheries

Under Alternative C, only activities for renewable energy development and marine minerals would occur. Applicable routine IPFs for recreational fisheries from renewable energy development and marine minerals activities are active acoustic sound sources (such as underwater noise from subbottom profilers, side-scan sonar, and multibeam depth sounders), vessel traffic, and seafloor disturbance.

4.4.8.1. Impacts of Routine Activities

The elimination of G&G activities in support of oil and gas exploration under Alternative C would reduce the extent, severity, and timing of active acoustic sound sources, vessel traffic, and vessel exclusion zones; therefore, impacts would be incrementally decreased or eliminated under Alternative C.

Active Acoustic Sound Sources

The BOEM does not anticipate that airguns would be used for renewable energy site assessment activities. Under Alternative C, other non-airgun G&G surveys (HRG surveys and geotechnical surveys) would still occur as part of renewable energy and marine minerals activities, while seismic surveys and their associated impacts would be eliminated.

Whereas active acoustic sound sources associated with the oil and gas program may occur throughout the entire AOI and may work continuously for weeks or months to complete the survey, active acoustic sound sources for renewable energy and marine minerals activities would only occur close to shore and would be of shorter survey duration (**Chapter 3**). For example, studies related to renewable energy are currently limited to about 46 km (25 nmi) from shore or 100 m (328 ft) water depth and would require one vessel and 3 days or less to complete, while marine minerals activities (i.e., sand source mining, existing borrow areas) are typically located in water depths between 10 and 30 m (33 and 98 ft), are restricted to a half dozen locations in the AOI, and would be only day-long survey efforts with one vessel.

Given the absence of serious injury or mortality to recreational fishes and the potential for behavioral changes from active acoustic sound exposure, it is likely that potential impacts would be intermittent, temporary, and short-term in terms of duration or frequency. Overall, exposure to active acoustic sound sources from G&G activities under Alternative C (i.e., electromechanical sources) is expected to produce **negligible** impacts to recreational fisheries.

Vessel Traffic

Total vessel traffic associated with G&G activities under Alternative C would decrease compared to Alternative A. Renewable energy and marine minerals surveys would generally be limited to day-long surveys relatively close to port. Although oil and gas seismic surveys would be eliminated under Alternative C, renewable energy and marine minerals surveys represent the potential for interference with recreational fishing operations, especially to those engaged in amateur and professional fishing tournaments. Recreational fisheries could be affected because G&G vessel traffic throughout the fishing grounds may prevent or limit access by recreational fishermen. Under Alternative C, airguns would not be utilized, thus eliminating a portion of vessel traffic as well as the vessel exclusion zones associated with airgun arrays and towed streamers. Vessel traffic has the potential to affect several recreational fishing activities within the AOI, but any effects would be intermittent, temporary, and very short-term. Vessel traffic disturbance and how it relates to recreational fishing activities are expected to be **negligible**.

4.4.8.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on recreational fisheries resources would be very similar to those analyzed for Alternative A (**Chapter 4.2.8.3**). The analysis concluded that a small spill at the sea surface would produce **negligible** impacts to recreational fisheries

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. A small diesel spill is expected to disperse and weather rapidly, with evaporation of volatile components. However, recreational fishing activity is expected to be precluded from a small area around the fuel source for a day or less during spill response operations. Given the relatively small size of the spill and the rapid loss of most spilled fuel through evaporation and dispersion, a small diesel fuel spill at the surface would have little to no effect on recreational fisheries. An accidental diesel fuel spill would be expected to result in **negligible** impacts to recreational fisheries under Alternative C.

4.4.8.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.8.1** and **4.4.8.2** determined that activities projected to occur under Alternative C would result in **negligible** impacts to recreational fishery activities as a result of active acoustic sound sources (i.e., electromechanical sources), vessel traffic, and accidental events. The same IPFs would contribute to the cumulative activities scenario under Alternative C. The cumulative activities scenario for recreational fishing activities, as outlined in **Chapter 4.2.8.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea.

The cumulative impact analysis identified negligible or small incremental increases in impacts from all IPFs under Alternative A. Under Alternative C there would be no activities associated with oil and gas exploration, which removes the use of airguns and towing of streamers and the associated impacts; therefore, potential impacts to recreational fishing would be slightly reduced. However, this slight reduction in impacts to recreational fishing from Alternative C would not result in a change in the cumulative scenario impact levels from those determined for Alternative A, and there would still be small incremental increases in impacts from underwater noise, since the oil and gas exploration activities typically occur further offshore than recreational fishing grounds. The incremental increases in cumulative impacts from vessel traffic exclusion zones and accidental events would still be negligible.

4.4.9. Recreational Resources

Under Alternative C, only activities for renewable energy development and marine minerals would occur. The only applicable routine IPF for recreational resources from renewable energy development and marine minerals activities is trash and debris. With elimination of oil and gas seismic surveys and their associated vessel exclusion zones, impacts from vessel exclusion to recreational resources would be eliminated.

4.4.9.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would reduce the extent, severity, and timing of trash and debris; therefore, impacts would be incrementally decreased under Alternative C.

Trash and Debris

All survey vessels performing work within U.S. jurisdictional waters are expected to comply with Federal regulations, which implement MARPOL 73/78. In addition, it remains to be determined if case-by-case review and approval of marine minerals and renewable energy surveys would include guidance for marine debris awareness. Therefore, with required compliance, the amount of trash and debris dumped offshore would be minimal as only accidental loss of trash and debris is anticipated, some of which could wash up on beaches and into harbors, embayments, and coastal salt marshes. Trash and debris on beaches would constitute aesthetic degradation of the recreational resource and adversely affect the current recreational use of the beach. Further, the presence of trash and debris could also result in a long-term loss of reputation as a pristine tourist destination. Trash and debris can also present a safety hazard, both on beaches and in boating and fishing areas, where it could foul boat engines and fishing gear. The most likely scenario is that trash and debris accidentally released from G&G activities could interfere with recreational use; however, the amount of vessel traffic associated with Alternative C that could accidentally lose trash and debris is very small when compared to overall vessel traffic and vessel traffic levels under Alternative A. Therefore, impacts to recreational resources under Alternative C from trash and debris would be expected to be reduced compared to Alternative A and would be **negligible**.

4.4.9.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on recreational resources would be very similar to those analyzed for Alternative A (**Chapter 4.2.9.3**). The analysis concluded that a small spill at the sea surface would be unlikely to have any effect.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. A small diesel spill is expected to disperse and weather rapidly, with evaporation of volatile components. Given the relatively small size of the spill and the rapid loss of most spilled fuel through evaporation and dispersion, a small diesel fuel spill at the surface would have little to no effect on recreational resources. If the worst-case scenario spill were to occur, it could limit the access of recreational uses and limit the full use of the recreational resource for a short period of time. The impact of a diesel fuel spill on recreational resources is expected to be **negligible** to **minor**, depending on location of the spill.

4.4.9.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.9.1** and **4.4.9.2** determined that activities projected to occur under Alternative C would result in **negligible** to **minor** impacts to recreational resources as a result of trash and debris and accidental fuel spills. The same IPFs would contribute to the cumulative activities scenario under Alternative C. The cumulative activities scenario for recreational resources, as outlined in **Chapter 4.2.9.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified incremental increases in impacts from all IPFs under Alternative A. Under Alternative C there would be no activities associated with oil and gas exploration, resulting in elimination of impacts associated with exclusion zones. There would be only a negligible incremental increase in impacts from all remaining IPFs under Alternative C.

4.4.10. Archaeological Resources

Under Alternative C, only activities for renewable energy development and marine minerals would occur. The applicable routine IPF for archaeological resources from renewable energy development and marine minerals activities is seafloor disturbance. Drilling discharges are only associated with COST and shallow test well drilling operations exclusive to the oil and gas program, and would not occur under Alternative C.

4.4.10.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would reduce the extent, severity, and timing of seafloor disturbance impacts and remove drilling discharge impacts; therefore, impacts would be incrementally decreased under Alternative C.

Seafloor Disturbance

Sources of seafloor disturbance that may result from G&G activities are bottom sampling (cores and grabs); placement of anchors, nodes, cables, or other bottom-founded equipment; and placement of anchored monitoring buoys (**Table 3-10**). Bottom sampling activities have the potential to affect both historic and prehistoric archaeological resources via physical damage.

The Alternative A scenario indicates that individual grab samples, core samples, and bottom-founded meteorological buoys would affect a relatively small portion of the seafloor within the AOI (**Chapter 3.5.1.8**). As discussed in **Chapter 4.2.10.2**, the impacts from seafloor-disturbing activities area expected to be **negligible** for Alternative A. Most of the proposed activities under Alternative A that include bottom sampling are associated with the renewable energy and marine minerals program areas. The removal of the oil and gas exploration activities would only slightly reduce the overall number of bottom samples taken (50-300 samples) (**Table 3-4**), and all other seafloor-disturbing activities could still occur under Alternative C. Because of the rich maritime history and potential for submerged prehistoric resources in the Mid- and South Atlantic Planning Areas, all activities that disturb the seafloor would be subject to an avoidance survey as outlined by BOEM's *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 285* (USDOI, BOEM, 2011d) in order to ensure that historic and prehistoric submerged cultural resources are not impacted. If existing protective measures and lease stipulations are followed, then no adverse impacts to submerged cultural resources are anticipated, and impacts to archaeological resources from seafloor disturbance associated with G&G activities would be **negligible** under Alternative C. If, during the course of G&G activity, it is determined that a potential shipwreck or prehistoric site has been located, the operator must immediately halt operations and take the necessary steps to ensure that the site is not disturbed further. The BOEM must also be notified within 48 hr of the discovery.

4.4.10.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on archaeological resources would be very similar to those analyzed for Alternative A (**Chapter 4.2.10.3**). The analysis concluded that a small spill at the sea surface would be unlikely to have any effect.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. A small diesel spill is expected to disperse and weather rapidly, with evaporation of volatile components. Particulate matter contaminated with diesel fuel would eventually reach the seafloor, either within or outside the AOI, depending upon spill location, water depth, ambient currents, and sinking rate. However, given the relatively small size of the spill and the loss of most spilled fuel through evaporation and dispersion, a small diesel fuel spill at the surface would have no effect on the seafloor and would not require seafloor cleanup activity. An accidental diesel fuel spill would be expected to result in **negligible** impacts to archaeological resources.

4.4.10.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.10.1** and **4.4.10.2** determined that activities projected to occur under Alternative C would result in negligible impacts to archaeological resources as a result of seafloor disturbance and accidental events; no impacts would result from drilling discharges because no COST or shallow test wells would be drilled. The same IPFs would contribute to the cumulative activities scenario under Alternative C. The cumulative activities scenario for archaeological resources, as outlined in **Chapter 4.2.10.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified only negligible incremental increases in impacts from all IPFs under Alternative A. Under the Alternative C cumulative activities scenario, G&G activity under the oil and gas program would not occur along with the associated impacts. Therefore, impacts to archaeological resources would be slightly reduced, but this minor decrease would not be enough to modify the cumulative impacts determined under Alternative A and would still result in a negligible incremental increase in impacts from seafloor disturbance and accidental events for Alternative C. No incremental impacts from drilling discharges would be expected under Alternative C.

4.4.11. Marine Protected Areas

Under Alternative C, only activities for renewable energy development and marine minerals would occur. Applicable routine IPFs for MPAs from renewable energy development and marine minerals activities are active acoustic sound sources (e.g., electromechanical noise sources including subbottom profilers, depth sounders, side-scan sonar), trash and debris, and seafloor disturbance. Drilling discharges are only associated with COST and shallow test well drilling operations exclusive to the oil and gas program and would not occur under Alternative C.

4.4.11.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would reduce the extent, severity, and timing of active acoustic sound sources, trash and debris, seafloor disturbance impacts, and remove drilling discharge impacts; therefore, impacts would be incrementally decreased under Alternative C.

Active Acoustic Sound Sources

The BOEM does not anticipate that airguns would be necessary for renewable energy site assessment activities. Of the various G&G activities discussed in **Chapter 3**, the oil and gas program would account for most of the airgun and electromechanical noise sources and have the largest potential for affecting MPAs. Additionally, because of the nature of renewable energy and marine minerals projects (i.e., their limited spatial distribution, occurring within 46 km [25 nmi] from shore or 100 m [328 ft] water depth), activities associated with the oil and gas program have a greater potential to affect MPAs through noise. Under Alternative C, oil and gas activities would not occur, but other non-airgun G&G surveys (HRG surveys and geotechnical surveys) would be performed as part of renewable energy and marine minerals activities. Under Alternative C, impacts from active acoustic sound sources would be decreased; impacts would be **negligible** for the various MPA resources affected. Airgun noise impacts would be eliminated and electromechanical impacts would be reduced under Alternative C. Impacts to MPA resources from electromechanical sources would be **negligible**.

National Marine Sanctuaries

As discussed in **Chapter 4.2.11**, depending on the distance from survey project areas to an NMS and sensitive species and habitats contained therein, noise-generating activities from G&G surveys associated with renewable energy and marine minerals projects could potentially affect benthic communities, marine mammals, sea turtles, marine and coastal birds, and fisheries resources and EFH, any of which may be present within an NMS. Cultural or archaeological resources would also be present; however, no impacts to these resources from noise sources are expected.

The active acoustic sound sources associated with Alternative C are mid- and high-frequencies that are not anticipated to be detected by benthic communities or invertebrates; therefore, there would be no impacts to benthic communities within NMSs from active acoustic sound sources under Alternative C.

While no mortality or injury to marine mammals is expected from noise exposure, behavioral impacts may occur. Survey protocols include the use of ramp up in conjunction with clearance of a safety zone, visual (and possibly passive acoustic) monitoring, and shutdown procedures if marine mammals are detected within the safety zone. With these mitigation measures, it is not expected that the impacts of noise from under Alternative C would adversely affect either listed or protected marine mammal species that may be present in an NMS. Impacts from noise associated with active acoustic sound sources are expected to be **negligible**.

Active acoustic sound sources under Alternative C (e.g., side-scan sonars, subbottom profilers, and depth sounders) usually operate at one or two (sometimes three) main operating frequencies, which typically fall in the range from 2 to 900 kHz. While the majority of these frequencies are higher than the functional hearing range of sea turtles (i.e., turtle hearing at 200 Hz-16 kHz) and are not likely to be heard by them, the lower frequency sources (e.g., boomer) fall within their hearing range. Therefore, impacts from active acoustic sound sources on sea turtles are expected to be **negligible**.

Seabirds and waterfowl that rest on the water surface or shallow-dive for only short durations would not come in contact with active acoustic sounds generated from G&G surveys, or the contact would be for such a short time that it would result in a **negligible** impact. Diving seabirds and waterfowl could be susceptible to active acoustic sounds generated from side-scan sonar and subbottom profilers. However, these seismic pulses are highly directive, with beam widths as narrow as few degrees or narrower; the ramifications of this directionality include a lower risk of high level exposure to diving birds that may forage close to (but lateral to) a seismic vessel. Based on the directionality of the sound generated from seismic airgun surveys, it is expected that there would be no mortality or life-threatening injury and little disruption of behavioral patterns or other non-injurious effects of any diving seabirds or waterfowl from this direct impact, resulting in a **negligible** impact.

The mobile nature of the surveys, short duration, as well as the temporary surveying of small areas of the seafloor relative to the overall area, and the propensity of fishes to move away from noise that is affecting them, suggest that impacts would be **negligible** to fisheries and EFH.

Impacts to recreational resources are unlikely to occur because recreational fishing activities and watersports such as diving are likely to be precluded in advance of a G&G survey for safety purposes. The transient interference from survey vessels would have **negligible** impacts to recreational resources in NMSs where fishing is allowed.

Other Federal Fishery Management Areas

HRG surveys are not precluded from deepwater MPAs; however, all of the deepwater MPAs are located farther offshore than the areas surveyed for renewable energy and mineral mining activities (e.g., <46 km [25 nmi] from shore or 100 m [328 ft] water depth for renewable energy, water depths between 10 and 30 m [33 and 98 ft] for marine minerals). Therefore, there would be no impact to MPAs from G&G survey activities under Alternative C.

Coastal Marine Protected Areas

Noise from G&G surveys also could potentially affect fishes, marine mammals, and sea turtles in coastal MPAs, despite their location outside the main G&G survey areas. Impacts to fishes, marine mammals, and sea turtles under Alternative C in coastal MPAs range from no impact to **negligible**, especially since most coastal MPAs lie inshore of the main G&G survey areas. Impacts to benthic organisms, primarily invertebrates, in these coastal MPAs from noise generated from G&G surveys are also not expected. Overall, such impacts would be expected to range between negligible and minor at the population level. Noise emanating from G&G survey activities is unlikely to affect biological, cultural, or archaeological resources contained in coastal/State-designated MPAs (e.g., shipwrecks such as the *Queen Anne's Revenge* and in artificial reefs).

Trash and Debris

All survey vessels performing work within U.S. jurisdictional waters are expected to comply with Federal regulations, which include MARPOL 73/78. In addition, it remains to be determined if case-by-case review and approval of marine minerals and renewable energy surveys would include guidance for marine debris awareness. Therefore, with required compliance with Federal regulations, the amount of trash and debris dumped offshore would be minimal as only accidental loss of trash and debris is anticipated. However, due to the small anticipated amount of accidentally lost trash and debris, impacts would be unchanged under Alternative C (**negibible**).

Seafloor Disturbance

Sources of seafloor disturbance that may result from G&G activities are bottom sampling (cores and grabs); placement of anchors, nodes, cables, or other bottom-founded equipment; and placement of anchored monitoring buoys (**Table 3-10**). Placement of equipment on the seafloor can and would damage areas where direct contact with the seafloor occurs. The BOEM would require site-specific information regarding potential sensitive benthic communities (including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. The BOEM would use this information to ensure that physical impacts to sensitive benthic communities are avoided. Therefore, seafloor-disturbing impacts to sensitive benthic communities within MPAs are expected to be avoided.

National Marine Sanctuaries

Federal regulations prohibit certain activities in the Monitor NMS (**Chapter 4.2.11.2**). Given these restrictions, seafloor disturbance within NMS waters from G&G activities would not occur. Under Alternative C, no impact to benthic communities or archaeological/cultural resources in NMSs would be expected from G&G activities.

Additionally, under the renewable energy program, BOEM has issued *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 285* (USDOI, BOEM, 2011d). The guidelines specify that a site characterization survey must reliably cover any portion of the site that would be affected by all seafloor-disturbing activities and recommend avoidance as a primary mitigation strategy for objects of historical or archaeological significance.

Other Federal Fishery Management Areas

HRG surveys are not precluded from deepwater MPAs; however, all of the deepwater MPAs are located farther offshore than the areas surveyed for renewable energy and mineral mining activities (e.g., <46 km [25 nmi] from shore or 100 m [328 ft] water depth for renewable energy, water depths between 10 and 30 m [33 and 98 ft] for marine minerals). Therefore, there would be no impact to MPAs from G&G survey activities under Alternative C.

Coastal Marine Protected Areas

G&G surveys involving seafloor disturbance could potentially affect benthic organisms, primarily invertebrates, in coastal MPAs. Overall, such impacts would be expected to be **negligible** in terms of potential impacts at the population level. Seafloor disturbance from G&G survey activities are unlikely to be allowed in coastal MPAs that contain submerged cultural or archaeological resources (e.g., shipwrecks such as the *Queen Anne's Revenge* and in artificial reefs). Therefore, seafloor disturbances are not likely to affect biological and archaeological resources in these coastal MPAs.

4.4.11.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on archaeological resources would be very similar to those analyzed for Alternative A (**Chapter 4.2.11.3**). The analysis concluded that a small spill at the sea surface would be unlikely to have any effect.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. A small diesel spill is expected to disperse and weather rapidly, with evaporation of volatile components. Such small spills are unlikely to significantly affect biota, habitats, and submerged cultural resources within each NMS and coastal MPAs. All survey activity would take place inshore of the deepwater MPAs; therefore, there would be no impacts within deepwater MPAs. Marine and coastal birds could possibly contact spilled fuel, which could cause injury or mortality. However, while individual birds may be oiled during a diesel spill, such impacts would be unlikely to affect marine and coastal birds at a population level. Impacts are expected to range between **negligible** and **minor**.

4.4.11.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.11.1** and **4.4.11.2** determined that activities projected to occur under Alternative C would result in **negligible** to **minor** impacts to MPAs as a result of active acoustic sound sources (i.e., electromechanical sources), seafloor disturbance, and accidental events. The same IPFs would contribute to the cumulative activities scenario under Alternative C. The cumulative activities scenario for MPAs, as outlined in **Chapter 4.2.11.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified negligible to minor incremental increases in impacts from all IPFs under Alternative A. Under the Alternative C cumulative activities scenario, G&G activity under the oil and gas program would not occur along with the associated impacts; active acoustic sound sources (i.e., airguns) and drilling discharge impacts would not occur. Therefore, impacts to MPAs would be slightly reduced, but this minor decrease would not modify the cumulative impacts determined under Alternative A. Negligible to minor incremental increases in impacts from all IPFs would occur under the cumulative scenario as a result of Alternative C.

4.4.12. Other Marine Uses

Under Alternative C, only activities for renewable energy development and marine minerals would occur. Applicable routine IPFs for other marine uses from renewable energy development and marine minerals activities are vessel traffic, onshore support activities, seafloor disturbance. Alternative C would not include any aeromagnetic surveys or installation of COST or shallow test wells; therefore, there would be no impacts from aircraft traffic or noise.

4.4.12.1. Impacts of Routine Activities

The elimination of oil and gas exploration under Alternative C would reduce the extent, severity, and timing of vessel traffic and seafloor disturbance; therefore, impacts for these IPFs would be incrementally decreased under Alternative C. Aircraft traffic and associated noise would be eliminated under Alternative C. Vessel traffic and seafloor disturbance are discussed below.

Vessel Traffic

Vessel traffic associated with G&G activities under Alternative C would increase in specific areas, thereby increasing the potential for interference with other marine uses such as shipping and marine transportation, military range complexes and civilian space program use, sand and gravel mining, ODMDSs, communication and research activities from bottom-founded structures, and known sea bottom obstructions. Under Alternative C, airguns would not be utilized, thus eliminating the vessel exclusion zones associated with airgun arrays and towed streamers. Renewable energy and marine minerals surveys typically involve only a single survey vessel, and vessel traffic would not be significantly increased when compared to existing vessel traffic in nearshore or offshore waters. Survey vessels related to renewable energy or marine minerals activities would be relatively small and are expected to make daily round trips to their shore base. The renewable energy scenario would require 4,255 vessel round trips for HRG surveys and 3,106-9,969 vessel round trips for geotechnical surveys over the 9-year timeframe analyzed in this Programmatic EIS. The marine minerals scenario would require 180 vessel round trips for HRG surveys and 93-615 vessel round trips for geotechnical surveys over the 9-year timeframe analyzed in this Programmatic EIS. If smaller ports are used for the smaller vessels (approximately 20 m [66 ft]) deployed for the types of surveys required for the renewable energy and marine mineral programs, there could be limited effects from the increased vessel traffic on port capacity, navigation into the port, and the potential for accidents. Impacts to large ports from G&G vessel traffic are expected to be **negligible**. Impacts on smaller ports are expected to range from **negligible** to **minor** and should be evaluated on a project-specific basis.

Seafloor Disturbance

Sources of seafloor disturbance that may result from G&G activities are bottom sampling (cores and grabs); placement of anchors, nodes, cables, or other bottom-founded equipment; and placement of anchored monitoring buoys (**Table 3-10**). Placement of equipment on the seafloor can and would damage areas where direct contact with the seafloor occurs.

The proposed action scenario indicates that individual grab samples, core samples, and bottom-founded meteorological buoys would affect a relatively small portion of the seafloor within the AOI (**Chapter 3.5.1.8**). As discussed in **Chapter 4.2.12.2**, the impacts from seafloor-disturbing activities were determined to be **negligible**. Most of the proposed activities under Alternative A that include bottom sampling are associated with the renewable energy and marine minerals program areas. The removal of the oil and gas exploration activities would only slightly reduce the overall number of bottom samples taken (50-300 samples) (**Table 3-4**), and all other seafloor-disturbing activities could still occur under Alternative C. Two activities under Alternative C (renewable energy development and marine minerals surveys) are consistent with the ongoing use of specific other marine uses (sand and gravel mining and renewable energy development), and one activity is in direct conflict with Alternative C (oil and gas exploration) and would not be occurring. These activities will not be analyzed in this discussion since activities consistent with or not occurring will not impact other marine uses.

G&G activities that could cause seafloor disturbance would not impact shipping and marine transportation. Coordination with DOD and NASA would occur for seafloor-disturbing activities or placement of bottom-founded equipment or structures (including requiring site-specific information) to reduce or eliminate potential impacts to military range complex and NASA areas; impacts to communication and research activities from bottom-founded structures would be **negligible**. The G&G activities that could cause seafloor disturbance would avoid ODMDSs. As a result, G&G activities would not impact ODMDSs. The BOEM would require site-specific information regarding potential archaeological resources and sensitive benthic communities (including hard/live bottom areas, deepwater coral communities, and chemosynthetic communities) prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. The BOEM would use this information to ensure that there are no physical impacts to archaeological resources and other sea bottom obstructions. Therefore, impacts to known sea bottom obstructions would be **negligible**.

4.4.12.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on recreational resources would be very similar to those analyzed for Alternative A (**Chapter 4.2.12.3**). The analysis concluded that a small spill at the sea surface would be unlikely to have any effect.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. A small diesel spill is expected to disperse and weather rapidly, with evaporation of volatile components. The impacts would depend on the size and location of the spill, in addition to the meteorological conditions. If a small diesel spill were to occur, it would have **negligible** impact on other marine uses, since it would only prohibit full use of a small area by other marine users for a very limited amount of time.

4.4.12.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.12.1** and **4.4.12.2** determined that activities projected to occur under Alternative C would result in negligible to minor incremental increases in impacts to other marine uses as a result of vessel traffic, aircraft traffic and noise, seafloor disturbance, and accidental events, depending on the IPF. The same IPFs would contribute to the cumulative activities scenario under Alternative C. The cumulative activities scenario for other marine uses, as outlined in **Chapter 4.2.12.4**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified incremental increases in impacts from all IPFs under Alternative A. Under Alternative C there would be no activities associated with oil and gas exploration, which would only slightly incrementally decrease the cumulative impacts. However, this small decrease in impacts from Alternative C would not change the overall cumulative impacts and would still result in negligible to minor incremental increases in impacts from vessel traffic, aircraft traffic and noise, seafloor disturbance, and accidental events.

4.4.13. Human Resources and Land Use

Under Alternative C, only activities for renewable energy development and marine minerals would occur. As discussed in **Chapter 4.2.13**, applicable routine IPFs for human resources and land use from renewable energy development and marine minerals activities are the potential effects of onshore support activities.

4.4.13.1. Impacts of Routine Activities

The elimination of G&G activities in support of oil and gas exploration under Alternative C would substantially lessen the number of vessels used and the potential effects to onshore support activities. In

Chapter 4.2.13.2, it was determined that, based on the projected level of G&G survey activity and associated demands for shore base space, supplies, and services, impacts from onshore activities on human resources and land use are expected to be **negligible**. Under Alternative C, only smaller vessels (<20-30 m [65-98 ft]) associated with the renewable energy and marine minerals programs would require onshore support facilities (**Chapters 3.3.2** and **3.4.2**). Although these vessels would typically return to port daily and use small crews, this is a reduction in the onshore support required for Alternative A; therefore, the impact would be unchanged (**negligible**).

4.4.13.2. Impacts of Accidental Fuel Spills

Under Alternative C, impacts of an accidental fuel spill on human resources and land use would be very similar to those analyzed for Alternative A (**Chapter 4.2.13.3**). The analysis concluded that a small spill at the sea surface would have a **negligible** impact on human resources and land use.

Alternative C would reduce the number of surveys and vessels because of the elimination of oil and gas activities, but this reduction would not substantially change the risk of a small fuel spill. Overall, the risk of a small fuel spill and the potential impacts on human resources and land use would be the same as under Alternative A and would be **negligible**.

4.4.13.3. Cumulative Impacts

Impact analyses presented in **Chapters 4.4.13.1** and **4.4.13.2** determined that activities projected to occur under Alternative C would result in negligible impacts to human resources and land use as a result of onshore support facility activities and accidental events. These IPFs would also contribute to the cumulative activities scenario under Alternative C. The cumulative activities scenario for human resources and land use, as outlined in **Chapter 3.6**, includes nine reasonably foreseeable activities in the AOI: (1) oil and gas development; (2) renewable energy development; (3) marine minerals use; (4) geosequestration; (5) LNG import terminals; (6) commercial and recreational fishing; (7) military range complexes and civilian space program use; (8) shipping and marine transportation; and (9) dredged material disposal. Two broader cumulative impact sources also were identified: (1) climate change and (2) cumulative noise in the sea. The cumulative impact analysis identified only negligible incremental increases in impacts from onshore facility activities and negligible to minor incremental increases in impacts for accidental events under Alternative A (**Chapter 4.2.13.4**). Under Alternative C there would be no G&G activities associated with oil and gas exploration, but this would not change the overall cumulative impacts, resulting in negligible incremental increases in impacts from onshore facility activities and negligible to minor incremental increases in impacts for accidental events under Alternative C.

4.5. OTHER NEPA CONSIDERATIONS

4.5.1. Unavoidable Adverse Impacts of the Proposed Action

NEPA regulations require an EIS to disclose any adverse environmental effects that cannot be avoided should the proposal be implemented (40 CFR 1502.16).

The use of airguns during seismic airgun surveys for oil and gas exploration and development would result in unavoidable Level B harassment of marine mammals and may cause behavioral responses in sea turtles and fishes. Mortality or injury to marine mammals and sea turtles is expected to be avoided to the maximum extent practicable through protective measures included in the proposed action, including time-area closures and operational mitigation measures as described in **Chapter 2** and **Appendix C**. However, some marine mammals may be exposed to sound levels that constitute Level A harassment and that may induce TTS or PTS.

During HRG surveys for characterization of renewable energy and marine minerals sites, the use of other acoustic sources such as side-scan sonars, boomer and chirp subbottom profilers, and multibeam depth sounders may cause behavioral responses in marine mammals that would also constitute Level B harassment. Mortality or injury to marine mammals and sea turtles is expected to be avoided through protective measures included in the proposed action, including time-area closures and operational mitigation measures as described in **Chapter 2** and **Appendix C**. It is highly unlikely that these animals would be exposed to sound levels that constitute Level A harassment (in marine mammals) or that may induce TTS or PTS during these HRG surveys. Some other unavoidable adverse effects on marine life would be expected to occur as a result of the proposed action. For example, seafloor-disturbing activities such as geological and geotechnical sampling and placement of bottom-founded equipment or structures would inevitably disturb soft bottom benthic communities. Impacts to sensitive benthic communities (such as coral, hard/live bottom, and chemosynthetic communities) are expected to be avoided, as BOEM would require site-specific information prior to approving any G&G activities involving seafloor-disturbing activities or placement of bottom-founded equipment or structures in the AOI. The magnitude of unavoidable benthic community impacts is expected to be negligible.

4.5.2. Irreversible and Irretrievable Commitment of Resources

NEPA regulations require an EIS to identify any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented (40 CFR 1502.16). Resources include renewable and nonrenewable natural resources, including fish and wildlife habitat. A commitment of resources is irreversible when project impacts limit the future options for a resource or cannot be reversed, except perhaps in the extreme long-term. It applies primarily to the effects of use of non-renewable resources, which are those resources that cannot be replenished by natural means, such as oil, natural gas, iron ore, and cultural resources. An irretrievable commitment refers to the use or consumption of a resource that is neither renewable nor recoverable (e.g., the disturbance of a cultural site) for use by future generations or is lost for a period of time.

The proposed action discussed in this Programmatic EIS would allow industry to conduct surveys to investigate the geology and geophysics of the seafloor within the AOI. In terms of renewable resources, the proposed action would not result in the destruction of marine resources such that the range of potential uses of the marine environment would be limited. Nonrenewable resources that would be consumed during the operation of survey vessels include fuel and oil. There would be no building or facility construction, so the consumption of materials typically associated with such construction (concrete, metal, sand, fuel, etc.) would not occur. Energy typically associated with construction activities would not be expended and irretrievably lost. The proposed surveys would also require a commitment of human labor and financial resources. Since the reuse of these resources may not be possible, they would be irreversibly and irretrievably committed as part of the proposed seismic airgun surveys. Nonetheless, commitment of these resources would not be expected to be significant. While cultural resources are distributed throughout the AOI, none would be irreversibly and irretrievably committed or lost should the proposed action be implemented. No critical habitat associated with threatened or endangered species would be lost as result of implementation of the proposed action.

4.5.3. Relationship Between Short-term Uses of the Environment and the Maintenance and Enhancement of Long-term Productivity

The NEPA regulations require an EIS to analyze the relationship between a project's short-term impacts on the environment and the effects those impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment (40 CFR 1502.16). Impacts that narrow the range of beneficial uses of the environment are of particular concern. The proposed G&G surveys would allow industry to investigate the geology and geophysics of the seafloor within the AOI. This action would require both short-term and long-term commitments of human labor and financial resources. Nonrenewable resources that would be consumed during the operation of seismic research vessels include fuel and oil. The planned monitoring and mitigation measures, which include avoiding sensitive habitats and/or seasons, visual monitoring, and safety radii, would all serve to minimize the effects of the proposed surveys. The majority of effects from G&G surveys would be temporary in nature. As a result, implementation of the proposed action would not result in any environmental impacts that would significantly affect the maintenance and enhancement of long-term productivity of the marine environment.

CHAPTER 5

CONSULTATION AND COORDINATION

5. CONSULTATION AND COORDINATION

5.1. DEVELOPMENT OF THE PROPOSED ACTION

The BOEM has prepared this Draft Programmatic EIS to evaluate reasonably foreseeable G&G survey activities in Federal and State waters of the Mid- and South Atlantic OCS for three program areas: oil and gas, renewable energy, and marine minerals. The BOEM conducted early coordination with appropriate Federal and State agencies and other concerned parties to develop the proposed action in this Draft Programmatic EIS. Key agencies and organizations were contacted, including the NMFS. Based on the information and analysis presented in **Chapter 4**, this Programmatic EIS presents the environmental impacts of the proposed action and the alternatives in comparative form, defining the issues and providing a clear basis for choice among options by decisionmakers and the public.

5.2. NOTICE OF INTENT TO PREPARE A PROGRAMMATIC EIS

The NOI to prepare a Programmatic EIS was published in the *Federal Register* on January 21, 2009 (*Federal Register*, 2009a). The NOI included a Call for Interest to industry to solicit information on any potential interest for future G&G activities on the Atlantic OCS. The comment period on the initial NOI closed on March 23, 2009; however, this Agency did not move forward on the Programmatic EIS at that time. On April 2, 2010, a *Federal Register* notice was published announcing the reopening of the public comment period for the Programmatic EIS and listing the dates, times, and locations (**Chapter 5.3**) of public scoping meetings (*Federal Register*, 2010c). The public comment period closed on May 17, 2010.

5.3. DEVELOPMENT OF THE DRAFT PROGRAMMATIC EIS

The BOEM prepared this Draft Programmatic EIS as lead agency and NOAA as cooperating agency in accordance with CEQ regulations implementing NEPA (40 CFR 1502.20), USDOI Implementing Procedures for NEPA (*Federal Register*, 2008e), and NOAA procedures for implementing NEPA (USDOC, NOAA, 1999).

The BOEM initiated the scoping process to assist with the identification of relevant environmental issues to be analyzed in this Programmatic EIS. The process was used to identify and eliminate from further detailed study issues that are not significant or that have been covered by prior environmental review, or that did not meet the purpose and need for the proposed action. The scoping process was directed at Federal, State, local, and tribal governments; commercial interests; environmental groups; and the general public.

Public scoping meetings were held for the purpose of soliciting comments from stakeholders on the scope of the Programmatic EIS, identifying issues to be analyzed, and identifying possible alternatives and mitigation measures. In addition to accepting oral and written comments at each public meeting, BOEM accepted written comments by mail and through a dedicated email address. The locations and dates were as follows:

Houston, Texas
Tuesday, April 20, 2010
Marriott Houston Intercontinental Hotel
George Bush Intercontinental Airport
One meeting

Jacksonville, Florida
Wednesday, April 21, 2010
Marriott Hotel
4760 Salisbury Road,
Two meetings

Savannah, Georgia
Friday, April 23, 2010
Coastal Georgia Center
305 Fahm Street
Two meetings

Newark, New Jersey
Tuesday, April 27, 2010
Sheraton Newark Airport Hotel
Two meetings

North Charleston, South Carolina
Tuesday, April 27, 2010
Embassy Suites
5055 International Boulevard
Two meetings

Norfolk, Virginia
Thursday, April 29, 2010
Hilton Norfolk Airport
1500 N. Military Highway
Two meetings

Wilmington, North Carolina
Thursday, April 29, 2010
Hilton Wilmington Riverside
301 North Water Street
Two meetings

5.3.1. Comments Received During Scoping

During the initial scoping period, January 21, 2009 to March 23, 2009, BOEM received 17 email comments from State agencies (6), non-governmental interest groups (5), industry operators (2), geophysical contractors (3), and a member of the public. For the second scoping period, April 2, 2010 to May 17, 2010, BOEM received a total of 965 comments through email (75%), formal letters (18%), and public meeting testimony (7%). The latter included both oral and written comments submitted at the public meetings. Comments were received from individuals and organizations in 49 U.S. states and two foreign countries (Canada and France). Most of the comments were received from private citizens. Other sources included Federal, State, and local government agencies, members of Congress, and other stakeholders. The Other Stakeholders category comprises representatives from environmental groups, industry groups and companies, engineering and consulting firms, and oil and gas companies.

A total of 798 comments was received that expressed concerns, issues, or recommendations specific to G&G activities (123) and comments relating to both offshore drilling activities and G&G activities (675). Of these comments, 80 percent were opposed to G&G activities, 13 percent supported them, and 7 percent were neutral. Many of the comments cited broad concerns; comments that focused on particular resources generally fell into one of three categories: (1) biological resources; (2) socioeconomics, cultural resources, and other marine uses; and (3) recommendations for alternatives or mitigation to be considered in the Programmatic EIS. See **Figure 5-1** for a distribution of comments by state of origin.

The scope and content of the Programmatic EIS have been formulated to ensure the issues and concerns expressed by stakeholders during the scoping process have been fully addressed.

5.3.2. Cooperating Agency

The BOEM is required, per 43 CFR 46.225, to invite eligible government entities to participate as cooperating agencies during the development of an environmental impact statement. As defined by CEQ regulations (40 CFR 1508.5), a cooperating agency may be any Federal agency that has jurisdiction by law or special expertise with respect to environmental impacts expected from a proposal. The NOI, published on January 21, 2009, issued an invitation to other Federal agencies and State, tribal, and local governments to consider becoming cooperating agencies in the preparation of the Programmatic EIS. During the 2009 scoping period, BOEM received no expressions of interest by any Federal, State, or local government agency having jurisdiction or special expertise with respect to becoming a cooperating agency.

It has been this Agency's practice to invite interest in cooperating agency relationships in the Notice of Intent to prepare an EIS that is published in the *Federal Register*. The BOEM also issued letters (included in **Appendix K**) on March 18, 2011, to the Northeast and Southeast regional offices of NMFS inviting the agency to participate as a cooperating agency in the preparation of the Programmatic EIS. The NMFS responded in a letter dated April 25, 2011 (also included in **Appendix K**), expressing interest in serving in that capacity through the NEPA process. The nature and scope of the proposed action involving the use of acoustic sources and the potential impacts to marine resources under the jurisdiction of the NMFS, particularly marine mammals and sensitive marine species, including those listed or proposed for listing as threatened or endangered under the ESA, led to NMFS's decision to participate as a cooperating agency.

An MOA delineating the roles and responsibilities of each agency was signed December 12, 2011 by BOEM and January 3, 2012 by NMFS (also included in **Appendix K**). The MOA defines the respective roles and responsibilities of BOEM and NMFS in the development of the Programmatic EIS. In addition to the regulations and requirements discussed elsewhere in this document, this Programmatic EIS has been reviewed by NMFS in accordance with applicable USDOC guidelines (USDOC, NOAA, 1999).

On April 7, 2011, BOEM headquarters contacted by email an extended contact list of COE representatives in East Coast offices and explained the proposed action that BOEM was preparing to evaluate in this Programmatic EIS.

On April 27, 2011, BOEM's NEPA coordinator for this Programmatic EIS contacted Daniel Small of the COE South Atlantic Division office in Atlanta, Georgia, by telephone and follow up email the same day to provide a schedule and other supporting information that acquainted the COE with the proposed action BOEM was evaluating and to ask if the COE was interested in exploring the possibility of becoming a cooperating agency for this NEPA evaluation.

On May 5, 2011, headquarters staff and the NEPA coordinator teleconferenced with Joseph Wilson and Daniel Small of the COE to answer questions about the NEPA evaluation and to be sure there were no further questions.

On May 16, 2011, BOEM headquarters contacted Daniel Small, Joseph Wilson, and Henry Wicker of the COE to provide additional information as follow-up to the May 5 teleconference. Finally, on May 17, 2011, Jill Lewandowski was identified to Daniel Small, Megan Gaffney-Smith, John Furry, Katherine Trott, Henry Wicker, and Joseph Wilson as BOEM's point of contact for this NEPA evaluation if there were any questions. The BOEM has had no contact with the COE regarding this evaluation after May 17.

On August 10, 2011, BOEM's Gulf of Mexico region staff contacted Janet Mizzi, Ken Graham, and Glenn Smith of FWS by email to ask if FWS wished to discuss the possibility of becoming a cooperating agency and any questions about the associated ESA Section 7 consultation that would accompany the NEPA process. No response was received from the FWS.

5.4. DISTRIBUTION OF THE DRAFT PROGRAMMATIC EIS FOR REVIEW AND COMMENT

The BOEM will provide copies of the Draft Programmatic EIS to the following public and private agencies and groups, and Indian Tribes. Tribal nations along the Atlantic seaboard from Massachusetts to Florida were contacted in the spirit of the recent DOI Tribal consultation policy (USDOI, 2011b). Local libraries in the seven states adjacent to the area of interest, also listed below, will be provided copies of this document. To initiate the public review and comment period on this Draft Programmatic EIS, BOEM published a Notice of Availability in the *Federal Register*, and public notices will be mailed with this Draft Programmatic EIS and will be placed on the BOEM Internet website. All comments received on the Draft Programmatic EIS will be considered during preparation of the Final Programmatic EIS.

Federal Agencies

Congress
- Congressional Budget Office
- House Resources Subcommittee on Energy and Mineral Resources
- Senate Committee on Energy and Natural Resources

Department of Commerce
- National Oceanic and Atmospheric Administration
  - Silver Spring, Maryland
- National Marine Fisheries Service
  - Silver Spring, Maryland
  - St. Petersburg, Florida
  - Miami, Florida
  - Monitor NMS
  - Gray's Reef NMS
- National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, Silver Spring, Maryland

Department of Defense
- Department of the Air Force
- Department of the Army
- Corps of Engineers
- Department of the Navy
  - Office of Naval Research

Department of Energy
- Strategic Petroleum Reserve PMD

Department of the Interior
- Bureau of Ocean Energy Management
  - OCS Regions, Office of Environment
  - Headquarters, Environmental Division
  - Headquarters, Resource Evaluation Division
- Fish and Wildlife Service
  - Jacksonville, Florida
  - Washington, D.C.
- Geological Survey
- National Park Service
- Office of Environmental Policy and Compliance
- Office of the Solicitor

Department of State
- Coast Guard
- Department of Transportation
- Environmental Protection Agency
  - Region 3
  - Region 4
- Marine Mammal Commission
- National Aeronautics and Space Administration
  - Wallops Island Flight Facility
- Office of Environmental Protection
- Office of Pipeline Safety

State and Local Agencies

Delaware
- Governor's Office
- Delaware Coastal Management Program
- Delaware Department of Natural Resources and Environmental Control

Maryland
- Governor's Office
- Department of Natural Resources

Virginia
- Governor's Office
- Department of Environmental Quality
- Department of Mines, Minerals, and Energy

North Carolina
- Governor's Office
- Coastal Resources Commission
- Department of Environmental and Natural Resources

South Carolina
- Governor's Office
- Department of Health and Environmental Control-Office of Ocean and Resource Management

Georgia
- Governor's Office
- Department of Natural Resources

Florida
- Governor's Office
- Bureau of Archaeological Research
- Department of Community Affairs
- Department of Environmental Protection

Libraries

Repository libraries for Government documents will be provided a copy of the Draft Programmatic EIS if the document is in accord with the library's selection criteria for items received from the U.S. Government Printing Office.

Industry

American Petroleum Institute
American Exploration and Production Council
BP Offshore Exploration and Production Operations
Chevron U.S.A.
CGGVeritas
Coastal Technology Corporation
Ecology & Environment Inc.
Exxon Mobil Corporation
Florida Petroleum Council
Fugro
Geo-Marine, Inc.
Georgia Petroleum Council
Halliburton Energy Services
Independent Petroleum Association of America
International Association of Geophysical Contractors
International Association of Drilling Contractors
ION GX Technology
Natural Gas Supply Association
National Ocean Industry Association
New Jersey Petroleum Council
North Carolina Petroleum Council
PBS&J

Piedmont Natural Gas Company
Petroleum Equipment Suppliers Association
Schlumberger-Western Geco
Shell Exploration
Shell North Atlantic Exploration Group
South Carolina Petroleum Council
Southeast Energy Alliance
Taylor Engineering, Inc.
TetraTech
TGS
U.S. Oil and Gas Association
Virginia Offshore Wind Coalition
Virginia Petroleum Council
Western Geco

Special Interest Groups and Non-Government Organizations

American Littoral Society
Americans for Prosperity
Cape Fear River Watch
Center for a Sustainable Coast
Chesapeake Bay Foundation
Chesapeake Bay Group
Citizens for Sound Conservation
Clean Ocean Action
Coastal Conservation League
Consumer Energy Alliance
CPE-Coastal Planning and Engineering
Defenders of Wildlife
Duval Audubon Society
Eastern Shore Defense Alliance
Environment New Jersey
Environment North Carolina
Hampton Roads Chamber of Commerce
Kiawah Conservancy
Legacy Offshore
Natural Resources Defense Council
New Jersey Sierra Club
North Carolina Coastal Federation
Oceana
Pender Watch and Conservancy
Save the Manatee Club
Sierra Club
Southern Environmental Law Center
Surfrider Foundation
The Nature Conservancy
Women's International League for Peace and Freedom

Ports/Docks

Port of Virginia
North Carolina State Ports Authority
South Carolina Ports Authority
Georgia Ports Authority
Jacksonville Port Authority
Canaveral Port Authority

Academic Institutions

Massachusetts Institute of Technology
University of California, Berkeley
Woods Hole Oceanographic Institution
University of Georgia
Duke University
Virginia Institute of Marine Sciences
University of Delaware
Skidaway Institute of Oceanography

Indian Tribe or Organization

Seminole Tribe of Florida
Miccosukee Tribe
Catawba Indian Nation
Eastern Band of Cherokee Indians
Tuscarora Nation
Tonawanda Band of Seneca
Seneca Nation of Indians
Saint Regis Mohawk Tribe
Onondaga Nation
Oneida Indian Nation
Cayuga Nation
Shinnecock Indian Nation
Mohegan Indian Tribe
Mashantucket Pequot Tribal Nation
Narragansett Indian Tribe
Mashpee Wampanoag Tribe
Wampanoag Tribe of Gay Head (Aquinnah)

5.5. PUBLIC HEARINGS

The Draft Programmatic EIS contains BOEM's data/information, analysis, and conclusions that are now available for review and comment. The BOEM will, in accordance with 30 CFR 556.26, hold public hearings to solicit comments on the Draft Programmatic EIS. The hearings will provide the Secretary of the Department of the Interior with information from interested parties to help in the evaluation of the effects of the proposed action. Five public hearings are scheduled to receive written and oral comments in the following cities identified below. An announcement of the dates, times, and specific locations for the public hearings will be included in the Notice of Availability for the Draft Programmatic EIS.

- Jacksonville, Florida;
- Savannah, Georgia;
- Charleston, South Carolina;
- Norfolk, Virginia; and
- Wilmington, North Carolina.

5.6. COASTAL ZONE MANAGEMENT ACT

The CZMA (16 U.S.C. 1451 et seq.) was enacted by Congress to protect the coastal environment from increasing demands associated with commercial, industrial, recreational, and residential uses, including State and Federal offshore energy development. Provisions in the CZMA help the States develop coastal management programs (CMPs) to manage and balance competing uses of the coastal zone. All of the Atlantic States have approved CMPs (see **Appendix B** for more information). Requirements for the CZM consistency information are based on the approval of listed activities according to NOAA's Office of Coastal and Resource Management. If the activity is unlisted, the State must go through the process of the Office of Coastal and Resource Management approving a State's unlisted activity request on a case-by-case basis (15 CFR 930.54). Federal agencies must follow the Federal consistency provisions delineated in 15 CFR 930.

There are several standards of "Federal consistency." Federal agency activities must be "consistent to the maximum extent practicable" with relevant enforceable policies of a State's federally approved CMP (15 CFR 930 Subpart C) (e.g., OCS lease sales, renewable energy competitive lease sales, and marine minerals negotiated competitive agreements). Private activities that require a Federal permit or license must be "fully consistent" with enforceable policies (15 CFR 930 Subpart D) (e.g., G&G permits, renewable energy non-competitive permitted activities, and negotiated non-competitive marine minerals agreement). The OCS plan activities must be "fully consistent" with enforceable policies (15 CFR 930 Subpart E) (e.g., exploration, development, and production activities, and renewable energy competitive plan). Many G&G ancillary seismic activities under 30 CFR 550 require the preparation of an OCS plan that would be reviewed pursuant to 15 CFR 930, Subpart E. See the "Frequently Asked Questions for Ancillary Activities" document (USDOI, BOEM, 2011o) for a list of activities that require the preparation of an OCS plan. If an activity will have direct, indirect, or cumulative effects, the activity is subject to Federal consistency.

For oil and gas related activities, a G&G permit must be obtained from BOEM prior to conducting off-lease geological or geophysical exploration or scientific research on unleased OCS lands or on lands under lease to a third party (30 CFR 551.4 (a) and (b)). Geological investigations include various seafloor sampling techniques to determine the geochemical, geotechnical, or engineering properties of the sediments. The G&G activities conducted by another Federal agency are not subject to BOEM authorization. Under the EPAct of 2005, BOEM does not have authority to regulate survey activities conducted off-lease and there is no requirement for a G&G permit to be obtained from BOEM for conducting renewable energy survey activities.

Ancillary activities are defined in 30 CFR 550.105 with regulations outlined in 30 CFR 550.207 through 550.210. Ancillary activities are activities conducted on-lease and include G&G exploration and development G&G activities; geological and high-resolution geophysical, geotechnical, archaeological, biological, physical oceanographic, meteorological, socioeconomic, or other surveys; or various types of modeling studies. This Agency issued NTL 2009-G34, "Ancillary Activities," to provide updated guidance and clarification on conducting ancillary activities in BOEM's Gulf of Mexico OCS Region. While there is not an NTL in place regarding Ancillary Activities, for the Atlantic Region it is suggested that the operator review NTL 2009-G34 as a method of general guidance for the permitted activity process.

The CZMA places requirements on any applicant for an OCS plan that describes in detail Federal license or permit activities affecting any coastal use or resource, in or outside of a State's coastal zone. The applicant must provide in the OCS plan submitted to BOEM a consistency certification and necessary data and information for the State to determine that the proposed activities comply with the enforceable policies of the State's CMP, approved by NOAA, and that such activities will be fully consistent with those enforceable policies (16 U.S.C. 1456(c)(3)(A) and 15 CFR 930.76).

In accordance with the requirements of 15 CFR 930.76, the BOEM sends copies of an OCS plan, including the consistency certification and other necessary data and information, to the designated State CMP agency by receipted mail or other approved communication. If no State-agency objection is submitted by the end of the consistency review period, BOEM shall presume consistency concurrence by the State (15 CFR 930.78(b)). The BOEM can require modification of a plan.

If BOEM receives a written consistency objection from the State, BOEM will not approve any activity described in the OCS plan unless (1) the operator amends the OCS plan to accommodate the objection and concurrence is subsequently received or conclusively presumed; (2) upon appeal, the Secretary of Commerce, in accordance with 15 CFR 930 Subpart H, finds that the OCS plan is consistent with the objectives or purposes of the CZMA or is necessary in the interest of national security; or (3) the original objection is declared invalid by the courts.

5.7. ENDANGERED SPECIES ACT

To initiate the formal consultation process under Section 7 of the ESA, BOEM will submit a draft BA to NMFS and FWS. In the BA, BOEM has made a determination regarding the affect of the proposed action on listed species and their critical habitats. In December 2011 this Agency received comments from NMFS on our draft BA and we are in the process of responding to them or amending it to begin the consultation.

If, after reviewing the BA, NMFS and FWS determine that listed species are likely to be adversely affected, they will issue a BO that will include any recommendations or modifications to the proposed action, terms and conditions, and protective measures. If the conclusion of the BO is that the proposed action is not likely to jeopardize the continued existence of listed species or destroy or adversely modify critical habitat, NMFS will issue an ITA that exempts the take of listed species from ESA take prohibitions. The BO is expected to be included as an appendix in the Final Programmatic EIS.

5.8. MARINE MAMMAL PROTECTION ACT

While this document contains extensive information about the study area relevant to an application for an ITA, including estimates of incidental take of marine mammals, its review of G&G activities is programmatic in nature and therefore will not result in an application for an ITA under Section 101(a)(5) of the MMPA. Operators will be required to obtain ITAs as necessary in conjunction with BOEM authorization. This document shall serve as a reference for environmental documentation regarding future site-specific actions.

5.9. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The proposed action may adversely affect EFH, defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." Therefore, BOEM must consult with the Secretary of Commerce, through NMFS and the appropriate FMC, regarding potential effects to EFH. As part of the streamlined EFH consultation process, BOEM will request consultation under the Magnuson-Stevens FCMA in conjunction with this Programmatic EIS. **Table 5-1** identifies the locations within this document for the critical elements of the EFH assessment. It is anticipated that the EFH consultation process will be completed within the time frame of the NEPA process. The Programmatic EIS contains information relevant and applicable to support future consultations on EFH for site-specific G&G actions.

5.10. NATIONAL MARINE SANCTUARY ACT

Section 304(d) of the NMSA requires that Federal agencies consult with NOAA'S ONMS for any Federal action internal or external to an NMS that is "likely to destroy, cause the loss of, or injure a sanctuary resource." There is a small likelihood that an NMS in the AOI could be affected by G&G activity at some point within the proposed action scenario. The BOEM does not allow direct impacts, such as from bottom disturbing activity within NMSs, but seismic activity permitted in proximity to an NMS may indirectly affect animals in the NMS. The proposed action may adversely affect areas protected by the NMSA, such as Gray's Reef NMS, in which case BOEM must consult with the ONMS regarding potential effects on a NMS.

Table 5-1 identifies the locations within this document for the critical elements of the EFH assessment. In the Gulf of Mexico, even for the wide-ranging activity consequent to an OCS lease sale, consultations under the NMSA are included as part of EFH consultations because the information needs are so similar. The BOEM has a similar expectation for a programmatic level NMSA consultation in the Atlantic AOI. **Table 5-2** identifies the locations within this document for critical elements of an NMSA assessment. When specific proposed actions for G&G activity are before BOEM, the need for a specific NMSA Section 304(d) consultation will be addressed. At the programmatic level it is anticipated that the NMSA consultation will be completed as part of the EFH consultation for this NEPA evaluation. The Programmatic EIS contains information relevant and applicable to support future consultations on the NMSA for site-specific G&G actions.

Chapter 6

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CHAPTER 7

PREPARERS

7. PREPARERS

7.1. BOEM PREPARERS AND REVIEWERS

Preparers

Gary D. Goeke, Chief, Regional Assessment Section

Thomas Bjerstedt, Lead NEPA Coordinator, Physical Scientist
Perry Boudreaux, Assisting NEPA Coordinator, Biologist
Jill Lewandowski, Headquarters' Coordinator, Protected Species

Roger Amato, Geologist, Marine Mineral Scenario
Ron Brinkman, Geophysicist, Technologies and Oil and Gas Scenario
Michael Celata, Deputy Regional Supervisor, Resource Evaluation
Deborah Epperson, Protected Species Issues
Brian Hooker, Environmental Scientist, Renewable Energy Scenario
Rebecca Murphy, Geologist, Oil and Gas Scenario
Cina Poyer, Geologist, Oil and Gas Scenario
Kimberly Skrupky, Protected Species Issues
Domenic Smith, Geologist, Oil and Gas Scenario
Geoff Wikel, Oceanographer, Marine Mineral Scenario

Reviewers

Bob Cameron, Meteorologist
Brian Cameron, Environmental Scientist
Sindey Chaky, Social Scientist
Dennis Chew, Marine Biologist
Jeff S. Gleason, Biologist
Donald (Tre) W. Glenn III, Marine Biologist
Larry M. Hartzog, Environmental Scientist
Chin Hua (Chester) Huang, Meteorologist
Jack Irion, Supervisor, Social Sciences Unit
Mark Jensen, Economist
Doug Jones, Marine Archaeologist
Agatha (Arie) Kaller, Marine Biologist
Alexis Lugo-Fernandez, Oceanographer
Margaret Metcalf, Supervisor, Physical Science Unit
Deborah H. Miller, Technical Editor
Megan Milliken, Environmental Protection Specialist
Maureen M. Mulino, Marine Biologist
Michelle Nannen, Marine Biologist
Catherine A. Rosa, Environmental Assessment Program Specialist
James Sinclair, Marine Biologist
Odin Smith, Solicitor's Office
Sally Valdes, Biologist

7.2. CONTRACTOR PREPARERS

Name	Education/Expertise	Contribution
CSA International, Inc.		
William R. Sloger, Jr.	M.S. Environmental Studies, M.S. Civil Engineering, B.S. Civil Engineering; 20 years of experience	Project Manager; Co-author Chapters 1 and 5
Kimberley R. Olsen	B.S. Oceanographic Technology; 23 years of experience	Assistant Project Manager; Co-author Chapter 4 (Marine and Coastal Birds, Benthic Communities) and Appendices A and B
Brian J. Balcom	M.S. Marine Biology, B.S. Biology; 29 years of experience	Lead Impacts Analyst; Co-author Chapters 2, 3, and 4
Neal W. Phillips	Ph.D. Ecology, M.S. Marine Studies, B.S. Biological Sciences; 28 years of experience	Scientific Editor; Co-author Chapters 1, 2, 3, and 4 and Appendices A and C
Robert B. Cady	M.S. Oceanography, B.S. Marine Biology; 15 years of experience	Co-author Chapter 4 (Other Marine Uses) and Appendix B
Debra K. Fawcett	M.S. Marine Science, B.A. Biology; 11 years of experience	Co-author Chapter 4 (Benthic Communities)
Luis M. Lagera, Jr.	Ph.D. Environmental Sciences (Ecology), M.S. Biological Sciences, B.S. Zoology; 20 years of experience	Co-author Chapter 4 (Marine Protected Areas) and Appendix F
David B. Snyder	M.S. Marine Biology and Ichthyology, B.S. Zoology; 27 years of experience	Co-author Chapter 4 (Fisheries and EFH, Threatened and Endangered Fish Species, Commercial Fisheries, Recreational Fisheries) and Appendix A
Stephen T. Viada	M.S. Biological Oceanography, B.S. Zoology; 27 years of experience	Co-author Chapter 4 (Marine Mammals, Sea Turtles, Marine and Coastal Birds) and Appendix A
Kristen L. Metzger	M.A. Library and Information Science, B.A. Library Science/Education; 36 years of experience	Administrative Record, Librarian
Keith B. VanGraafeiland	B.S. Geography; 10 years of experience	GIS Analyst
Christopher L. Dean	B.A. Geography; 7 years of experience	GIS Specialist
Melody B. Powell	B.S. Zoology; 21 years of experience	Senior Technical Editor
Danielle Johnson	B.S. Interdisciplinary Social Science; 3 years of experience	Technical Editor
Karen Stokesbury	15 years of experience	Lead Word Processor and Document Production Coordinator
Marine Acoustics, Inc.		
Stanley J. Labak	M.S. Ocean Engineering, B.S. Ocean Engineering; 33 years of experience	Acoustic Impact/Take Analysis; Co-author Appendix E
Kathleen J. Vigness-Raposa	Ph.D. Landscape Ecology, M.S. Biological Oceanography, B.S. Education; 17 years of experience	Marine Biology; Marine Mammal Densities; Co-author Appendix A
Adam S. Frankel	Ph.D. Oceanography, M.S. Zoology, B.S. Biology; 27 years of experience	Acoustic Propagation and AIM Modeling; Co-author Appendix E

Name	Education/Expertise	Contribution
SEARCH		
Paul G. Sjordal	M.A. Anthropology, B.A. Anthropology; 12 years of experience	Principal Investigator; Co-author Chapter 4 (Archaeological Resources)
Jason M. Burns	M.A. History/Historical Archaeology, B.A. Anthropology; 15 years of experience	Project Manager; Co-author Chapter 4 (Archeological Resources)
Jeffrey M. Enright	M.A. Maritime History, B.A. Anthropology; 14 years of experience	GIS Specialist; Co-author Chapter 4 (Archaeological Resources)
ICF International, Inc.		
Erin A. Healy	M.S. Marine Science, B.A. Geology/Biology; 21 years of experience	Author Chapter 4 (Recreational Resources)
Alex Uriarte	Ph.D. Development Studies, M.S. Economics, B.A. Economics; 13 years of experience	Author Chapter 4 (Human Resources and Land Use)
JASCO		
Mikhail Zykov	Ph.D. Geophysics, M.S. Geology, B.S. Geology; 5 years of experience	Author Appendix D
Terry Deveau	M.S. Acoustics, B.S. Mathematics; 26 years of experience	Co-author Appendix D
Nicole Chorney	B.S. Combined Honours Physics and Astronomy, Mathematics minor; 5 years of experience	Co-author/Technical Editor Appendix D
Southall Environmental Associates, Inc.		
Brandon Southall	Ph.D. Ocean Sciences, M.S. Marine Science, B.A. Environmental Biology, B.A. English; 17 years of experience	Author Appendix H
University of Maryland		
Arthur Popper	Ph.D. Biology, B.A. Biology; 35 years of experience	Author Appendix J
Virginia Wesleyan College		
Soraya Moein Bartol	Ph.D. Marine Science, M.S. Marine Science, B.A. Biology; 19 years of experience	Author Appendix I

CHAPTER 8

GLOSSARY

8. GLOSSARY

Acoustics: The scientific study of sound, especially of its generation, transmission, and reception.

Acoustic backscatter device: Instrument that uses sound waves to collect measurement data to generate images (e.g., of the seafloor).

Acoustic Integration Model (AIM©): An animal movement and acoustics model that integrates information on the estimated propagation of sound from an underwater acoustic source and on the assumed movement patterns of simulated animals (animats) to predict the exposure of animats to underwater sound propagating through space and time.

Acute: Sudden, short term, severe, critical, crucial, intense, but usually of short duration.

Airgun: A pneumatic device used as an acoustic source to acquire marine seismic data. It is submerged below the water surface and towed behind a ship, usually as part of an array consisting of a number of airguns (i.e., airgun array).

Air quality: Assessment of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances. Air quality standards are the prescribed levels of substances in the outside air that cannot be exceeded during a specific time in a specified area.

Alternative: In the context of a NEPA document (i.e., an EA or EIS), a different method for accomplishing the Proposed Action. As examples, an alternative can consist of the same action in a different location, or the use of different mitigation measures.

Alternative energy: see *Renewable energy*.

Ambient noise: The typical or persistent environmental background noise present in the ocean, with contributions from natural sources (wind, waves, rain, animal sounds, earthquakes, etc.) and, often, from distant and indistinguishable anthropogenic sources such as shipping. Sound from specific nearby anthropogenic activities is usually not considered to be part of the ambient noise.

Ambient ocean noise: The sound profile within the ocean composed of both far and near sound sources of both natural and anthropogenic origin. Ambient ocean noise is also referred to as environmental background noise.

Amplitude: The maximum absolute value of a periodic curve measured along its vertical axis. For sound waves, it is the maximum amount that the wave's pressure differs from ambient pressure in the medium through which the sound wave is propagating.

Anadromous: Species of fish that are born in fresh water, migrate as juveniles to the ocean and grow into adults, and then return to fresh water to spawn.

Anthropogenic: Coming from human sources, relating to the effect of humankind on nature.

Anthropogenic noise: Noise related to or produced by human activities.

Anticyclone: Clockwise-rotating eddies in oceans of the northern hemisphere. Anticyclones generally migrate westward and transport large quantities of high-salinity, nutrient-poor water across the near-surface waters of the northern Gulf.

Array: The layout or arrangement of objects in a specific pattern, often in rows and columns.

Attenuation: Reduction; in this document, reduction of the level or intensity of sound.

Baleen whales: Whales with parallel rows of fibrous plates that hang from the upper jaw and are used for filter feeding. Also known as mysticetes (see *Mysticete*).

Barrel (bbl): A volumetric unit used in the petroleum industry; equivalent to 42 U.S. gallons or 158.99 L.

Bathymetry: The water depth at various places in a body of water; the information derived from measurements to determine water depth.

Bathypelagic: Pertaining to the subzone of the pelagic zone that generally includes waters deeper than 1,000 m. (3,300 ft). At this depth, there is little to no light, and photosynthesis is not possible. Consequently, there are no living plants, and most animals survive by consuming detritus falling from the pelagic zones above or by preying on other animals.

Behavioral effect: Defined in this Programmatic EIS as a change in an animal's behavior or behavior patterns that results from exposure to some stimulus (e.g., an anthropogenic acoustic exposure) and exceeds some defined criterion (e.g., extends beyond the range of normal daily variation in behavior).

Benthic: Referring to the bottom-dwelling community of organisms that live on or in either the sea bottom.

Biota: The combined flora and fauna of a region.

Biological Opinion: An FWS or NMFS evaluation of the impact of a proposed action on endangered and threatened species, in response to formal consultation under Section 7 of the ESA.

Block: A geographical area portrayed on official BOEM protraction diagrams or leasing maps that contains approximately 2,331 ha (9 mi^2).

Blowout: Uncontrolled flow of fluids from a wellhead or wellbore.

Boomer: A low-energy towed device used as an acoustic source to acquire marine seismic data. The acoustic pulse is generated when an electrical signal discharges a capacitor bank causing two spring-loaded, electrically charged plates in the boomer transducer to repel, creating a precisely repeatable pressure pulse primarily directed downward to the seafloor.

Bycatch: Nontarget organisms caught in fishing or other harvest operations and usually discarded.

Candidate species: Plants and animals for which FWS has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA but for which development of a listing regulation is precluded by other higher-priority listing activities.

Cape (spit): A type of sand bar or beach that is built out from the shore by deposition of sediment (typically sand) carried in the longshore current; these landforms have a characteristic "hook" shape when viewed from above (e.g., Cape Cod).

Catadromous: Term used to describe fishes that spend most of their adult lives in freshwater but migrate to the marine environment to spawn.

Cavitation: The sudden formation and subsequent collapse of low-pressure bubbles of air in fluids that are moving as a result of applied mechanical forces. The phenomenon of cavitation is the single largest contributor to underwater sound from ship propellers.

Cetacea or cetacean: An order of aquatic mammals including baleen whales (see *Mysticetes*) and toothed whales, dolphins, and porpoises (see *Odontocetes*).

Chemosynthetic: Organisms that obtain their energy from the oxidation of various inorganic compounds rather than from light (photosynthetic).

Chirp system: Chirp refers to a variety of pulsed sonar systems capable of conducting high-resolution reflection profiling of the subbottom using low energy acoustic sources with a nominal frequency range of a few kilohertz up to several tens or hundreds of kilohertz. Often chirp data are collected by sweeping through a range of frequencies in a single pulse, but some systems referred to as chirp may be associated with only a single frequency.

Clastic: Sediments composed of pieces of pre-existing rock.

Clathrate: Layer of frozen gas hydrate on the seafloor.

Clean Air Act (CAA): An act that establishes NAAQS for six criteria pollutants: SO_x, NO_2, CO, O_3, PM_{10} and $PM_{2.5}$, and Pb. Collectively, the criteria pollutants are indicative of the quality of the ambient air. The Act requires facilities to comply with emission limits or reduction limits stipulated in State Implementation Plans. Under this Act, construction and operating permits, as well as reviews of new stationary sources and major modifications to existing sources, are required. The Act also prohibits the Federal Government from approving actions that do not conform to SIPs.

Clean Water Act (CWA): An act that requires NPDES permits for discharges of effluents to surface waters, permits for stormwater discharges related to industrial activity, and notification of oil discharges to navigable waters of the U.S.

Coastal: An imprecise area of land and water located at the interface between the shore and the ocean, where physical, chemical, and biological processes occur as interactions between these two ecosystems or because of their proximity to each other.

Coastal state: A state bordering the Atlantic or Pacific Oceans or the Gulf of Mexico.

Coastal waters: Waters within the geographical areas defined by each State's Coastal Zone Management Program.

Coastal wetlands: Forested and nonforested habitats, mangroves, and marsh islands exposed to tidal activity. These areas directly contribute to the high biological productivity of coastal waters by input of detritus and nutrients, by providing nursery and feeding areas for shellfish and finfish, and by serving as habitat for birds and other animals.

Coastal zone: The coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder) strongly influenced by each other and in proximity to the shorelines of the several coastal states; the zone includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches and extends seaward to the outer limit of the U.S. territorial sea. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters. Excluded from the coastal zone are lands the use of which is by law subject to the discretion of or which is held in trust by the Federal Government, its officers, or agents.

Coastal Zone Management Act (CZMA): 16 U.S.C. 1451 et seq. The CZMA regulates development in coastal areas to protect their unique resources.

Coastal Zone Management Act Consistency Determination: A finding that an activity that affects land or water uses or natural resources in a State's coastal zone is in compliance with that State's federally approved Coastal Zone Management Program. Federal agencies must be consistent to the maximum extent practicable.

Code of Federal Regulations (CFR): A compilation of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the U.S. Each volume of the CFR is updated once each calendar year and is issued quarterly.

Continental margin The ocean floor that lies between the shoreline and the abyssal ocean floor; includes the continental shelf, continental slope, and continental rise.

Continental Offshore Stratigraphic Test (COST) well: Wells that involve drilling penetration into the sea bottom of more than 152 m (500 ft) and are primarily drilled to gather geological information (defined in 30 CFR 251).

Continental rise: A broad, gently dipping depositional plain that extends from the base of the continental slope from a depth of about 2,000 m (6,600 ft) to more than 5,000 m (16,400 ft).

Continental shelf: General term used by geologist to refer to the continental margin province that lies between the shoreline and the abrupt change in slope called the shelf edge, which generally occurs in the Gulf of Mexico at about 200 m (656 ft) water depth. The continental shelf is characterized by a gentle slope (about 0.1º). This is different from the judicial term used in Article 76 of the UNCLOS (see *Outer Continental Shelf*).

Continental slope: The continental margin province that lies between the continental shelf and continental rise, characterized by a steep slope (about 3º-6º).

Council on Environmental Quality (CEQ): A Federal council that coordinates Federal environmental efforts and works closely with Federal agencies and other White House offices to develop environmental policies and initiatives. Established by NEPA (see *National Environmental Policy Act*), the CEQ consists of three members appointed by the President. The CEQ regulations (40 CFR 1500-1508) describe the process for implementing NEPA, including preparation of EAs and EISs and the timing and extent of public participation.

Critical habitat: Defined in Section 3 of the ESA as (1) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the ESA, on which are found those physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

Crude oil: Petroleum in its natural state as it emerges from a well, or after it passes through a gas-oil separator but before refining or distillation; an oily, flammable, bituminous liquid that is essentially a complex mixture of hydrocarbons of different types with small amounts of other substances.

Cumulative impact: 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.

Decibel (dB): A relative unit used to describe sound intensities. It is used to express the relative difference, usually between acoustic or electrical signals, equal to 10 or 20 times the common logarithm of the ratio of the two quantities. Since the dB scale is logarithmic and not linear, a 20-dB sound is 10 times louder than a 10-dB sound, and a 30-dB sound is 100 times louder than a 10-dB sound.

Demersal: Living at or near the bottom of a waterbody but having the capacity for active swimming. Term used particularly when describing various fish species.

Demersal fishes: Those fishes that spend at least the adult portion of their life cycle in association with the ocean bottom.

Deposition: The laying down of matter by a natural process (e.g., the settling of particulate matter out of air or water onto soil or sediment surfaces).

Depth sounder: An instrument that indirectly determines the ocean floor depth by transmitting acoustic pulses from the ocean surface and listening for their reflection (or echo) from the seafloor. A single-beam depth sounder calculates the depth below the ship using the time it takes a sound pulse to travel to the seafloor, reflect, and then return back to the transducer. A multibeam depth sounder transmits a broad acoustic pulse from a specially designed transducer across the full swath across track then forms a receive beam that is much narrower (around 1 degree, depending on the system) to establish a two-way travel time of the acoustic pulse. If the speed of sound in water is known for the full water column, the depth and position of the return signal can be determined from the receive angle and the two-way travel time.

Development: Activities that take place following discovery of economically recoverable mineral resources, including geophysical surveying, drilling, platform, construction, operation of onshore support facilities, and other activities that are for the purpose of ultimately producing the resources.

Diapir: Intrusion of fluid rock (e.g., molten rock, salt, or mud) caused by the difference in buoyancy and pressure between it and the overlying rock.

Discharge: Something that is emitted; flow rate of a fluid at a given instant expressed as volume per unit of time.

Dispersion: A suspension of finely divided particles in a medium.

Distinct Population Segment (DPS): A vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or DPSs of vertebrate species.

Diurnal: Having a daily cycle or occurring every day.

Domestic: Produced in or indigenous to a particular country.

Drilling fluid (drilling mud): A mixture of clay, water or refined oil, and chemical additives pumped continuously downhole through the drill pipe and drill bit, and back up the annulus between the pipe and the walls of the borehole to a surface pit or tank. The mud lubricates and cools the drill bit, lubricates the drill pipe as it turns in the wellbore, carries rock cuttings to the surface, serves to keep the hole from crumbling or collapsing, and provides the weight or hydrostatic head to prevent extraneous fluids from entering the well bore and to downhole pressures; also called drilling fluid.

Easement: Authorization for the use, for a specified purpose, of land that is not owned by the user. For the OCS, a right of use and easement usually refer to the authorization by BOEM to an operator for the construction and maintenance of a structure or structures on OCS lands not subject to a lease granted to the operator.

Echolocation: The use of reflected sound waves by some animals to gather critical information such as the location of obstructions, predators, or food, or for purposes of reproduction.

Ecosystem: A group of organisms and their physical environment interacting as an ecological unit.

Effluent: The liquid waste of sewage and industrial processing.

Electromagnetic field: The field of energy resulting from the movement of alternating electric current along the path of a conductor, composed of both electrical and magnetic components and existing in the immediate vicinity of, and surrounding, the electric conductor. Electromagnetic fields exist both in high-voltage electric transmission power lines and in low-voltage electric conductors in homes and appliances.

Embayment: A small bay or any small semi-enclosed coastal water body in which the opening to a larger body of water is restricted.

Endangered species: Under the ESA, any species that is in danger of extinction throughout all or a significant portion of its range (ESA §3[6]).

Endangered Species Act (ESA): A U.S. Federal law whose purpose is to protect and recover imperiled species and the ecosystems upon which they depend. It is administered by FWS and the NMFS. The FWS has primary responsibility for terrestrial and freshwater organisms, including manatees, polar bears, walruses, sea otters, and nesting sea turtles, while the responsibilities of NMFS are mainly marine wildlife including all cetaceans and sea turtles (in the marine stage), most pinnipeds, and anadromous fish such as salmon. Under the ESA, species may be listed as either endangered or threatened. The ESA also requires the designation of critical habitat for listed species (see *Critical habitat*).

Energy: The capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy) or heat.

Energy Policy Act of 2005: A bill passed in August 2005 that included new authority (Section 388) for MMS (now BOEM) to regulate alternative energy resources on the OCS.

Environmental Impact Statement (EIS): A document required of Federal agencies by NEPA for major proposals or legislation that would or could significantly affect the environment.

Environmental justice: The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

Epifauna: Organisms living on the surface of the sediment/sea bed.

Epifaunal: A community of marine organisms that live attached to hard substrates or move around and live on hard substrates.

Epipelagic: Pertaining to a subzone of the pelagic zone where there is enough light for photosynthesis. Generally includes waters from the surface to approximately 200 m (660 ft) in depth.

Essential Fish Habitat (EFH): As identified in the Magnuson-Stevens Fishery Conservation and Management Act, those waters and substrate that are defined within Fishery Management Plans for federally managed fish species as necessary to fish for spawning, breeding, feeding, or growth to maturity.

Estuary: Coastal semi-enclosed body of water that has a free connection with the open sea and where freshwater meets and mixes with seawater.

Exclusive Economic Zone (EEZ): The maritime region extending 200 nmi from the baseline of the territorial sea, in which the U.S. has exclusive rights and jurisdiction over living and nonliving natural resources.

Executive Order 12898: An executive order, signed in 1994, establishing environmental justice as a Federal Government priority and directing all Federal agencies to make environmental justice part of their mission. Environmental justice calls for fair distribution of environmental hazards.

Executive Order 13158: An executive order, signed in 2000, establishing the National Marine Protected Areas Initiative.

Executive Order 13547: An executive order, signed in 2010, entitled Stewardship of the Ocean, Our Coasts, and the Great Lakes. The executive order establishes a national policy to ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhance the sustainability of ocean and coastal economies, preserve our maritime heritage, support sustainable uses and access, provide for adaptive management to enhance our understanding of and capacity to respond to climate change and ocean acidification, and coordinate with U.S. national security and foreign policy interests.

Exploration Plan (EP): A plan that must be prepared by the operator and submitted to BOEM for approval before any exploration or delineation drilling is conducted on a lease.

Exploration well: A well drilled in unproven or semi-proven territory to determining whether economic quantities of oil or natural gas deposit are present; exploratory well.

Extended Continental Shelf: Judicial term used in Article 76 of the UNCLOS that extends beyond 200 nmi from shore. For purpose of this Draft Programmatic EIS, the seaward limit of the AOI shall be defined as a line 350 nmi (648 km) from shore. Article 76 of UNCLOS provides two constraint lines for defining the limit of the ECS: the seaward limit of Federal jurisdiction may be set at the farthest of 200 nmi seaward of the baseline from which the breadth of the territorial sea is measured or, if the continental shelf can be shown to exceed 200 nmi, a distance not greater than a line 100 nmi from the 2,500-m isobaths, or a line 350 nmi from the baseline.

Extralimital: Known on the basis of only a few records that probably resulted from unusual wanderings of animals into the region.

Fault: A fracture in the earth's crust accompanied by displacement of one side of the fracture with respect to the other and in a direction parallel to the fracture.

Federal Register: The official daily publication for actions taken by the U.S. Federal Government, such as Rules, Proposed Rules, and Notices of Federal agencies and organizations, as well as Executive Orders and other Presidential documents.

Frequency: In acoustics, a description of the rate of vibration, measured in cycles per second. One cycle per second is usually referred to as 1 Hz. Frequency is perceived by humans as pitch.

Frequency (pitch): For sound waves, frequency is the rate at which the source-producing sound wave is vibrating or the rate at which the sound-producing body completes one vibration cycle. Frequency is expressed in units of Hertz (Hz), where 1 Hz is equal to one complete vibration cycle per second.

Gas hydrates: Gas molecules (e.g., methane) trapped in water-ice "cages" in subsea deposits.

Geochemical: Of or relating to the science dealing with the chemical composition of and the actual or possible chemical changes in the crust of the earth.

Geology: The study of the materials, processes, environments, and history of the earth, including rocks and their formation and structure.

Geophysical survey: A method of exploration in which geophysical properties and relationships are measured remotely by one or more geophysical methods.

Gulf Stream: The powerful, warm, and swift Atlantic Ocean current that is the western boundary current of the North Atlantic subtropical gyre (the clockwise circulation pattern produced by the earth's rotation).

After passing Cape Hatteras, the Gulf Stream flows northeast toward Europe.

Habitat: A specific type of environment that is occupied by an organism, a population, or a community.

Harassment: Two definitions of harassment are used in this Programmatic EIS, depending on context. Under the ESA, harassment is an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Under the 1994 Amendments to the MMPA, harassment is any act of pursuit, torment, or annoyance which (a) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (b) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild (Level B harassment).

Hazardous materials: Materials, including nonwaste substances, that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health or welfare or the environment. Such materials may be transported to and from, stored at, and/or used at alternative energy and alternate use project sites approved on the OCS.

High-frequency cetaceans: Species of cetaceans having a functional hearing range between 200 Hz and 180 kHz. Refer to Southall et al. (2007) for more information.

High-resolution geophysical (HRG) survey: A survey conducted to evaluate the suitability of a specific site for oil and gas exploration and development activities, renewable energy facilities, or marine mineral uses. The surveys are conducted to assess subseafloor conditions and to detect geohazards, archaeological resources, and certain types of benthic communities. The HRG surveys for oil and gas exploration may use an airgun in addition to electromechanical sources such as side-scan sonar, boomer or chirp subbottom profiler, and single or multibeam depth sounder. The HRG surveys for renewable energy and marine minerals sites are not expected to use airguns.

Hydrocarbons: Any of a large class of organic compounds containing primarily carbon and hydrogen. Hydrocarbon compounds are divided into two broad classes: aromatic and aliphatics. They occur primarily in petroleum, natural gas, coal, and bitumens.

Hydrophone: Essentially an underwater microphone, a hydrophone is an underwater receiver used to detect the pressure change caused by sound waves propagating through the water. That pressure is converted to electrical energy which can be recorded or measured.

Incidental harassment: An accidental taking. This does not mean that the taking is unexpected, but rather it includes those takings that are infrequent, unavoidable, or accidental.

Incidental Take Authorization (ITA): In 1981, Congress amended the MMPA to provide for "incidental take" authorizations for maritime activities, provided NMFS found the takings would be of small numbers and have no more than a "negligible impact" on those marine mammal species not listed as depleted under the MMPA (i.e., listed under the ESA) and not having an "unmitigable adverse impact" on subsistence harvests of these species. These "incidental take" authorizations, also known as LOAs, require that regulations be promulgated and published in the *Federal Register*

Incidental take: Takings that result from, but are not the purpose of, carrying out an otherwise lawful activity (e.g., fishing) conducted by a Federal agency or applicant (see *Taking*).

Infauna: Animals living within the sediment.

Infrastructure: The facilities associated with oil and gas development, e.g., refineries, gas processing plants, etc.

Intensity: For sound, intensity is the measure of the amount of energy that is transported over a given area per unit of time. Sound intensity is expressed in units of W/m^2.

Invertebrate: An organism lacking a backbone or spinal column. Any animal other than a fish, amphibian, reptile, bird, or mammal.

Lease: Authorization that is issued under Section 8 or maintained under Section 6 of the OCSLA and that authorizes exploration for, and development and production of, minerals.

Lease sale: The competitive auction of leases granting companies or individuals the right to explore for and develop certain minerals under specified conditions and periods of time.

Lessee: A party authorized by a lease, or an approved assignment thereof, to explore for and develop and produce the leased deposits in accordance with regulations at 30 CFR 250.

Letter of Authorization (LOA): The MMPA provides for "incidental take authorizations" for maritime activities, provided NMFS finds that the takings would be of small numbers, would have no more than a negligible impact on the affected marine mammal species or stock, and would not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses. These "incidental take" authorizations, or LOAs, require that regulations be promulgated and published in the *Federal Register* outlining: (a) permissible methods and the specified geographical region of taking; (b) the means of effecting the least practicable adverse impact on the species or stock and its habitat and on the availability of the species or stock for "subsistence" uses; and (c) requirements for monitoring and reporting, including requirements for the independent peer review of proposed monitoring plans where the proposed activity may affect the availability of a species or stock for taking for subsistence uses.

Level A harassment: Under the MMPA, Level A harassment includes any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild.

Level B harassment: Level B harassment is any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where the patterns are abandoned or significantly altered. Unlike Level A harassment, which is solely associated with physiological effects, both physiological and behavioral effects have the potential to cause Level B harassment.

Localized: In close proximity to where work is being conducted.

Logarithmic: A mathematical term of the ratio of values expressed by the base 10 or e. If the base is 10, the logarithm is called *common*. If the base is e, the logarithm is called *natural*. Human perception of the amplitude or "loudness" of sound follows a logarithmic, rather than a linear, relationship. For every increase in sound loudness perceived as a simple additive quantity, the loudness or amplitude actually increases as a multiplier of the initial amplitude.

Low-frequency cetaceans: Species of cetaceans having a functional hearing range between 7 Hz and 22 kHz. Refer to Southall et al. (2007) for more information.

Marine Mammal Protection Act (MMPA): Enacted in October 1972, the MMPA provides protection for all marine mammals. The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.

Marine Protected Area (MPA): A marine area established under Executive Order 13158.

Masking: The obscuring of sounds of interest by interfering sounds, generally at the same or similar frequencies.

Meteorological buoy: A buoy containing equipment designed to measure current and wave conditions to determine whether a site is suitable for a wind turbine.

Meteorological tower: A tower containing equipment designed to measure wind speeds and to determine whether a site is suitable for a wind turbine.

Mid-frequency cetaceans: Species of cetaceans having a functional hearing range between 150 Hz and 160 kHz. Refer to Southall et al. (2007) for more information.

Minerals: As used in this document, minerals include oil, gas, sulphur, and associated resources, and all other minerals authorized by an Act of Congress to be produced from public lands as defined in Section 103 of the Federal Land Policy and Management Act of 1976.

Mitigation measure: Measures that will minimize, avoid, rectify, reduce, eliminate, or compensate for significant environmental effects.

Moratorium: Delay; a period during which certain proceedings or obligations are suspended.

M-weighting: Frequency-weighting functions developed by Southall et al. (2007) for use in assessing the effects of underwater sounds on marine mammal. The weighting functions (designated "M" for marine mammals) are analogous to the C-weighting function for humans, which is commonly used in measuring high-amplitude sounds. Refer to Southall et al. (2007) for more information.

Mysticete: Any whale of the suborder Mysticeti having plates of whalebone (baleen plates) instead of teeth. Mysticetes are filter-feeding whales, also referred to as baleen whales, such as blue, fin, gray, and humpback whales.

National Ambient Air Quality Standards (NAAQS): Air quality standards established by the CAA, as amended. The primary NAAQS specify maximum outdoor air concentrations of criteria pollutants to protect public health within an adequate margin of safety. The secondary NAAQS specify maximum concentrations that would protect the public welfare from any known or anticipated adverse effects of a pollutant.

National Environmental Policy Act (NEPA): A U.S. Federal law passed by Congress in 1969 (42 U.S.C. 4321 et seq.) establishing a national policy to provide a process for the consideration of environmental issues in Federal agency planning and decision-making. The potential environmental impacts of proposed Federal actions on the human and natural environment were to be considered prior to decision making. The NEPA procedures require that environmental information be made available to the public and the decision makers before decisions are made. Information contained in the NEPA documents must focus on the relevant issues in order to facilitate the decision-making process.

National Historic Preservation Act (NHPA): A Federal statute that established a Federal program to further the efforts of private agencies and individuals in preserving the nation's historic and cultural foundations.

National Marine Fisheries Services (NMFS): A Federal agency that is a part of NOAA. The NMFS is responsible for the management, conservation, and protection of living marine resources within the U.S. EEZ. The NMFS is currently referred to as NOAA Fisheries.

National Oceanic and Atmospheric Administration (NOAA): A Federal agency that manages commercial and recreational fisheries within Federal waters and designates EFH to help conserve Gulf fishery resources.

Nitrogen dioxide (NO_2): A reddish-brown gas that is a strong oxidizing agent, produced by combustion (as of fossil fuels). The reactive oxides of nitrogen in the atmosphere are largely NO and NO_2, known together as NO_x. During the day, there exists a rapid interconversion of NO and NO_2 (see *Nitrogen oxides*). Nitrogen dioxide is one of the six criteria air pollutants specified under Title I of the CAA.

Nitrogen oxides (NO_x): Nitrogen oxides include various nitrogen compounds, primarily nitric oxide (NO) and nitrogen dioxide (NO_2). They form when fossil fuels are burned at high temperatures and react with volatile organic compounds to form ozone, the main component of urban smog. They are also precursor pollutants that contribute to the formation of acid rain and to impairment of visibility.

Noise: Unwanted sound; a subjective term reflective of societal values regarding what constitutes unwanted or undesirable intrusions of sound.

Nonattainment area: An area that is shown by monitoring data or by air-quality modeling calculations to exceed primary or secondary ambient air quality standards established by USEPA.

Nonlisted species: Species that are not listed as threatened or endangered by State or Federal agencies.

Notice of Intent (NOI): A written notice published in the *Federal Register* that announces the intent to prepare an EIS under the NEPA. Also provides information about a proposed Federal action, alternatives, the scoping process, and points of contact within the lead Federal agency regarding the EIS.

Ocean current: Continuous forward movement of ocean water driven by wind and solar heating of the waters near the equator, although some ocean currents result instead from variations in water density and salinity.

Odontocete: Any toothed whale (i.e., cetacean without baleen plates) of the suborder Odontoceti (e.g., sperm whales, killer whales, beaked whales, dolphins, and porpoises).

Operator: An individual, partnership, firm, or corporation having control or management of operations on a leased area or portion thereof. The operator may be a lessee, designated agent of the lessee, or holder of operating rights under an approved operating agreement.

Outer Continental Shelf (OCS): All submerged lands that comprise the continental margin adjacent to the U.S. and seaward of State offshore lands.

Outer Continental Shelf (OCS) lands: Offshore lands located outside of State coastal waters. Generally, OCS lands begin approximately 3.3 statute mi offshore with respect to coastal States, except in the cases of Texas and the west coast of Florida, where OCS lands begin approximately 10.2 statute mi offshore.

Outer Continental Shelf Lands Act (OCSLA), as amended: An act authorizing the U.S. Department of the Interior to regulate activities related to the development of mineral resources on the OCS.

Ozone (O_3): A strong-smelling, reactive gas consisting of molecules composed of three oxygen atoms. It is formed in the atmosphere by chemical reactions involving nitrogen oxides and volatile organic compounds in sunlight. A major constituent of smog, it can impair the respiratory system and damage plants and ecosystems. Ozone is a criteria air pollutant under the CAA.

Pascal (Pa): A unit of pressure equivalent to 1 newton of force applied evenly over 1 m^2. The unit is named after Blaise Pascal, the eminent French mathematician, physicist, and philosopher.

Passive acoustic monitoring (PAM): A listening system that, in the marine environment, utilizes hydrophones, signal processing software, and (usually) some degree of human listening to detect and often to localize the vocalizations of marine mammals.

Pelagic: A broad term applied to species that inhabit the open, upper portion of marine waters rather than waters adjacent to land or near the seafloor.

Pelagic fishes: Fish that spend most of their lives swimming in the water column, as opposed to on or near the bottom.

Permanent threshold shift (PTS): Exposure to high-intensity sound may result in auditory effects such as noise-induced threshold shift, or simply a threshold shift. If the threshold shift becomes a permanent condition, generally as a result of physical injury to the inner ear and hearing loss, it is known as PTS.

Physical oceanography: The scientific study of ocean physics, including ocean currents, waves, and tides.

Physiographic: Pertaining to the physical features of the land, in particular its slope and elevation.

Physiological effect: Defined in this Programmatic EIS as a variation in an animal's physiology that results from an anthropogenic acoustic exposure and exceeds the normal daily variation in physiological function.

Pinger: A pulse generator using underwater sound to transmit data, such as subject location.

Pinniped: Any member of a suborder (Pinnipedia) of aquatic carnivorous mammals (i.e., seals and sea lions) with all four limbs modified into flippers

Pitch: A property of sound; sound wave frequency as perceived by the receptor. In music, two tones whose frequencies make a

2:1 ratio are said to be separated by an octave interval; a frequency ratio of 5:4 ration defines a third; a frequency ratio of 4:3 defines a fourth; a frequency ration of 3:2 defines a fifth.

Plankton: Passively floating or weakly motile aquatic plants (phytoplankton) and animals (zooplankton).

Planning Area: A subdivision of an offshore area used as the initial basis for considering blocks to be offered for lease in the U.S. Department of Interior's areawide offshore oil and gas leasing program.

Platform: A steel or concrete structure from which offshore development wells are drilled.

PM_{10}: Particles with an aerodynamic diameter of less than or equal to 10 micrometers (0.0004 in.). These can be inhaled through the upper airways and deposited in the lower airways and gas-exchange tissues in the lung. PM_{10} is one of the six criteria air pollutants specified under Title I of the CAA.

$PM_{2.5}$: Particles with an aerodynamic diameter of less than or equal to 2.5 micrometers (0.0001 in.). A greater fraction of particles in this size range can penetrate and be deposited deep in the lungs, and smaller portions of $PM_{2.5}$ (e.g., >0.1 micrometer) can enter the bloodstream. $PM_{2.5}$ is one of the six criteria air pollutants specified under Title I of the CAA.

Pneumatic: Operated by pressurizing air.

Population: A group of individuals of the same species occupying a defined locality during a given time that exhibit reproductive continuity from generation to generation.

Production: Activities that take place after the successful completion of any means for the extraction of resources, including bringing the resource to the surface, transferring the produced resource to shore, monitoring operations, and drilling additional wells or workovers.

Proposed species: Candidate species that were found to warrant listing as either threatened or endangered and were officially proposed as such in a *Federal Register* notice after the completion of a status review and consideration of other protective conservation measures. Public comment is always sought on a proposal to list species under the ESA. The NMFS generally has one year after a species is proposed for listing under the ESA to make a final determination whether to list a species as threatened or endangered.

Protected species observer (PSO): A trained, dedicated, and experienced individual responsible for conducting visual watches for protected species, such as marine mammals and sea turtles, during marine seismic surveys; previously called Marine Mammal Observer or MMO.

Province: A spatial entity with common geologic attributes. A province may include a single dominant structural element such as a basin or a fold belt, or a number of contiguous related elements.

Pulse: A brief, broadband, atonal, transient sound; e.g., an explosion, gun shot, airgun pulse, or pile driving strike. Pulses are characterized by a rapid rise from ambient pressure to maximal pressure, and (at least near the source) by short duration.

Raptor: Bird of prey (e.g., an eagle, owl, or hawk).

Ramp up (or soft start): Turning on airguns or other acoustic source at low power and gradually and systematically increasing the output until full power is achieved (usually over a period of minutes). The appropriate ramp up or soft-start method depends on factors such as the type of seismic survey equipment being used and vessel speed.

Received level: The level of sound that arrives at the receiver (e.g., a marine mammal) or listening device (hydrophone). The received level is the source level minus the transmission losses from the sound traveling through the water.

Record of Decision (ROD): A concise summary of the decision made by the project proponent (e.g., BOEM) from the alternatives presented in a Final EIS. The ROD is published in the *Federal Register*.

Recreational beaches: Frequently visited, sandy areas along the shorefront that support multiple recreational activities at the land-water interface (e.g., National Seashores, State Park and Recreational Areas, county and local parks, urban beachfronts, and private resorts).

Red tides: Blooms of single-cell algae that produce potent toxins harmful to marine organisms and humans and are a natural phenomenon in the Gulf of Mexico, occurring primarily off southwestern Florida and Mexico.

Region: In this document, geographic areas on the OCS off the coast of the U.S. where the BOEM has jurisdiction to regulate actions, including oil and gas development and development of mineral resources.

Relict: A remnant or fragment of the vegetation of an area that remains from a period when the vegetation was more widely distributed.

Relief: The difference in elevation between the high and low points of a surface.

Renewable energy: For the purposes of this Programmatic EIS, renewable energy is defined as energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include biomass, hydrological, geothermal, solar, wind, ocean, thermal, wave action, and tidal.

Reserves: Proved oil or gas resources.

Resonance: A phenomenon that exists when an object is vibrated at a frequency near its natural frequency of vibration – the particular frequency at which the object vibrates most readily.

Rig: A structure used for drilling an oil or gas well.

Right-of-way: In property law, an easement to use another's land for passage. For the OCS, a right-of-way is most commonly used for pipelines that cross lands that the operator does not control entirely by lease.

Root-mean-square (rms) sound pressure: Average sound pressure over some specified time interval. For airgun pulses, the averaging time is commonly taken to be the approximate duration of one pulse, which in turn is commonly assumed to be the time interval within which 90 percent of the pulse energy arrives. The rms sound pressure level (in dB) is typically ~10 dB less than the peak level, and ~16 dB less than the peak-to-peak level.

Salinity: A measure of the salt content of water, usually expressed in parts per thousand (ppt).

Salt marshes: Intertidal wetlands that occur on the margins of estuaries, protected bays, and the landward side of barrier islands.

Scoping: An early and open process with Federal and State agencies and interested parties to identify possible alternatives and the significant issues to be addressed in an EIS.

Seagrass beds: More-or-less continuous mats of submerged, rooted, marine, flowering vascular plants occurring in shallow tropical and temperate waters. Seagrass beds provide habitat, including breeding and feeding grounds, for adults and/or juveniles of many of the economically important shellfish and finfish.

Sediment: Material that has been transported and deposited by water, wind, glacier, precipitation, or gravity; a mass of deposited material.

Sedimentary basin: A geologically (but not necessarily topographically) depressed area with thick sediments (sedimentary rocks) in the interior and thinner sediments at the edges.

Seeps (hydrocarbon): Gas or oil that reaches the surface along bedding planes, fractures, unconformities, or fault planes.

Seismic: Of, subject to, or caused by an earthquake or earth vibration.

Shallow test wells: Wells that involve drilling into the sea bottom to depths less than 152 m (500 ft) and are primarily drilled to gather geological information (30 CFR 251).

Shoal: The sandy elevation of the bottom of a body of water, constituting a hazard to navigation; a sandbank or sandbar.

Short-term: Lasting for a limited time (not permanent).

Sound exposure level (SEL): The total noise energy produced from a single noise event; the SEL is the integration of all the acoustic energy contained within the event. The SEL takes into account both the intensity and the duration of a noise event. The SEL is stated in dB re 1 μPa^2 s for underwater sound.

Sound navigation and ranging (sonar): Any anthropogenic (manmade) or animal (e.g., bats, dolphins) system that uses transmitted and/or received acoustic signals for navigation, communication, and determining position and bearing of a target. There are two broad types of anthropogenic sonar: active and passive. *Active sonar* involves the production of a signal that propagates through the environment and bounces off objects (such as a prey item). That reflected sound, or echo, travels back to the receiver, which interprets the echo. Therefore, active sonar involves two-way sound transmission. *Passive sonar* involves one-way sound transmission from an acoustic source (such as conspecific) to a receiver or listener.

Sound pressure level (SPL): A measure of the rms, or "effective" sound pressure, converted to decibels. The SPL is expressed in dB re 1 μPa for underwater sound and dB re to 20 μPa for airborne sound.

Source level: The received sound pressure level measured or estimated at a nominal distance of 1 m from the source. It is often expressed as dB re: 1 μPa at 1 m or in bar-m. For a distributed source, such as an airgun array, the nominal overall source level, as used in predicting received levels at long distances, exceeds the level measurable at any one point in the water near the sources.

Sparker: A low-energy acoustic source that generates a precisely timed electrical arc that momentarily vaporizes water between positive and negative leads. The collapsing bubbles produce a broad band omnidirectional pulse which can penetrate several hundred meters into the ocean bottom. Hydrophone arrays towed nearby receive the return signals.

Species of (special) concern: A species that may have a declining population, limited occurrence, or low numbers for any of a variety of reasons.

Structure: Any OCS facility that extends from the seafloor to above the waterline; in petroleum geology, any arrangement of rocks that may hold an accumulation of oil or gas.

Sulfur oxides (SO_x): A collective term for oxides of sulfur, of which the principal air pollutants are sulfur dioxide (SO_2), sulfur trioxide (SO_3), and sulfur mist generated by the combination of the sulfur oxides with water in the air. These gases are formed primarily by fossil fuel combustion. SO_x contributes to respiratory illness, particularly in children and the elderly, and aggravates existing heart and lung diseases. It also contributes to the formation of acid rain and to visibility impairments. SO_x is one of the six criteria air pollutants specified under Title I of the clean Air Act.

Supply vessel: A boat that ferries food, water, fuel, and drilling supplies and equipment to an offshore rig or platform and returns to land with refuse that cannot be disposed of at sea.

Surficial: Pertaining to or lying on the surface of the earth.

Taking: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any endangered or threatened species, or to attempt to engage in any such conduct (including actions that induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts). Harassments are the most common form of taking associated with OCS Program activities.

Temporary: Lasting for a limited time (not permanent).

Temporary threshold shift (TTS): Exposure to high-intensity sound may result in auditory effects such as noise-induced threshold shift, or simply a threshold shift. If the threshold shift recovers completely after a few minutes, hours, or days, it is known as TTS. A threshold shift represents an increase in the auditory threshold (i.e., a reduced ability to hear) at a particular frequency. By definition, TTS is recoverable and results from the temporary, non-injurious distortion of hearing-related tissues. In this Programmatic EIS, the smallest measurable amount of TTS (onset TTS) is taken as the best indicator for slight temporary sensory impairment. Because it is non-injurious, the acoustic exposure associated with onset TTS is used to define the outer limit of the portion of the Level B harassment zone attributable to physiological effects.

Terrace: A flat, wave-cut platform of various unconsolidated sedimentary deposits.

Terrigenous: Pertaining to sediments derived from land sources.

Terrigenous clastic sediments: Sediments derived from pre-existing, land-derived sources, delivered to the ocean by rivers and streams.

Threatened species: Under the ESA, any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (ESA §3[20]).

Topography: The elevation or slope of the land surface.

Transmission loss: Pressure or energy losses that occur as the sound travels through the water. Losses occur because the wavefront spreads over an increasingly large volume as the sound propagates, and because of additional processes including scattering and the absorption of some of the energy by water.

Turbidity: Reduced water clarity due to the presence of suspended matter.

Turbine: A device in which a stream of water or gas turns a bladed wheel, converting the kinetic energy of the flow into mechanical energy available from the turbine shaft. Turbines are considered the most economical means of turning large electrical generators. They are typically driven by steam, fuel vapor, water, or wind.

Upwelling: The process by which warm, less-dense surface water is drawn away from a shoreline by offshore currents and replaced by cold, denser water brought up from the subsurface.

U.S. Territorial Waters: Sea areas within 12 nmi of the U.S. coastline, normally measured from the official baselines of the country (typically the mean of the lower low tide locations for the U.S.), for which coastal nations exercise sovereignty.

Velocity: For acoustics, the speed at which a sound wave (a longitudinal wave) travels through a medium. Velocity is measured in units of distance/time. The velocity or speed of a sound wave in any medium is dependent on both the inertial and elastic properties of the medium. In air, the speed of sound is dependent on the air's pressure (a measure of its inertial property of density) and its temperature (a measure of the air's elastic property of deformation in response to an applied force – in this case, the sound wave). At 1 atmosphere of pressure and a temperature of 20°C (68°F), the speed of sound is approximately 343 m/s (750 mph).

Vibratory: Operated by causing rapid, small movement in a back and forth manner.

Water quality: The condition of water with respect to the amount of impurities in it.

Watt: An International System unit of power equal to 1 joule per second.

Wavelength: The distance from any point in the wave to the corresponding point in the next cycle of the wave. Longer wavelengths are perceived by the human ear as low tones, shorter wavelengths as high tones.

Weathering (of oil): The aging of oil due to its exposure to the atmosphere, resulting in marked alterations in its physical and chemical makeup.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources, protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.