UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF OCEAN ENERGY MANAGEMENT
GULF OF MEXICO OCS REGION
NEW ORLEANS, LOUISIANA

SITE-SPECIFIC ENVIRONMENTAL ASSESSMENT

OF

EXPLORATION PLAN NO. R-6606

FOR

SHELL OFFSHORE INC.

August 24, 2017

RELATED ENVIRONMENTAL DOCUMENTS

Programmatic Environmental Assessment for Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf
(OCS EIS/EA MMS 2004-054)

Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022
Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261
Final Environmental Impact Statement
(OCS EIS/EA BOEM 2017-009)

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

The Bureau of Ocean Energy and Management (BOEM) has prepared a Site-Specific Environmental Assessment (SEA) (No. R-6606) complying with the National Environmental Policy Act (NEPA). NEPA regulations under the Council on Environmental Quality (CEQ) (40 CFR §§ 1501.3 and 1508.9), the Department of the Interior (DOI) NEPA implementing regulations (43 CFR § 46), and BOEM policy require an evaluation of proposed major federal actions, which under BOEM jurisdiction includes approving a plan for oil and gas exploration or development activity on the Outer Continental Shelf (OCS).

NEPA regulation 40 CFR § 1508.27(b) requires significance to be evaluated in terms of context and intensity. The context and intensity of impacts caused by similar actions to that proposed were examined at a basin-wide scale in the Gulf of Mexico (GOM) in the:

- *Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf: Final Programmatic Environmental Assessment* (PEA) (USDOI, MMS, 2004) and
- *Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022 Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261-Final Environmental Impact Statement* (Multisale EIS) (OCS EIS/EA BOEM 2017-009).

This SEA tiers from these evaluations and considers the impacts of the proposed action.

The Proposed Action: Shell Offshore, Inc. (Shell) proposes to conduct a 3D high resolution survey using airguns with streamers. The vessel *Artemis Atlantic* will perform this operation. The proposed activity is located south of Louisiana in the following Mississippi Canyon Blocks:

Block	Lease
762	G7957
763	G7958
764	G8852
806	G7962
807	G7963
808	G6981
850	G9881
851	G9882
852	G33761

These Mississippi Canyon blocks are located in the Central Planning Area (CPA) of the GOM. The area of the proposed action is approximately 53 miles (85 kilometers) from the nearest Louisiana shoreline. The water depth at the survey area is 3,030 feet (924 meters). The proposed survey is expected to begin September 31, 2017 and last for approximately fifteen days.

Factors Considered in this Determination: The context and intensity of the proposed action are further analyzed at the site-specific level in this Environmental Assessment. The impact analysis for the proposed activity focused on the G&G activities and the resources that may be potentially impacted. The impact producing factors (IPF) include: (1) seismic noise from airguns, (2) vessel noise, and (3) vessel traffic.

In this SEA BOEM has considered three alternatives: (1) No Action; (2) Proposed Action as submitted; and (3) Proposed Action with Conditions of Approval. BOEM has assessed the impacts of the proposed action on the following significant resources:

- marine mammals;
- sea turtles; and
- fish.

The use of an active sound source (airgun) is potentially the most disruptive impact for a free-swimming individual or groups of marine mammals, turtles, and fish if they are in proximity to the airgun in operation. The effect of an active acoustic source is weighted most heavily out of all other potential impacting factors. Individual animals are vulnerable to injury if hit by the survey vessel from the proposed action. Conditions of approval include the monitoring of an exclusion zone by trained protected species observers and activation of survey shutdown requirements when mammals are observed: (1) within the exclusion zone or in proximity to an active sound source; or (2) near the vessel. The application of passive acoustic monitoring, a visually/acoustically monitored exclusion zone, shutdown criteria, and vessel avoidance are designed to remove the possibility that animals and an operating airgun are located in the same place at the same time. Groups or individuals are therefore not unduly affected by underwater noise, or exposed to being hit by the survey vessel. Impact significance levels are explained in Section 3.1 of this SEA. Impacts from the proposed activities to marine mammals, sea turtles, and fish have been mitigated to negligible.

Our evaluation in this SEA has selected alternative 3 and serves as the basis for approving the proposed action. BOEM concludes that no significant impacts are expected to occur to any affected resources by allowing the proposed action to proceed, provided that the specific conditions of approval identified below are met by the operator.

- **VESSEL-STRIKE AVOIDANCE/REPORTING:** The applicant will follow the guidance provided under BOEM's Notice to Lessees and Operators (NTL) No. 2016-G01 (*Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*). The NTL's guidance can be accessed on BOEM's internet website at http://www.boem.gov/BOEM-NTL-No-2016-G01/.

- **SEISMIC SURVEY OPERATION, MONITORING, AND REPORTING GUIDELINES**: The applicant will follow the guidance provided under BOEM NTL No. 2016-G02, "*Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program*." Additionally, the applicant will comply with the guidance under this NTL when operating in all water depths (not just in water depths > 200 m or in the Eastern Planning Area) and the NTL's "Shut-Down conditions" will be applied towards manatees. The NTL's guidance can be accessed on BOEM's internet website at http://www.boem.gov/BOEM-NTL-2016-G02/. Please report all marine life occurrences, all seismic gear interactions, and equipment hangs as part of the *Protected Species Observer Program* bi-monthly reporting.

- **MARINE TRASH AND DEBRIS AWARENESS AND ELIMINATION**: The applicant will follow the guidance provided under BSEE's Notice to Lessees and Operators (NTL) No. 2015-G03 (*Marine Trash and Debris Awareness and Elimination*). The NTL's guidance can be accessed on BSEE's website at https://www.bsee.gov/sites/bsee.gov/files/notices-to-lessees-ntl/alerts/ntl-2015-g03.pdf.

Conclusion: BOEM has evaluated the potential environmental impacts of the proposed action. Based on SEA No. R-6606, BOEM has determined that the proposed action would have no significant impact on the marine, coastal, and human environment provided that the avoidance measures required by the specific conditions of approval are met by the operator. Therefore, an Environmental Impact Statement will not be required.

MARK BELTER Digitally signed by MARK BELTER
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Unit Supervisor, Environmental Operations Section,
Office of the Environment, GOM OCS Region

August 24, 2017
Date

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SITE-SPECIFIC ENVIRONMENTAL ASSESSMENT (SEA) PREPARED FOR SHELL OFFSHORE, INC.'S REVISED EXPLORATION PLAN NO. R-6606

1. PROPOSED ACTION

The purpose of this Site-Specific Environmental Assessment (SEA) is to assess the specific impacts associated with Shell Offshore, Inc.'s (Shell) proposed ancillary geological and geophysical (G&G) survey activities on the Outer Continental Shelf (OCS) of the Gulf of Mexico (GOM). Section 1.3 of this SEA provides specific details on the G&G activities proposed in Shell's revised Exploration Plan (EP).

The SEA is tiered from*:*

- *Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf: Final Programmatic Environmental Assessment* (PEA) (USDOI, MMS, 2004) and
- *Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022 Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261; Final Environmental Impact Statement* (Multisale EIS) (OCS EIS/EA BOEM 2017-009).

"Tiering" is provided in the National Environmental Policy Act (NEPA) implementing regulations (40 CFR §§ 1502.20 and 1508.28) and is designed to reduce and simplify the length of environmental assessments by eliminating repetitive discussions of impacts considered in prior NEPA compliance documents, allowing analyses to focus on those site-specific concerns and effects related to the action proposed. Document tiering in the Bureau of Ocean Energy Management (BOEM) is subject to additional guidance under Department of the Interior (DOI) regulations at 43 CFR § 46.140 wherein the site-specific analysis must note which conditions and effects addressed in the programmatic document remain valid and which conditions and effects require additional review.

For this SEA, all of the analyses prepared in the PEA and Multisale EIS serve as a comprehensive starting point for the site specific environmental analysis of the proposed activities. To ensure analyses are sufficiently comprehensive and adequate to support decisionmaking for Shell's proposed activities, the following factors were identified for further analysis and are addressed in this SEA:

- **Noise/Vessel-Traffic Impacts on Marine Mammals** – the environmental baseline since completion of the 2004 PEA may have experienced slight changes and new information has become available;
- **Noise/Vessel-Traffic Impacts on Sea Turtles** – the environmental baseline since completion of the 2004 PEA may have experienced slight changes and new information has become available; and
- **Noise Impacts on Fish and Fisheries** – the environmental baseline since completion of the 2004 PEA may have experienced slight changes and new information has become available.

Marine mammals, sea turtles, fishes, and commercial and recreational fisheries, as indicated in the PEA, are susceptible to impacts from geophysical activities that may be considered adverse, but not significant. Impacts to fishes and commercial and recreational fisheries from the proposed activities are not expected due to the temporary nature of the operations. This SEA considers the potential for change in the status of resources and the potential for increased sensitivity of those resources to impacts from geophysical activities because of conditions or stresses that may be ongoing from the *Deepwater Horizon* explosion, spill, and response.

Therefore, Section 3 of this SEA will focus on how the new information relative to the cumulative environmental effects of this action. Where applicable, relevant affected environment discussions and impact analyses from the PEA and Multisale EIS are summarized and utilized for this site-specific analyses, and are incorporated by reference into this SEA. Relevant conditions of approval identified in the previous PEA and Multisale EIS have been considered in the evaluation of the proposed action.

1.1. Background

BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) are responsible for managing the development of OCS oil, gas, and mineral resources while ensuring safe operations and the protection of the human, marine, and coastal environments. One purpose of BOEM's regulatory program is to ensure that the G&G data is obtained in an environmentally safe manner. BOEM regulates leasing, exploration, development, production, and decommissioning, and they perform environmental analyses during each of these phases. BOEM's Resource Evaluation Program oversees "speculative" G&G data acquisition and permitting activities pursuant to 30 CFR §§ 551 and 580. Specifically, 30 CFR § 551 regulates prelease G&G exploratory operations for oil, gas, and sulfur resources, and 30 CFR § 580 regulates prelease prospecting activities. BOEM's Office of Leasing and Plans oversees "on-lease" or "ancillary" G&G data acquisition pursuant to 30 CFR § 550, which applies to postlease G&G exploratory operations.

The G&G surveys provide information used by industry and government to evaluate the potential for offshore oil and gas resources, renewable energy development, mineral resources exploration and development, and geologic hazards in a particular area. Industry needs accurate data to determine the location, extent, and properties of hydrocarbon resources. Information on shallow geologic hazards and seafloor geotechnical properties assists in the safe and economical exploration, development, production, and transportation of hydrocarbons.

The scope of the effects on GOM resources from activities proposed in Shell's revised EP, No. R-6606, were fully discussed and analyzed in the PEA. Neither the specific location, equipment, nor the duration of this proposal will result in impacts different from those discussed in the PEA or Multisale EIS prepared since that time. Existing peer-reviewed scientific literature and environmental monitoring suggests the proposed activity will not result in a different cumulative impact conclusion from what was made in the PEA. This information was not available or considered during the preparation of the PEA. Therefore, this SEA was prepared by BOEM to evaluate the operator's proposed ancillary activities in light of the new information.

1.2. Purpose of and Need for the Proposed Action

Shell has submitted an application to conduct an ancillary activity on the OCS. The purpose of the proposed action is to conduct a 3D high resolution survey using airguns. This information can be utilized to evaluate the potential for, and develop plans for, the development and production of hydrocarbon resources on the OCS, which would help satisfy the Nation's need for energy. Additional information regarding seismic activities can be found on page II-10 and in Table III-1 of the PEA.

The need for this action is established by BOEM's responsibility under the Outer Continental Shelf Lands Act (OCSLA) to make OCS lands available for expeditious and orderly development, subject to environmental safeguards, in a manner that is consistent with the maintenance of competition and other national needs. Section 11 of the OCSLA, 43 U.S.C. 1340, requires anyone seeking to conduct such activities to first obtain approval from BOEM. The Secretary of the Interior oversees the OCS oil and gas program, and BOEM and BSEE are the agencies charged with this oversight and regulated management of the permitted or otherwise authorized oil and gas activities. The Secretary is required to balance orderly resource development with protection of the human, marine, and coastal environments while ensuring that the U.S. public receives a fair return for resources discovered on and produced from public lands (43 U.S.C. 1332(3)).

In response to the proposed action in Shell's application, BOEM has regulatory responsibility, consistent with the OCSLA and other applicable laws, to approve, approve with modifications or conditions of approval, or deny the application. BOEM's regulations provide criteria that BOEM will apply in reaching a decision and providing for any applicable conditions of approval.

1.3. Description of the Proposed Action

Shell proposes to conduct a 3D high resolution survey using airguns with streamers. The vessel *Artemis Atlantic* will perform this operation. The proposed activity is located south of Louisiana in the following Mississippi Canyon Blocks:

Block	Lease
762	G7957
763	G7958
764	G8852
806	G7962
807	G7963
808	G6981
850	G9881
851	G9882
852	G33761

These Mississippi Canyon blocks are located in the Central Planning Area (CPA) of the GOM. The area of the proposed action is approximately 53 miles (mi) (85 kilometers (km)) from the nearest Louisiana shoreline. The water depth at the survey area is 3,030 feet (ft) (924 meters (m)). The proposed survey is expected to begin September 31, 2017 and last for approximately fifteen days (Shell, 2017).

Airguns

The sound source typically used in most seismic surveys is an airgun array. An airgun array consists of pneumatic devices that produce acoustic output through the rapid release of a volume of compressed air. The airgun array is designed to direct the high energy bursts of low-frequency sound (termed a "shot") downward toward the seafloor. Reflected sounds from below the seafloor are received by an array of sensitive hydrophones on cables (collectively termed "streamers") that are either towed behind a survey vessel, attached to cables/nodes placed on or anchored to the seafloor, or placed within the wellbore during VSP surveys. A typical full-scale array produces a source level of 248-255 dB re µPa-m, zero-to-peak (referring to the waveform of the sound pulse). Typical seismic arrays being used in the GOM produce source levels (sound pressure levels) of approximately 240 dB re 1 µPa @ 1 m. While the seismic array pulses are directed toward the ocean bottom, sound can propagate horizontally for several kilometers (Richardson et al., 1995). Measurements of sources at sea (Goold and Fish, 1998; Sodal, 1999) have demonstrated that, although airgun arrays are primarily a source of low-frequency energy, there is also some transmission of energy at higher frequencies. These energies encompass the entire audio frequency range of 20 Hz to 20 kHz (Goold and Fish, 1998) and may extend well into the ultrasonic range up to 50 kHz (Sodal, 1999).

2. ALTERNATIVES CONSIDERED

2.1. The No Action Alternative

Alternative 1 – *No Action Alternative.* If this alternative is selected the applicant would not undertake the proposed activity. This alternative might prevent the exploration and development of hydrocarbons, resulting in the potential loss of royalty income and energy resources for the United States.

2.2. The Proposed Action as Submitted

Alternative 2 – If this alternative is selected the applicant would undertake the proposed activity as requested in the application. No additional conditions of approval would be required by BOEM.

2.3. The Proposed Action with Additional Conditions of Approval

Alternative 3 – This is BOEM's *Preferred Alternative*. If this alternative is selected the applicant would undertake the proposed activity, as requested in the application, but with the conditions of approval identified by BOEM (listed in Section 2.4 below and described in the effects analyses) to fully address the site- and project-specific impacts of the proposed action.

2.4. Summary and Comparison of the Alternatives

If selected, Alternative 1, the No Action Alternative, would prevent the applicant from acquiring the proper permits and the subsequent collection of seismic data on the OCS. If the survey is not deployed, the opportunity for Shell to efficiently and expeditiously develop their lease may be forfeited. The information would not be available to industry and government to assist in their evaluation of offshore oil and gas resources in a particular area. Alternative 1 would not result in any impacts to the environmental resources analyzed in Chapter 3, but it does not meet the underlying purpose and need.

If selected, Alternative 2 would allow for the collection of seismic data, as requested in the plan, but would not include any conditions of approval or monitoring. Alternative 2 meets the underlying purpose and need of the proposed action but could cause unacceptable impacts to the environmental resources analyzed, as described in Chapter 3 (e.g., hearing loss in marine mammals, injuries to marine mammals and sea turtles from vessel strikes). Further, Alternative 2 would not require the implementation of conditions of approval and monitoring measures developed by BOEM, in coordination with the National Marine Fisheries Service (NMFS). to limit the potential for lethal and sublethal impacts to marine mammals and sea turtles. Implementation of these standard conditions of approval and monitoring measures was assumed as part of the analysis in the NMFS 2007 Endangered Species Act (ESA) Biological Opinion (BO) and BOEM is committed to requiring their implementation.

Alternative 3 is the Preferred Alternative, based on the analysis of potential impacts to resources described in Chapter 3, because it meets the underlying purpose and need, and also implements conditions of approval and monitoring requirements that adequately limit or negate potential impacts. The G&G activities proposed will provide Shell with sufficiently accurate data to determine the location, extent, and properties of potential hydrocarbon resources. Additionally, the collected data supports BOEM's regulatory and oversight responsibilities while promoting the development of hydrocarbon resources, potentially resulting in increased royalty income as well as energy resources for the United States.

Other alternatives regarding Agency oversight of the G&G permitting program, identified in Sections II.B-II.E of the PEA, were reviewed with the alternatives listed above chosen as reasonable for the current proposed action.

Conditions of Approval Required under the Preferred Alternative

The need for and utility of the conditions of approval are discussed in the relevant impact analysis sections of this SEA. The following conditions of approval and reporting requirements were identified to ensure adequate environmental protection and post-activity compliance:

- **VESSEL-STRIKE AVOIDANCE/REPORTING:** The applicant will follow the guidance provided under BOEM's Notice to Lessees and Operators (NTL) No. 2016-G01 (*Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*). The NTL's guidance can be accessed on BOEM's internet website at http://www.boem.gov/BOEM-NTL-No-2016-G01/.

- **SEISMIC SURVEY OPERATION, MONITORING, AND REPORTING GUIDELINES**: The applicant will follow the guidance provided under BOEM NTL No. 2016-G02, "*Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program*." Additionally, the applicant will comply with the guidance under this NTL when operating in all water depths (not just in water depths > 200 m or in the Eastern Planning Area) and the NTL's "Shut-Down conditions" will be applied towards manatees. The NTL's guidance can be accessed on BOEM's internet website at http://www.boem.gov/BOEM-NTL-2016-G02/. Please report all marine life occurrences, all seismic gear interactions, and equipment hangs as part of the *Protected Species Observer Program* bi-monthly reporting.

- **MARINE TRASH AND DEBRIS AWARENESS AND ELIMINATION**: The applicant will follow the guidance provided under BSEE's Notice to Lessees and Operators (NTL) No. 2015-G03 (*Marine Trash and Debris Awareness and Elimination*). The NTL's guidance can be accessed on BSEE's website at https://www.bsee.gov/sites/bsee.gov/files/notices-to-lessees-ntl/alerts/ntl-2015-g03.pdf.

2.5. ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

A viable alternative is required to be a logical option for carrying out the proposed action, ensure that the purpose of and need can be met, and be feasible under the regulatory directives of the OCSLA and all other applicable guidance. As such, other alternatives regarding Agency oversight of the G&G permitting program, identified in Sections II.B-II.E of the PEA, were reviewed with the alternatives listed above chosen as reasonable for the current proposed action. Several other alternatives were considered and reviewed during the coordination of the resource reviews, but they were ultimately dismissed and not analyzed further since they did not meet the aforementioned requirements. The following alternative was considered and given review; however, it was not accepted for the reasons discussed below.

Alternative Requiring Imposition of NTL No. 2016-G02 Shut-Down Conditions for Delphinids

This analysis also considered whether to apply the shutdown conditions of NTL No. 2016-G02 to delphinids. From a biological standpoint, the best available information suggests that delphinids are considered mid-frequency specialists (i.e., auditory bandwidth of 150 Hz to 160 kHz) (Southall et al., 2007). Low frequency seismic arrays, such as the one considered for use under this proposed action, generally operate in the frequency range of 20 Hz to 20 kHz (Goold and Fish, 1998) and may extend well into the ultrasonic range up to 50 kHz (Sodal, 1999). Therefore, while the majority of the seismic noise occurs at frequencies below that of delphinids, there are some components that may enter into the hearing range of delphinids (Goold and Fish, 1998). These higher frequency components would be at lower intensity levels (i.e., not as loud). It is unclear, though, from a scientific standpoint whether any of the seismic noise that might be heard by delphinids is in fact disruptive.

Delphinids are known to bow ride on operating seismic vessels. BOEM funded a data synthesis study on the effectiveness of seismic survey conditions of approval and marine mammal observer reports (USDOI, BOEM, 2012) that analyzed protected species observer (PSO) data collected from 2002-2008 in the GOM. Approximately 58 percent (%) of all dolphin sightings, occurred within the 500 m exclusion zone, and of these, 33% were exhibiting bow-riding behavior.

Looking at these records for a typical year (2009), approximately 400 (~27%) were delphinids within the 500 meter exclusion zone with operating airguns. In that same year, there were 55 records of shut downs for whales within the 500 m exclusion zone. If sources had also been shut down for the 400 sightings of delphinids, this would have resulted in a 7-fold increase in the number of shutdowns. There is little doubt then that a shut-down provision for delphinids within the exclusion zone would have a significant impact on seismic operations, such as those under the proposed action.

BOEM next considered whether a provision could be applied to allow for a reasonable exception for bow riding delphinids. For example, a provision could be considered that would allow PSOs to call for a power down (versus immediate shut down) of the seismic source to the smallest airgun should any delphinid enter, or come close to entering, the 500 meter exclusion zone referenced on page 2, bullet 4 under Definitions of NTL No. 2016-G02. If the delphinid(s) leave the exclusion zone or engage in bow riding behavior then the PSO could call for the immediate return of the array to full power. This would allow for an opportunity for the PSO to determine if the behavior of the animal(s) warranted a shut down and if not would allow the applicant to return to full power more quickly (versus a shut down followed by a 30 minute clearance of the zone and a 20-40 minute ramp up procedure).

Based on the PSO sighting records, it is clear that shut downs for delphinids would result in an impact to industry activities. Unlike other sound producing activities (e.g., sonar), seismic surveys occur on specified tracklines that need to be followed in order to meet the data quality objectives of the survey. In other words, seismic vessels in operation cannot simply divert away from nearby marine mammals without a loss in data quality. As stated above, an analysis of 2009 PSO data (USDOI, BOEM, 2012) indicate that if shut downs for delphinids within the exclusion zone were employed there would have been a 7-fold increase in shut downs of seismic arrays that year. Each of these shut downs would have required a 30 minute observation period to ensure animals have left the exclusion area followed by a 20-40 minute ramp up procedure. In all likelihood, these shut downs would then have required the applicants to return to an earlier point in the track line and resurvey the area again. This not only results in substantially more expense in down time and repositioning of seismic arrays and streamers, but would also likely increase the duration of and amount of total seismic noise for each affected survey area.

Conclusion

Based on the analysis above, BOEM believes it is essential to more fully investigate and vet the application of NTL No. 2016-G02 to delphinids before requiring it as a condition of approval measure in the GOM (under Alternative 3) or considering it as an additional alternative to the proposed action. It is BOEM's intention, therefore, to fully analyze the application of this condition of approval.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

3.1. INTRODUCTION

The discussion below will: (1) describe/summarize the pertinent potentially affected resources; (2) determine whether the proposed G&G activities and their impact-producing factors (IPFs) will have significant impacts on the marine, coastal, or human environments of the GOM; and (3) identify significant impacts, if any, that may require further NEPA analysis in an EIS. The description of the affected environment and impact analysis are presented together in this section for each resource.

For each potentially affected resource, BOEM staff reviewed and analyzed all currently available peer-reviewed literature and integrated these data and findings into the analyses below. The analyses cite the best available, relevant scientific literature. BOEM performed this analysis to determine whether Shell's proposed survey activities will significantly impact the marine, coastal, or human environments of the GOM. For the impact analysis, resource-specific significance criteria were developed for each category of the affected environment. The criteria reflect consideration of both the context and intensity of the impact at issue (see 40 CFR § 1508.27). The criteria for impacts to environmental resources are classified into one of the three following levels:

Significant Adverse Impact (including those that could be mitigated to nonsignificance);

Adverse but Not Significant Impact; or

Negligible Impact.

Preliminary screening for this assessment was based on a review of this relevant literature; previous SEAs; the PEA (USDOI, MMS, 2004); the Multisale EIS (USDOI, BOEM, 2017); and relevant literature pertinent to historic and projected activities.

BOEM initially considered the following resources for impact analysis:

- marine mammals (including Endangered Species Act (ESA)-listed species and strategic stocks);
- sea turtles (all are ESA-listed species);
- fishes (including listed species and ichtyoplankton);
- commercial and recreational fisheries;
- coastal and marine birds (including ESA-listed species);
- benthic communities;
- archaeological resources;
- military uses;
- recreational and commercial diving;
- marine transportation;
- geology/sediments; and
- air and water quality.

In the PEA, the impact analysis focused on a broad group of G&G activities and resources with the potential for non-negligible impacts. First, a matrix identifies impact agents associated with each type of G&G activity (Table III-1 of the PEA; USDOI, MMS, 2004). The impact agents include: (1) airgun noise; (2) sonar noise; (3) seafloor disturbance; (4) vessel traffic; (5) towed streamers; and (6) aircraft traffic. A second matrix in the PEA identifies resources potentially affected by each type of G&G activity (Table III-2 of the PEA; USDOI, MMS, 2004). The preliminary analysis in the PEA considers surveys of the type proposed by Shell as well as impacts to resources by type of activity. To assist with subsequent coordination, the PEA's analysis further defines the level of impact associated with each interaction as follows:

No Impact (i.e., no measurable impact to a resource evident);

Negligible Impact (i.e., measurable but relatively minor impact to a resource predicted); or

Potentially Adverse Impact (i.e., possible measurable impact to a resource predicted).

The PEA notes that seismic surveys have historically covered a large area of the GOM each year and, when unmitigated, have the greatest potential for "significant" impacts on protected and other sensitive marine species in comparison with other OCSLA-approved activities, including, but not limited to, exploration and development drilling. Further, it acknowledges increasing concerns in the regulatory and scientific communities regarding acoustic impacts on marine life, including marine mammals, turtles, and fishes. Species of particular concern are those whose hearing capabilities (based on vocalization characteristics) fall within the low frequencies introduced into the marine environment by seismic and geophysical activities. The PEA provides a comprehensive characterization of biological resources that may be adversely affected by G&G activities. This information is summarized in the various resource-specific descriptions of the affected environment and impact analyses in sections that follow.

However, for the purposes of this SEA, BOEM has not included analyses on resource areas that were evaluated and considered under the PEA as having negligible impacts (see 40 CFR § 1508.27) from G&G activities. Such a procedure is consistent with the NEPA concept of tiering (40 CFR § 1502.20). Additionally, since no expansion or modification of support bases or related vessel construction work are proposed as a result of this activity, socioeconomic effects were not analyzed due to the type, the temporary nature, and employment size of the survey activity. The most recent evaluation of the best available peer-reviewed scientific literature continues to support this conclusion for the following resource categories:

- commercial and recreational fisheries;
- coastal and marine birds (including ESA-listed species);
- benthic communities;
- archaeological resources;
- military uses;
- recreational and commercial diving;
- marine transportation;
- geology/sediments; and
- air and water quality.

For this SEA, BOEM evaluated the potential impacts from the operator's proposed G&G activities for the following resource categories:

- marine mammals (including threatened/endangered and non-ESA-listed species);
- sea turtles (all are ESA-listed species); and
- fish and fisheries (including listed species and ichtyoplankton).

3.2. Marine Mammals

3.2.1. Description

The U.S. Gulf of Mexico marine mammal community is diverse and distributed throughout the northern Gulf waters. Twenty-one species of cetaceans regularly occur in the GOM (Jefferson et al., 1992; Davis et al., 2000) and are identified in the NMFS GOM Stock Assessment Reports (SAR) (Waring et al., 2016) in addition to one species of Sirenian. The GOM's marine mammals are represented by members of the taxonomic order Cetacea, which is divided into the suborders Mysticeti (i.e., baleen whales) and Odontoceti (i.e., toothed whales), as well as the order Sirenia, which includes the manatee.

Threatened or Endangered Marine Mammal Species

There is only one cetacean, the sperm whale (*Physeter macrocephalus*) and one Sirenian, the West Indian manatee (*Trichechus manatus*) that regularly occur in the GOM and that are listed as endangered under the Endangered Species Act (ESA). The sperm whale is common in oceanic waters of the northern GOM and appears to be a resident species. The West Indian manatee typically inhabits only coastal marine, brackish, and freshwater areas. The life history, population dynamics, status, distribution, behavior, and habitat use of baleen and toothed whales can be found in Chapter 4.9.1 of the Multisale EIS, as is incorporated by reference, and also in the NMFS 2015 SAR (Waring et al., 2016). The distribution, feeding habits, habitat use, and population estimates of manatees can be found in Chapter 4.9.1.1 of the Multisale EIS. On January 8, 2016 (81 FR 1000), the United States Fish and Wildlife Service (FWS) issued a proposed rule and notice to reclassify the West Indian manatee from endangered to threatened (*Federal Register*, 2016a). On December 8, 2016 (81 FR 88639), NMFS issued a proposed rule to list the Bryde's whale (*Balaenoptera edeni*) as endangered (*Federal Register*, 2016b).

Non-ESA-Listed Marine Mammal Species

One baleen cetacean, (Bryde's whale) and 19 toothed cetaceans (including beaked whales and dolphins) occur in the GOM. Of these species, only the sperm whale is protected under the ESA; however all marine mammals are protected under the Marine Mammal Protection Act (1972). The only commonly occurring baleen whale in the northern GOM is the Bryde's whale. Most sightings have been made in the DeSoto Canyon region and off western Florida, although there have been some in the west-central portion of the northeastern GOM. The best estimate of abundance for Bryde's whales in the northern GOM is 33 individuals (Waring et al., 2016).

Non-ESA-listed toothed cetaceans include all of the dolphin and small whale species in the GOM and comprise 19 species. The *Kogia* species, which include pygmy and dwarf sperm whales, are small and cryptic whales that inhabit offshore waters. Very little is known of their life history. The beaked whales have been highly publicized in the last several years due to strandings and deaths attributed to military sonar. Beaked whales are not as small as *Kogia*, but they are just as difficult to detect during surveys. As with *Kogia*, very little is known about beaked whales (Waring et al., 2016).

Additional information on non-ESA-listed marine mammal species of the GOM is provided in Chapter 4.9.1.1 of the Multisale EIS, and in the NMFS 2015 SAR (Waring et al., 2016) and is incorporated by reference into this SEA.

Marine Mammal Hearing

All marine mammals produce and use sound to communicate with another animal of the same species, to navigate and sense their environment, to locate and capture prey, and to detect and avoid predators (Southall et al., 2007). The hearing of marine mammals varies based on individuals, absolute threshold of the species, masking, localization, frequency discrimination, and the motivation to be sensitive to a sound (Richardson et al., 1995). Southall et al. (2007) described the frequency sensitivity in five functional hearing groups of marine mammals by combining behavioral and electrophysiological audiograms with comparative anatomy, modeling, and response measured in ear tissues. For potentially affected marine mammal species in the GOM, the main functional hearing groups include: (1) low-frequency cetaceans with an estimated auditory bandwidth of 7 Hz to 22 kHz; (2) mid-frequency cetaceans with functional hearing of approximately 150 Hz to 160 kHz; and (3) high-frequency cetaceans with functional hearing estimated from 200 Hz to 180 kHz. These hearing sensitivity and frequency ranges are based on audiograms that are obtained by either: (1) behavioral testing on captive, trained animals; or (2) electrophysiological or auditory evoked potential (AEP) methods (Richardson et al., 1995). Currently, there are no behavioral or AEP audiograms for low-frequency cetaceans available. Audiograms, both behavioral and AEP, are available for some mid-frequency and high-frequency cetaceans (Richardson et al., 1995; Nedwell et al., 2004; Southall et al., 2007; Au and Hastings, 2008).

3.2.2. Impact Analysis

The IPFs associated with the proposed action that could affect both ESA-listed and non-ESA-listed marine mammals are primarily noise from survey activities and collisions with seismic survey vessels. Chapter III.C.1 of the PEA contains a discussion of the potential impacts from survey operations on marine mammal resources (USDOI, MMS, 2004). Additional information about routine impacts from oil and gas activity on impacts on marine mammals is addressed in Chapter 4.9.1.2.1 of the Multisale EIS and the current ESA Section 7 consultation for the Five-Year Outer Continental Shelf Oil and Gas Leasing Program (2007-2012) in the Central and Western Planning Areas of the Gulf of Mexico (5-Year Program) (USDOC, NMFS, 2007). The discussions are summarized below and are incorporated by reference into this SEA. In their 2007 BO, NMFS recognized that "sperm whales are expected to be harassed through disruption of important biological behaviors as a result of the use of airguns in seismic surveys." The best available scientific information also indicates that seismic airgun noise may affect non-ESA-listed marine mammal species (Southall et al., 2007).

3.2.2.1. *Alternative 1*

If Alternative 1, the No Action Alternative, is selected the applicant would not undertake the proposed activities. Therefore, the IPFs to marine mammals would not occur. For example, there would be no vessel noise or seismic airgun noise that would result in behavioral change, masking, or non-auditory effects to marine mammals, no long-term or permanent displacement of the animals from preferred habitats, and no destruction or adverse modification of any habitats. Since there would be no vessel traffic related to the towing of the airgun array, there would be no risk of collisions with marine mammals.

3.2.2.2. *Alternative 2*

If Alternative 2, the Proposed Action, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application. Examples of potential impacts to marine mammals without implementation of the above referenced conditions of approval and monitoring include, but are not limited to: injury from vessel strikes, hearing loss from seismic noise, disruption of feeding and other behaviors from seismic noise and vessel presence. This Alternative would not adequately limit or negate potential impacts to marine mammals.

3.2.2.3. *Alternative 3*

If Alternative 3, the Proposed Action with Additional Conditions of Approval, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application; however, the applicant would be required to undertake additional conditions of approval as identified by BOEM, in coordination with NMFS and in accordance with the NMFS ESA consultation requirements (i.e., NTL No. 2016-G01for *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting* and NTL No. 2016-G02 for *Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program*). For the reasons set forth below, inclusion of these measures under Alternative 3 limits or minimizes potential impacts to marine mammals.

Potential Impacts to Marine Mammals from Seismic Noise

Marine mammals exposed to natural or manmade noise may experience physical and psychological effects, ranging in magnitude from none to severe (Southall et al., 2007). Four areas of primary concern for marine mammals exposed to elevated noise levels include the following: (1) permanent hearing loss; (2) temporary hearing loss; (3) behavioral response; and (4) masking (Nowacek et al., 2007). Other literature also suggests that there may be non-auditory effects, such as gas-bubble formation and stress.

Scientific uncertainty remains regarding the nature and magnitude of the actual impacts of seismic noise on the behavior of marine mammals, particularly when it comes to distinguishing between a general behavioral response and a biologically significant one. As noted in Southall et al. (2007), some of this uncertainty is related to data suffering from low sample sizes, limited information on received sound levels and background noise, insufficient measurements of all potentially important contextual variables, and/or insufficient controls with most behavioral studies suffering from at least some of these problems.

Permanent Hearing Loss

Permanent hearing loss in a marine mammal (i.e., permanent threshold shift [PTS]) is defined as the deterioration of hearing due to prolonged or repeated exposure to sounds that accelerate the normal process of gradual hearing loss (Kryter, 1985) or the permanent hearing damage due to brief exposure to extremely high sound levels (Richardson et al., 1995). PTS results in a permanent elevation in hearing threshold - that is, an unrecoverable reduction in hearing sensitivity (Southall et al., 2007). Direct physical effects, such as PTS, require relatively intense, received energy that would be expected to occur only at short distances from the seismic survey source (Nowacek et al., 2007; Zimmer and Tyack, 2007). According to Southall et al. (2007), PTS for cetaceans from multiple pulse sources (e.g., seismic) is established at 230 dB re 1 μPa (peak).

Temporary Hearing Loss

Manmade sound may also cause temporary and reversible hearing loss called a temporary threshold shift (TTS), which may continue for minutes to hours or even days. A TTS is quite common in humans and often occurs after being exposed to loud sounds, such as a fireworks demonstration, in a modern sports stadium, or at a rock concert. The duration of TTS depends on a variety of factors, including intensity and duration of the auditory stimulus; and recovery can take minutes, hours, or days as well. Animals suffering from TTS over longer time periods, such as hours or days, may be considered to have a change in a biologically significant behavior, as they could be prevented from detecting sounds that are biologically relevant, including communication sounds, sounds of prey, or sounds of predators (U.S. DoN, 2008a and 2008b).

Behavioral Response

In Southall et al. (2007), an expert panel reviewing available literature on behavioral response to anthropogenic noise were unable to reach a consensus on what level of sound may serve as a threshold for behavioral reactions in marine mammals. A number of studies document behavioral effects in response to seismic surveys, primarily for mysticetes (Richardson et al., 1995). Mysticetes are considered low-frequency cetaceans with an estimated auditory bandwidth of 7 Hz to 22 kHz. The mysticetes (i.e., baleen whales) have been one of the most studied groups of marine mammals in terms of observations of behavioral changes in response to seismic operations. There is clearly a possible overlap between the expected frequencies of best-hearing sensitivity (low threshold) in mysticetes and maximal airgun output at source. It is generally considered that the auditory abilities of all mysticete species are broadly similar, based upon vocalization frequencies and ear anatomy (Ketten, 1998). Given that no direct audiograms of mysticetes have been obtained, it is impossible to define what level of sound above hearing threshold may cause behavioral effects, which would be expected to be variable, complicated, and dependent upon more than simply the received sound level. The mysticete species found in the GOM (i.e., blue, fin, sei, humpback, and minke, whales) are considered rare, extralimital, or uncommon (Würsig et al., 2000), with the exception of the Bryde's whale, and their occurrence within the proposed action area potentially affected by noise is not expected.

Sperm whales are a highly vocal species under natural conditions (they produce echolocation clicks almost continuously during dives). They are considered a mid-frequency cetacean with functional hearing of approximately 150 Hz to 160 kHz. Interruption or cessation of their vocal activity has often been cited as a reaction to manmade noise. Watkins and Schevill (1975) showed that sperm whales interrupted click production in response to pinger (6 to 13 kHz) sounds. Mate et al. (1994) reported temporarily decreased sperm whale abundance in an area of seismic operations in the northeastern GOM. However, acoustic arrays recorded sperm whales producing click sequences during dives within 4 nautical miles of an active, 3D seismic vessel during surveys conducted in 2001. Further, Weir (2008) found few obvious, visible responses of sperm (and humpback) whales to seismic airgun sounds off Angola, although only overt responses were examined, and subtle or longer range responses may not have been detected.

From 2002 to 2005, BOEM funded a multiyear, interdisciplinary study on sperm whales in the GOM, called the Sperm Whale Seismic Study (SWSS). A summary report was produced in 2006 (Jochens et al., 2006) and a synthesis report was released in 2008 (Jochens et al., 2008). These reports provide the following conclusions regarding sperm whales in the GOM and their response to seismic surveys:

- During controlled exposure experiments (CEEs), researchers could detect "no horizontal avoidance of the seismic source for exposure levels (RLs) of <150 dB re 1 µPa (rms)." Similarly, opportunistic studies detected no apparent horizontal avoidance or displacement of sperm whales associated with operational seismic surveys;
- Although a small sample, the CEE data results did not confirm the assumption that whales swim away from an airgun as it ramps up or approaches the whale at full power;
- In contrast to the lack of avoidance response, the CEE results showed there may be statistically significant changes in the swimming and foraging behavior of sperm whales exposed to the sound of airguns in the exposure range (RL) of 111-147 dB re 1 µPa (rms) (131-164 dB re 1 µPa [peak to peak]; see Table I in Madsen et al., 2006) at distances of approximately 1.4-12.6 km from the sound source; and
- There was the "discovery of a statistically significant 60% reduction in foraging for one whale coupled with evidence that other whales are less sensitive…"

Sperm whales are most likely to be acoustically aware of their environment and can exhibit behavioral reactions in a number of ways, including interruption of vocal activity and foraging. However, there are, as yet, insufficient data to assign thresholds for acoustic disturbance to sperm whales. An additional factor to consider is the deep-diving habit of sperm whales. Unlike mysticetes, which may remain close to the surface for long periods, sperm whales spend a small percentage of time at the surface during the course of feeding activity. They surface for longer periods (average 9 minutes) between deeper dives to replenish myoglobin oxygen reserves (Watwood et al., 2006). This means they may be less likely to receive any mitigative effects afforded by sea state and near surface conditions that could buffer or dissipate sound that can occur in some instances. In addition, the sperm whale may dive to a depth where an operating seismic vessel could potentially pass directly over it without visually detecting the sperm whale.

Little is known about the hearing sensitivity of dwarf/pygmy sperm whales. Pulsed sounds with peak frequencies below 13 kHz have been recorded from pygmy sperm whales (Caldwell and Caldwell, 1987), and the anatomical and physiological features of the dwarf sperm whale head have been shown to be consistent with production of echolocation clicks (Cranford et al., 1996; Goold and Clarke, 2000). Audiograms have only recently been obtained for pygmy sperm whales and dwarf sperm whales (Cook et al., 2006; Finneran, 2009; Ridgway and Carder, 2001), but data remain insufficient to ascribe avoidance thresholds. It is possible, however, that these species may, as in the case of sperm whales, be sensitive to a wide range of sound frequencies, including those produced by seismic airgun arrays. This factor, along with their similar deep-diving habits and relatively widespread distributions in the GOM, may warrant concerns for these species from seismic survey activities, similar to those described for the sperm whale.

The Delphinids are also considered mid-frequency cetaceans with functional hearing of approximately 150 Hz to 160 kHz. They represent a diverse group including the true dolphins, killer whales, and pilot whales. There have been few studies of the impact of seismic surveys on species of Delphinidae; indeed, Richardson et al. (1995) comment on an almost total lack of studies on effects of G&G seismic activities on delphinid species. This higher frequency energy must be taken into account when considering seismic interactions with delphinids. Further, and contrary to early perceptions, the high-frequency components of airgun emissions are of sufficient level to exceed the dolphin auditory threshold curve at these low frequencies, even after considerable spreading loss (Goold and Fish, 1998).

Since the delphinid auditory system has a relatively poor response at the low-frequency end (about 110 dB re 1 µPa at 200 Hz; but see Table 2 in Southall et al., 2007) and increases in sensitivity toward the ultrasonic range; there is a clear gradient of increasing sensitivity that exists over a broad frequency range up to the frequency of peak sensitivity. Further, although an airgun pulse will have maximal energy at a few tens of Hertz, with energy decreasing towards the higher frequencies, there is also an increase in dolphin hearing sensitivity in this region. So, although toothed whales specialize in hearing ranges generally outside of the majority of seismic survey impulse sounds, there is still the potential for sounds from these surveys to fall within the acoustic sensitivity of toothed whales.

Masking

Auditory masking occurs when a sound signal that is of importance to a marine mammal (e.g., communication calls, echolocation, and environmental sound cues) is rendered undetectable due to the high noise-to-signal ratio in a frequency band relevant to a marine mammal's hearing range. In other words, noise can cause the masking of sounds that marine mammals need to hear in order to function effectively (Erbe et al., 1999). The presence of the masking noise can make it so that the animal cannot discern sounds of a given frequency. Yet at a given level it would be able to do so in the absence of the masking noise. If sounds used by the marine mammals are masked to the point where they cannot provide the animal with needed information, critical natural behaviors could be disrupted and harm could result (Erbe and Farmer, 1998). In the presence of the masking sounds, the sounds the animal needs to hear must, therefore, be of greater intensity for it to be able to detect and to discern the information in the sound.

In the case of seismic surveys in the GOM, where potential masking noise takes a pulsed form with a low duty cycle (~6-10%, or a 1-s disturbance in the sound field in every 10-15 s of ambient noise), the effect of masking is likely to be low relative to continuous sounds such as ship noise. Some whales are known to continue calling in the presence of seismic pulses. Their calls can be heard between the seismic pulses (e.g., Richardson et al., 1986; McDonald et al., 1995; Nieukirk et al., 2004; Smultea et al., 2004). Although there is one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles et al,. 1994), more recent studies report that sperm whales continued calling in the presence of seismic pulses (Madsen et al., 2002; Tyack et al., 2003; Smultea et al., 2004; Holst et al., 2006; Jochens et al., 2008).

Non-Auditory Effects

The best available scientific information shows that resonance can occur in marine animals but may not necessarily cause injury, and any such injury is not expected to occur below a sound pressure level of 180 dB re 1 μPa. Damage to the lungs and large sinus cavities of cetaceans from air space resonance is not regarded as a likely significant, non-auditory injury because resonance frequencies of marine mammal lungs are generally below that of the Surveillance Towed Active Sonar System-Low Frequency Active (SURTASS LFA) sonar signal (Finneran, 2003); therefore, they are below the seismic survey source signal. Further, biological tissues are heavily damped, and tissue displacement at resonance is predicted to be exceeding small. Lung tissue damage is generally uncommon in acoustic-related strandings (Southall et al., 2007). Additionally, since there is abundant anatomical evidence that marine mammals have evolved and adapted to dramatic fluctuations in pressure during long, deep dives that seem to exceed their aerobic capacities (Williams et al., 2000), it is very unlikely that significant lung resonance effects could be realized from the proposed seismic survey operations.

Currently, the available research is inconclusive on whether marine mammals can suffer from a form of decompression sickness caused by *in vivo* (in the natural body) nitrogen gas-bubble expansion. It is theorized that this may be caused by diving and then surfacing too quickly, forcing nitrogen bubbles to form in the bloodstream and tissues. Jepson et al. (2003) published a brief communication in *Nature* magazine on gas-bubble lesions found in stranded cetaceans (Canary Islands Stranding, 2002). Findings suggested acute and chronic tissue damage in stranded cetaceans that they believe resulted from the formation of *in vivo* gas bubbles and stated that the animals showed severe, diffuse vascular congestion and marked, disseminated microvascular hemorrhages associated with widespread fat emboli in vital organs, particularly the liver. They also stated that the lesions were consistent with acute trauma due to *in vivo* bubble formation that resulted from rapid decompression, which occurs in decompression sickness. A response to this article was posted in *Nature* by Piantadosi and Thalmann (2004) of the Duke University Medical Center and Divers Alert Network (DAN), stating that whales do not develop sufficient gas supersaturation in the tissues on ascent to cause extensive bubble formation in the liver. All communications state, though, that further investigation is needed, including an analysis of the composition of the gas in the bubbles (Jepson et al., 2003; Piantadosi and Thalmann, 2004; Fernández, et al., 2004). In addition, Jepson et al. (2003) and Fernández, et al. (2005) reported on necropsies of stranded beaked whales, which were interpreted as consistent with a decompression-like syndrome (Nowacek et al., 2007).

Based on the current knowledge of gas exchange and physiology of marine mammals, Hooker et al. (2009) developed a mathematical model to predict blood and tissue levels of nitrogen gas for three species of beaked whales: northern bottlenose; Cuvier's beaked; and Blainville's beaked whales. They suggested that deep-diving marine mammals live with, and manage high levels of nitrogen gas in their tissues and blood. Because of differences in dive behavior, predicted nitrogen levels were higher in Cuvier's beaked whales than in northern bottlenose whales and Blainville's beaked whales. The authors state that some Cuvier's beaked whale strandings could be explained by a higher abundance of the species in the area; their results suggest that species differences in behavior and/or physiology may also play a role.

Studies pertaining to the effects of stress and stress responses in mammals, including studies on marine mammals, have been reviewed by Wright et al. (2007) and Curry (1999). The stress studies investigate physiological responses to disturbance (e.g., increase in stress hormones or heart rate) rather than looking for changes in behavior (e.g., avoidance and disruption of foraging). However, in most cases, the biological importance of stress responses in marine mammals (e.g., effects on energetics, survival, reproduction, and population status) remains unknown.

Potential Impacts to Marine Mammals from Vessel Noise

The dominant source of noise from vessels is from the propeller operation; and the intensity of this noise is largely related to ship size and speed. Vessel noise from the proposed action will produce low levels of noise, generally in the 150 to 170 dB re 1 μPa-m at frequencies below 1,000 Hz. Vessel noise is transitory and generally does not propagate at great distances from the vessel. As a result, the NMFS

2007 ESA BO concluded that the effects to sperm whales from vessel noise are discountable (USDOC, NMFS, 2007).

Potential Impacts to Marine Mammals from Vessel Traffic

Given the scope, timing, and transitory nature of the proposed action, and the conditions of approval and monitoring requirements, the proposed seismic survey is not expected to result in vessel strikes from increased vessel traffic to marine mammals in the GOM. The possibility of a ship strike between a slow-moving seismic survey vessel (typically moving between 4 and 5 knots) and a marine mammal is low (USDOI, MMS, 2004). Further, BOEM requires the implementation of NTL No. 2016-G01, which provides guidelines on the implementation of monitoring programs to minimize the risk of vessel strikes to protected species and to report observations of injured or dead protected species. The NMFS 2007 ESA BO recognizes that the risk of collision with sperm whales "is expected to be reduced to discountable levels" with implementation of the vessel strike avoidance measures (USDOC, NMFS, 2007). Deep-diving whale species, the faster diving marine mammal species with less surface recovery time, would be expected to have even less risk of vessel strikes. In 1995, an oil crew workboat struck and killed a manatee in a canal near coastal Louisiana (Fertl et al., 2005). Manatees are infrequently found in water depths where the survey activities are proposed, though some recent deepwater sightings have occurred. As of April 2014, five manatee sightings have been reported in the deepwater of the GOM. These include three sightings from PSOs on seismic vessels and two visual observations from a drilling rig and ship at depths ranging from 465 to 6,000 ft (142 to 1,829 m). Sightings at these depths are uncommon. Seismic survey operations should pose little, if any, risk to them.

Conclusion

The sections above discuss marine mammal hearing in general and the potential range of effects to marine mammals from seismic noise, including: (1) permanent hearing loss; (2) temporary hearing loss; (3) behavioral response; (4) masking; and (5) non-auditory effects. As described, seismic noise has the potential, individually or cumulatively, to result in any of these potential impacts to marine mammal species commonly found in the GOM and proposed action area. However, BOEM finds that the potential for such effects from the proposed action is unlikely to rise to significant levels for the following reasons:

- Mysticetes, as low-frequency hearing specialists, are the species groups most likely to be susceptible to impacts from nonpulse sound (intermittent or continuous) given that their hearing ranges overlap most closely with the noise frequencies produced from drilling (Southall et al., 2007). However, most mysticete species that may occur in the GOM (i.e., North Atlantic right, blue, fin, sei, humpback, and minke) are considered either "extralimital," "rare," or "uncommon" within the GOM (Wursig et al., 2000; Waring et al., 2016). The only commonly occurring baleen whale in the northern GOM is the Bryde's whale which is limited in its range. Given the small geographic scope of the proposed action, the presence of these species within the action area is unlikely. However, the potential for significant impacts is minimized given the implementation of the required shutdown and ramp-up.

- Manatees are not typically common in the proposed action area, though some deepwater sightings have occurred. As they predominantly inhabit only coastal marine, brackish, and freshwater areas they are not expected to occur regularly in the area of the proposed action.

- The remaining marine mammal species in the GOM are considered either mid-frequency hearing specialists (e.g., sperm whales, beaked whales, and dolphins) with hearing ranges that slightly overlap with sound frequencies produced from seismic noise (Southall et al., 2007), or high-frequency specialists (pygmy and dwarf sperm whales). Therefore, the potential for seismic noise produced from this proposed action to cause auditory and non-auditory effects, PTS, TTS, behavioral changes, or masking on these species is further limited although not entirely eliminated.

- To further minimize or reduce the potential for impacts, BOEM instituted several key mitigation and monitoring requirements under NTL No. 2016-G02 (*Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program*) described below. These measures were developed in 2003 in coordination with NMFS. They are meant to be conservative (i.e., they afford additional protection to the species). As a result of the implementation of this NTL, page 71 of the NMFS 2007 BO concluded that PTS was unlikely to occur to sperm whales given the requirements under NTL No. 2016-G02 and that implementation of these measures would limit the potential for harassment. These measures, although needing further testing for effectiveness, represent the best available mitigation strategy for seismic surveys as recognized in the most recent NMFS Incidental Take Authorizations (ITA) under the Marine Mammal Protection Act (MMPA). All PSOs must have completed PSO training in accordance with NMFS National Standards for a Protected Species Observer and Data Management Program: A Model for Seismic Surveys (Baker et al., 2013). The following is a summary of the mitigation and monitoring requirements under NTL No. 2016-G02 in waters >200 m deep:

  - establishment of a 500-m exclusion zone around the seismic source vessel (this exclusion zone is then continually monitored for the presence of whales [and sea turtles] by dedicated PSOs);
  - shut down of the seismic sound source should a PSO observe a whale within or approaching the exclusion zone;
  - delay of the restart of surveys until the animal has left the area and no other whales (or sea turtles) are sighted for an additional 30 minutes; and
  - slow ramp-up of seismic sound sources at the start or restart of surveys (e.g., the gradual increase in seismic noise) so as to allow an animal to leave the area before the seismic sound reaches potentially disturbing levels.

- The NMFS 2007 BO concluded that "masking would be unlikely to occur due to the characteristics of airgun pulses" (page 71).
- The NMFS 2007 BO also found that impacts to sperm whales would be expected to be limited to the potential for TTS and behavioral changes. The same can be inferred for other mid-frequency hearing specialists, such as dwarf/pygmy sperm whales and dolphins. The BO also states that behavioral changes, should they occur, would be "limited to the duration of exposure to the noise."
- Reporting requirements mandated in NTL No. 2016-G02 have resulted in numerous years of observation data. BOEM has completed a study to summarize and synthesize submitted seismic survey observer reports for the years 2002-2008 (Barkaszi et al., 2012). While the data has demonstrated a number of short-term behavioral effects, the consequences in the long-term remain unknown. It is also clear that the data have limitations regarding the collection, interpretation and analysis of behavioral observations in relation to their use in impact assessment. Results of this and future syntheses might lead to recommendations for both BOEM and NMFS as to the effectiveness of current required mitigation measures, as well as suggestions for new and/or improved mitigation.
- NMFS sets the 180-decibel (dB) root-mean-squared (rms) isopleth where on-set of auditory injury or mortality to cetaceans may occur. Southall et al. (2007) suggests this level should rather be at 230 dB rms for a single-sound exposure event, such as seismic noise. The 500-m exclusion zone established in NTL No. 2016-G02 encompasses an area larger than where the 180 dB rms isopleths would fall and, thus, represents a conservative protective zone. The likelihood of injury, when the zone is monitored for needed shut downs, is therefore greatly minimized.

In conclusion, given the scope, timing, and transitory nature of the proposed action and given the conditions of approval and monitoring requirements in place, the noise related to the proposed seismic survey is not expected to result in PTS, TTS, behavioral change, masking, or non-auditory effects to marine mammals in the GOM that would rise to the level of significance. The geographic scope of the proposed action is small in relation to the ranges of marine mammals in the GOM. The proposed seismic activities are not expected to cause long-term or permanent displacement of the animals from preferred habitats, nor will they result in the destruction or adverse modification of any habitats. Survey activities will involve limited vessel traffic related to the towing of the airgun array that carries some risk of collisions; however, animals may avoid the sound source of the moving vessels, reducing the likelihood of collision. BOEM has issued applicable regulations and guidelines to minimize/negate the chance of vessel strike to marine mammals, including NTL No. 2016-G01 (*Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*), and BOEM also employs protected species lease stipulations.

3.2.3. Cumulative Impact Analysis

Chapter III.B.7 and Chapter I.A of Appendix F of the PEA, and Chapters 4.9.1.2.3 of the Multisale EIS address the cumulative impacts on marine mammals a result of oil and gas leasing, exploration, development and production activities, including G&G activities.

The proposed action may cumulatively affect protected marine mammals when viewed in light of the unusual mortality event (UME). Marine mammals could be impacted by the degradation of water quality resulting from operational discharges; vessel traffic; noise generated by platforms, drillships, helicopters, vessels, and seismic surveys; explosive structure removals; oil spills; oil-spill-response activities; loss of debris from service vessels and OCS structures; commercial fishing; capture and removal; and pathogens. The cumulative impact on marine mammals is expected to result in a number of chronic and sporadic sublethal effects (i.e., behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources.

Few deaths are expected from chance vessel collisions, ingestion of plastic material, commercial fishing, and pathogens. Deaths as a result of structure removals are not expected to occur due to mitigation measures that the operator must adhere to during operations. Disturbance (noise from vessel traffic and drilling operations, etc.) and/or exposure to sublethal levels of toxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them more vulnerable to parasites and diseases that normally would not be fatal. The net result of any disturbance will depend upon the size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). Natural phenomena, such as tropical storms and hurricanes, are impossible to predict but do occur in the GOM.

Unusual Mortality Event (UME) for Cetaceans in the GOM

On December 13, 2010, NMFS declared an UME for cetaceans (whales and dolphins) in the Gulf of Mexico. An UME is defined under the Marine Mammal Protection Act as a "stranding that is unexpected, involves a significant die-off of any marine mammal population, and demands immediate response." Evidence of the UME was first noted by NMFS as early as February 2010. Through July 2014, and as indicated in the table below, a total of 1,141 cetaceans (5% stranded alive and 95% stranded dead) have stranded during the UME, with a vast majority of these strandings involving premature, stillborn, or neonatal bottlenose dolphins. Based upon analysis of stranding data, NOAA defined the spatial and temporal boundaries of this UME to include all cetaceans that stranded in Alabama, Mississippi, and Louisiana from March of 2010 – July of 2014 and all cetaceans other than bottlenose dolphins that stranded in the Florida Panhandle (Franklin County through Escambia County) from March 2010 – July of 2014. However, NOAA stated that these boundaries could be adjusted in the future based upon the availability of new results or analyses. NOAA has declared the UME closed on July 31, 2014. More detail on the stranding numbers for this UME can be found on NMFS' website: http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm (USDOC, NMFS, 2016).

Unusual Mortality Event Cetacean Data for the Northern Gulf of Mexico

Cetaceans Stranded	Phase of Oil-Spill Response	Dates
89 cetaceans stranded	Prior to the response phase for the oil spill	March 1, 2010 - April 29, 2010
119 cetaceans stranded or were reported dead offshore	During the initial response phase to the oil spill	April 30, 2010 - November 2, 2010
933 cetaceans stranded*	After the initial response phase ended	November 3, 2010 – July 31, 2014**

**This number includes 13 dolphins that were killed incidental to fish-related scientific data collection and 1 dolphin killed incidental to trawl relocation for a dredging project.*

***The initial response phase ended for all four states on November 2, 2010, but then re-opened for eastern and central Louisiana on December 3, 2010 and closed again on May 25, 2011.*

The UME investigation and the *Deepwater Horizon* Natural Damage Resource Assessment have determined that the *Deepwater Horizon* Event resulted in the death of marine mammals and is the most likely explanation of the elevated stranding numbers that persisted after the spill event. Seismic surveys were not cited as a cause directly or indirectly. Data has supported that the adrenal and lung disease observed in dolphins was most likely due to exposure to petroleum products from the spill event. This has resulted in both dolphin mortalities, which peaked from March 2010 – July 2014, and fetal loss. Research, while ongoing, suggests that the effect on these populations has not ended, with evidence of failed pregnancies found in 2015 (USDOC, NMFS, 2016).

A study by Carmichael et al. (2012) suggested that natural stressors combined with the *Deepwater Horizon* event may have created a "perfect storm" for bottlenose dolphins in the northern Gulf of Mexico. Many coastal species in the northern Gulf of Mexico, including dolphins, experienced unusually harsh winter conditions in early 2010, which were followed by the *Deepwater Horizon* event. Another potential stressor was introduced in January 2011 when large volumes of cold freshwater, associated with melt water from an unusually large winter snowfall near the Mobile Bay watershed, entered the nearshore coastal systems very rapidly. This event happened days prior to the start of unusually high numbers of perinatal (near term to neonatal) bottlenose dolphin mortalities in the northern GOM from January to April 2011.

Conclusion

The effects of the proposed action, when viewed in light of the effects associated with other relevant activities, may impact marine mammals in the GOM. With the implementation of the required conditions of approval for seismic survey and vessel operations under Alternative 3, as well as the limited scope, timing, and geographic location of the proposed action, effects from the proposed seismic activities on marine mammals will be negligible. For animals that may be continuing to experience stress/sublethal impacts from natural or anthropogenic stressers, the additional conditions of approval should act to further reduce impacts and provide an abundance of precaution.

3.3. Sea Turtles

3.3.1. Description

The life history, population dynamics, status, distribution, behavior, and habitat use of sea turtles can be found in Appendix E of the PEA and Chapters 4.9.2 of the Multisale EIS and is incorporated by reference into this SEA. Of the extant species of sea turtles, five are known to inhabit the waters of the GOM (Pritchard, 1997): the leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), Kemp's ridley (*Lepidochelys kempii*), and loggerhead (*Carettra caretta*). The loggerhead turtle is the most abundant turtle in the GOM (Dodd, 1988). The leatherback turtle is the most abundant turtle in the northern GOM continental slope (Mullin and Hoggard, 2000). These five species are all highly migratory, and individual animals will migrate into nearshore waters as well as other areas of the North Atlantic Ocean, GOM, and Caribbean Sea.

All five species of sea turtles found in the Gulf of Mexico have been federally listed as endangered or threatened since the 1970's. Critical habitat was designated for the distinct population segment of Northwest Atlantic loggerhead turtles on 10 July 2014 in 79 CFR 79 39755 39854 (*Federal Register*, 2014).

In 2007, FWS and NMFS published 5-year status reviews for federally listed sea turtles in the GOM (USDOC, NMFS and USDOI, FWS,2007a-e). A 5-year review is an ESA-mandated process that is conducted to ensure that the listing classification of a species as either threatened or endangered is still accurate. Both agencies share jurisdiction for federally listed sea turtles and jointly conducted the reviews. After reviewing the best scientific and commercially available information and data, agencies determined that the current listing classification for the five sea turtle species remain unchanged. Updated 5-year reviews for hawksbill and leatherback turtles were published in 2013 that support the current listing status for these species (USDOC, NMFS and USDOI, FWS, 2013a-b).

Sea Turtle Hearing

The anatomy of sea turtle ears and measurements of auditory brainstem responses of green and loggerhead sea turtles demonstrate that sea turtles are sensitive to sounds, with an effective hearing range within low frequencies (Bartol et al., 1999; Lenhardt et al., 1983; Moein et al., 1994; Ridgway et al., 1969). Although external ears are absent, sea turtles have a tympanum composed of layers of superficial tissue over a depression in the skull that forms the middle ear. The tympanum acts as additional mass loading to the ear, allowing for reduction in the sensitivity of sound frequencies and increasing low-frequency, bone-conduction sensitivity (Bartol et al., 1999; Lenhardt et al., 1985). Lenhardt et al. (1983) and Moein et al. (1993 and 1994) found that bone-conducted hearing appears to be an effective reception mechanism for sea turtles (i.e., loggerhead and Kemp's ridley) with both the skull and shell acting as receiving surfaces for water-borne sounds at frequencies of 250-1,000 Hz. The NMFS 2007 BO indicated that adult sea turtles are sensitive to low- and mid-frequency sounds, specifically in the 200- to 2,000-Hz frequency range (USDOC, NMFS, 2007). Unlike marine mammals, sea turtles "do not appear to greatly utilize environmental sound, at least at far distances in the open ocean" (USDOC, NMFS, 2007).

3.3.2. Impact Analysis

The diversity of a sea turtle's life history leaves it susceptible to many natural and human impacts, including impacts while it is on land, in the benthic environment, and in the pelagic environment. The IPFs associated with the proposed action that could affect sea turtles include (1) seismic noise; (2) vessel noise; (3) vessel traffic. Section III.C.2 of the PEA contains a discussion of the potential impacts from survey operations on sea turtles (USDOI, MMS, 2004). Additional information about routine impacts from oil and gas activity on sea turtles is addressed in Chapters 4.9.2.2.1 of the Multisale EIS. The discussions are summarized below and are incorporated by reference into this SEA.

3.3.2.1. Alternative 1

If Alternative 1, the No Action Alternative, is selected the applicant would not undertake the proposed activities. Therefore, the IPFs to sea turtles would not occur. For example, there would be no vessel noise or seismic airgun noise that would result in behavioral change, masking, or non-auditory effects to sea turtles, no long-term or permanent displacement of the animals from preferred habitats, and no destruction or adverse modification of any habitats. Since there would be no vessel traffic related to the towing of the airgun array, there would be no risk of collisions with sea turtles.

3.3.2.2. Alternative 2

If Alternative 2, the Proposed Action, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application. Examples of potential impacts to sea turtles without implementation of the above referenced conditions of approval and monitoring include, but are not limited to: injury from vessel traffic and disruption of feeding and other behaviors from vessel presence. This Alternative would not adequately limit or negate potential impacts to sea turtles.

3.3.2.3. Alternative 3

If Alternative 3, the Proposed Action with Additional Conditions of Approval, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application; however, the applicant would be required to undertake additional conditions of approval as identified by BOEM, in coordination with NMFS and in compliance with the NMFS ESA consultation requirements (i.e., NTL No. 2016-G01 (*Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*) and NTL No. 2016-G02 (*Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program*). For the reasons set forth below, inclusion of these measures under Alternative 3 limits or negates potential impacts to sea turtles (e.g., vessel strikes, behavioral disruption from vessel presence).

Potential Impacts to Sea Turtles from Seismic Noise

The first IPF associated with the proposed action that could affect ESA-listed sea turtles is impacts from seismic survey noise. Although little is known about the effects of anthropogenic noise on sea turtles, potential impacts of seismic surveys may include auditory effects (PTS and TTS) and/or behavioral disturbance. There is limited evidence of TTS in sea turtles. In the 1994 study of juvenile loggerheads, sponsored by the U.S. Dept. of the Army, Corps of Engineers (Moein et al., 1994), sea turtles were contained in a pen in shallow water as they were exposed to pulses from a single airgun. Both behavioral and physiological responses were observed. The turtles avoided airgun pulses at received levels at 175-180 dB re 1 µPa but habituated by the third presentation of the sounds. In some cases, habituated animals remained close to the airgun as it was operating. In 10-15 percent of the sea turtles exposed to airgun pulses, a temporary shift in auditory responses was measured. Received levels causing the shift are not known.

Additional studies have noted possible reactions to low-frequency noise, such as that associated with the proposed action, including startle responses and rapid swimming (McCauley et al., 2000a) and swimming toward the surface at the onset of the sound (Lenhardt, 1994). Recent investigations reported that green and loggerhead sea turtles increased their swimming activities when exposed to low-frequency noise; these activities become more erratic as the exposure level increases (McCauley et al., 2000a). Weir (2007) did not document obvious behavioral avoidance to airguns but suggested responsive actions by sea turtles to the vessel and towed equipment. Sea turtles may alter their behaviors when a vessel approaches, and thereby suspend feeding, resting, or interacting with conspecifics. Such disruptions are expected to be temporary, however, and should not affect the overall survival and reproduction of individual turtles.

Page 18 of the NMFS 2007 BO concluded that the effects from seismic noise on sea turtles are "reduced to discountable levels" with the implementation of NTL No. 2016-G02. The BO acknowledges that sea turtles may exhibit behavioral change through avoidance response, but this response would be limited to the vicinity of the survey. Further, avoidance is more likely in response to the presence of the vessel than the seismic noise itself (USDOC, NMFS, 2007). Given the scope, timing, and transitory nature of the proposed action, the implementation of NTL No. 2016-G02, and that the best available information indicates that sea turtles do not appear to use environmental sound heavily to meet daily needs for survival, BOEM concurs with NMFS in that effects to sea turtles from seismic noise are expected to be negligible.

Popper et al. (2014), published sound exposure guidelines for fishes and sea turtles. A sea turtle would need to be close to the seismic sound source at 210 dB cum or >207 dB peak to cause mortal injury (Popper et al., 2014). Low frequency sounds can cause moderate TTS in turtles at relatively near or intermediate vicinity to the source. Continuous sounds can cause masking and behavioral effects, though the consequences for survival of sea turtles are unknown (Popper et al., 2014).

Potential Impacts to Sea Turtles from Vessel Noise

The second IPF associated with the proposed action that could affect ESA-listed sea turtles is impacts from vessel noise with seismic vessels. The dominant source of noise from vessels is propeller operation, and the intensity of this noise is largely related to ship size and speed. Vessel noise from the proposed action would produce low levels of noise, generally in the 150 to 170 dB re 1 µPa-m at frequencies below 1,000 Hz. Vessel noise is transitory and generally does not propagate at great distances from the vessel. Also, available information indicates that sea turtles do not greatly utilize environmental sound. As a result, the NMFS 2007 BO concluded that effects to sea turtles from vessel noise are discountable (USDOC, NMFS, 2007). The Popper et al. (2014) sound exposure guidelines were broad-ranging and provided non-quantified, generalized guidelines for shipping noise as a low risk of impairment, unless the turtle is in the near field range (within tens of meters), which would pose a moderate risk of temporary threshold shift (TTS) that can recover over time. The risk for noise to cause masking and behavior effects range from low to high depending on the location of the turtle relative to the noise (Popper et al., 2014).

Potential Impacts to Sea Turtles from Vessel Traffic

Sea turtles spend at least 3-6 percent of their time at the surface for respiration and perhaps as much as 26 percent of time at the surface for basking, feeding, orientation, and mating (Lutcavage et al., 1997). Data show that collisions with all types of commercial and recreational vessel traffic are a cause of sea turtle mortality in the GOM (Lutcavage et al., 1997). Stranding data for the U.S. Gulf and Atlantic Coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993 about 9 percent of living and dead stranded sea turtles had boat strike injuries (Lutcavage et al., 1997). Vessel-related injuries were noted in 13 percent of stranded turtles examined from the GOM and the Atlantic during 1993 (Teas, 1994), but this figure includes those that may have been struck by boats post-mortem. In Florida, where coastal boating is popular, 18 percent of strandings documented between 1991 and 1993 were attributed to vessel collisions (Lutcavage et al., 1997). Large numbers of loggerheads and 5-50

Kemp's ridley turtles are estimated to be killed by vessel traffic per year in the U.S. (NRC, 1990; Lutcavage et al., 1997).

There have been no documented sea turtle collisions with seismic survey-related vessels in the GOM; however, collisions with small or submerged sea turtles may go undetected. Based on sea turtle density estimates in the GOM, the encounter rates between sea turtles and vessels would be expected to be greater in water depths less than 200 m (USDOC, NMFS, 2007). To further minimize the potential for vessel strikes, BOEM requires operators to implement NTL No. 2016-G01, which contains vessel strike avoidance measures for sea turtles and other protected species. With implementation of these measures and a PSO on the lookout for sea turtles, the NMFS 2007 BO concluded that the risk of collisions between oil/gas-related vessels (including those for G&G, drilling, production, decommissioning, and transport) and sea turtles is appreciably reduced, but strikes may still occur. This Opinion then grants BOEM an Incidental Take Statement that includes a set number of allowable takes of sea turtles by vessel strikes (USDOC, NMFS, 2007). As per the required reporting under NTL No. 2016-G01, BOEM monitors for any takes that have occurred as a result of vessel strikes and also requires that any operator immediately report the striking of any animal (see requirements under NTL No. 2016-G01). To date, there have been no reported strikes of sea turtles by seismic vessels. Given the scope, timing, and transitory nature of the proposed action and with these established conditions of approval, effects to sea turtles from seismic vessel collisions is expected to be negligible.

Conclusion

The sections above discuss sea turtle hearing in general and the potential range of effects to sea turtles from the proposed action, including: (1) seismic noise; (2) vessel noise; and (3) vessel traffic. As described, effects of seismic noise on sea turtles will not rise to the level of significance for the following reasons:

- The best available scientific information indicates that sea turtles do not greatly use sound in the environment for survival; therefore, disruptions in environmental sound would have little effect.
- To further minimize or reduce the potential for impacts, BOEM instituted several key mitigation and monitoring requirements under NTL No. 2016-G02 *(Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program*) described below. These measures were developed in 2003 in coordination with NMFS. They are meant to be conservative (i.e., they afford additional protection to the species). As a result of the implementation of this NTL, the NMFS 2007 BO concluded that effects of seismic noise on sea turtles was "discountable."
- The scope, timing, and transitory nature of the proposed action will produce limited amounts of seismic noise in the environment.
- As described, effects of vessel noise on sea turtles are considered "discountable" (USDOC, NMFS, 2007). The risk of collisions between sea turtles and vessels associated with the proposed action exist but would not rise to the level of significance given:
- BOEM requires compliance with NTL No. 2016-G01, which provides guidelines on monitoring programs to minimize the risk of vessel strikes to sea turtles and other protected species and the reporting of any observations of injured or dead protected species.
- The NMFS 2007 BO recognizes that these measures should appreciably reduce the potential for vessel strikes. Further, this Opinion found "no jeopardy" to sea turtles from vessel strikes related to the proposed action and granted a limited number of Incidental Take Authorizations to BOEM for sea turtle mortalities by vessel strikes. BOEM continues to monitor for any strikes to ensure this authority is not exceeded. To date, there have been no reported strikes of sea turtles by seismic vessels.
- The scope, timing, and transitory nature of the proposed action will result in limited opportunity for sea turtles and vessel strikes.

3.3.3. Cumulative Impact Analysis

Chapter III.C.7 and Chapter I.B of Appendix F of the PEA, and Chapter 4.9.2.2.3 of the Multisale EIS address the cumulative impacts on sea turtles as a result of oil and gas leasing, exploration, development and production activities, including G&G activities. The information from these documents is incorporated by reference in this EA.

Activities considered under the cumulative scenario, including the proposed action, may affect protected sea turtles or critical habitat. Sea turtles may be impacted by the degradation of water quality resulting from operational discharges, vessel traffic, noise generated by platforms, drillships, helicopters and vessels, seismic surveys, explosive structure removals, oil spills, oil-spill-response activities, loss of debris from service vessels and OCS structures, commercial fishing, capture and removal, and pathogens. The cumulative impact of these ongoing OCS activities on sea turtles is expected to result in a number of chronic and sporadic sublethal effects (i.e., behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may stress and/or weaken individuals of a local group or population and that may predispose them to infection from natural or anthropogenic sources.

Few deaths are expected from chance collisions with OCS service vessels, ingestion of plastic material, commercial fishing, and pathogens. Deaths as a result of OCS structure removals are not expected to occur due to requisite mitigation measures. Disturbance (noise from vessel traffic and drilling operations, etc.) and/or exposure to sublethal levels of toxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them more vulnerable to parasites and diseases that normally would not be fatal. The net result of any disturbance depends upon the size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). Mitigation is in place to reduce vessel strike mortalities (i.e., NTL No. 2016-G01).

Natural disturbances such as hurricanes can cause significant destruction of nests and topography of nesting beaches (Pritchard, 1980; Ross and Barwani, 1982; Witherington, 1986). Tropical storms and hurricanes are a normal occurrence in the GOM and along the Gulf Coast. Generally, the impacts have been localized and infrequent; however, few areas of the Gulf Coast did not suffer some damage in 2004 and 2005. Some impacts of the hurricanes, such as loss of beach habitat, continue to impact sea turtles that would have otherwise used those areas as nesting beaches. Increases or decreases in beach armoring and other structures may impact all nesting sea turtles in the areas affected. Hurricanes and tropical activity may temporarily remove some of these barriers to suitable nesting habitat.

Incremental injury effects from the proposed action on sea turtles are expected to be negligible for seismic and vessel noise and minor for vessel collisions but not rise to the level of significance. This is mainly because of the limited scope, duration, and geographic area of the proposed action and the requirements under NTL Nos. 2016-G01 and 2016-G02.

Conclusion

The effects of the proposed action, when viewed in light of the effects associated with other relevant activities, may affect sea turtles occurring in the GOM. With the implementation of the required mitigation measures for seismic survey and vessel operations (NTL Nos. 2016-G01 and 2016-G02) and the scope of the proposed action, incremental effects from the proposed seismic activities on sea turtles will be negligible (seismic and vessel noise) to minor (vessel strikes). The best available scientific information indicates that sea turtles do not greatly use sound in the environment for survival; therefore, disruptions in environmental sound would have little effect.

3.4. FISH RESOURCES AND ESSENTIAL FISH HABITAT

3.4.1. Description

The life history, population dynamics, status, distribution, behavior, and habitat use of fish and essential fish habitat can be found in Chapter 4.7of the Multisale EIS, and is incorporated by reference into this SEA.

Threatened or Endangered Species

Two GOM fish species, the Gulf sturgeon and the smalltooth sawfish, are protected under the ESA. The Gulf sturgeon is listed as threatened; the smalltooth sawfish is listed as endangered. The Gulf sturgeon is predominantly distributed in the nearshore waters of the northeastern GOM, and currently, the smalltooth sawfish is predominantly distributed in the nearshore waters of south Florida (USDOI, FWS and Gulf States Marine Fisheries Commission, 1995; USDOC, NMFS, 2009).

Non-ESA-Listed Species

Approximately 1,540 species of fishes are recorded in the GOM and Florida Keys (McEachran, 2009). NOAA, working with the South Atlantic and Gulf of Mexico Fishery Management Councils, manage 71 and 40 fish and crustacean species, respectively, within the Federal waters of the GOM. Distinctive fish assemblages are recognized within broad habitat classes including demersal (soft bottom and hard bottom), coastal pelagic, and oceanic pelagic (epipelagic and midwater) species. Fish are also classified by their movement patterns. Billfishes (marlins and sailfish), swordfish, tuna, and many shark species are considered highly migratory, as they are widely distributed geographically and occur from coastal waters seaward into the open ocean. Highly migratory species move vertically in the water column to feed, usually on a daily basis, and move great geographic distances for feeding or reproduction (USDOC, NMFS, 2006). An example is the Atlantic bluefin tuna, which are known to use the GOM in the spring for spawning grounds (Teo et al., 2007a and 2007b; Teo and Block, 2010).

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act, as amended in 1996 by the Sustainable Fisheries Act, mandates that the regional Fishery Management Councils, through Fishery Management Plans, describe and identify EFH for each federally managed species, minimize adverse effects on such habitat caused by fishing, and identify other actions that encourage the conservation and enhancement of such habitats. Almost the entire GOM is within a designated EFH. Further, the Gulf of Mexico regional Fishery Management Council amended their Gulf of Mexico plans (referred to as Generic Amendment Number 3, 2005) to more specifically designate that habitats less than 100 fathoms (600 ft) are identified and described as EFH.

Fish Hearing

All fish species have hearing and skin-based mechanosensory systems (inner ear and lateral line) used to detect sound in their environment (Fay and Popper, 2000; Popper, 2003). These sounds may be produced by other fish, other organisms (e.g., snapping shrimp, marine mammals), or other naturally occurring sounds such as waves breaking on the shore, rain on the water surface, etc. Many Gulf fish species are known to actively use sound to mediate specific behaviors (e.g., spawning). Anthropogenic (human-generated) sounds may affect fishes through auditory masking, behavioral modification, temporary hearing loss, or physiological injury. Masking of important environmental sounds or social signals could potentially reduce foraging success, increase predation, or disrupt reproduction. Studies suggest responses to anthropogenic sound can vary, even among members of a species. However, startle responses generally include avoidance behaviors away from adverse conditions. Responses may also vary with duration and frequency of exposure to a given signal. Fishes in close proximity to intense sound sources may experience temporarily reduced hearing sensitivity or TTS. These effects depend upon the type of sound, duration of sound, distance of sound, and fish species (Popper and Hastings, 2009). Injury to fishes as a result of rapid changes in pressure (barotrauma) may occur in close proximity to an intense sound source.

Hearing mechanisms in fishes have been studied extensively (Fay and Popper, 2000; Ladich and Popper, 2004; Webb et al., 2008), but the specific capabilities of species and the received-sound levels where potentially adverse impacts may occur are not well known. Furthermore, Popper and Fay (2011) suggest the broad designation of fishes as "hearing specialists" and "hearing generalists" is not sufficient to classify the hearing abilities of fishes. They recommend that the range of hearing capabilities across species is more like a continuum that includes the relative contributions of hydrostatic pressure to the overall hearing capabilities of a species. Although studies have investigated physiological impacts (McCauley et al., 2000c; McCauley et al., 2003) and behavioral response (Skalski et al., 1992; Engas et al., 1996; Slotte et al., 2004; Lokkeborg et al., 2012; Fewtrell and McCauley, 2012) in several species, results are generally inconclusive and cannot be applied at the population level (National Science Foundation, 2011). However, information gaps are widely recognized (Hawkins et al., 2014; Popper et al., 2014) and broad guidance has been developed to minimize potential impacts to fishes and sea turtles resulting from anthropogenic sound exposure. The sections below provide a synopsis of the available information relevant to the effects on fish from exposure to seismic and other anthropogenic sound.

3.4.2. Impact Analysis

Distinctive fish assemblages can be found within a broad range of habitats in continental shelf and oceanic waters. The IPF associated with the proposed action that could affect fish is noise from survey activities. Chapter III.D.2 of the PEA contains a discussion of the potential impacts from survey operations on fish resources (USDOI, MMS, 2004). Additional information about routine impacts from oil and gas activity on fish is addressed in Chapter 4.7.2.1 of the Multisale EIS. The discussions are summarized below and are incorporated by reference into this SEA.

3.4.2.1. Alternative 1

If Alternative 1, the No Action Alternative, is selected the applicant would not undertake the proposed activities. Therefore, the IPFs to fish would not occur. For example, there would be no seismic airgun noise that would result in behavioral change, masking, or non-auditory effects to the animals, no long-term or permanent displacement of the animals from preferred habitats, and no destruction or adverse modification of any habitats.

3.4.2.2. Alternative 2

If Alternative 2, the Proposed Action as Proposed, is selected the applicant would undertake the proposed activities, as requested and conditioned in the application. As described in the analyses below, impacts to fish from the proposed action (e.g., hearing loss or behavioral disruption from seismic noise), are expected to be short-term, localized and not lead to significant impacts. Although the conditions of approval outlined in Chapter 2.4 and discussed in the marine mammal and sea turtle sections are requisite for permit approval, their implementation will not increase or decrease the potential for effects to fish from the proposed action.

3.4.2.3. Alternative 3

If Alternative 3, the Proposed Action with Additional Conditions of Approval, is selected, the applicant would undertake the proposed activities, as requested and conditioned in the application; however, the applicant would be required to undertake additional conditions of approval as identified by BOEM. As described in the analyses below, impacts to fish from the proposed action (e.g., hearing loss or behavioral disruption from seismic noise), are expected to be short-term, localized and not lead to significant impacts. Although the conditions of approval outlined in Chapter 2.4 would be included, their implementation would not increase or decrease the potential for effects to fish from the proposed action.

Potential Impacts to Fish Resources from Seismic Noise

Fish ears respond to changes in pressure and particle motions (van Bergeijk, 1967; Schuijf, 1981; Kalmijn, 1988 and 1989; Schellert and Popper, 1992; Hawkins, 1993; Fay, 2005). Fish exposed to natural or manmade sound may experience physical and behavioral effects, ranging in magnitude from negligible to severe. The four areas of primary concern for fish exposed to elevated noise levels include: (1) hearing loss; (2) behavioral response; (3) masking; and (4) non-auditory effects.

Hearing Loss

To result in hearing loss, a sound must exceed the specific hearing threshold of that fish for a certain period of time (Popper, 2005). The consequences of temporary or permanent hearing loss in individual fish or a fish population is largely unknown. However, it likely depends upon the number of individuals affected and whether critical behaviors involving sound (e.g., predator avoidance, prey capture, orientation and navigation, reproduction, etc.) are adversely affected.

McCauley et al. (2003) found that caged pink snapper exposed to airgun sounds (600 pulses with peak-to-peak source levels of approximately 223 dB re 1 µPa) experienced observable anatomical damage to the auditory structures and that this damage did not repair 58 days after exposure. The damage as quantified by missing hair cells was relatively low, but the potential for impaired function in the remaining cells and the wider implications of potentially reduced fitness were not tested. Popper et al. (2005) documented TTS of northern pike and lake chub in the Mackenzie River Delta but found that broad whitefish receiving a source level of 177 dB re 1 μPa^2 s showed no TTS. In both cases, the repetitive exposure to sound was greater than is expected in a typical seismic survey. Fishes involved in the study by Popper et al. (2005) were examined for damage to the sensory cells of the inner ear as a result of exposure to seismic sound, and no damage was observed (Song et al., 2008).

Behavioral Response

Behavioral effects from seismic noise on fishes can include changes in distribution, migration, mating, and ability to be caught. In general, any adverse effects on fish behavior or fisheries due to seismic surveys may depend on the species in question and the nature of the fishery (i.e., season, duration, and fishing method). Responses may also depend on the age of the fish, motivational state, size, and numerous unknown factors that are difficult, if not impossible, to quantify. Studies investigating the effects of sound (including seismic survey sound) on fish behavior were conducted on both uncaged and caged individuals (Chapman and Hawkins, 1969; Pearson et al., 1992; Santulli et al., 1999; Wardle et al., 2001; Hassel et al., 2003; Boeger et al., 2006) noted that fish typically exhibited a sharp "startle" response at the onset of a sound, followed by a return to normal behavior after the sound ceased. Investigation by Jorgenson and Gyselman (2009) indicated that behavioral characteristics of Arctic riverine fishes were generally unchanged by exposure to airgun sound.

Disturbance to fish population structures and distributions could result in reduced catch. An example would be temporary displacement of fish from traditional fishing grounds. Hirsh and Rodhouse (2000) reviewed studies investigating the hypothesis that seismic survey sounds have a deleterious effect on (usually commercial) fishing success. In most cases, these studies (e.g., Skalski et al., 1992; Engås et al., 1996) found that fishing catch of one or more target species declined with the onset of seismic survey operations and remained depressed throughout this activity and for days after. These effects, as reviewed in Boertmann et al. (2010), depend on species, fishing gear, and other environmental parameters. Further, reduced catch rates have been reported in some marine fisheries during seismic surveys; in several cases the findings are confounded by other sources of disturbance (Dalen and Raknes, 1985; Dalen and Knutsen, 1986; Løkkeborg, 1991; Skalski et al., 1992; Engås et al., 1996). No change was determined in catch-per-unit-effort of fish when airgun pulses were emitted, particularly in the immediate vicinity of the seismic survey (Pickett et al., 1994; La Bella et al., 1996; Wardle et al., 2001). For certain species, reductions in catch may have resulted from a change in behavior of the fish, such as a change in vertical or horizontal distribution (Slotte et al., 2004) and simply coincided with the seismic work.

Masking

Masking is defined as the effect of an acoustic source interfering with the reception and detection of an acoustic signal or other sound of biological importance to a receiver. Any sound within an animal's hearing range can mask relevant sounds. Theoretically, the airguns or airgun arrays and vessel sound could contribute minimally to localized, short-term, and transitory masking of sound detection by some marine fishes, at least those species whose sound detection capacities are in the frequency range of the seismic survey sound source(s). However, there have been no documented studies concluding that seismic surveys resulted in the masking of any biologically relevant sounds for any fish species. This is most likely due to the roving nature of the G&G surveys or the limited exposure area where survey-related energy can be found. For example, some surveying technologies (e.g., vibroseis) may have operational frequencies or cycles that present an increased potential for locally masking biologically relevant sounds. For a discussion of the biological relevance of ambient and signal sounds to fish, see Fay and Popper (2000).

Non-Auditory Effects

Existing research suggests there is a potential for non-auditory injury or mortality of fish in the immediate vicinity of a high-energy acoustic source. Airguns and airgun arrays may potentially injure or kill fishes within several meters at the time of discharge (Kostyvchenko, 1973; Dalen and Knutsen, 1986; Booman et al., 1996; Dalen et al., 1996). The potential for injury is greater among fishes with trapped gas pockets or swim bladders that expand and contract with the ambient pressure changes. There are few studies that specifically investigate the effects of airgun sound on fish larvae and eggs, but existing research suggests these life stages are no more vulnerable to intense sound than adult fishes. Other studies document no egg, larvae, or fish mortality resulting from exposure to seismic sources (Falk and Lawrence, 1973; Holliday et al., 1987; La Bella et al., 1996; Santulli et al., 1999; McCauley et al., 2000b and 2000c; Thomsen, 2002; Hassel et al., 2003; McCauley et al., 2003; Popper, 2005; Payne et al., 2009).

The potential for anthropogenic sound to affect any individual organism is dependent on the proximity to the source, signal characteristics, received peak pressures relative to the static pressure, cumulative sound exposure, species, motivation, and the receiver's prior experience. In addition, environmental conditions (e.g., temperature, water depth, and substrate) affect sound speed, propagation paths, and attenuation, resulting in temporal and spatial variations in the received signal for organisms throughout the ensonified area (Hildebrand, 2009). These factors are of particular importance when considering the use of data and results produced by various studies. For example, the recent study by McCauley et al. (2017) was conducted in shallow waters near Tasmania, Australia and the methods used differ significantly from and are not representative of OCS seismic survey activities.

Plankton are generally distributed across the shelf with areas of high and low concentration influenced by wind, tidal movement, currents, and river discharge. Phytoplankton and zooplankton are critical constituents of a marine ecosystem and are often identified as having potentially increased vulnerability to certain impact producing factors. As explained above, potential adverse impacts to zooplankton are expected to be spatially limited and indistinguishable across broader areas as a result of combined environmental factors and distribution and timing of the proposed survey activities.

Physiological effects may also include cellular and/or biochemical responses by fish to acoustic stress. Such stress potentially affects fish by increasing mortality or reducing reproductive success. However, primary and secondary stress responses of fish after exposure to seismic survey sound appear temporary (Sverdrup et al., 1994; McCauley et al., 2000b and 2000c). The periods necessary for these biochemical changes to return to normal are variable and depend on numerous aspects of the biology of the species and of the sound stimulus.

Conclusion

Noise from the proposed action could potentially result in acute injury and mortality of a minimal number of individuals of some species of fish, their larvae, and/or eggs when in very close proximity to a high-energy acoustic source. The proposed action may result in short-term, localized behavioral reactions. Highly migratory species like the bluefin tuna are found in the proposed action area at certain times of the year. However, given the small area and timeframe exposed to seismic noise under the proposed action, the transience of the moving seismic source relative to the GOM, and the small number of fish potentially within this localized area, the chance of non-auditory injury or mortality would be limited to an insignificant number of individuals. Seismic effects on such a small number of individuals would be insignificant at the population scale and considerably smaller than the natural mortality rate. Therefore, based on the limited best available science, seismic surveys are not expected to result in significant auditory or non-auditory injury or mortality on marine fish at the population scale. Finally, the frequency range of some G&G survey equipment (e.g., airguns) overlaps with the likely hearing range of the ESA-listed fish species; however, neither of these species are found routinely beyond state waters.

3.4.3. Cumulative Impact Analysis

Cumulative impacts on fish and EFH that result from oil and gas leasing, exploration, development, and production activity including G&G activities are discussed in Chapter III.D.7 and Appendix I of the PEA, and Chapter 4.7.2.3 of the Multisale EIS. The information from these documents is incorporated by reference in this EA.

Activities considered under the cumulative scenario, including the proposed action, may affect fish and fisheries. Degradation of water quality from multiple human activities as described in the Multisale EIS will continually affect fish and fisheries species. The cumulative impact of these ongoing OCS activities on fish and fisheries is expected to result in a number of chronic and sporadic lethal and sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) effects that may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources. Finally, nonanthropogenic sources such as red tides and tropical storms may add to the cumulative impacts on fish resources in the northern GOM. The proposed action is a short-term event in a portion of the GOM; therefore, the effects from the proposed action will be slight in regards to these ongoing impacts.

The net result of any disturbance depends upon the size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, and the accommodation time in response to prolonged stress.

Conclusion

The effects of the proposed action, when viewed in light of the effects associated with other relevant activities, may impact fish and fisheries occurring in the GOM. However, given the scope of the proposed action, incremental effects from the proposed seismic activities on fish and fisheries will be negligible.

3.5. OTHER CONSIDERATIONS

A discussion of the other resources considered but not analyzed under this SEA is found in Section III of the PEA (USDOI, MMS, 2004) and Chapter 3 of the Multisale EIS (USDOI, BOEM, 2017).

4. CONSULTATION AND COORDINATION

The information in this SEA was obtained from BOEM personnel listed on pages VI-1 and VI-2 of the PEA and in consultation with other Federal agencies, the private sector, and academia personnel found on pages IV-1 and IV-2 of the PEA (USDOI, MMS, 2004) and Chapter 7 of the Multisale EIS (USDOI, BOEM, 2017).

The ESA (16 U.S.C. §§ 1631 et seq.), as amended (43 U.S.C. §§ 1331 et seq.), establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend. BOEM is currently in consultation with NMFS and FWS regarding the OCS oil and gas program in the GOM. BOEM is acting as the lead agency in the ongoing consultation, with BSEE's assistance and involvement. Following the *Deepwater Horizon* explosion and oil spill, the programmatic consultation was reinitiated and expanded in scope and it will include both existing and future OCS oil and gas leases in the Gulf of Mexico through 2022. This consultation also considers any changes in baseline environmental conditions following the *Deepwater Horizon* explosion, oil spill, and response and includes post lease activities associated with OCS oil and gas activities in the Gulf of Mexico, including G&G and decommissioning activities.

With consultation ongoing, BOEM and BSEE will continue to comply with: all reasonable and prudent measures based on the most recent and best available information available; the terms and conditions under the existing consultations; and the current BOEM- and BSEE-required mitigation, monitoring, and reporting requirements. BOEM and BSEE will also continue to closely evaluate and assess risks to listed species and designated critical habitat in upcoming environmental compliance documentation under NEPA and other statutes.

BOEM originally petitioned NMFS for incidental-take regulations under Subpart I of the MMPA and consultation under Section 7 of the ESA. When the PEA was completed, BOEM revised its MMPA petition in 2004 with the updated information and is currently in consultation awaiting promulgation of the take regulations. BOEM has worked closely with NMFS to update all the information submitted in 2002-2005 and to incorporate the most recent and best available information. BOEM updated and submitted a revised petition package to NMFS in 2011 and has resubmitted a revised application on October 17, 2016. The notice of receipt and request for comments and information for the revised application was published in the Federal Register on December 8, 2016 (81 FR 88664). On September 30, 2016 BOEM also published the Draft Programmatic Environmental Impact Statement (PEIS) for G&G Activities in the GOM. BOEM is the lead agency with BSEE and NMFS serving as cooperating agencies for development of the PEIS (http://www.boem.gov/Gulf-of-Mexico-Geological-and-Geophysical-Activities-Programmatic-EIS/ for schedule and other information).

During the interim, NMFS worked with BOEM in developing the mitigation under NTL No. 2016-G01 (*Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*) and NTL No. 2016-G02 (*Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program*), to ensure that marine mammals and sea turtles were afforded the best possible protection in lieu of the regulations/Incidental Take Statement. Adherence to NTL No. 2016-G02 is assumed in the impact analyses and considered to mitigate the effects of the action in this SEA.

In accordance with the National Historic Preservation Act (54 U.S.C. §§ 300101 *et seq.*), Federal agencies are required to consider the effects of their undertakings on historic properties. The implementing regulations for Section 106 of the National Historic Preservation Act, issued by the Advisory Council on Historic Preservation (36 CFR § 800), specify the required review process. In accordance with 36 CFR § 800.8(c), BOEM intends to use the NEPA substitution process and documentation for preparing an EIS/ROD or an EA/FONSI to comply with Section 106 of the National Historic Preservation Act in lieu of 36 CFR § 800.3-800.6.

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