

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

SITE-SPECIFIC ENVIRONMENTAL ASSESSMENT

OF

GEOLOGICAL & GEOPHYSICAL
SURVEY APPLICATION NO. L18-004

FOR

FUGRO USA MARINE, INC.

March 7, 2018

RELATED ENVIRONMENTAL DOCUMENTS

Gulf of Mexico OCS Proposed Geological and Geophysical Activities
Western, Central, and Eastern Planning Areas
Final Programmatic Environmental Impact Statement
(OCS EIS/EA BOEM 2017-051)

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)

Gulf of Mexico OCS Lease Sale
Final Supplemental Environmental Impact Statement 2018
(OCS EIS/EA BOEM 2017-074)

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

The Bureau of Ocean Energy Management (BOEM) has prepared a Site-Specific Environmental Assessment (SEA) (No. L18-004) complying with the National Environmental Policy Act (NEPA), NEPA regulations under the Council on Environmental Quality (CEQ) (40 CFR part 1501.3 and part 1508.9), the United States Department of the Interior (DOI) NEPA implementing regulations (43 CFR part 46), and the Bureau of Ocean Energy Management (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 part 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:

- Gulf of Mexico OCS Proposed Geological and Geophysical Activities Western, Central, and Eastern Planning Areas Final Programmatic Environmental Impact Statement (GOM G&G PEIS) (OCS EIS/EA BOEM 2017-051),
- 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), and
- Gulf of Mexico Lease Sale Final Supplemental Environmental Impact Statement 2018 (2018 SEIS) (OCS EIS/EA BOEM 2017-074).

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

The Proposed Action: Fugro USA Marine, Inc. (Fugro) proposes to conduct a geologic survey consisting of boring and box cores. There are twenty-six proposed collection sites located in West Delta Blocks 43, 44, 45 and 46 in the Central Planning Area of the GOM. The area of the proposed action is approximately 12 miles (19 kilometers) from the nearest Louisiana shoreline and in a water depth of approximately 66 feet (20 meters). The operations will be conducted from the vessel, the *R/V Fugro Enterprise*. Site-specific analysis was completed using Fugro's description of the proposed operations; however, specific technical information regarding the G&G activities described in the permit application is proprietary and therefore not included in this document. The proposed survey is expected to take approximately one month to complete.

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) seafloor disturbance, (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 resources:

- marine mammals;
- sea turtles;
- archaeological resources; and
- other users (e.g., military).

Individual animals are vulnerable to injury if hit by the survey vessel from the proposed action. The application of the vessel avoidance condition of approval is designed to remove the possibility of ship strike to the animals. Impact significance levels are explained in Section 3.1 of this SEA. Impacts from

the proposed activities to marine mammals, sea turtles, archaeological resources, and other users 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/>.
- **NON-RECURRING MITIGATION (ARCHAEOLOGY):** This review indicates that there are no identified potential archaeological targets that exist in the area of the proposed box core deployment within the Federal waters of the Outer Continental Shelf (OCS). The project area has received either limited or no previous archaeological survey, and is likely to contain archaeological materials that may be impacted by the proposed operations. If the applicant discovers man-made debris that appears to indicate the presence of a shipwreck (e.g., a sonar image or visual confirmation of an iron, steel, or wooden hull, wooden timbers, anchors, concentrations of man-made objects such as bottles or ceramics, piles of ballast rock) within or adjacent to the proposed action area during the proposed survey operations, they will be required to immediately halt operations, take steps to ensure that the site is not disturbed in any way, and contact the BOEM Regional Supervisor for Environment within 48-hours of its discovery. They must cease all operations within 1,000 feet (305 meters) of the site until the Regional Director instructs you on what steps are required to assess the site's potential historic significance and to protect it. If a box core impacts any submerged object, then the applicant must also submit a report detailing each instance of this activity. This report should include the coordinates of the impact (to DGPS accuracy), a description of the submerged object, any damage that may have resulted from the box core operations, and any photographic or video imagery that is collected. The applicant must submit a copy of any data collected as a result of these investigations.

If remote-sensing survey data is collected for any reason during the course of this project (i.e., side-scan sonar, sector-scan sonar, multi-beam bathymetry, or magnetometer) then the applicant must submit copies of these data to BOEM.

- **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. L18-004, BOEM has determined that the proposed action would have no significant impact on the marine, coastal, or 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.

DOUGLAS JONES Digitally signed by DOUGLAS JONES
Date: 2018.04.19 17:05:48 -05'00'

Acting Unit Supervisor, Environmental Operations Section
Office of Environment, GOM OCS Region

Date

Table of Contents

Page

FINDING OF NO SIGNIFICANT IMPACT (FONSI).....	2
1. PROPOSED ACTION.....	5
1.1. Background.....	6
1.2. Purpose of and Need for the Proposed Action.....	6
1.3. Description of the Proposed Action.....	7
2.1. The No Action Alternative.....	7
2.2. The Proposed Action as Submitted.....	7
2.3. The Proposed Action with Additional Conditions of Approval.....	7
2.4. Summary and Comparison of the Alternatives.....	7
3. DESCRIPTION OF THE AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS.....	8
3.1. Introduction.....	8
3.2. Marine Mammals.....	10
3.2.1. Description.....	10
3.2.2. Impact Analysis.....	11
3.2.3. Cumulative Impact Analysis.....	13
3.3. Sea Turtles.....	14
3.3.1. Description.....	14
3.3.2. Impact Analysis.....	15
3.3.3. Cumulative Impact Analysis.....	17
3.4. Archaeological Resources.....	18
3.4.1. Description.....	18
3.4.2. Impact Analysis.....	18
3.4.3. Cumulative Impact Analysis.....	21
3.5. Other Users of the OCS.....	22
3.6. Other Considerations.....	22
4. CONSULTATION AND COORDINATION.....	22
5. BIBLIOGRAPHY.....	23
6. PREPARERS.....	28
7. REVIEWERS.....	28

**SITE-SPECIFIC ENVIRONMENTAL ASSESSMENT (SEA)
PREPARED FOR
FUGRO USA MARINE, INC.
GEOLOGICAL AND GEOPHYSICAL SURVEY APPLICATION
NO. L18-004**

1. PROPOSED ACTION

Fugro USA Marine, Inc. (Fugro) has submitted a permit application to conduct a geologic survey on the Outer Continental Shelf (OCS) of the Gulf of Mexico (GOM). This Site-Specific Environmental Assessment (SEA) evaluates the specific impacts associated with Fugro's proposed geological and geophysical (G&G) survey activities. Section 1.3 of this SEA provides specific details on the G&G activities proposed in Fugro's application.

The SEA is tiered from:

- Gulf of Mexico OCS Proposed Geological and Geophysical Activities Western, Central, and Eastern Planning Areas Final Programmatic Environmental Impact Statement (GOM G&G PEIS) (OCS EIS/EA BOEM 2017-051) (USDOJ, BOEM, 2017a),
- 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) (USDOJ, BOEM, 2017b), and,
- Gulf of Mexico Lease Sale Final Supplemental Environmental Impact Statement 2018 (2018 SEIS) (OCS EIS/EA BOEM 2017-074) (USDOJ, BOEM, 2017c).

"Tiering" is provided in the National Environmental Policy Act (NEPA) implementing regulations (40 CFR part 1502.20 and part 1508.28). It is designed to reduce and simplify the size 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 the United States Department of the Interior (DOI) regulations at 43 CFR part 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 GOM G&G PEIS, Multisale EIS, and 2018 SEIS are sufficiently comprehensive and adequate to support decision making for Fugro's proposed activities, with the following exceptions:

- **Vessel Noise and Traffic Impacts on Marine Mammals** – the environmental baseline since completion of the GOM G&G PEIS may have experienced slight changes and/or new information has become available;
- **Vessel Noise and Traffic Impacts on Sea Turtles** – the environmental baseline since completion of the GOM G&G PEIS may have experienced slight changes and/or new information has become available;
- **Seafloor Disturbance** – site specific analysis is required to assess the impacts on archaeological resources that were not known during the preparation of the programmatic analyses; and
- **Space-Use conflicts with other Users of the OCS** – survey operations have the potential to interfere with ongoing military operations in the area of the proposed action; and,

Marine mammals, sea turtles, fishes, other uses (military), and commercial and recreational fisheries, as indicated in the GOM G&G PEIS, 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, and other human activities.

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 GOM G&G PEIS, Multisale EIS, and 2018 SEIS are summarized and utilized for this site-specific analyses, and are incorporated by reference into this SEA. Relevant conditions of approval identified in the current GOM G&G PEIS, Multisale EIS, and 2018 SEIS have been considered in the evaluation of the proposed action.

1.1. BACKGROUND

BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) are mandated to manage the development of OCS oil, gas, mineral resources, and renewable energy 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 and BSEE regulate 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 parts 551 and 580. Specifically, 30 CFR part 551 regulates prelease G&G exploratory operations for oil, gas, and sulfur resources, and 30 CFR part 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 part 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. Additionally, the results of G&G surveys characterize sea bottom conditions before installing a renewable energy facility or to verify the completion of decommissioning activities.

The scope of the effects on GOM resources from activities proposed in Fugro's G&G survey application, No. L18-004, were fully discussed and analyzed in the GOM G&G PEIS. The proposed activity location, equipment, and duration will not result in impacts different from those discussed in the GOM G&G PEIS, Multisale EIS, or 2018 SEIS 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 GOM G&G PEIS. This information was not available or considered during the preparation of the GOM G&G PEIS. Therefore, this SEA was prepared by BOEM to evaluate the operator's proposed G&G activities in light of any new changes in the baseline and/or new information.

1.2. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

Fugro has submitted a permit application to conduct a G&G activity on the OCS. The permit application proposes to conduct boring and collect box cores. 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 in Appendix F of the GOM G&G PEIS.

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 Fugro'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

Fugro proposes to conduct a geologic survey consisting of boring and box cores. There are twenty-six proposed collection sites located in West Delta Blocks 43, 44, 45 and 46 in the Central Planning Area of the GOM. The area of the proposed action is approximately 12 miles (19 kilometers) from the nearest Louisiana shoreline and in a water depth of approximately 66 feet (20 meters). The operations will be conducted from the vessel, the *R/V Fugro Enterprise*. Site-specific analysis was completed using Fugro's description of the proposed operations; however, specific technical information regarding the G&G activities described in the permit application is proprietary and therefore not included in this document. The proposed survey is expected to take approximately one month to complete (Fugro, 2018).

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 geologic data on the OCS. The information would not be available to industry and government to assist in their evaluation of offshore oil and gas resources, geologic hazards, or potential renewable energy sites 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 geologic data, as requested in the application, 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., injuries to marine mammals and sea turtles from vessel strikes). 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. Additionally, supplemental condition of approval measures were identified and will need to be imposed to provide further protection for marine mammals (see Section 3.2.3).

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 Fugro 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 Chapter 2 of the GOM G&G PEIS, were reviewed with the alternatives listed above chosen as reasonable for the current proposed action.

Conditions for Approval Required under the Preferred Alternative

The need for and utility of the following 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/>.
- **NON-RECURRING MITIGATION (ARCHAEOLOGY):** This review indicates that there are no identified potential archaeological targets that exist in the area of the proposed box core deployment within the Federal waters of the Outer Continental Shelf (OCS). The project area has received either limited or no previous archaeological survey, and is likely to contain archaeological materials that may be impacted by the proposed operations. If the applicant discovers man-made debris that appears to indicate the presence of a shipwreck (e.g., a sonar image or visual confirmation of an iron, steel, or wooden hull, wooden timbers, anchors, concentrations of man-made objects such as bottles or ceramics, piles of ballast rock) within or adjacent to the proposed action area during the proposed survey operations, they will be required to immediately halt operations, take steps to ensure that the site is not disturbed in any way, and contact the BOEM Regional Supervisor for Environment within 48-hours of its discovery. They must cease all operations within 1,000 feet (305 meters) of the site until the Regional Director instructs you on what steps are required to assess the site's potential historic significance and to protect it. If a box core impacts any submerged object, then the applicant must also submit a report detailing each instance of this activity. This report should include the coordinates of the impact (to DGPS accuracy), a description of the submerged object, any damage that may have resulted from the box core operations, and any photographic or video imagery that is collected. The applicant must submit a copy of any data collected as a result of these investigations.

If remote-sensing survey data is collected for any reason during the course of this project (i.e., side-scan sonar, sector-scan sonar, multi-beam bathymetry, or magnetometer) then the applicant must submit copies of these data to BOEM.

- **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>.

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 (IPF) 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 Fugro'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 part 1508.27). The criteria for impacts to environmental resources are generally classified into one of the three following levels:

1. *Significant Adverse Impact* (including those that could be mitigated to nonsignificance);
2. *Adverse but Not Significant Impact*, or
3. *Negligible Impact*.

Preliminary screening for this assessment was based on a review of this relevant literature; previous SEAs; the GOM G&G PEIS (USDOL, BOEM, 2017a); the Multisale EIS (USDOL, BOEM, 2017b); the 2018 SEIS (USDOL, BOEM, 2017c); 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 ichthyoplankton);
- 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 GOM G&G PEIS, 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 (Chapter 3 of the GOM G&G PEIS; USDOL, BOEM, 2017a). The impact agents include: (1) active acoustic sound sources; (2) vessel and equipment noise; (3) vessel traffic; (4) aircraft traffic and noise; (5) stand-off distance; (6) vessel discharges; (7) trash and debris; (8) seafloor disturbance; (9) drilling discharges; (10) entanglement; and (11) accidental fuel spills. The preliminary analysis in the GOM G&G PEIS considers surveys of the type proposed by Fugro as well as impacts to resources by type of activity. To assist with subsequent coordination, the GOM G&G PEIS's analysis further defines the level of impact associated with each interaction as follows:

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

The GOM G&G PEIS 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 to 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 GOM G&G PEIS 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 GOM G&G PEIS as having negligible impacts (see 40 CFR part 1508.27) from G&G activities. Such a procedure is consistent with the NEPA concept of tiering (40 CFR part 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;
- recreational and commercial diving;
- marine transportation;
- geology/sediments; and
- air and water quality.

For this SEA, BOEM evaluated the potential impacts from the applicant's proposed G&G activities in the GOM on the following resource categories:

- marine mammals (including threatened/endangered and non-ESA-listed species);
- sea turtles (all are ESA-listed species);
- archaeological resources; and
- other users of the OCS (i.e., space-use conflicts with military uses).

3.2. MARINE MAMMALS

3.2.1. Description

In the northern GOM, there are 22 marine mammal species likely to occur within the AOI, based on current distributional data (Davis and Fargion, 1996; Würsig et al., 2000; Southall et al., 2007; Jefferson et al., 2008; Waring et al., 2013, 2014, 2015, 2016). These species represent two taxonomic orders: Cetacea (whales and dolphins) and Sirenia (manatees). Cetacea is subdivided into two suborders: Mysticeti (baleen whales) and Odontoceti (toothed whales and dolphins). Seven additional cetacean species may occur within the GOM, but they are considered rare or extralimital within the region (i.e., their presence in the GOM would be outside of their normal distributional range) (Waring et al., 2014). These include six mysticete species (North Atlantic right whale, common minke whale, sei whale, blue whale, fin whale, and humpback whale) and one odontocete species (Sowerby's beaked whale). Because these species are not regular inhabitants of the GOM and therefore are unlikely to be exposed to Gulf of Mexico G&G activities, they are not considered further in this analysis.

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 4.2 and Appendix E of the GOM G&G

PEIS and Chapter 4.9 of the Multisale EIS and 2018 SEIS, and 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 4.2 and Appendix E of the GOM G&G PEIS and in Chapter 4.9 of the Multisale EIS and 2018 SEIS. 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 20 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 4.2 and Appendix E of the GOM G&G PEIS and in Chapter 4.9 of the Multisale EIS and 2018 SEIS, 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 35 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 survey vessels. Chapter 4.2 of the GOM G&G PEIS contains a discussion of the potential impacts from survey operations on marine mammal resources (USDOI, BOEM, 2017a). Additional information about routine impacts from oil and gas activity on impacts on marine mammals is addressed in Chapter 4.9 of the Multisale EIS and 2018 SEIS and the current ESA Section 7 consultation for the Five-Year Outer Continental Shelf Oil and Gas Leasing Program (2017-2022) 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.

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 that would result in effects to marine mammals. Since there would be no vessel traffic related to the survey activities, 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, disruption of feeding and other behaviors from 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-G01 for *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*). For the reasons set forth below, inclusion of this measure under Alternative 3 limits or minimizes potential impacts to marine mammals.

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 μ Pa-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 (USDOJ, BOEM, 2017a). 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

In conclusion, given the scope, timing, and transitory nature of the proposed action and given the conditions of approval and monitoring requirements in place, vessel related noise is not expected to result in 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. Survey activities will involve limited vessel traffic that carries some risk of collisions; however, animals may avoid 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 4.2 of the GOM G&G PEIS , and Chapters 4.9 of the Multisale EIS and 2018 SEIS 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 vessel operations under Alternative 3, as well as the limited scope, timing, and geographic location of the proposed action, effects from the proposed activities on marine mammals will be negligible. For animals that may be continuing to experience stress/sublethal impacts such as the UME, 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 Chapter 4.3 and Appendix E of the GOM G&G PEIS and Chapters 4.9 of the Multisale EIS and 2018 SEIS 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 (*Caretta 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 USDOl, 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 USDOl, 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 primarily (1) vessel noise; and (2) vessel traffic. Chapter 4.3 of the GOM G&G PEIS contains a discussion of the potential impacts from survey operations on sea turtles (USDOl, BOEM, 2017a). Additional information about routine impacts from oil and gas activity on sea turtles is addressed in Chapter 4.9 of the Multisale EIS and 2018 SEIS. 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 that would result in effects to sea turtles. Since there would be no vessel traffic related to the towing of the survey activities, 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 for *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*). For the reasons set forth below, inclusion of this measure 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 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 μ Pa-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

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 survey 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 4.3 of the GOM G&G PEIS, and Chapter 4.9 of the Multisale EIS and 2018 SEIS 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. ARCHAEOLOGICAL RESOURCES

3.4.1. Description

Archaeological resources are any material remains of human life or activities that are at least 50 years of age and that are of archaeological interest (30 C.F.R. 551.1). As obligated under OCSLA regulations (30 C.F.R. 551.6(a)(5)), applicants are not allowed to disturb archaeological resources while conducting their survey activities. The description of archaeological resources (prehistoric and historic) can be found in Chapters 4.13 of the Multisale EIS and 2018 SEIS. The following information is a summary of these descriptions and is hereby incorporated by reference into this SEA.

Prehistoric

Geographic features that have a high probability for associated prehistoric sites in the northwestern and north central Gulf (from Texas to Alabama) include barrier islands and back barrier embayments, river channels and associated floodplains and terraces, and salt dome features. Also, a high probability for prehistoric resources may be found landward of a line which roughly follows the 60 m bathymetric contour, which represents the Pleistocene shoreline during the last glaciation some 12,000 years ago when the coastal area of Texas and Louisiana is generally considered to have been populated. BOEM is currently reviewing evidence to determine if a change in the currently accepted area of prehistoric site probability is warranted.

Historic

Historic archaeological resources on the OCS include shipwrecks and single light house (Ship Shoal Light). Historic research has identified over 4,000 potential shipwreck locations in the Gulf, nearly 1,500 of which occur on the OCS (Garrison et al., 1989). The historic record, however, is by no means complete, and the current ability to predict potential sites has proven inaccurate. As demonstrated by several studies (e.g., Pearson et al., 2003; Lugo-Fernandez et al., 2007; Krivor et al., 2011; Rawls and Bowker-Lee, 2011), many more shipwrecks are likely to exist on the seafloor than have been accounted for in available historic literature. Currently a high-resolution remote sensing survey is the most reliable method for identifying and avoiding historic archaeological resources.

A 2003 study recommended including some deepwater areas, primarily on the approach to the Mississippi River, among those lease areas requiring archaeological investigation. With this in mind, BOEM revised its guidelines for conducting archaeological surveys in 2005 and added about 1,200 lease blocks to the list of blocks requiring an archaeological survey and assessment in advance of oil and gas industry activities. Archaeological survey blocks were further expanded in 2011 and current requirements are posted on the BOEM website under NTL No. 2005-G07 and Joint NTL No. 2011-G01. At present, high-resolution geophysical, ROV, and/or diver survey is required for all new bottom disturbing activities by the oil and gas industry. Historic shipwrecks have, with the exception of three significant vessels found by treasure salvors, been primarily discovered through oil industry sonar surveys in water depths up to 9,000 ft (2,743 m). In fact, in the last five years, over four dozen potential shipwrecks have been located and several of these ships have been confirmed visually as historic vessels. Many of these wrecks were not previously suspected to exist in these areas, based on the historic record. The preservation of historic wrecks found in deep water has been outstanding because of a combination of environmental conditions and limited human access.

3.4.2. Impact Analysis

The IPF associated with the proposed action that could affect archaeological resources is seafloor disturbance from core sampling. The historically-available literature is not sufficient to identify historic shipwreck losses in the area of the proposed action as historic records of losses occurring this far offshore are not location-specific (Pearson et al., 2003; Krivor et al., 2011; Rawls and Bowker-Lee, 2011). However, if a historic resource exists in the survey area, direct physical contact with a shipwreck site could destroy fragile materials, such as hull remains or artifacts, and could disturb the site context (Atauz et al., 2006; Church and Warren, 2008).

The IPF that could be associated with accidental events include seafloor disturbances from jettisoned/lost debris. Similar to routine impacts, discarded/lost material that falls to the seabed has the potential to

damage and/or disturb archaeological resources.

Appendix F II.C of the PEA contains a discussion of the potential impacts from survey operations on archaeological resources (USDOJ, MMS, 2004). Additional information about routine impacts from oil and gas activity on impacts on archaeological resources is addressed in Chapters 4.13 of the Multisale EIS and 2018 SEIS. These discussions are summarized below and hereby 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 IPF to archaeological resources would not occur. For example, there would be no bottom impacts from core sampling that would result in potential loss of any known or unknown historic archaeological resource.

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. Examples of potential impacts to archaeological resources without implementation of the conditions of approval noted in Section 2.4 and the following analysis include, but are not limited to, damage to potential archaeological resources from the proposed survey activities. The operator proposes core sampling activities at sites that may be located near potential archaeological resources which, without additional conditions of approval, may lead to potential impacts to those sites.

Routine Activities

Historic modeling assumes that shipwrecks would be found closest to shore along the Federal/State boundary or within ten mi (16 km) of their reported loss location. However high-resolution geophysical data acquired by oil and gas industry remote sensing surveys now indicate that this model is too limited. For example, several vessel casualties from World War II with historically reported coordinates were later discovered well over ten mi (16 km) outside the 9-mi² area assumed to be their location by the model (Irion, 2002). An early nineteenth century steamship lost off the Texas coast was found by treasure salvors over 120 mi (193 km) from the area of its presumed loss in the MMS model (Irion, Official Communication, 2011). These situations, coupled with the fact that no confirmed historic shipwreck sites had been found in any of the designated historic high probability area in 20 years, led to a new study released in 2003 (Pearson et al., 2003) to reassess the high-probability model. Some of the recommendations of this study were implemented in July 2005 with the revision of NTL No. 2005-G07, (*Archaeological Resource Surveys and Reports*), which added 1,802 lease blocks, mostly in deepwater areas in Mississippi Canyon (MC), Green Canyon (GC), and Viosca Knoll (VK) areas, to the “high-probability” block list. Table 3.8.1 notes the results of archaeological surveys and reviews in the last five years.

Year	Side Scan Sonar Targets Mitigated by Avoidance	Magnetic Anomalies Mitigated by Avoidance
2012	165	561
2013	182	503
2014	174	403
2015	281	517
2016	100	365

The addition of the new blocks, the current requirement that all new bottom disturbing activity by the oil and gas industry be cleared by high-resolution geophysical, ROV, and/or diver survey, industry’s resultant survey data, and the subsequent increase in the number of shipwrecks discovered further suggests that the potential distribution of significant historic resources is wider than originally thought.

Recent research on historic shipping routes from the 16th through the 19th centuries concluded that in areas greater than 200 m deep bottom-disturbing OCS activities may coincide with the colonial French and Spanish trade routes between Veracruz, New Orleans, and Havana, increasing the likelihood that historic shipwrecks could be located in this area of the GOM (Lugo-Fernandez et al., 2007; Krivor et al., 2011). A wide variability within the general route may be expected as a result of several factors that affected navigation during this period including: the limited capabilities of the navigational technology available to sailors of the time, shifting currents, and prevailing wind patterns and storms

The Western and Central Gulf was traversed extensively by shipping throughout the 19th and 20th centuries as new ports developed along the Texas coast, such as Galveston (est. 1825) and Brazos Santiago (1848). With the advent of steam, oil screw, and gasoline or diesel-propelled vessels and improved navigational instruments, sailors' options to set a course irrespective of prevailing winds and currents greatly increased expanding even further the potential for a shipwreck to have occurred in the area of proposed action.

Impacts to a historic site could result from direct physical contact from core sampling, causing irreversible damage. The undisturbed provenience of archaeological data (i.e., the 3-dimensional location of archaeological artifacts) allows archaeologists to accumulate a record of where every item is found, and to develop a snapshot as to how artifacts relate to other items or the site as a whole. The analysis of artifacts and their provenience is one critical element used to make a determination of eligibility to the National Register of Historic Places and is essential in understanding past human behavior and ways of life. Impacts from the proposed operations could alter the provenience and destroy fragile remains, such as the hull, wood, glass, ceramic artifacts and possibly even human remains, or information related to the operation or purpose of the vessel. The destruction and loss of this data eliminates the ability of the archaeologist to fully and accurately detail activity areas found at the site, variation and technological advances lost to history, the age, function, and cultural affiliation of the vessel, and its overall contribution to understanding and documenting the maritime heritage and culture of the region.

Accidental Events

An IPF that could result from an accidental event is from the loss of debris from the survey and support vessels during survey operations. Debris such as structural components (i.e., grating, wire, tubing, etc.), boxes, pallets, and other loose items can become dislodged during heavy seas or storm events and fall to the seabed. Similar to the impacts noted under Routine Activities, if debris were to fall onto an unknown archaeological resource, damage could destroy fragile materials, such as hull remains and artifacts, and could disturb the site's context and associated artifact assemblage. Additionally, lost material could result in the masking of actual archaeological resources or the introduction of false targets that could be mistaken in the remote sensing record as historic resources.

Conclusion

Based on the previous information, study conclusions, and the number of confirmed wrecks recently found in similar water depths, there is reason to believe that archaeological resources could be present in the area of the proposed action. Routine impacts may include damage and/or disturbance to the potential resources from core sampling activities. Impacts from accidental events related to the proposed action such as debris lost from the survey and support vessels could lead to impacts similar to those expected from routine impacts. If the operator's seabed disturbing activities make contact with these targets, it might have a significant impact on the resources. Since it is likely that submerged archaeological resources could exist in the area of the proposed action, without necessary avoidance conditions of approval, selecting Alternative 2 could result in significant impacts to archaeological resources.

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. The conditions of approval outlined in Section 2.4 are expected to decrease the potential for effects to archaeological resources.

Routine Activities

As previously noted, the operator's proposed activities have the potential to cause impacts to potential archaeological resources not identified through pre-existing archaeological survey. Impacts to a historic site could result from direct physical contact causing irreversible damage. The undisturbed provenience of archaeological data (i.e., the 3-dimensional location of archaeological artifacts) allows archaeologists to accumulate a record of where every item is found, and to develop a snapshot as to how artifacts relate to other items or the site as a whole. The analysis of artifacts and their provenience is one critical element used to make a determination of eligibility to the National Register of Historic Places and is essential in understanding past human behavior and ways of life. Impacts from core sampling could alter the provenience and destroy fragile remains, such as the hull, wood, glass, ceramic artifacts and possibly even human remains, or information related to the operation or purpose of the vessel. The destruction and loss of this data eliminates the ability of the archaeologist to fully and accurately detail activity areas found at the site, variation and technological advances lost to history, the age, function, and cultural affiliation of the vessel, and its overall contribution to understanding and documenting the maritime heritage and culture of the region.

As described in Chapter 2 of this SEA, the applicant proposes to conduct geologic survey activities that will involve core sampling activities, disturbing the seabed in the area of the proposed action. If the core sampling is deployed near or atop of a potential archaeological resource, they could destroy artifacts or disrupt the provenance and stratigraphic context of archaeological structures, features, and/or artifacts, associated sediments, and paleoindicators from which scientific value of the archaeological resource is derived (Atauz et al., 2006; Church and Warren, 2008).

Accidental Events

The analysis of the possible impacts from accidental events for Alternative 3 remains the same as that discussed for Alternative 2, above. An IPF that could result from an accidental event is from the loss of debris from the survey vessel during survey operations. Debris such as structural components (i.e., grating, wire, tubing, etc.), boxes, pallets, and other loose items can become dislodged during heavy seas or storm events and fall to the seabed. Similar to the impacts noted under Routine Activities, if debris were to fall onto an unknown archaeological resource, damage could destroy fragile materials, such as hull remains and artifacts, and could disturb the site's context and associated artifact assemblage. Additionally, lost material could result in the masking of actual archaeological resources or the introduction of false targets that could be mistaken in the remote sensing record as historic resources.

Conclusion

Based on the previous information, study conclusions, and the number of confirmed wrecks recently found in similar water depths, there is reason to believe that archaeological resources could be present in the area of the proposed action. The review of core sampling locations conducted for this analysis determined that there are no known targets within the area of the proposed action. If an unknown archaeological resource were to exist where bottom-disturbing operations are proposed to occur, and the operator were unaware of its existence prior to disturbing the bottom, the operator's activities might have a significant impact on that resource. Such impact would be damage and/or disturbance to the resource from the core sampling activities. Routine impacts may include damage and/or disturbance to the potential resources from core sample placement. Impacts from accidental events related to the proposed action such as debris lost from the survey and support vessels could lead to impacts similar to those expected from routine impacts.

3.4.3. Cumulative Impact Analysis

Chapters 4.13 of the Multisale EIS and 2018 SEIS address the cumulative impacts of oil and gas operations, including G&G activities, on archaeological resources. Concerns related to potential pollution events caused by a blow-out/spill are also included. Discussions are summarized below and are hereby incorporated by reference into this SEA.

The loss or discard of steel debris associated with oil and gas exploration and development, fishing or other maritime activities could result in the masking of historic shipwrecks or the introduction of false targets that could be mistaken in the remote sensing record as historic resources. Loss of significant or

unique historic archaeological information from commercial fisheries (trawling) is not expected. It is unlikely that activities that could adversely impact historic resources in near-shore waters, such as dredging, sport diving, commercial treasure hunting, or tropical storms, have impacted historic period shipwrecks in the water depths in the proposed project area.

Several IPFs may threaten historic archaeological resources. An impact could result from contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) and a historic shipwreck. The OCS development prior to requiring archaeological survey has possibly impacted wrecks containing significant or unique historic information.

Recent research on historic shipping routes concluded that this area was located along the colonial French and Spanish trade route between Vera Cruz, New Orleans, and Havana, which therefore increases the probability that an historic shipwreck could be located in this area (Lugo-Fernandez et al. 2007; Krivor et al., 2011). However, impacts to historic shipwrecks in the project area are unlikely due to the standard industry practice that includes video inspection of the seafloor prior to core sampling and BOEM's positive reporting requirement in the event of a shipwreck discovery. Direct physical contact with a shipwreck site could destroy fragile remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context (Atauz et al., 2006; Church and Warren, 2008). The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, as well as the loss of information on maritime culture for the time period to which the ship dates.

Conclusion

Considering the potential cumulative impacts from all other GOM activities, the operator's proposed activities would constitute the primary effect, if any, on any known or unknown archaeological resource that may exist in the area of the proposed action.

3.5. OTHER USERS OF THE OCS

BOEM is required to consider the impact of the proposed action on other users of the GOM OCS; one of the most prevalent users is the U.S. military. All military activities in the GOM OCS occur within military warning areas designated by the Federal Aviation Administration in coordination with the U.S. Department of Defense. Space-use conflicts related to military activities were addressed in 4.12 of the GOM G&G PEIS (USDOJ, BOEM, 2017a); potential impacts related to military warning areas were determined to be negligible. Lessees and permittees conducting G&G operations within these warning areas are required to coordinate with the appropriate military command.

The survey operations and routes to be taken by vessels in support of Fugro's proposed survey will not operate within Military Warning Areas (MWA). BOEM's website contains a map of the MWAs and EWTAs in the GOM (see http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/MWA_boundaries-pdf.aspx) and includes contact information (see <http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/Military-Contacts-pdf.aspx>). Using this information, the coordination condition of approval has proven effective over many years to reduce the risk of interrupting planned military or geophysical activities.

3.6. OTHER CONSIDERATIONS

A discussion of the other resources considered but not analyzed under this SEA is found in Chapter 5 of the GOM G&G PEIS (USDOJ, BOEM, 2017a) and Chapter 3 of the Multisale EIS and 2018 SEIS (USDOJ, BOEM, 2017b and c).

4. CONSULTATION AND COORDINATION

The information in this SEA was developed by BOEM subject matter experts and in consultation with other Federal agencies, the private sector, and academia personnel found in Chapter 6 of the GOM G&G PEIS (USDOJ, BOEM, 2017a) and Chapter 5 of the Multisale EIS and 2018 SEIS (USDOJ, BOEM, 2017b and c).

The ESA (16 U.S.C. part 1631 et seq.), as amended (43 U.S.C. part 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 2004 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) 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).

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. part 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 part 800), specify the required review process. In accordance with 36 CFR part 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 part 800.3-800.6.

5. BIBLIOGRAPHY

- Atauz, A.D., W. Bryant, T. Jones, and B. Phaneuf. 2006. Mica shipwreck project: Deepwater archaeological investigation of a 19th century shipwreck in the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-072. 116 pp.
- Au, W.L. and M.C. Hastings. 2008. Principles of marine bioacoustics. New York: Springer-Verlag.
- Bartol, S.M., J.A. Musick, and M.L. Lenhardt. 1999. Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*). *Copeia* 3:836-840.
- Carmichael R.H., Graham W.M., Aven A., Worthy G., Howden S. 2012. Were Multiple Stressors a 'Perfect Storm' for Northern Gulf of Mexico Bottlenose Dolphins (*Tursiops truncatus*) in 2011?

Internet website: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0041155> Accessed February 22, 2018.

- Church, R.A. and D.J. Warren. 2008. Viosca Knoll wreck: Discovery and investigation of an early nineteenth-century sailing ship in 2,000 feet of water. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-018. 41 pp.
- Cranford, T.W., M. Amundin, and K.S. Norris. 1996. Functional morphology and homology in the odontocete nasal complex: Implications for sound generation. *J. Morphol.* 228(3): 223-285.
- Davis, R.W. and G.S. Fargion. 1996. Distribution and Abundance of Cetaceans in the North-Central and Western Gulf of Mexico: Final Report. Volume II: Technical Report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 96-0027. 357 pp.
- Dodd, C.K., Jr. 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta* (Linnaeus 1758). U.S. Fish and Wildlife Service Biological Report 88(14). Government Printing Office; Washington, D.C.
- Federal Register*. 2014. Endangered and threatened species: Critical habitat for the northwest Atlantic Ocean loggerhead sea turtle distinct population segment (DPS) and determination regarding critical habitat for the North Pacific Ocean loggerhead DPS. Final rule (50 CFR 256). 79 FR 39855, pp. 39855-39912.
- Federal Register*. 2016a. Endangered and Threatened Wildlife and Plants: 12-Month Finding on a Petition to Downlist the West Indian Manatee, and Proposed Rule to Reclassify the West Indian Manatee as Threatened; Proposed Rule. Proposed Rules (50 CFR part 17). 81 FR 1000, pp. 1000-1026.
- Federal Register*. 2016b. Endangered and Threatened Wildlife and Plants: Notice of 12-Month Finding on a Petition to List the Gulf of Mexico Bryde's Whale as Endangered Under the Endangered Species Act (ESA); Proposed Rule. 81 FR 88639, pp. 88639-88656.
- Federal Register*. 2017. Endangered and Threatened Wildlife and Plants: Reclassification of the West Indian manatee From Endangered to Threatened (50 CFR part 17). 82 FR 16668, pp. 16668-16704.
- Fernández, A., M. Arbelo, R. Deaville, I.A.P. Patterson, P. Castro, J.R. Baker, E. Degollada, H.M. Ross, P. Herráez, A.M. Pocknell, E. Rodríguez, F.E. Howie, A. Espinosa, R.J. Reid, J.R. Jaber, V. Martin, A.A. Cunningham, and P.D. Jepson. 2004. Pathology: Whales, sonar and decompression sickness (reply). *Nature* 428(6984), 15 Apr.). doi: 10.1038/nature02528a.
- Fertl, D., A.J. Schiro, G.T. Regan, C.A. Beck, N.M. Adimey, L. Price-May, A. Amos, G.A.J. Worthy and R. Crossland. 2005. Manatee occurrence in the Northern Gulf of Mexico, west of Florida. *Gulf and Caribbean Research* Vol. 17:69-94.
- Fugro. 2018. Application for permit to conduct geological or geophysical exploration for mineral resources or scientific research in the Outer Continental Shelf, L18-004, February 2018.
- Geraci, J.R. and D.J. St. Aubin. 1980. Offshore petroleum resource development and marine mammals. A review and research recommendations. *Marine fisheries review*. 42:1-12.
- Goold, J.C., and P.J. Fish. 1998. Broadband spectra of seismic survey airgun emissions, with reference to dolphin auditory thresholds. *J. Acoust. Soc. Am.* 103(4): 2177-2184.
- Goold, J.C., and M.R. Clarke. 2000. Sound velocity in the head of the dwarf sperm whale, *Kogia simus*, with anatomical and functional discussion. *J. Mar. Biol. Assoc. U.K.* 80(3):535-542.
- Irion, Jack B. 2002. Cultural Resource Management of Shipwrecks on the Gulf of Mexico Outer Continental Slope. Paper presented at the 2nd MIT Conference on Technology, Archaeology, and the Deep Sea. Internet website: <http://web.mit.edu/deeparch/www/events/2002conference/papers/Irion.pdf>. Accessed February 22, 2018.

- Irion, J.B. 2011. Official Communication. Bureau of Ocean Energy Management, Regulation and Enforcement. New Orleans, LA. February 23, 2011.
- Krivor, M.C., J. de Bry, N.J. Linville, and D.J. Wells. 2011. Archival investigations for potential colonial-era shipwrecks in ultra-deep water in the Gulf of Mexico. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-004. 158 pp.
- Lenhardt, M. L., S. Bellmund, R.A. Byles, S.W. Harkins, and J.A. Musick. 1983. Marine turtle reception of bone-conducted sound. *J. Aud Res.* 23, 119–125.
- Lenhardt, M. L., Klinger, R. C., and Musick, J. A. 1985. "Marine turtle middle-ear anatomy," *Journal of Auditory Research* 25, 66-72.
- Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival. In: Lutz, P.L. and J.A. Musick, eds. *The biology of sea turtles*. Boca Raton, FL: CRC Press. Pp. 387-409.
- Moein, S., M. Lenhardt, D. Barnard, J. Keinath, and J. Musick. 1993. Marine turtle auditory behavior. *Journal of the Acoustical Society of America* 93(4, Pt 2):2,378.
- Moein, S.E., J.A. Musick, J.A. Keinath, D.E. Barnard, M. Lenhardt, and R. George. 1994. Evaluation of seismic sources for repelling sea turtles from hopper dredges. Report from Virginia Institute of Marine Science, Gloucester Point, VA, to U.S. Army Corps of Engineers.
- Mullin, K.D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships, chapter 4. In: Davis, R.W., W.E. Evans, and B. Würsig, eds. *Cetaceans, sea turtles and birds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report*. U.S. Dept. of the Interior, Geologic Survey, Biological Resources Division, USGS/BRD/CR-1999-005 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, OCS Study MMS 2000-003. 364 pp.
- National Research Council (NRC). 1990. *Decline of the sea turtles: Causes and prevention*. Committee on Sea Turtle Conservation. Washington, DC: National Academy Press. 280 p.
- National Science Foundation (NSF). 2011. Final Programmatic Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey. Arlington, Virginia.
- Nedwell, J., B. Edwards, A. Turnpenny, J. Gordon. 2004. Fish and Marine Mammal Audiograms: A summary of available information. Subacoustech Report Reference: 534R0214, September 2004. To: Chevron Texaco Ltd., TotaFinaElf Exploration UK Plc, DSTL, DTI and Fugro U.K. Exploration and Production Ltd.
- Pearson, C.E., S.R. James, Jr., M.C. Krivor, S.D. El Darragi, and L. Cunningham. 2003. Refining and Revising the Gulf of Mexico Outer Continental Shelf Region High-Probability Model for Historic Shipwrecks: Final report. Volume I: Executive Summary. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-060, 13 pp., 3 volumes.
- Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D., Bartol, S., Carlson, T., Coombs, S., Ellison, W.T., Gentry, R., Halvorsen, M.B., Løkkeborg, S., Rogers, P., Southall, B.L., Zeddies, D., Tavolga, W.N. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4 TR-2014*. Springer and ASA Press, Cham, Switzerland.
- Pritchard, P.C.H. 1980. The Conservation of Sea Turtles: Practices and Problems. *American Zoologist*. 20(3): 609-617.
- Pritchard, P.C.H. 1997. Evolution, phylogeny, and current status. Lutz, P.L. and J.A. Musick, eds. *The Biology of Sea Turtles*. Boca Raton, FL: CRC Press. pp. 1-28.
- Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. *Marine mammals and noise*. San Diego, CA: Academic Press. 576 pp.

- Ridgway S.H., Wever E.G., McCormick J.G., Palin J, Anderson J.H. 1969. Hearing in the giant sea turtle, *Chelonia mydas*. Proc Natl Acad Sci USA. 64:884–890.
- Rawls, J.K. and Dayna Bowker-Lee. 2011. Shipwreck research in the New Orleans Notarial Archives. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA., OCS Study BOEMRE 2011-040.
- Ross, J.P. and Barwani, M.A. 1982. Review of sea turtles in the Arabian area. In K.A. Bjorndal, ed. Biology and conservation of sea turtles, pp. 373-383. Washington, DC, Smithsonian Institution Press.
- Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise expo-sure criteria: initial scientific recommendations. Aquat. Mamm. 33(4):411-522.
- Sverdrup, A., E. Kjellsby, P.G. Krüger, R. Fløysand, F.R. Knudsen, P.S. Enger, G. Serck-Hanssen, and K.B. Helle. 1994. Effects of experimental seismic shock on vasoactivity of arteries, integrity of the vascular endothelium and on primary stress hormones of the Atlantic salmon. Journal of Fish Biology 45:973-995.
- Teas, W.G. 1994. Marine turtle stranding trends, 1986-1993. In: Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Eliazar, comps. Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-SEFSC-351. Pp. 293-295.
- Thomsen, B. 2002. An experiment on how seismic shooting affects caged fish. Thesis, Faroese Fisheries Laboratory, University of Aberdeen, Aberdeen, Scotland. 16 August.
- Tyack, P., M. Johnson, and P. Miller. 2003. Tracking responses of sperm whales to experimental exposures of airguns. p. 115-120 In: A.E. Jochens and D.C. Biggs (eds.), Sperm whale seismic study in the Gulf of Mexico/Annual Report: Year 1. OCS Study MMS 2003-069. Rep. from Texas A&M Univ., College Station, TX, for U.S. Minerals Manage. Serv., Gulf of Mexico OCS Region, New Orleans, LA.
- U.S. Dept. of Commerce (USDOC), National Marine Fisheries Service (NMFS). 2007. Endangered Species Act Section 7 consultation on the effects of 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. Biological Opinion. June 29. F/SER/2006/02611. 127 pp.
- U.S. Dept. of Commerce (USDOC), National Marine Fisheries Service (NMFS). 2016. 2010 – Present Cetacean Unusual Mortality Event in Northern Gulf of Mexico. Internet website: http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm. Last updated May 26, 2016. Accessed February 22, 2018.
- U.S. Dept. of Commerce (USDOC), National Marine Fisheries Service (NMFS) and U.S. Dept. of the Interior (USDOI), Fish and Wildlife Service (FWS). 2007a. Green sea turtle (*Chelonia mydas*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Office of protected Resources, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 102 pp. Internet website: <http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-green-turtle-5-year-review-final.pdf>. Accessed February 22, 2018.
- U.S. Dept. of Commerce (USDOC), National Marine Fisheries Service (NMFS) and U.S. Dept. of the Interior (USDOI), Fish and Wildlife Service (FWS). 2007b. Kemp's ridley sea turtle (*Lepidochelys kempii*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Office of protected Resources, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 50 pp. Internet website: <http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-Kemps-ridley-turtle-5-year-review-final.pdf>. Accessed February 22, 2018.
- U.S. Dept. of Commerce (USDOC), National Marine Fisheries Service (NMFS) and U.S. Dept. of the Interior (USDOI), Fish and Wildlife Service (FWS). 2007c. Loggerhead sea turtle (*Caretta caretta*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries

- Service, Office of protected Resources, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 65 pp. Internet website: <http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-Loggerhead-turtle-5-year-review-final.pdf>. Accessed February 22, 2018.
- U.S. Dept. of Commerce (USDOC), National Marine Fisheries Service (NMFS) and U.S. Dept. of the Interior, Fish and Wildlife Service (FWS). 2007d. Leatherback sea turtle (*Caretta caretta*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Office of protected Resources, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 65 pp. Internet website: <http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-leatherback-turtle-5-year-review-final.pdf>. Accessed February 22, 2018.
- U.S. Dept. of Commerce (USDOC), National Marine Fisheries Service (NMFS) and U.S. Dept. of the Interior, Fish and Wildlife Service (FWS). 2007e. Hawksbill sea turtle (*Eretmochelys imbricata*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 90 pp. Internet website: <http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-hawksbill-turtle-5-year-review-final.pdf>. Accessed February 22, 2018.
- U.S. Dept. of Commerce (USDOC), National Marine Fisheries Service (NMFS) and U.S. Dept. of the Interior (USDO I), Fish and Wildlife Service (FWS). 2013a. Hawksbill sea turtle (*Eretmochelys imbricata*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Office of protected Resources, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 92 pp. Internet website: http://www.nmfs.noaa.gov/pr/pdfs/species/hawksbillseaturtle2013_5yearreview.pdf. Accessed February 22, 2018.
- U.S. Dept. of Commerce (USDOC), National Marine Fisheries Service (NMFS) and U.S. Dept. of the Interior (USDO I), Fish and Wildlife Service (FWS). 2013b. Leatherback sea turtle (*Dermochelys coriacea*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Office of protected Resources, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 92 pp. Internet website: http://www.nmfs.noaa.gov/pr/listing/5yearreview_leatherbackturtle.pdf. Accessed February 22, 2018.
- U.S. Department of the Interior (USDO I), Minerals Management Service (MMS). 2004. Geological and geophysical exploration for mineral resources on the Gulf of Mexico outer continental shelf: Final programmatic environmental assessment. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2004-054. <http://www.boem.gov/BOEM-Newsroom/Library/Publications/2004/2004-054.aspx>. Accessed February 22, 2018.
- U.S. Dept. of the Interior (USDO I), Bureau of Ocean Energy Management (BOEM). 2017a. Gulf of Mexico OCS Proposed Geological and Geophysical Activities Western, Central, and Eastern Planning Areas Final Programmatic Environmental Impact Statement (GOM G&G PEIS). 4 vols. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA BOEM 2017-051. Internet website: <https://www.boem.gov/BOEM-2017-051-v1/>. Accessed February 22, 2018.
- U.S. Dept. of the Interior (USDO I), Bureau of Ocean Energy Management (BOEM). 2017b. 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). 3 vols. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA BOEM 2017-009. Internet website: <https://www.boem.gov/BOEM-EIS-2017-009-v1/>. Accessed February 22, 2018.

U.S. Dept. of the Interior (USDO), Bureau of Ocean Energy Management (BOEM). 2017c. Gulf of Mexico OCS Oil and Gas Lease Sale Final Supplemental Environmental Impact Statement 2018 (2018 SEIS). 2 vols. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA BOEM 2017-074. Internet website: <https://www.boem.gov/BOEM-EIS-2017-074-v1/>. Accessed February 22, 2018.

U.S. Department of Interior (USDO), Fish and Wildlife Service (FWS) and Gulf States Marine Fisheries Commission. 1995. Gulf Sturgeon Recovery Plan. Atlanta Georgia. 170 pp (page 3).

Waring, G.T., Josephson, E., Maze-Foley K, Rosel, P.E., editors. 2016. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2015. NOAA Tech Memo NMFS NE 238; 512 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nmfs.noaa.gov/pr/sars/pdf/atlantic2015_final.pdf. Accessed February 22, 2018.

Witherington, B.E. 1986. Human and natural causes of marine turtle clutch and hatchling mortality and their relationship to hatchling production on an important Florida nesting beach. Unpublished Master's Thesis, University of Central Florida, Orlando. 141 p.

Würsig, B., T.A. Jefferson, and D.J. Schmidley. 2000. The Marine Mammals of the Gulf of Mexico. Texas A&M University Press, College Station, TX. 232 pp.

6. PREPARERS

Denise G. Matherne –	NEPA Coordinator; Physical Scientist
Scott Sorset –	Archaeology; Marine Archaeologist
Tre Glenn –	Marine Mammals and Sea Turtles; Protected Species Biologist
Arie Kaller –	Fish; Marine Biologist

7. REVIEWERS

Bruce Cervini –	NEPA Coordinator; Physical Scientist
Doug Jones –	Acting Unit Supervisor; Senior Marine Archaeologist