OCS EIS/EA
BOEM 2022-040

Commercial and Research Wind Lease and Grant Issuance and Site Assessment Activities on the Outer Continental Shelf of the Gulf of Mexico

Draft Environmental Assessment

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

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ABBREVIATIONS AND ACRONYMS

$\mu g/m^3$	micrograms per cubic meter
μPa	micropascal
2017-2022 GOM Multisale EIS	*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 Multisale Environmental Impact Statement*
ac	acre
ADCP	Acoustic Doppler Current Profiler
ADIOS	Automated Data Inquiry for Oil Spills
AFB	Air Force Base
Area ID	Area Identification
AQRV	air quality-related value
bbl	barrel
Bcf	billion cubic feet
BiOp	Biological Opinion
BOE	billion barrels of oil equivalent
BOEM	Bureau of Ocean Energy Management
BOP	blowout preventer
B.P.	before present
Breaux Act	Coastal Wetlands Planning, Protection and Restoration Act (also: CWPPRA)
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
Call	Call for Information
CAP	criteria air pollutant
CD	Consistency Determination
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CHIRP	Compressed High Intensity Radar Pulse
CIAP	Coastal Impact Assistance Program
CO	carbon monoxide
COA	conditions of approval
CO_2	carbon dioxide
CODAR	coastal ocean dynamic applications radar
COP	Construction and Operations Plan
CPA	Central Planning Area
CPAP	criteria precursor air pollutant

CPRA	Coastal Protection and Restoration Authority
CPT	cone penetration test
CWPPRA	Coastal Wetlands Planning, Protection and Restoration Act (also: Breaux Act)
CZMA	Coastal Zone Management Act
dB	decibels
DPS	Distinct Population Segment
e.g.	for example
EIA	Economic Impact Area
EIS	environmental impact statement
EPA	Eastern Planning Area
EPAct	Energy Policy Act
ESA	Endangered Species Act of 1973
et al.	and others
et seq.	and the following
FERC	Federal Energy Regulatory Commission
FGBNMS	Flower Garden Banks National Marine Sanctuary
FONSI	Finding of No Significant Impact
FPSO	floating production, storage, and offloading system
FR	*Federal Register*
FSN	Final Sale Notice
ft	feet
FWS	Fish and Wildlife Service
G&G	geological and geophysical
GAP	General Activities Plan
GAO	U.S. Government Accountability Office
GHG	greenhouse gas
GIS	geographic information system
GIWW	Gulf Intracoastal Waterway
GOM	Gulf of Mexico
GOMESA	Gulf of Mexico Energy Security Act
ha	hectare
HABHRCA	Harmful Algal Bloom and Hypoxia Research and Control Act
HAP	hazardous air pollutants
HRG	high-resolution geophysical
Hz	Hertz
i.e.	that is
in	inch

IPCC	Intergovernmental Panel on Climate Change
IPF	impact-producing factor
ITS	Incidental Take Statement
JEDI	Jobs and Economic Development Impact
kHz	kilohertz
km	kilometer
kn	knot
LCA	Louisiana Coastal Area
LCE	Loop Current eddies
LNG	liquefied natural gas
LOOP	Louisiana Offshore Oil Port
m	meter
MARAD	Maritime Administration (U.S. Department of Transportation)
MARPOL	The International Convention for Prevention of Marine Pollution from Ships
met	meteorological
mi	mile
mm	millimeter
MMbbl	million barrels
MMIS	Marine Minerals Information System
MMS	Minerals Management Service
N.	north
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NEPA	National Environmental Policy Act
NH_3	ammonia
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
nmi	nautical mile
NO	nitrogen monoxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NPDES	National Pollutant Discharge Elimination System
NTL	Notice to Lessees and Operators
NWP	Nationwide Permit

O_3	ozone
Ocean Dumping Act	Marine Protection, Research, and Sanctuaries Act of 1972 (also: MPRSA)
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
ODMDS	ocean dredged-material disposal sites
ONRR	Office of Natural Resources Revenue (U.S. Department of the Interior)
OPAREA	operating areas
P	phosphorus
Pb	lead
PM	particulate matter
$PM_{2.5}$	particulate matter less than or equal to 2.5 μm
PM_{10}	particulate matter less than or equal to 10 μm
ppb	parts per billion
ppm	parts per million
PSBF	potentially sensitive biological features
PSD	Prevention of Significant Deterioration
PSN	Proposed Sale Notice
re	referenced to
RESTORE Act	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
RFI	Request for Interest
ROV	remotely operated vehicle
ROW	right-of-way
RUE	right-of-use
S	sulfur
SAP	Site Assessment Plan
SAV	submerged aquatic vegetation
SBF	synthetic-based fluid
SBP	sub-bottom profiler
Secretary	Secretary of the Interior
SO_2	sulphur dioxide
SOC	standard operating condition
SODAR	sonic detection and ranging
Task Force	Gulf of Mexico Renewable Energy Intergovernmental Task Force
TCW	treatment, completion, workover
TPWD	Texas Parks and Wildlife Department

Trustees	Natural Resource Damage Assessment Trustees
Trustee Council	Natural Resource Damage Assessment Trustee Council
TRW	Topographic Rossby Waves
TSS	traffic separation schemes
U.S.	United States
U.S.C.	United States Code
USCG	U.S. Coast Guard
USDOI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VGP	Vessel General Permit
VOC	volatile organic compound
W.	west
WEA	Wind Energy Area
WPA	Western Planning Area
yr	year

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CHAPTER 1

PURPOSE AND NEED

1 PURPOSE AND NEED

The U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM) has prepared this environmental assessment (EA) to determine whether the issuance of leases and grants within the Call Area (**Figure 1-1**) in the Gulf of Mexico (GOM) would lead to reasonably foreseeable significant impacts on the environment and, thus, whether an environmental impact statement (EIS) should be prepared before a lease or grant is issued. BOEM's approach for this EA is to analyze the entire GOM Call Area rather than using the Area Identification (Area ID) process to identify Wind Energy Areas (WEA), followed by preparation of an EA covering only those areas to be considered for potential leasing. Although the National Environmental Policy Act (NEPA) analysis is not required at the Area ID stage, BOEM has decided to prepare this EA prior to the identification of the WEAs as an exercise of agency discretion. This approach not only allows greater flexibility for future identification of WEAs but also provides NEPA coverage for unsolicited requests for non-competitive commercial or research leases that could be received in the GOM Call Area.

On November 1, 2021, BOEM published the Call for Information and Nominations (Call), outlining the GOM Call Area, which is located within the Central Planning Area (CPA) and Western Planning Area (WPA) on the Outer Continental Shelf (OCS) portion of the Gulf of Mexico (**Figure 1-1**). The GOM Call Area comprises the area located seaward of the Gulf of Mexico Submerged Lands Act Boundary, bounded on the east by the north-south line located at 89.858° W. longitude and bounded on the south by the 400-meter (m) (1,312-foot [ft]) bathymetry contour and the U.S.-Mexico Maritime Boundary established by the Treaty Between the Government of the United States of America and the Government of the United Mexican States on the Delimitation of the Continental Shelf in the Western Gulf of Mexico beyond 200 Nautical Miles (U.S.-Mexico Treaty), which took effect in January 2001.

The purpose of the Proposed Action is to issue commercial and/or research leases within the GOM Call Area and grant rights-of-way (ROWs) and rights-of-use and easement (RUEs) in the region to provide lessees/grantees the exclusive right to submit to BOEM survey plan(s) for site characterization; Site Assessment Plan(s) (SAP) to assess the physical metocean characteristics of the areas within the GOM Call Area; and either a General Activities Plan (GAP) or a Construction and Operations Plan (COP) which would be subject to additional environmental review. This includes both competitive leases and unsolicited requests for non-competative commercial or research leases that could be received in the GOM Call Area. BOEM's issuance of these leases and grants is needed to (1) confer the exclusive right to submit plans to BOEM for potential development, such that the lessees and grant holders may conduct the site characterization and site assessment activities necessary to determine the suitability of their leases and grants for commercial offshore wind production and/or transmission and develop plans for BOEM's review; and (2) impose terms and conditions intended to ensure that site characterization and site assessment activities are conducted in a safe and environmentally responsible manner. The issuance of a lease by BOEM to the lessee conveys no right to proceed with construction and operation of a wind energy facility; the lessee acquires only the exclusive right to submit a plan to conduct these activities.

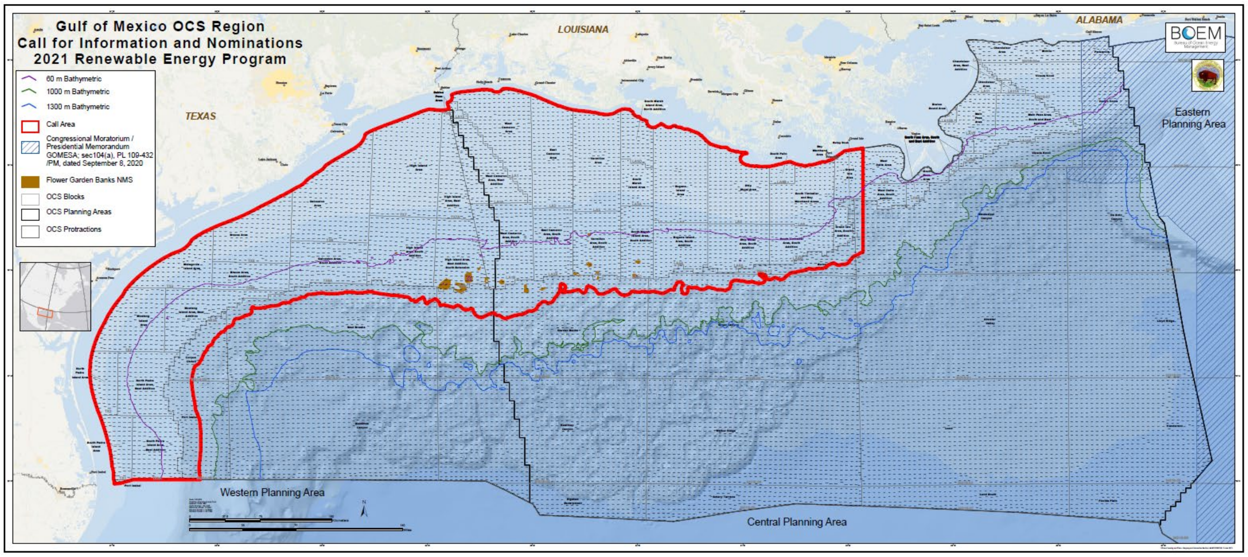

Figure 1-1. Gulf of Mexico Renewable Energy Call Area.

CHAPTER 2

THE PROPOSED ACTION AND ALTERNATIVES

2 THE PROPOSED ACTION AND ALTERNATIVES

2.1 THE PROPOSED ACTION

The Proposed Action for this EA is the issuance of commercial and/or research wind energy lease(s) within the GOM Call Area that BOEM has designated on the Gulf of Mexico OCS, and the granting of ROWs and RUEs in support of wind energy development. Issuance of leases or grants would allow for site characterization activities and only the submittal of SAPs and either a GAP or COP for BOEM's consideration and approval, which does not constitute an irreversible and irretrievable commitment of resources. Therefore, BOEM's environmental analysis is focused on the effects of site characterization and site assessment activities expected to take place after the issuance of commercial and research wind energy leases.

This EA analyzes BOEM's issuance of up to 18 leases within the GOM Call Area, the issuance of potential project easements associated with each lease, and the issuance of grants for export cable corridors and associated offshore collector/converter platforms. The ROWs, RUEs, and potential project easements would be located in the OCS areas of the GOM, extending from the Call Area through to State waters and to the onshore energy grid. It is reasonably expected that the Proposed Action would be followed by site assessment activities on leases and site characterization activities on the leases, grants, and potential easements. A lessee would submit a SAP to describe site assessment activities for BOEM's review (30 CFR § 585.605-613). Site assessment activities would most likely include the temporary placement of meteorological (met) buoys and oceanographic devices. Site characterization activities would most likely include geophysical, geotechnical, and biological surveys. While site characterization activities that extend into State waters and onshore to ports or existing substations are a reasonably foreseeable result of a wind energy lease issued in the GOM Call Area, BOEM is not authorizing any activities in State waters and onshore areas and does not have regulatory authority to apply mitigating measures outside of the OCS.

2.1.1 Scope of the Environmental Assessment

BOEM's wind energy program occurs in four distinct phases, as shown in **Appendix A, Figure A.2.0-1**. Pursuant to NEPA, 42 U.S.C. §§ 4321-4370f, as well as the Council on Environmental Quality (CEQ) regulations at 40 CFR § 1501.3, this EA has been prepared to assist BOEM in considering whether site characterization and site assessment activities expected to take place after issuance of an OCS wind energy lease within the GOM Call Area would lead to reasonably foreseeable significant impacts on the human environment and, thus, whether an EIS should be prepared before leases are issued.

This analysis covers the effects of site characterization activities (i.e., surveys of the proposed lease area) and site assessment activities (i.e., construction and operation of up to two buoys per lease) expected to take place after issuance of an OCS wind energy lease within the GOM Call Area. This analysis does not consider construction and operation of any commercial wind energy facilities, which would be evaluated if the lessee submits a COP or a GAP and a site- and project-specific NEPA analysis would be conducted. BOEM takes this approach based on several factors.

First, BOEM does not consider the issuance of a lease to constitute an irreversible and irretrievable commitment of public resources. **Appendix A, Figure A.2.0-1** describes BOEM's phased planning and authorization process for offshore wind development. Under this process, the issuance of a lease grants the lessee only the exclusive right to submit to BOEM a SAP, GAP, and COP proposing development of the leasehold; the lease does not, by itself, authorize any activity within the lease area. After lease issuance, a lessee would conduct surveys and, if authorized to do so pursuant to an approved SAP, install meteorological measurement devices to characterize the site's environmental and socioeconomic resources and conditions, and to assess the wind resources in the lease area. A lessee would collect this information to determine whether the site is suitable for commercial or research development and, if so, submit a COP with its project-specific design parameters for BOEM's review.

BOEM encourages early coordination between the lessee, regulatory agencies, and other ocean users prior to the submission of a SAP to discuss pre-survey planning and to ensure that all surveys are conducted in a manner that addresses the regulatory information requirements for a SAP (https://www.boem.gov/sites/default/files/renewable-energy-program/BOEM-Renewable-SAP-Guidelines.pdf). Pre-survey coordination also provides an opportunity for BOEM and the lessee to discuss common goals and expectations, agree upon the technical aspects and key parameters for the surveys, and advise of the authorizations or permits from other resource agencies that are necessary before a lessee contracts and mobilizes an offshore survey.

Should a lessee submit a COP or GAP, BOEM would consider its merits; perform the necessary consultations with the appropriate State, Federal, local, and tribal entities; solicit input from the public and the Intergovernmental Task Force; and perform an independent, comprehensive, site- and project-specific NEPA analysis. This separate site- and project-specific NEPA analysis may take the form of an EIS and would provide additional opportunities for public involvement pursuant to NEPA and the CEQ regulations at 40 CFR parts 1500-1508. On April 20, 2022 CEQ published a final rule in the *Federal Register* to implement Phase 1 of changes to their NEPA implementing regulations. The final rule went into effect on May 20, 2022 *(Federal Register 2022)*. BOEM would use this information to evaluate the potential environmental and socioeconomic consequences associated with the lessee-proposed project when considering whether to approve, approve with modification, or disapprove a lessee's COP pursuant to 30 CFR § 585.628. After lease issuance, but prior to COP approval, BOEM retains the authority to prevent the environmental impacts of a commercial offshore wind energy facility from occurring. BOEM would do this by disapproving a COP for failure to meet the statutory standards set forth in the Outer Continental Shelf Lands Act (OCSLA).

Second, BOEM does not consider the impacts resulting from the development of a commercial wind energy facility within the GOM Call Area to be reasonably foreseeable at this time. Project design and the resulting environmental impacts are often site-specific. Therefore, it would be premature to analyze environmental impacts related to potential approval of any future COP at this this time (Michel et al. 2007; Musial and Ram 2010). There are a number of design parameters that would be identified in a project proposal, including turbine size, foundation type, project layout, installation methods, and associated onshore facilities. However, the development of these parameters would be determined by information collected by the lessee during site characterization and site assessment activities, and potential advances in technology during the extensive time period between lease issuance and COP submittal. Each design parameter, or combination of parameters, would have varying environmental effects. Therefore, additional analyses under NEPA would be required before any future decision is made regarding construction and operation of wind energy facilities on the OCS.

2.1.2 Approach for this EA

BOEM's approach for this EA is to analyze the entire GOM Call Area rather than using the Area ID process to identify WEAs, followed by preparation of an EA covering only those areas to be considered for potential leasing. Although NEPA analysis is not required at the Area ID stage, BOEM has decided to prepare this EA prior to the identification of the WEAs as an exercise of agency discretion. This approach not only allows greater flexibility for future identification of WEAs but also provides NEPA coverage for unsolicited requests for non-competitive commercial or research leases that could be received in the GOM Call Area.

BOEM's long-standing conventional energy program in the GOM has provided many decades of research in the region from which to support this analysis. Considering the stakeholders in the GOM, who are familiar with the regional analysis for NEPA under the conventional energy program, BOEM chose to follow a similar approach in the GOM for consistency and comparability. Analyzing the entire GOM Call Area aligns with the conventional energy NEPA approach in that assessment is at a regional level and allows the analysis to be used for more than one wind energy lease sale. It provides flexibility for the identification of several WEAs and lease areas over time in the GOM Call Area and allows for up to 18 leases to be considered under this analysis. Eighteen leases, leases which is the high end of the scenario to be considered in this EA, was based on the current total of wind energy leases in the Atlantic that have been issued since the beginning of the Renewable Energy Program. BOEM expects to issue no more than 6-8 leases per sale in the GOM.

2.2 ALTERNATIVES CONSIDERED

BOEM considered three alternatives in this EA. Of the alternatives considered in this EA, Alternative A is the No Action Alternative, which includes other ongoing activities and future planned actions. Alternative B would result in site characterization and site assessment activities in the GOM Call Area and along export cable corridors to shore. Alternative C would result in site characterization and site assessment activities in the GOM Call Area and along export cable corridors to shore, excluding the Toppgraphic Features Stipulation Blocks. BOEM is analyzing this third alternative to consider not allowing site characterization and site assessment activities in sensitive benthic habitat in order to assist the decisionmaker in understanding the impacts avoided from not allowing site characterization and site assessment activities in these areas should the decisionmaker choose to eliminate these areas of sensitive benthic habitat.

2.2.1 Alternative A—No Action

Alternative A is no action; no renewable energy lease issuance in the GOM. Under Alternative A, no wind energy leases would be issued, and site assessment activities would not occur within the GOM Call Area. Although some site characterization surveys for renewable energy (e.g., geological, geophysical, biological, and archaeological surveys that are conducted on unleased or ungranted areas of the OCS) do not require BOEM approval and could still be conducted under Alternative A, these activities are less likely to occur without a commercial wind energy lease.

2.2.2 Alternative B—Wind Energy OCS Lease Issuance in the GOM Call Area

Alternative B would allow for lease issuance within the GOM Call Area (**Figure 16.2.2-1**). BOEM is analyzing the entire GOM Call Area. All blocks within the GOM Call Area may be offered with the exception of whole and partial blocks located within the exterior boundaries of any unit of the National Park System, National Wildlife Refuge System, National Marine Sanctuary System, or any National Monument, as provided in subsection 8(p)(10) of OCSLA. Alternative B includes the issuance of up to 18 commercial and research wind energy leases over multiple lease sales and site characterization and site assessment activities within the GOM Call Area as identified in **Figure 2.2.2-1** and the granting of ROWs and RUEs in support of wind energy development.

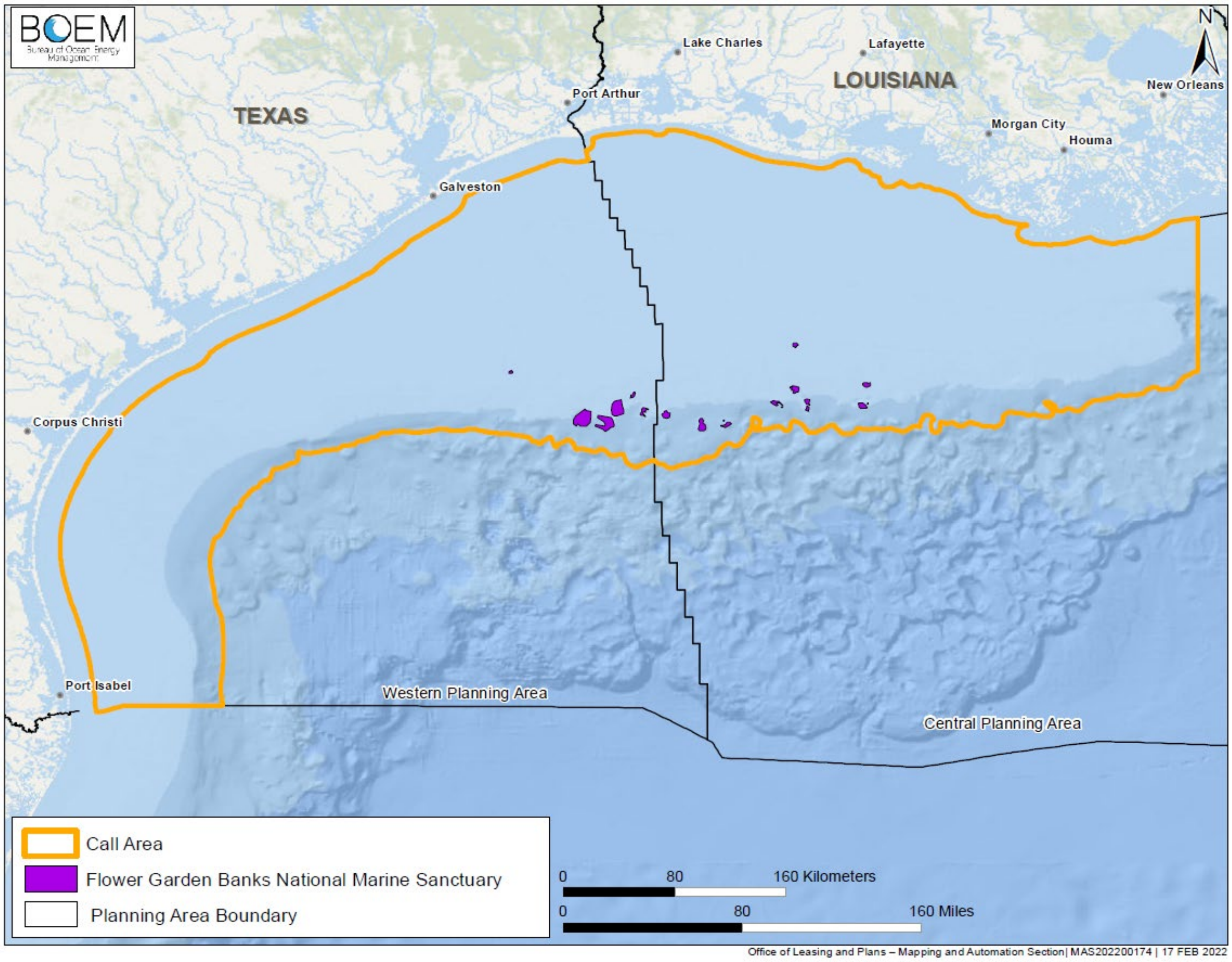

Figure 2.2.2-1. Gulf of Mexico Call Area.

2.2.3 Alternative C—Wind Energy OCS Lease Issuance in the GOM Call Area Excluding the Topographic Features Stipulation Blocks

Alternative C would allow for lease issuance only in certain portions of the GOM Call Area (**Figure 16.2.3-2**). This alternative may offer all blocks within the GOM Call Area for renewable energy lease issuance, with the following exceptions:

(1) whole and partial blocks located within the exterior boundaries of any unit of the National Park System, National Wildlife Refuge System, National Marine Sanctuary System, or any National Monument, as provided in subsection 8(p)(10) of the OCSLA, would be unavailable for lease; and

(2) whole or partial Topographic Features Stipulation Blocks would be unavailable for lease.

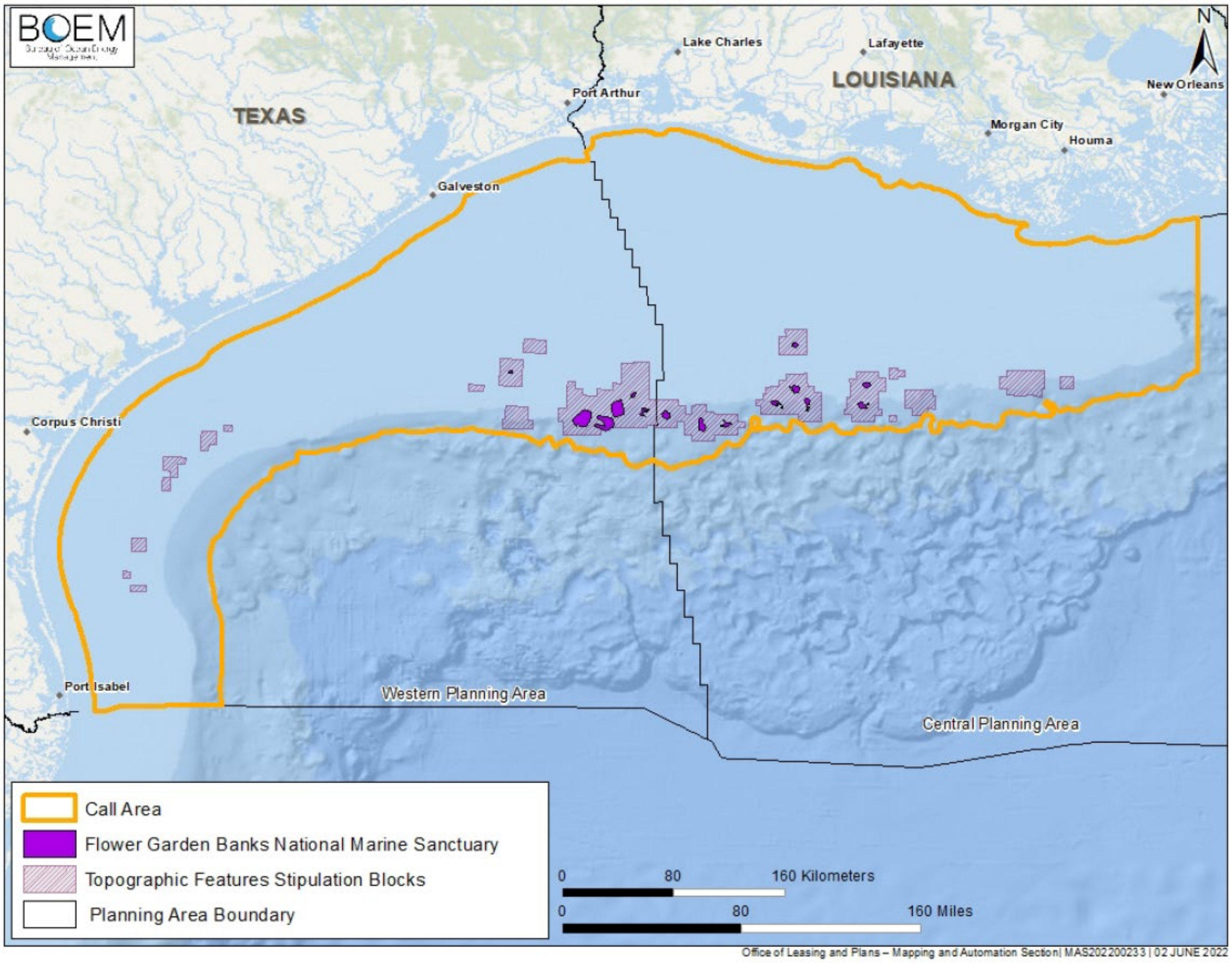

Figure 2.2.3-2. Gulf of Mexico Call Area Excluding the Topographic Features Stipulation Blocks.

Alternative C includes the issuance of up to 18 commercial and research wind energy leases over multiple lease sales and site characterization and site assessment activities within the GOM Call Area as identified in **Figure 16.2.3-2** above and the granting of ROWs and RUEs in support of wind energy development.

2.2.4 Alternatives Considered but Not Analyzed in Detail

BOEM considered other alternatives for this EA but did not analyze them in detail because they did not assist the decisionmaker in understanding the differences in impacts from site characterization and site assessment activities for those alternatives. Although some comments received during scoping for the EA, as well as on the Call and RFI, suggested aspects that might reduce impacts to resources at the next stage of the process, i.e., the wind energy development stage, those suggestions for alternatives did not show a difference in impacts from site assessment and site characterization activities. For example, the removal of areas with high seabird habitat suitability and a 20-nautical mile (nmi) (23-mile [mi]; 37-kilometer [km]) coastal buffer for bird foraging habitat are not appropriate as an alternative for this EA, but are being considered in a parallel and more applicable step of this process, the WEA identification. Seabird habitat, migratory bird pathways, areas of concentrated commercial fishing activity and oil and gas industry, U.S. Department of Defense activities, as well as other potential space-use conflicts as well as areas of interest requested by the Governor of Louisiana, are being considered in the WEA identification process. Consultations and discussions with other Tribal, Federal, State, and local agencies, as well as other stakeholders, are being held to consider these issues. Other scoping comments did not suggest alternatives that met the purpose and need and/or would not have resulted in different impacts from the alternatives analyzed. Because the Proposed Action will not result in the approval of a wind energy facility and is expected to result only in site assessment and site characterization activities, BOEM has determined that there are no additional alternatives that would result in meaningful differences in impacts to the various resources when compared to the alternatives analyzed in this EA.

2.2.5 Information Considered in Scoping This EA

The following information was used in scoping this EA.

- Comments received in response to the June 11, 2021, RFI to assess interest in potential offshore wind development in the Gulf of Mexico OCS (https://www.regulations.gov/document/BOEM-2021-0041-0001).
- Comments received in response to the November 1, 2021, Call for Information and Nominations (Call) to further assess commercial interest in wind energy leasing in the Gulf of Mexico (https://www.regulations.gov/docket/BOEM-2021-0077).
- Comments received in response to the January 11, 2022, Press Release announcing the intent to prepare this EA and the associated 30-day scoping period (https://www.regulations.gov/docket/BOEM-2021-0092).
- Ongoing consultation and coordination with the members of BOEM's Gulf of Mexico Intergovernmental Renewable Energy Task Force (Task Force) (https://www.boem.gov/renewable-energy/state-activities/gulf-mexico-gom-intergovernmental-renewable-energy-task-force).
- Ongoing consultation and coordination with Indian Tribes in the Gulf of Mexico Region (Tribes).
- Ongoing coordination with the members of the Gulf of Mexico fisheries groups through the Gulf of Mexico Fisheries Summit on January 19 and 20, 2022 (https://www.boem.gov/renewable-energy/state-activities/gulf-mexico-fisheries-summit).
- Ongoing coordination between BOEM and the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Coastal Ocean Science for Wind Energy Area ID.
- Ongoing or completed consultations with other Federal agencies, including the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), U.S. Department of Defense, and U.S. Coast Guard (USCG).

- Research and review of current relevant NEPA documents that assess similar activities, as well as relevant scientific and socioeconomic literature (**Appendix G**).

2.2.6 Other Pertinent Environmental Reviews or Documentation

BOEM is aware of other environmental reviews, studies, and technical reports relevant to the resources under consideration in this EA. The following relevant regulatory documents and literature considered in this EA and incorporated by reference, where appropriate, are listed below.

- *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a). This document describes the affected environment and details the impact analyses for the impact-producing factors (IPFs).
- *Commercial and Research Wind Lease and Grant Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf of the New York Bight: Final Environmental Assessment* (BOEM 2021b). This EA describes assumptions and IPFs anticipated for site assessment and site characterization activities.
- *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf* (BOEM 2019). This document describes IPFs and impacts associated with offshore wind projects.
- *Gulf of Mexico OCS Proposed Geological and Geophysical Activities: Western, Central, and Eastern Planning Areas; Final Programmatic Environmental Impact Statement* (BOEM 2017). This document describes geological and geophysical activities in the GOM.
- *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York, Revised Environmental Assessment* (BOEM 2016). This EA describes assumptions and IPFs anticipated for site assessment and site characterization activities.
- *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf: Final Environmental Impact Statement* (MMS 2007b). This document describes alternative energy development and production and alternate use of facilities on the OCS.

CHAPTER 3

ASSUMPTIONS, IMPACT-PRODUCING FACTORS, AND SCENARIO

3 ASSUMPTIONS, IMPACT-PRODUCING FACTORS, AND SCENARIO

BOEM's assumptions for the Proposed Action (Alternatives B and C) in this EA are summarized in **Chapter 3.1** and **Table 3.1-1,** and details are provided in **Appendix A**. The IPFs are summarized in **Chapter 3.2** and detailed in **Appendix B**. The scenario is summarized in **Chapter 3.3** and detailed estimates of survey effort and air emissions are provided in **Appendix E**. This scenario is based on the requirements of the renewable energy regulations at 30 CFR part 585, BOEM's guidance for lessees, previous lease applications and plans that have been submitted to BOEM, previous EAs prepared for similar activities, and the biological assessment evaluating the effects of survey and data collection activities associated with renewable energy on the Atlantic OCS (Baker and Howson 2021). Unless otherwise noted, assumptions in this chapter are based on these sources.

3.1 ASSUMPTIONS

When preparing the scenario, BOEM based its estimate of foreseeable future activities on historical trends of an emerging Renewable Energy Program on the Atlantic OCS. The following information summarizes the assumptions used in this EA. For a full description of assumptions and IPFs, refer to **Appendices A and B**, respectively.

As of January 2022, when this scenario was formed, BOEM had 18 (17 commercial and 1 research) active wind energy leases on the Atlantic OCS offshore Delaware, Virginia, Rhode Island, Massachusetts, Maryland, New Jersey, New York, North Carolina, and Florida (https://www.boem.gov/renewable-energy/state-activities). Considering that the Proposed Action is the issuance of commercial and research wind energy lease(s) within the GOM Call Area that BOEM has designated on the Gulf of Mexico OCS and the granting of ROWs and RUEs in support of wind energy development, BOEM anticipates up to 18 leases to be issued in the early development of the Renewable Energy Program in the GOM. Therefore, BOEM anticipates a range of 1 to 18 leases issued for initial planning purposes and environmental impact analysis. This would include competitive leases from an auction, as well as non-competitive, limited, and research leases. The scope would also include site characterization and site assessment activities for up to 18 leases and any ROWs and RUEs approved in support of those leases. BOEM expects to issue no more than 6-8 leases per lease sale.

For estimating the amount of site characterization and site assessment activities that may occur for each individual issuance of an OCS wind energy lease, BOEM made the overall assumptions based on the relevant information and assumptions in the New York Bight EA (BOEM 2021b), which represents the best available and most up to date information about site characterization and site assessment activities (refer to **Table 3.1-1**).

Table 3.1-1. Assumptions for Foreseeable Activities in the Gulf of Mexico Call Area.

Overall Assumptions for Foreseeable Activities
A wind energy lease would be located in an area within the GOM Call Area (**Figure 1-1**).
BOEM would develop and analyze standard operating conditions, lease stipulations, and other guidance specific to a proposed RFI, Call Area, WEA, or lease sale area in their environmental analysis before an OCS wind energy lease would be executed.
BOEM would issue up to 18 leases, which would average 80,000 acres each (in areas large enough to accommodate these leases).
BOEM would likely issue more than one lease, but no more than 6-8 per lease sale, for a Wind Energy Area greater than 80,000 acres.
A lessee would install 1-2 buoys per lease.
There would be 2 export cable corridors per lease.
A backbone transmission system with offshore converter collector platforms (platforms located within the export cable corridors) could be granted an easement.
Surveying and Sampling Assumptions
Site characterization surveys would likely begin within 1 year following execution of a lease (based on the likelihood that a lessee would complete the majority of site characterization prior to installing a meteorological buoy). Site characterization surveys would then continue on an intermittent basis for the following 5 years leading up to the preparation and submittal of the Construction and Operations Plan.
Lessees would likely survey the entire lease area during the 5-year site assessment term to collect required geophysical and geotechnical information for siting of commercial facilities (wind turbines). The surveys may be completed in phases, with the meteorological buoy areas likely to be surveyed first. The estimated area of impact from geotechinical and benthic survey activities range from $0.1m^2$ to $10m^2$ ($1.08ft^2$ to $107.64ft^2$) per buoy site.
Sub-bottom sampling (e.g., cone penetration test, vibracores, grab samples, etc.) of the GOM Call Area or a lease area would require a sub-bottom sample at every potential wind turbine location (which would occur only in a portion of a GOM Call Area where structural placement is allowed) and one sample per kilometer of export cable corridor. Sampling would also be conducted at locations where offshore collector and/or converter platforms are proposed. The amount of effort and vessel trips required to collect the geotechnical samples vary greatly by the type of technology used to retrieve the sample. Benthic sampling could also include nearshore, estuarine, and submerged aquatic vegetation habitats along a potential export cable corridor.
Installation, Operation and Maintenance, and Decommissioning Assumptions
Meteorological buoy installation and decommissioning would each likely take approximately 1 day.
Meteorological buoy installation would likely occur in Year 2 after a lease execution, and decommissioning would likely occur in Year 6 or Year 7 after a lease execution.
Assumptions for Generation of Noise
The following activities and equipment would generate noise: high-resolution geophysical survey equipment and vessel engines during site characterization surveys; and meteorological buoy(s) installation, operations and maintenance, and decommissioning.

The timing of lease issuance, as well as weather and sea conditions, would be the primary factors influencing the timing of site characterization surveys and site assessment activities. Under the reasonably foreseeable scenario, BOEM could issue leases in early 2023. It is assumed that lessees would begin survey activities as soon as possible after receiving a lease, and when sea states and weather conditions allow for site characterization survey activities. For leases issued in early 2023, the earliest surveys would likely begin in the spring of 2023. Lessees have up to a one year preliminary term to begin site characterization surveys and submit a SAP, then up to 5 years after SAP approval to perform additional site characterization and site assessment activities before they must submit a COP (30 CFR § 585.235(a)(1-2)).

3.1.1 High-Resolution Geophysical Surveys

High-resolution geophysical (HRG) surveys acquire geophysical information to support facility and transmission cable siting, including information to determine whether shallow hazards will impact seabed support of the infrastructure, to obtain information pertaining to the presence or absence of benthic and archaeological resources, and to conduct bathymetric charting. Side-scan sonars, sub-bottom profilers, magnetometers, and multibeam echosounders may be used during HRG surveys and could add noise to the underwater environment. The types of equipment, survey methodology, and sound characteristics that may be used during these surveys as well as potential IPFs are described in **Appendices A and B**. BOEM's renewable energy guidelines are designed to meet the geophysical data requirements at 30 CFR §§ 585.610-585.611. Implementation of the guidance by the leasee will ensure compliance for survey data submissions.

3.1.2 Geotechnical Surveys

Geotechnical surveys are performed to assess the suitability of shallow sediments to support a structure foundation (i.e., gather information to determine whether the seabed can support foundation structures) or transmission cables under operational and environmental conditions that could potentially be encountered (including extreme weather events), as well as to document the sediment characteristics necessary for design and installation of all structures and cables. Samples for geotechnical evaluation are typically collected using shallow-bottom coring and surface sediment sampling devices taken from a survey or drilling vessel. Likely methods to obtain samples and potential resulting IPFs are described in **Appendices A and B**. BOEM's renewable energy guidelines are designed to meet the geotechnical data requirements at 30 CFR §§ 585.610-585.611. Implementation of the guidance by the leasee will ensure compliance for survey data submissions.

3.1.3 Biological Surveys

Biological surveys may be necessary to characterize the biological resources that could be affected by the proposed activity or could affect activities in the proposed plan. Benthic habitat surveys, avian and bat surveys, and marine fauna surveys (e.g. fish, marine mammals, sea turtles) may be reasonably expected as part of the Proposed Action. Biological survey equipment types, methodologies, and their potential IPFs associated with the Proposed Action are described in **Appendices A and B**. For biological surveys, BOEM assumes that all vessels associated with the Proposed Action would be required to abide by the Standard Operating Conditions (SOCs), which are described in **Appendix H** and will be detailed in the Final Sale Notice. NMFS may require additional measures from the lessee to comply with the Marine Mammal Protection Act and/or the Endangered Species Act. BOEM's renewable energy guidelines are designed to meet the biological data requirements at 30 CFR §§ 585.610-585.611. Implementation of the guidance by the leasee will ensure compliance for survey data submissions.

3.1.4 Meteorological Buoy – Installation, Operation and Maintenance, Decommissioning

The Proposed Action includes installation, operation and maintenance, and decommissioning of meteorological buoys for assessing wind conditions. Meteorological buoys are anchored to the seafloor at fixed locations and regularly collect observations from many different atmospheric and oceanographic sensors. This EA assumes that a maximum of two buoys per lease would be installed. **Appendices A and B** also describe the equipment types; activities related to installation, operation and maintenance, and decommissioning of the meteorological buoys; and any associated potential IPFs. BOEM assumes that any activities would take place in accordance with any lease stipulations, SOCs, and applicable laws and regulations, which will be included in the proposed or final sale notices.

3.1.5 Non-Routine Events

Reasonably foreseeable non-routine and low-probability events and hazards that could occur during site characterization and site assessment related activities include (1) unintentional releases into the environment, such as fuel spills and trash and debris; (2) strikes and collisions (including entanglement); and (3) response activities such as spill response and lost equipment recovery.

Detailed descriptions of unintentional releases into the environment, strikes and collisions, and response activities and their potential IPFs are found in **Appendices A and B**. Accordingly, the potential impacts to GOM resources from non-routine events are described in **Chapter 4**, should a non-routine event from site assessment or site characterization activities impact a resource.

Unintentional Releases into the Environment

Spills

A spill of petroleum product could occur as a result of hull damage from collisions with a meteorological buoy or between vessels, accidents during the maintenance or transfer of offshore equipment and/or crew, or due to natural events (i.e., strong waves or storms). From 2010 to 2020, the average spill size for vessels other than tank ships and tank barges was 114 gallons (432 liters) (USCG 2011); should a spill from a vessel associated with the Proposed Action occur, BOEM anticipates that the volume would be similar. Diesel would be expected to dissipate very rapidly, evaporate, and biodegrade within a few days (MMS 2007a). Vessels are expected to comply with USCG requirements relating to prevention and control of oil spills and to 33 CFR part 151, 33 CFR part 154, and 33 CFR part 155; and the U.S. Environmental Protection Agency's (USEPA) requirements at 40 CFR part 300, which contain guidelines for implementation and enforcement of vessel response plans, facility response plans, and shipboard oil pollution emergency plans.

Trash and Debris

The discharge of marine debris in the offshore environment is subject to a number of laws and treaties. These laws and treaties include the Marine Debris Research, Prevention, and Reduction Act; the Marine Plastic Pollution Research and Control Act; and the MARPOL-Annex V treaty. Regulation and enforcement of these laws is conducted by a number of agencies, such as BSEE, USEPA, NOAA, and USCG. BOEM assumes compliance with these laws and treaties.

Strikes and Collisions

Strikes are defined as a vessel or aircraft unintentionally hitting a resource or habitat, including entanglements. Collisions are defined as a vessel or aircraft unintentionally hitting another vessel, aircraft, or structure. BOEM issued Notice to Lessees and Operators (NTL) No. 2016-G01, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting," for oil and gas and sulphur leases in the GOM which explains how operators must implement measures to minimize the risk of vessel strikes to protected species and to report observations of injured or dead protected species. This NTL was reissued June 19, 2020 and as of March 13, 2020, BOEM has implemented the terms and conditions and reasonable and prudent measures of the 2020 NMFS Biological Opinion (BiOp), including Appendix C, "Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols," which has been applied in place of NTL No. 2016-G01 for lease sale stipulations and conditions of approval for permits, plans, and other authorizations approved by BOEM. Through consultation with NMFS and/or FWS, similar protective measures, best management practices, and protocols that have been developed through years of conventional energy operation consultations in the GOM and refined through BOEM's renewable energy program may be implemented for an OCS wind energy lease as required by the Endangered Species Act (ESA). These protective measures and best management practices, referred to as SOCs, are described in **Appendix H** and will be detailed in the Final Sale Notice. Risk of collisions is reduced through USCG Navigation Rules and Regulations, safety fairways, and traffic separation schemes for vessels transiting into and out of the ports of the GOM. BOEM anticipates that aerial surveys (if necessary) would not be conducted during periods of storm activity because the reduced visibility conditions would not meet visibility requirements for conducting the surveys; flying at low elevations would pose a safety risk during storms and times of low visibility.

Response Activities

Spill Response

As described in the "Spills" section above and in **Appendices A and B**, spills of petroleum products are possible and would most likely be diesel. These spills are expected to remain relatively small, and diesel is known to dissipate rapidly. An acceptable response is to allow the spill to degrade naturally, if the dissipation will occur without assistance. Sorbent booms and pads could also be likely responses for larger spills relative to the amounts related to site characterization and site assessment activities. Vessels are expected to comply with USCG requirements relating to prevention and control of oil spills and to 33 CFR part 151, 33 CFR part 154, and 33 CFR part 155; and USEPA requirements at 40 CFR part 300, which contain guidelines for implementation and enforcement of vessel response plans, facility response plans, and shipboard oil pollution emergency plans.

Recovery of Lost Survey Equipment

Equipment used during site characterization and site assessment activities (e.g., towed HRG survey equipment, cone penetration test components, grab sampler, buoys, lines, and cables) could be accidentally lost during survey operations. Additionally, it is possible (although unlikely) that a meteorological buoy could disconnect from the clump anchor. In the event of lost equipment, recovery operations may be undertaken to retrieve the equipment. For the recovery of lost survey equipment, BOEM would work with the lessee/operator to develop an emergency response plan. Selection of a mitigation strategy would depend on the nature of the lost equipment, and further consultation may be necessary.

3.2 IMPACT-PRODUCING FACTORS

This EA analyzes the effects of routine activities and accidental events associated with lease and grant issuance, site characterization activities (i.e., biological, geological, geotechnical, and archaeological surveys of the GOM Call Area), and site assessment activities (i.e., meteorological buoy deployment, operation, and decommissioning) within the GOM Call Area and within potential easements associated with export cable corridors. It does not consider construction and operation of any commercial wind energy facilities on a lease or grant in the GOM Call Area, which would be evaluated separately if a lessee submits a COP. The IPFs associated with the various activities in the Proposed Action that could affect resources include the following:

- air emissions and pollution;
- discharges and wastes;
- bottom disturbance;
- noise;
- coastal land use/modification;
- lighting and visual impacts;
- offshore habitat modification/space use;
- socioeconomic changes and drivers;
- unintended releases into the environment;
- response activities; and
- strikes and collisions.

The IPFs associated with OCS wind energy activities and non-OCS wind energy activities that are considered in this EA are described in detail in **Appendix B**.

3.3 SCENARIO

The single OCS wind energy lease scenario describes the site characterization and site assessment activities that could occur as a result of the issuance of a single OCS wind energy lease, and the high-end OCS wind energy lease scenario describes the site characterization and site assessment activities that could occur as a result of the issuance of 18 OCS wind energy leases. Ranges of activity within the scenarios were developed to characterize the full range of potential environmental impacts that could result from reasonably foreseeable activities and activity levels as a result of lease issuance. In preparation of the COP, survey activity is anticipated to occur on the OCS within the lease export cable corridor, the OCS wind energy lease, and the “backbone” transmission grid system (described in **Appendix A.3.2.1.4**). Additionally, vessel traffic is assumed to transit from seaport to an OCS energy wind lease to complete surveys. BOEM continually updates models and formulas used to develop the scenarios used in environmental analyses. This scenario is based on the requirements of the renewable energy regulations at 30 CFR part 585, BOEM’s guidance for lessees, previous lease applications and plans that have been submitted to BOEM, previous EAs prepared for similar activities (refer to **Chapter 2.2.6** and **Appendix G**), and the biological assessment evaluating the effects of survey and data collection activities associated with renewable energy on the Atlantic OCS (Baker and Howson 2021). The Proposed Action scenarios presented herein were calculated based on the following factors:

- average estimated distance from coastal ports to a given area within the GOM Call Area;
- estimated activity required to complete site characterization and site assessment activities for a single OCS wind energy lease issuance and the high-end OCS wind energy lease scenario (issuance of 18 OCS wind energy leases); and
- existing survey methodology.

The scenario details for the geological, geophysical, and biological survey activity for the issuance of a single OCS wind energy lease that could occur in the GOM Call Area and the transmission cable route to shore are shown in **Table 3.3-1**. The scenario details for the survey activity for the high-end OCS wind energy lease issuance scenario (issuance of 18 OCS wind energy leases) is provided in **Table 3.3-2**. The implementation of best management practices and SOCs may reduce the impacts from activities shown in these tables, and BOEM assumes the lessee would follow BOEM’s guidelines to meet the data requirements at 30 CFR §§ 585.610-585.611. **Appendix H** describes these SOCs, outlining protective measures and best management practices. Further detail on SOCs will be provided in the Final Sale Notice. Potential emissions from survey activity for the issuance of a single OCS wind energy lease and for the high-end OCS wind energy lease issuance scenario (issuance of 18 OCS wind energy leases) are shown in **Tables 3.3-3 and 3.3-4**.

Table 3.3-1. Site Characterization Activities – Offshore Surveys for the Issuance of a Single OCS Wind Energy Lease.

Survey Task	Vessel Type	Single OCS Wind Energy Lease					
		Total No. of Vessel Round Trips	Duration of Survey Task (years)	No. of Vessel Round Trips (per year)[3]	Avg. Miles per Round Trip (nautical miles)[4]	Total (nautical miles/year)[5]	Activity (hours/year)[6]
HRG Survey – Export Cable Routes	Crew Boat	248	5	50	82	4,069	904
HRG Survey – Total Backbone	Crew Boat	273	5	55	76	4,170	927
HRG Surveys – Lease Area	Crew Boat	10	5	2	1,034	2,067	1,395
Geotechnical Sampling[1]	Small Tug Boat	7	5	2	4,261	8,522	710
Avian[2], Marine Mammal, and Sea Turtle Surveys[7]	Crew Boat	36	5	8	130	933	93
Fish Surveys[7]	Crew Boat	3	5	1	1,905	1,905	614

[1] Assumes all sampling round trips over the 5-year period were performed using a Small Tug Boat in conjunction with a small cargo barge, which does not have an engine. Geotechnical and benthic sampling are presumed to occur concurrently for the export cable. Turbine and transmission station survey site factor is based on 12-megawatt turbines, resulting in 69 total turbines for a single OCS wind energy lease.
[2] Assumes all avian surveys are completed by boat to obtain the worst-case scenario.
[3] Round trips per year are estimated by dividing the total round trips per task by the number of years over which the surveys will be conducted.
[4] Average miles per round trip was calculated by averaging the round trip to the centroid of each lease area from the nearest of the potential staging ports identified within this environmental assessment.
[5] Distances for the high-resolution geophysical (HRG) surveys and HRG survey cable routes are based on vessel-hours and speed. Distances for other surveys are based on calculated round trips multiplied by the average round-trip nautical miles.
[6] Assumes the following average speeds to estimated activity hours based on total nautical miles traveled:

- HRG Survey – 4.5 knots
- Tugs Boats/Barges – 12 knots
- Avian Survey – 10 knots
- Fish Survey – 3.1 knots (average trawl speed)

No time for the vessels spent at idle was captured in this calculation.
[7] Avian, marine mammal, and sea turtle surveys are 3 years/lease area. Fish surveys are 2 years/lease area. Assumes avian, marine mammal, sea turtle, and fish surveys occur over 5 years over all lease areas.

Table 3.3-2. Site Characterization Activities – Offshore Surveys for the High-End OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Survey Task	Vessel Type	High-End OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases)					
		Total No. of Vessel Round Trips	**Duration of Survey Task (years)**	**No. of Vessel Round Trips (per year)[3]**	**Avg. Miles Per Round Trip (nautical miles)[4]**	**Total (nautical miles/year)[5]**	**Activity (hours/year)[6]**
HRG Survey – Export Cable Routes	Crew Boat	1063	5	213	173	36,798	8,177
HRG Survey – Total Backbone	Crew Boat	273	5	55	76	4,170	927
HRG Surveys – Lease Areas	Crew Boat	175	5	35	3,228	112,994	25,110
Geotechnical Sampling[1]	Small Tug Boat	50	5	10	3,364	33,635	2,803
Avian[2], Marine Mammal, and Sea Turtle Surveys[7]	Crew Boat	648	5	130	130	16,795	1,679
Fish Surveys[7]	Crew Boat	62	5	13	2,637	34,284	11,059

[1] Assumes all sampling round trips over the 5-year period were performed using a Small Tug Boat in conjunction with a small cargo barge, which does not have an engine. Geotechnical and benthic sampling are presumed to occur concurrently for the export cable. Turbine and transmission station survey site factor are based on 12-megawatt turbines, resulting in 1,240 total turbines for 18 leases.

[2] Assumes all avian surveys are completed by boat to obtain the worst-case scenario.

[3] Round trips per year are estimated by dividing total round trips per task by the number of years over which the surveys will be conducted.

[4] Average miles per round trip was calculated by averaging the round trip to the centroid of each lease area from the nearest of the potential staging ports identified within this environmental assessment.

[5] Distances for the high-resolution geophysical (HRG) survey and HRG survey cable routes are based on vessel hours and speed. Distances for other surveys are based on calculated round trips multiplied by average round-trip nautical miles.

[6] Assumes the following average speeds to estimated activity hours based on total nautical miles traveled:

- HRG Survey – 4.5 knots
- Tugs Boats/Barges – 12 knots
- Avian Survey – 10 knots
- Fish Survey – 3.1 knots (average trawl speed)

No time for the vessels spent at idle was captured in this calculation.

[7] Avian, marine mammal, and sea turtle surveys are 3 years/lease area. Fish surveys are 2 years/lease area. Assumes avian, marine mammal, sea turtle, and fish surveys occur over 5 years over all lease areas.

Table 3.3-3. Detailed Emission Estimation of Annual Emissions by Activities for an Average Year for the Issuance of a Single OCS Wind Energy Lease.

Phase/Source Description	Emissions (tons/year)								Emissions (metric tons/year)			
	CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	NH_3 [2]	PB [2]	CO_2	N_2O	CH_4	CO_{2e}
Surveys												
Site Characterization – Offshore Surveys												
Vessel Travel – HRG	34.73	26.51	0.76	0.65	0.67	0.02	0.01	0.00	1,589.60	0.05	0.21	1,608.81
Vessel Travel – Geotech and Benthic	1.72	10.97	0.32	0.27	0.28	0.01	0.01	0.00	724.75	0.02	0.10	733.50
Vessel Travel – Biologic	0.91	5.82	0.10	0.14	0.15	0.00	0.00	0.00	348.75	0.01	0.05	352.97
Site Characterization – Per Year from Years 1-5	**37.36**	**43.30**	**1.17**	**1.06**	**1.09**	**0.03**	**0.02**	**0.00**	**2,663.10**	**0.08**	**0.35**	**2,695.27**
Meteorological Buoys												
Site Assessment – Installation												
Vessel Travel	0.05	0.32	0.01	0.01	0.01	0.00	0.00	0.00	18.96	0.00	0.00	19.19
Site Assessment – Installation Year 2	**0.05**	**0.32**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**18.96**	**0.00**	**0.00**	**19.19**
Site Assessment – Offshore O&M												
Vessel Travel	0.07	0.42	0.01	0.01	0.01	0.00	0.00	0.00	25.28	0.00	0.00	25.44
Site Assessment – O&M Per Year from Years 2-6	**0.07**	**0.42**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**25.28**	**0.00**	**0.00**	**25.44**
Site Assessment – Offshore Decommission [1]												
Vessel Travel	0.05	0.32	0.01	0.01	0.01	0.00	0.00	0.00	18.96	0.00	0.00	19.19
SUBTOTAL Decommissioning – Year 7	**0.05**	**0.32**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**18.96**	**0.00**	**0.00**	**19.19**

CO = carbon monoxide; CO_2 = carbon dioxide; CO_{2e} = carbon dioxide equivalents; CH_4 = methane; HRG = high-resolution geophysical; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; O&M = operations and maintenance; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Assumes potential emissions for meteorological buoy decommissioning are the same as for installation.
[2] Emission factors using fraction values in **Table E-13** of **Appendix E**.

Table 3.3-4. Detailed Emission Estimation of Annual Emissions by Activities for an Average Year for the High-End OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases)[1]

Phase/Source Description	**Emissions (tons/year)**									**Emissions (metric tons/year)**		
	CO	**NO_x**	**VOC**	**$PM_{2.5}$**	**PM_{10}**	**So_2**	**NH_3**	**Pb**	**CO_2**	**N_2O**	**CH_4**	**CO_{2e}**
Surveys												
Site Characterization – Offshore Surveys												
Vessel Travel – HRG	44.11	281.22	5.17	6.87	7.08	0.17	0.13	0.00	16,860.13	0.50	2.23	17,063.85
Vessel Travel – Geotech and Benthic	6.79	43.29	1.24	1.06	1.09	0.03	0.02	0.00	2,860.61	0.08	0.38	2,895.17
Vessel Travel – Biologic	8.36	53.29	1.53	1.30	1.34	0.03	0.03	0.00	3,195.02	0.36	1.64	12,523.31
Site Characterization – Per Year from Years 1-5	**59.26**	**377.80**	**7.95**	**9.23**	**9.51**	**0.23**	**0.18**	**0.00**	**22,915.77**	**0.94**	**4.25**	**32,482.34**
Meteorological Buoys												
Site Assessment – Installation												
Vessel Travel	0.89	5.69	0.16	0.14	0.14	0.00	0.03	0.00	341.30	0.01	0.05	345.42
Site Assessment – Installation Year 2	**0.89**	**5.69**	**0.16**	**0.14**	**0.14**	**0.00**	**0.03**	**0.00**	**341.30**	**0.01**	**0.05**	**345.42**
Site Assessment – Offshore O&M												
Vessel Travel	1.19	7.59	0.22	0.19	0.19	0.00	0.00	0.00	25.28	0.00	0.00	25.44
Site Assessment – O&M Per Year from Years 2-6	**1.19**	**7.59**	**0.22**	**0.19**	**0.19**	**0.00**	**0.00**	**0.00**	**25.28**	**0.00**	**0.00**	**25.44**
Site Assessment – Offshore Decommission [2]												
Vessel Travel	0.89	5.69	0.16	0.14	0.14	0.00	0.03	0.00	341.30	0.01	0.05	345.42
SUBTOTAL Decommissioning – Year 7	**0.89**	**5.69**	**0.16**	**0.14**	**0.14**	**0.00**	**0.03**	**0.00**	**341.30**	**0.01**	**0.05**	**345.42**

CO = carbon monoxide; CO_2 = carbon dioxide; CO_{2e} = carbon dioxide equivalents; CH_4 = methane; HRG = high-resolution geophysical; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; O&M = operations and maintenance; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Maximum range of leases assessed for this EA is 18 leases.
[2] Assumes potential emissions for meteorological buoy decommissioning are the same as for installation.
[3] Emission factors calculated using fraction values in **Table E-14** of **Appendix E**.

CHAPTER 4

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

4 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Each resource section of this chapter includes a summary description of the affected resource and an analysis of the potential environmental consequences of site assessment and site characterization activities under each alternative for that particular resource. The Federal and State waters of the GOM Call Area and the adjacent coastal states of Texas and Louisiana are generally the affected environment considered in each resource chapter. Current baseline conditions, which include past and present activities in the GOM, are described for each resource and are used to determine the incremental impact of the Proposed Action on the resource. Cumulative impacts include the incremental impact of the proposed action when added to the past, present, and reasonably foreseeable activities in the GOM, including those related to the OCS Oil and Gas Program and Marine Minerals Program. Effects from Alternatives B and C were compared to the cumulative impacts for each resource for both a single OCS wind energy lease issuance and for the high-end of the scenario (issuance of 18 OCS wind energy leases) to determine the impacts of the alternatives. BOEM expects to issue no more than 6-8 leases per sale.

BOEM used a localized geographic scope to evaluate impacts from the Proposed Action for resources that are fixed in nature (i.e., their location is stationary such as benthic and archaeological resources) or for resources where impacts from the Proposed Action would occur only in waters in and directly around the GOM Call Area (e.g., water quality). This analysis includes potential activities that are anticipated to occur on the Gulf of Mexico OCS offshore Texas and Louisiana, as well as activities that may take place in waters between the Call Area and the coastline, including State waters. However, the geographic boundaries for the analysis for marine mammals, sea turtles, fish/fishing, and birds include the entire GOM and coastal estuaries, given their highly mobile and, in some cases, migratory nature. Additionally, the area for cultural, historical, and archaeological resources encompasses the depth and breadth of the seabed between the coastline and the Call Area as well as the Call Area itself. BOEM has not defined onshore areas from which the site characterization activities would be visible as part of the analysis area because BOEM has concluded that the equipment and vessels performing these activities would be indistinguishable from existing lighted vessel traffic from an observer onshore. In addition, there is no indication that the issuance of a lease or grant of a RUE or ROW and subsequent site characterization and site assessment would involve expansion of existing port infrastructure. Therefore, onshore staging activities are not considered as part of the cultural, historical, and archaeological resources analysis area.

4.1 ANALYSIS APPROACH

In order to assess the potential impacts of site assessment and site characterization activities to the physical, environmental, and socioeconomic resources in the Call Area, a set of assumptions and a scenario were developed, along with descriptions of IPFs that could occur from routine activities and accidental events associated with the Proposed Action. Analysis of the various alternatives considers these IPFs (described in detail in **Appendix B**) within a distinct framework that includes frequency, duration, and geographic extent. Frequency (whether rare, intermittent, or continuous) refers to how often the factor occurs. Duration refers to how long the factor lasts from less than a year to many years. Geographic extent covers what areas are affected and, depending on the factor, how large of an area is affected. Using this information, knowledge and experience were applied to conduct analyses of the potential effects of the Proposed Action on resources.

The approach of this analysis is to focus on the potential IPFs from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and after the issuance of 18 OCS wind energy leases, as well as accidental events and cumulative impacts associated with those activities under each alternative. For each resource, the potential effects of all IPFs described in **Appendix B** were analyzed, and the IPFs determined to impact each resource as a result of site assessment and site characterization activities are discussed in the following resource sections.

The Environmental Consequences sections of this EA includes a description of the baseline conditions of the affected environment. The baseline considers past and present activities in the GOM, including those related to the OCS Oil and Gas Program and Marine Minerals Program. Within the baseline description, any other factor that is currently impacting the resource, including climate change, is also acknowledged within the overall baseline environment description for that resource and is included in the overall impact-level determination. **Figure 4.1-1** below provides a visualization of the baseline considered in this analysis, as well as a visualization for site assessment and site characterization activities expected as a result of the Proposed Action, and future foreseeable activities in the GOM. The baseline environment is represented in green in **Figure 4.1-1**.

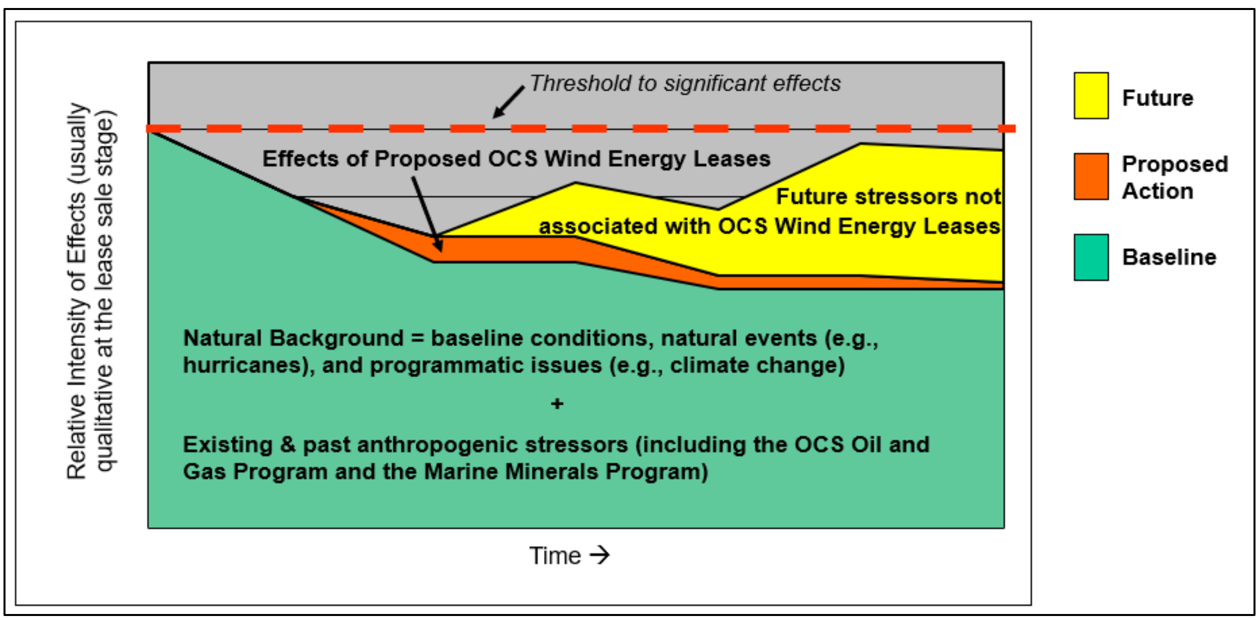

Figure 4.1-1. Diagram showing an illustration of the baseline environment (green), impacts of future activities not associated with OCS wind energy leases (yellow), and the potential impacts of the Proposed Action (orange). Cumulative impacts are the sum of the Proposed Action (orange), baseline environment (green), and future activities not associated with OCS wind energy leases (yellow).

The EA also includes a description of the incremental and cumulative impacts of each alternative. The incremental contribution of each alternative is the direct and indirect impacts of the site assessment and site characterization activities expected to take place following issuance of a single OCS wind energy lease issuance and for the issuance of 18 OCS wind energy leases. The potential magnitude for the range of direct incremental impacts from site assessment and site characterization activities for each of these IPFs that directly impacts a resource is provided in the table shown in each resource analysis section. The range of incremental impacts was determined by adding the impacts of each individual IPF for a single OCS lease issuance (low end of the range of impacts represented in the table) and for 18 OCS wind energy lease issuances (high end of the range of impacts represented in the table) that impacted each resource. The resource analysis following each table also includes any indirect impacts identified from site assessment and site characterization activities. The impacts from site assessment and site characterization activities are represented in orange in **Figure 4.1-1**.

To determine cumulative impacts of site assessment and site characterization activities, impact levels from IPFs associated with site assessment and site characterization activities were added to the baseline (past + present conditions) and future foreseeable activities (reasonably foreseeable activities in the GOM, including those related to the OCS Oil and Gas Program and Marine Minerals Program). To help visualize the cumulative impacts shown in the tables, the baseline is represented by the green portion of the diagram in Figure 4.1-1, future foreseeable activities are represented by the yellow portion of the diagram, and the incremental contribution of impacts from all IPFs for a single OCS wind energy lease issuance or the 18 OCS wind energy lease issuances would be the orange portion of the diagram in **Figure 4.1-1**. The sum of the baseline (green), the future foreseeable activities (yellow), and the incremental contribution of impacts from all IPFs for site assessment and site characterization activities (orange) represents the cumulative impacts for each alternative. The sum of the baseline (green) and the future foreseeable activities (yellow) in **Figure 4.1-1** is also representative of the impacts of the No Action Alternative, because there would be no additional impacts from site assessment and site characterization activities occurring under this alternative.

As part of the cumulative analysis, the incremental impact of site assessment and site characterization activities (orange in **Figure 4.1-1**) under Alternatives B and C were also compared to the effects of the cumulative impacts of each alternative (green + yellow + orange in **Figure 4.1-1**) for each resource for both a single OCS wind energy lease issuance and for the issuance of 18 OCS wind energy leases. That analysis focuses on comparing the potential impact level from IPFs associated with site assessment and site characterization activities to the impact level of those same IPFs found in the cumulative case.

Under Alternatives B and C, BOEM would require each lessee to avoid or minimize potential impacts on the environment by complying with various requirements, should the decision-maker choose to implement these requirements in the Final Sale Notice. These requirements are referred to as standard operating conditions (SOCs) (**Appendix H**) and would be implemented through lease stipulations. These stipulations will be detailed in the Final Sale Notice. In order to assist the decision-maker in choosing which SOCs to apply in the Final Sale Notice, for those resources that have the potential to have impacts mitigated by the application of SOCs or lease stipulations, the impacts of site assessment and site characterization activities on environmental and socioeconomic resources are analyzed both with and without the application of these potential protective measures and impacts are described in detail in each applicable resource analysis section of this chapter. The protective measures chosen by the decision-maker will be outlined and committed to in the Finding of No Significant Impact (FONSI) and described in detail in the Final Sale Notice.

For the analyses of Alternatives B and C in the sections below, it is assumed that each lessee would undertake the largest expected number of site characterization surveys (i.e., shallow hazards, geological, geotechnical, archaeological, and biological surveys) in the Call Area. Under Alternatives B and C, BOEM anticipates that no more than two met buoys would be installed within a proposed lease. BOEM anticipates that each lease could have up to two transmission cable routes (for connecting future wind turbines to an onshore power substation) or would utilize a backbone transmission system.

Effects from installation, construction, and operation of a full-scale wind energy facility are outside the scope of the analysis for the Proposed Action and, therefore, are not addressed in this EA. Effects associated with site assessment and site characterization activities are the focus of this EA and include multiple actions that are intended to aid a future NEPA analysis for a wind energy facility in the event a developer proposes one. The purpose of this NEPA analysis is to identify potential effects on resources, including wildlife species, from the Proposed Action.

4.2 Impact-Level Determination

The environmental consequences in each resource chapter include an analysis of applicable IPFs that could occur under any of the alternatives (i.e., Alternatives A, B, and C). It must be emphasized that, in arriving at the overall conclusions for certain environmental resources (e.g., fish and invertebrates, benthic communities and habitats) for each alternative, the conclusions are based on potential impacts to the resources or species population as a whole, not to individuals, small groups of animals, or small areas of habitat.

This EA uses a four-level classification scheme (negligible, minor, moderate, and major) to characterize the environmental impacts predicted if an Action Alternative or the No Action Alternative is implemented. Definitions of impacts are presented in three separate groups: (1) biological, physical, and archaeological resources; (2) socioeconomic resources; and (3) protected species. Impact-level definitions used in this EA are described in **Table 4.2-1**.

Table 4.2-1. Impact-Level Descriptions for Resources in the Gulf of Mexico.

Impact Level	Biological, Archaeological, and Other Physical Resources	Socioeconomic Resources	Protected Species
Negligible	• Either no effect or no measurable or detectable impacts. • For water quality there is either no effect or the magnitude of impact is less than minor to the point of being barely detectable and is, therefore, discountable.	• Either no effect or no measurable or detectable impacts.	• An individual or group of animals would be subject to nominal to slight measurable impacts. No mortality or injury to any individual would occur, and no disruption of behavioral patterns would be expected. The disturbance would last only as long as the human-caused stimulus was perceptible to the individual or group.
Minor	**Adverse localized impacts on the affected resource(s), including** • the local ecosystem health; • the extent and quality of local habitat for both special-status species and species common to the proposed project area; • the richness or abundance of local species common to the proposed project area; • air or water quality; and • archaeological and benthic resource(s) could be avoided; • Most impacts on the affected resource could be avoided with proper mitigation. • **OR** measurable impacts that occur would be small and the affected resource is expected to recover completely without remedial or mitigating action.	• Small-scale measurable or unmeasurable adverse impact, temporary in duration within a geographically small area (less than county/parish level). • Adverse impacts on the affected activity or community could be avoided with proper mitigation.	• An individual or group of animals would be subject to a human-caused stimulus and be disturbed, resulting in an acute behavioral change. No mortality or injury to an individual or group would occur. • Most impacts on the affected resource could be avoided with proper mitigation.
Moderate	**A notable and measurable localized adverse impact on the affected resource(s), including** • the local ecosystem health; • the extent and quality of local habitat for both special-status species and species common to the proposed project area; • the richness or abundance of local species common to the proposed project area; • air or water quality; and • archaeological and benthic resource(s) would be anticipated, some of which may be irreversible; • Proper mitigation would reduce impacts substantially during the life of the Proposed Action. • **OR** the affected resource would recover completely when remedial or mitigating action is taken.	• Medium-scale measurable or unmeasurable adverse impact and may last from a few weeks to 1 year and geographically may range from census block level to multiple counties/parishes. • Proper mitigation would reduce impacts substantially during the life of the Proposed Action.	• An individual or group of animals would be subject to a human-caused stimulus and be disturbed, resulting in a chronic behavioral change. Individuals may be impacted but at levels that do not affect the fitness of the population. Some impacts to individual animals may be irreversible. • Proper mitigation would reduce impacts substantially during the life of the Proposed Action.

Impact Level	Biological, Archaeological, and Other Physical Resources	Socioeconomic Resources	Protected Species
Major	**A regional or population-level impact on the affected resource(s), including** • ecosystem health; • the extent and quality of habitat for both special-status species and species common to the proposed project area; • the richness or abundance of local species common to the proposed project area; • air or water quality; and • archaeological and benthic resource(s) would be anticipated; • Proper mitigationwould reduce impacts somewhat during the life of the Proposed Action. • **AND** the affected resource would not fully recover, even after the impacting agent is gone and remedial or mitigating action is taken.	• Large-scale measurable or potentially unmeasurable adverse impact, long-lasting (1 year to many years), and may occur over a geographic range from census block level to large regional area. • Proper mitigation would reduce impacts somewhat during the life of the Proposed Action.	• An individual or group of animals would be subject to a human-caused stimulus, resulting in physical injury or mortality, and would include sufficient numbers that the continued viability of the population is diminished, including annual rates of recruitment or survival. Impacts would also include permanent disruption of behavioral patterns that would affect a species or stock. • Proper mitigation would reduce impacts somewhat during the life of the Proposed Action.

4.3 RESOURCES ELIMINATED FROM FURTHER CONSIDERATION

NEPA requires issues and resources that are impacted by the proposed action be the focus of the analysis. Because many of the activities described in this EA have been previously analyzed in the *Gulf of Mexico OCS Proposed Geological and Geophysical Activities: Western, Central, and Eastern Planning Areas; Final Programmatic Environmental Impact Statement* (BOEM 2017), the *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf: Final Environmental Impact Statement* (MMS 2007b), and other relevant environmental documents (**Chapter 2.2.6** and **Table G-1** of **Appendix G**), the potential for impacts is well documented. Analyses provided in these documents are incorporated by reference and address some of the resources and issues discussed in this EA in greater detail. Although not all of these previous documents specifically address the GOM Call Area, the same types of activities described in this EA are addressed in those documents. Additionally, activities within the Proposed Action of this EA do not include the installation of meteorological (met) towers. Although the results presented in many previous EAs had included met tower installation, this potential source of impact has been removed from recent, including the present, analysis and may account for a different (reduced) impact rating relative to some prior assessments. The evaluations and conclusions in those documents are consistent with BOEM's impact determinations in this EA.

In order to comply with the page limits given in Section 1501.5 of the CEQ implementing regulations, BOEM has focused the main body of this EA on the impacts for resources that reach a level of minor, moderate, or major. Resources that are expected to experience negligible or no impacts from the site assessment and site characterization activities have been scoped out of this EA. For detailed descriptions on why these resources are expected to have negligible or no impacts, refer to

Appendix F. However, the resources listed below could be within the scope of analysis for future actions (i.e., development of a wind lease area).

For the purpose of this EA, the following resources were not carried forward for detailed impact analysis:

- water quality;
- pelagic communities and habitats;
- birds;
- bats;
- land use and coastal infrastructure;
- commercial fisheries;
- recreational fishing;
- recreation;
- environmental justice; and
- demographics and employment.

4.4 RESOURCES ANALYZED IN DETAIL

The potential impacts to resources from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario, as well as accidental events and cumulative impacts associated with those activities under each alternative, are analyzed in the following chapters. The resources analyzed in the following sections within this chapter were determined to have potential impacts from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and/or under the high-end of the OCS wind energy lease issuance scenario.

Table 4.4-1 is a summary table that shows the range of potential impacts of site characterization and site assessment activities under each alternative for the resources analyzed in detail in this EA. For each resource, **Table 4.4-1** shows the range of impacts from all IPFs for a single OCS wind energy lease issuance (low end of the range) and 18 OCS wind energy lease issuances (high end of the range). Also, to put the incremental impacts of site assessment and site characterization activities into perspective of cumulative impacts occurring in the GOM, the range of the incremental contribution of impacts from all IPFs from site assessment and site characterization activities compared to the cumulative impacts for a single OCS wind energy lease issuance and 18 OCS wind energy lease issuances was included in **Table 4.4-1**. To help visualize the impacts shown in the table, the range of impacts from all IPFs for site assessment and site characterization activities would be represented by orange in **Figure 4.1-1** and the cumulative impacts would be represented by orange + green + yellow.

The IPFs affecting each resource from site assessment and site characterization activities are also identified in **Table 4.4-1**. The impacts of each individual IPF, along with the baseline and cumulative impacts, are discussed in detail in the tables and text for each resource analyzed in the sections below. In addition, for those resources that have the potential to have impacts mitigated by the application of SOCs or lease stipulations, the impacts of site assessment and site characterization activities are analyzed both with and without the application of these potential protective measures. As previously discussed, the protective measures chosen by the decision-maker will be outlined and committed to in the FONSI and described in detail in the Final Sale Notice.

Table 4.4-1. Summary Table for the Range of Impacts for a Single OCS Wind Energy Lease Issuance and for the 18 OCS Wind Energy Leases.

Magnitude of Potential Impact for Site Assessment and Site Characterization Activities					
Resource	IPFs Impacting Resource		Range of Incremental Impacts for Site Characterization and Site Assessment Activities for a Single OCS Wind Energy Lease and 18 OCS Wind Energy Leases		
			Alternative A (No Action)	Alternative B	Alternative C
Air Quality	• Air Emissions and Pollution		Range of Impacts from All IPFs		
			None	Negligible to Minor	Negligible to Minor
			Range of Incremental Contribution of Impacts from All IPFs Compared to Cumulative Impacts		
			None	Negligible to Minor	Negligible to Minor
Coastal Communities and Habitats	• Bottom Disturbance		Range of Impacts from All IPFs		
			None	Negligible to Minor	Negligible to Minor
			Range of Incremental Contribution of Impacts from All IPFs Compared to Cumulative Impacts		
			None	Negligible	Negligible
Benthic Communities and Habitats	• Bottom Disturbance		Range of Impacts from All IPFs		
		Without Protective Measures	None	Negligible to Minor	Negligible to Minor
		With Protective Measures	None	Negligible	Negligible
			Range of Incremental Contribution of Impacts from All IPFs Compared to Cumulative Impacts		
		Without Protective Measures	None	Negligible to Minor	Negligible to Minor

		With Protective Measures	None	Negligible	Negligible
Fish and Invertebrates	• Bottom Disturbance • Noise		Range of Impacts from All IPFs		
		Without Protective Measures	None	Negligible to Minor	Negligible to Minor
		With Protective Measures	None	Negligible	Negligible
			Range of Incremental Contribution of Impacts from all IPFs Compared to Cumulative Impacts		
		Without Protective Measures	None	Negligible to Minor	Negligible to Minor
		With Protective Measures	None	Negligible	Negligible
Marine Mammals	• Noise • Strikes and Collisions		Range of Impacts from all IPFs		
		Without Protective Measures	None	Moderate	Moderate
		With Protective Measures	None	Negligible to Minor	Negligible to Minor
			Range of Incremental Contribution of Impacts from all IPFs Compared to Cumulative Impacts		
		Without Protective Measures	None	Minor	Minor
		With Protective Measures	None	Negligible	Negligible
Sea Turtles	• Bottom Disturbance • Noise • Unintentional Releases to the Environment • Strikes and Collisions		Range of Impacts from all IPFs		
		Without Protective Measures	None	Negligible to Minor	Negligible to Minor
		With Protective Measures	None	Negligible	Negligible
			Range of Incremental Contribution of Impacts from all IPFs Compared to Cumulative Impacts		
		Without Protective Measures	None	Negligible	Negligible
		With Protective Measures	None	Negligible	Negligible

Cultural, Historic, and Archaeological Resources	• Bottom Disturbance		Range of Impacts from all IPFs		
		Without Protective Measures	None	Minor to Major	Minor to Major
		With Protective Measures	None	Negligible	Negligible
			Range of Incremental Contribution of Impacts from all IPFs Compared to Cumulative Impacts		
		Without Protective Measures	None	Minor to Major	Minor to Major
		With Protective Measures	None	Negligible	Negligible

4.4.1 Air Quality

4.4.1.1 Affected Environment Summary

Air quality is the degree to which the ambient air is free of pollution; it is assessed by measuring the pollutants in the air. To protect public health and welfare, the Clean Air Act (CAA) established National Ambient Air Quality Standards (NAAQS) for certain common and widespread pollutants. The six common "criteria" air pollutants are particle pollution (also known as particulate matter, $PM_{2.5}$ and PM_{10}); carbon monoxide (CO); nitrogen dioxide (NO_2); sulfur dioxide (SO_2); lead (Pb); and ozone (O_3). Since the primary NAAQS are designed to protect human health, BOEM focuses on the impact of these air pollutants to the states where there are permanent human populations. For more detail on air quality, refer to **Section D.2**, Air Quality, of **Appendix D**. The magnitude and severity of the potential effects from OCS-wind energy activities discussed herein could vary depending on numerous factors including, but not limited to, location, frequency, and duration of the activities; time of year; and/or the current condition of the air quality in the region, as well as meteorological conditions.

When monitored pollutant levels in an area of a state exceed the NAAQS for any pollutant, the area is classified as "nonattainment" for that pollutant. Since the Houston-Galveston-Brazoria area is in nonattainment status for the 8-hr O_3 NAAQS (USEPA 2020b), O_3 is analyzed in this chapter. Unlike other criteria air pollutants, ground-level (troposphere) O_3 is not directly emitted into the atmosphere. Ground-level O_3 is formed from photochemical reactions between NO_x (NO_2 + NO) and carbon containing air pollutants (volatile organic compounds [VOCs], CO, and methane [CH_4]) in the presence of sunlight and heat.

The air pollutants not analyzed in this chapter are as follows:

- criteria air pollutants—CO, Pb, NO_2 (NO_x includes NO_2), SO_2, PM_{10}, and $PM_{2.5}$;
- criteria precursor air pollutants—NH_3, VOCs, and NO_x;

- greenhouse gases—CO_2, CH_4, and N_2O; and
- select hazardous air pollutants

Air pollutants that appear to contribute less than 2 percent to the total emissions in the GOM based on past emission inventories were not analyzed. For more detail, refer to **Section D.2**, Air Quality, of **Appendix D** and **Tables E.2-1 and E.2-2** of **Appendix E**. Some of those air pollutants are monitored and well below the NAAQS, except for the St. Bernard Parish, Louisiana area. St. Bernard Parish in Louisiana is currently in nonattainment status for the 1-hr SO_2 NAAQS (USEPA 2020b). However, taking into consideration the Convention for Prevention of Marine Pollution (MARPOL) regulations on sulfur, the low number of calculated SO_2 emissions from site assessment and site characterization activities shown in **Table E.2-1** of **Appendix E**, and the 80.09-mi (129.8-km) distance from the Parish to the nearest point of the Call Area, the impacts of SO_2 at the St. Bernard Parish, Louisiana area from OCS wind energy activities would be negligible.

Class I Areas

In addition to the NAAQS, the CAA Amendments give special air quality and visibility protection to national parks and wilderness areas because air pollution can impact scenic resources. Each of these parks and wilderness areas are identified as Class 1 (highest air quality protection), Class 2 (moderate air quality protection), or Class 3 (least air quality protection) areas. For more detail on Class Areas, refer to **Section D.2**, Air Quality, of **Appendix D**. Moreover, under the CAA Amendments, the Federal Land Manager is responsible for the management of Class 1 parks and wilderness areas to protect the air quality-related values (AQRVs) (including visibility) of such lands and to consider adverse impacts on such values. The AQRVs include a visibility assessment, potential deposition (sulfur [S] and nitrogen [N]) effects, and potential O_3 effects on vegetation (USFS et al. 2010). The Call Area is about 60.15 mi (96.8 km) from the closest protected Class 1 area, Breton Wilderness Area in Louisiana. Class 1 areas are of concern; however, these areas were not analyzed in this chapter because of the low number of calculated emissions shown in **Table E.2-1** of **Appendix E** from site assessment and site characterization activities. Monitoring data has shown improvements at the Breton Wilderness Area. For more detail on Class 1 areas, refer to **Section D.2**, Air Quality, of **Appendix D**.

4.4.1.2 Impact Summary

The approach of this analysis is to focus on the potential IPFs from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases, as well as accidental events and cumulative impacts associated with those activities under each alternative. The potential effects of all IPFs described in **Appendix B** were analyzed, and the IPFs determined to directly impact this resource from site assessment and site characterization activities are discussed below. The potential magnitude for each of these IPFs is provided in **Table 4.4.1-1** to help the reader quickly identify the level of potential impacts for each IPF. In addition, to determine cumulative impacts of the proposed action, the sum of the proposed action plus baseline and future foreseeable activities in the GOM are shown in the table. In addition, for a single OCS wind energy lease issuance and for 18 OCS wind energy lease issuances, the range of the incremental contribution of impacts from all IPFs combined is shown as well as the range of incremental contribution of impacts from all IPFs combined compared to the cumulative impacts. The impact-level definitions are detailed in **Chapter 4.2**, and the analysis supporting these conclusions is discussed in detail in this chapter.

Table 4.4.1-1. Magnitude of Potential Impacts for Air Quality after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Magnitude of Potential Impact			
Impact Determinations for Baseline Conditions (Past + Present)			
Air Emissions and Pollution	Moderate		
Overall Baseline Impacts	Moderate		
Incremental Impact Determinations for Site Characterization and Site Assessment Activities			
	Alternative A (No Action)	Alternative B	Alternative C
Range of Impacts for Site Characterization and Site Assessment Activities for a Single OCS Wind Energy Lease and 18 OCS Wind Energy Leases for Each IPF			
Air Emissions and Pollution			
	None	Negligible to Minor	Negligible to Minor
Unintentional Releases to the Environment			
	None	Negligible to Minor	Negligible to Minor
Response Activities			
	None	Negligible to Minor	Negligible to Minor
Impacts for Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs			
	None	Negligible	Negligible
Incremental Contribution of Impacts from Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for all IPFs Compared to the Cumulative Impacts			
	None	Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for all IPFs			
	None	Minor	Minor
Incremental Contribution of Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs Compared to the Cumulative Impacts			
	None	Minor	Minor
Impact Determinations for Cumulative Activities (Baseline + Future + Site Characterization and Site Assessment Activities)			
Air Emissions and Pollution	Moderate		
Overall Cumulative Impacts	Moderate		

Note: Discharges and wastes, bottom disturbance, noise, coastal land use/modification, lighting and visual impacts, offshore habitat modification/space use, socioeconomic changes and drivers, and strikes and collisions were determined to have no or negligible impacts on air quality because of the small size and scope of the Proposed Action in comparison to the cumulative impacts or because the IPFs do not interact with air quality and therefore are not considered in further analysis in this EA.

4.4.1.3 Impact Analysis

4.4.1.3.1 Impact Determinations for the Baseline Environment and Ongoing and Future Activities Including Non-OCS Wind Energy Activities

As shown in **Table 4.4.1-2**, photochemical modeling for the GOM showed a maximum O_3 concentration of 0.0865 parts per million (ppm) for all existing sources. For more detail on the air quality modeling, refer to **Section D.2**, Air Quality, of **Appendix D**. Furthermore, the Houston-Galveston-Brazoria area is in nonattainment status for the 8-hr O_3 NAAQS (USEPA 2020b), and in calendar year 2021 monitoring data reported a O_3 maximum value of 0.077 ppm at Galveston monitoring site 1034 as a result of all existing non-OCS wind energy activities (USEPA 2020c). The effects of air emissions and pollution on air quality from non-OCS wind energy activities occurring in the baseline environment are **moderate** because the existing non-OCS wind energy activities are contributing to the exceedances in the 8-hr O_3 NAAQS determined by photochemical modeling and monitoring data. Because this is the only IPF affecting the baseline, the overall conclusion for baseline impacts is also **moderate**.

Table 4.4.1-2. Modeled and Monitored Values for O_3 in the Gulf of Mexico.

Criteria Air Pollutant	NAAQS	Maximum Concentration of the 4-km (2.5-mi) Domain – Base Case Year Results	2021 Maximum Monitored Value at Galveston Site 1034
8-hr O_3	0.070 ppm	86.5 ppb (0.0865 ppm)	0.077 ppm

ppb = parts per billion; ppm = parts per million.
Sources: **Table D.2** of **Appendix D** and USEPA (2020c).

4.4.1.3.2 Impact Determinations for Site Characterization and Site Assessment Activities Expected to Take Place after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario

Alternative A (No Action Alternative)

Under the No Action Alternative, BOEM would not issue any commercial or research OCS wind energy leases in the GOM Call Area, and there would be no effects on air quality attributable to the Proposed Action. Some site characterization surveys (e.g., biological surveys) and off-lease site assessment activities do not require BOEM approval and could still be conducted under Alternative A, but these activities would not be likely to occur without a commercial wind energy lease or grant. The incremental contribution of impacts from not issuing a single wind energy lease under Alternative A on air quality would be **none**. In addition, the overall high-end scenario impacts would be **none** because 18 OCS wind energy leases would not be issued in the Call Area. However, air quality in the GOM would continue to be exposed to ongoing and planned activities over the timeframe considered in this EA, such as non-OCS wind energy activities, including activities related to the OCS Oil and Gas Program and Marine Minerals Program.

Alternative B (Call Area)

Single OCS Wind Energy Lease Issuance

Table 4.4.1-3 shows a comparison between emissions amounts for precursor pollutants to O_3 from the single OCS wind energy lease and non-anthropogenic sources reported in the 2017 National Emission Inventory (USEPA 2020a). The effects of air emissions and pollution on air quality from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area are **negligible** because the calculated amounts for precursor pollutants to O_3 are very low and, when compared to non-anthropogenic sources, the emissions appear insignificant. Also, though 40 CFR § 93.153(b)(1) is not applicable, the potential to emit amounts for NO_x and VOC are below *de minimis* levels for O_3 nonattainment areas. Exceedances in *de minimis* levels could potentially impact NAAQS monitored at the States. The amounts are low so they pose no risk to changing existing O_3 NAAQS monitored levels.

Table 4.4.1-3. Comparison of Anthropogenic and Non-anthropogenic Emissions.

Precursor Pollutant to O_3	Highest Potential to Emit for a Single Lease (tons/year)*	Louisiana Biogenic Emissions from the 2017 National Emission Inventory (tons/year)
NO_x	22.77	21,761.75
VOC	0.65	1,111,618.98
CO	19.13	122,262.14

*From **Table E.2-1** of **Appendix E** and USEPA (2020a).

Air quality can be impacted from unintentional releases from fuel and crude oil spills that have the potential to emit air pollution (Middlebrook et al. 2012). These spills could contribute to air pollution potentially for a short duration until the event is resolved. Air pollutants associated with these events depend on the chemical composition of the product. The effects of unintentional releases to the environment on air quality from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** because of the infrequent and localized impacts of spills.

Response activities can impact air quality through emissions from the equipment used to operate vessels and aircraft. These sources of emissions would be mobile and not stationary. The effects of response activities on air quality from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** because of the infrequent and localized impacts of response activities.

The incremental contribution of impacts from all IPFs from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on air quality would be **negligible** because there would be very low amounts of emissions from precursor pollutants to O_3 and no risk to changing existing O_3 NAAQS monitored levels. The cumulative impacts of activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on air quality would be **moderate** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on air quality would be **negligible** because the calculated amounts for precursor pollutants to O_3 in **Table E.2-1** of **Appendix E** from these activities appear very low in comparison with amounts shown in **Tables B.1.2-2, B.1.2-3, and B.1.2-4** of **Appendix B** for existing baseline sources.

High-End OCS Wind Energy Lease Issuance Scenario

Table 4.4.1-4 shows a comparison between emissions amounts for precursor pollutants to O_3 from the high-end OCS wind energy lease issuance scenario and non-anthropogenic sources reported in the 2017 National Emission Inventory (USEPA 2020a). Although the calculated amounts for precursor pollutants to O_3 for the high-end OCS wind energy lease issuance scenario are higher than those calculated for a single OCS wind energy lease issuance, the effects of air emissions and pollution on air quality from the site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario are **minor** for Alternative B because the calculated amounts for precursor pollutants to O_3 are low and, when compared to non-anthropogenic sources, the emissions are minimal. Also, though 40 CFR § 93.153(b)(1) is not applicable, the potential to emit amounts for NO_x and VOC are below *de minimis* levels for O_3 nonattainment areas. Exceedances in *de minimis* levels could potentially impact NAAQS monitored at the States. The amounts are low so they pose little risk to changing existing O_3 NAAQS monitored levels.

Table 4.4.1-4. Comparison of Anthropogenic and Non-anthropogenic Emissions.

Precursor Pollutant to O_3	Highest Potential to Emit for High-End Lease (tons/year)*	Louisiana Biogenic Emissions from the 2017 National Emission Inventory (tons/year)
NO_x	225.22	21,761.75
VOC	6.48	1,111,618.98
CO	35.32	122,262.14

* From **Table E.2-2** of **Appendix E** and USEPA (2020a).

Air quality can be impacted from unintentional releases to the environment from fuel and crude oil spills that have the potential to emit air pollution (Middlebrook et al. 2012). These spills could contribute to air pollution potentially for a short duration until the event is resolved. Air pollutants associated with these events depend on the chemical composition of the product. The effects of unintentional releases to the environment on air quality from the site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario would be **minor** for Alternative B because there would be more risk to widespread impacts from spills in comparison to the potential for a spill with the issuance of a single OCS wind energy lease.

Response activities can impact air quality through emissions from the equipment used to operate vessels and aircraft. The effects of response activities on air quality from the site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario would be **minor** for Alternative B because there would be more risk to widespread impacts from response activities in comparison to the potential for response activities with the issuance of a single OCS wind energy lease.

The impacts from all IPFs for site assessment and site characterization activities from 18 OCS wind energy leases on air quality would be **minor** for Alternative B because there would be more risk to widespread impacts from precursor pollutants of O_3 caused by fuel and oil spills, and response activities from site assessment and site characterization activities from 18 OCS wind leases in comparison with the potential impacts from the activities associated with issuance of a single OCS wind energy lease. The cumulative impacts of activities expected to take place after issuance of 18 OCS wind energy leases under Alternative B on air quality would be **moderate** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, impacts for site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario are **minor** for Alternative B because the calculated amounts for precursor pollutants to O_3 shown in **Table E.2-2** of **Appendix E** are low in comparison with amounts shown in **Tables B.1.2-2, B.1.2-3, and B.1.2-4** of **Appendix B** for existing baseline sources of air emissions and pollution.

Alternative C (Call Area Excluding the Topographic Features Stipulation Blocks)

The impacts from Alternative C do not differ from Alternative B, which are discussed above. As with Alternative B, the incremental contribution of impacts for site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on air quality would be **negligible** because there would be very low amounts of emissions from precursor pollutants to O_3 and no risk to changing existing O_3 NAAQS monitored levels. The cumulative impacts of activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on air quality would be **moderate** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on air quality would be **negligible** because the calculated amounts for precursor pollutants to O_3 in **Table E.2-1** of **Appendix E** appear very low in comparison with amounts shown in **Tables B.1.2-2, B.1.2-3, and B.1.2-4** of **Appendix B** for existing baseline sources.

The overall high-end scenario impacts from OCS wind energy activities on air quality would be **minor** for Alternative C because there would be more risk to widespread impacts from precursor pollutants of O_3 caused by fuel and oil spills, and response activities in comparison with the potential impacts from the issuance of a single OCS wind energy lease. The cumulative impacts of activities expected to take place after issuance of 18 OCS wind energy leases under Alternative C on air quality would be **moderate** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, impacts for site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario are **minor** for Alternative C because the calculated amounts for precursor pollutants to O_3 shown in **Table E.2-2** of **Appendix E** appear low in comparison with amounts shown in **Tables B.1.2-2, B.1.2-3, and B.1.2-4** of **Appendix B** for existing baseline sources of air emissions and pollution.

4.4.2 Coastal Communities and Habitats

4.4.2.1 Affected Environment Summary

Coastal communities considered in this analysis include estuaries, wetlands, mangroves, submerged aquatic vegetation, beaches and barrier islands, and coastal coral reefs, extending no further than the State/Federal water boundary line of the Gulf of Mexico. These coastal and estuarine habitats provide critical nursery grounds and adult habitat for numerous species of fish and invertebrates, while seagrass beds provide foraging habitat for sea turtles and manatees. Most of the GOM coastal waters are designated as essential fish habitat. For more detail, refer to Chapter 3.2 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a).

4.4.2.2 Impact Summary

The approach of this analysis is to focus on the potential IPFs from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases, as well as accidental events and cumulative impacts associated with those activities under each alternative. The potential effects of all IPFs described in **Appendix B** were analyzed, and the IPFs determined to directly impact this resource from site assessment and site characterization activities are discussed below. The potential magnitude for each of these IPFs is provided in **Table 4.4.2-1** to help the reader quickly identify the level of potential impacts for each IPF. In addition, to determine cumulative impacts of the proposed action, the sum of the proposed action plus baseline and future foreseeable activities in the GOM are shown in the table. In addition, for a single OCS wind energy lease issuance and for 18 OCS wind energy lease issuances, the range of the incremental contribution of impacts from all IPFs combined is shown as well as the range of incremental contribution of impacts from all IPFs combined compared to the cumulative impacts. The impact-level definitions are detailed in **Chapter 4.2**, and the analysis supporting these conclusions is discussed in detail in this chapter.

Table 4.4.2-1. Magnitude of Potential Impacts on Coastal Communities and Habitats after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Magnitude of Potential Impact			
Impact Determinations for Baseline Condition (Past + Present)			
Bottom Disturbance	Moderate		
Overall Baseline Impacts	Moderate to Major		
Incremental Impact Determinations for Site Characterization and Site Assessment Activities			
	Alternative A (No Action)	Alternative B	Alternative C
Range of Impacts for Site Characterization and Site Assessment Activities for a Single OCS Wind Energy Lease and 18 OCS Wind Energy Leases for Each IPF			
Bottom Disturbance			
	None	Negligible to Minor	Negligible to Minor
Impacts for Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs			
	None	Negligible	Negligible
Incremental Contribution of Impacts from Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs Compared to the Cumulative Impacts			
	None	Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs			
	None	Negligible to Minor	Negligible to Minor
Incremental Contribution of Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs Compared to the Cumulative Impacts			
	None	Negligible	Negligible
Impact Determinations for Cumulative Activities (Baseline + Future + Site Characterization and Site Assessment Activities)			
Bottom Disturbance	Moderate		
Overall Cumulative Impacts	Moderate to Major		

Note: Air emissions and pollution, discharges and wastes, noise, coastal land use/modification, lighting and visual impacts, offshore habitat modification/space use, socioeconomic changes and drivers, unintended releases to the environment, response activities, and strikes and collisions were determined to have no or negligible impacts on coastal communities and habitats because of the small size and scope of the Proposed Action in comparison to the cumulative impacts or because the IPFs do not interact with coastal communities and habitats and, therefore, are not considered in further analysis in this EA.

4.4.2.3 Impact Analysis

4.4.2.3.1 Impact Determinations for the Baseline Environment and Ongoing and Future Activities Including Non-OCS Wind Energy Activities

Coastal communities and habitats are affected by bottom disturbance. Dredging of coastal waterways and ports is used to support ship traffic and increasingly larger vessels (Merk 2015), including those used to accommodate the transport of large OCS oil- and gas-related platforms or other structures or vessels. Dredging may lead to increased erosion rates, removal of sediments, increased turbidity, land loss, changes in salinity, and removal and burial of vegetation (Boesch et al. 1994; Erftemeijer and Lewis III 2006; Onuf 1996; Wilber and Clarke 2001). Pipelines associated with both State and OCS oil- and gas-related activity have also been shown to affect coastal communities and habitats. Many OCS oil- and gas-related pipelines make landfall on barrier island and wetland shorelines, leading to land loss (Baumann and Turner 1990; Johnston et al. 2009; Ko and Day 2004). Additionally, vessel anchoring and emplacement of pipelines in State waters can affect coastal communities and habitats by crushing or smothering organisms. The effects of bottom disturbance on coastal communities and habitats from non-OCS wind energy activities occurring in the baseline environment are **moderate** due to their potential impact on the extent and quality of local available habitat. Regulatory review of permitted activities, such as dredging and pipeline installation, by BOEM, the U.S. Army Corps of Engineers, and the Gulf Coast States can help reduce impacts from any permitted activities, but other forms of bottom disturbance are not regulated or mitigated.

Other baseline environmental impacts from natural and anthropogenic stressors, including sea-level rise, coastal development, and disturbance are known to affect coastal communities and habitats. Descriptions of these other impacts can be found in Chapter 4.2 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a). The overall baseline environmental impacts from non-OCS wind energy activities on coastal communities and habitats, including these natural and anthropogenic stressors, are **moderate to major** because of the range of impacts these stressors can have on coastal communities and habitats in the GOM.

4.4.2.3.2 Impact Determinations for Site Characterization and Site Assessment Activities Expected to Take Place after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario

Alternative A (No Action Alternative)

Under the No Action Alternative, BOEM would not issue any commercial or research OCS wind energy leases in the GOM Call Area, and there would be no effects on coastal communities and habitats attributable to the Proposed Action. Some site characterization surveys (e.g., biological surveys) and off-lease site assessment activities do not require BOEM approval and could still be conducted under Alternative A, but these activities would not be likely to occur without a commercial wind energy lease or grant. The incremental contribution of impacts from not issuing a single wind energy lease under Alternative A on coastal communities and habitats would be **none**. In addition, the overall high-end scenario impacts would be **none** because 18 OCS wind energy leases would not be issued in the Call Area. However, coastal communities and habitats in the GOM would continue to be exposed to ongoing and planned activities over the timeframe considered in this EA, such as non-OCS wind energy activities, including activities related to the OCS Oil and Gas Program and Marine Minerals Program.

Alternative B (Call Area)

Single OCS Wind Energy Lease Issuance

Bottom disturbance associated with geotechnical/sub-bottom sampling, biological surveys, and anchor emplacement and mooring could affect coastal communities and habitats along proposed export cable corridors. These activities could result in physical crushing or smothering of submerged aquatic vegetation (SAV) and other submerged coastal habitat. Physical disturbances along the seafloor are often accompanied by sediment resuspension, which can temporarily increase water turbidity and decrease the amount of light available for photosynthesis in shallow waters (refer to Chapter 4.4.3.2 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* [BOEM 2021a]). Despite these activities, the effects of bottom disturbance on coastal communities and habitats from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease issuance in the Call Area would be **negligible** due to the relatively small scope and scale of the activity expected to occur.

BOEM encourages early coordination prior to the submission of a SAP to discuss pre-survey planning and to ensure that all surveys are conducted in a manner that addresses the regulatory information requirements for a SAP (https://www.boem.gov/sites/default/files/renewable-energy-program/BOEM-Renewable-SAP-Guidelines.pdf). Pre-survey coordination also provides an opportunity for BOEM and the lessee to discuss common goals and expectations, agree upon the technical aspects and key parameters for the surveys, and advise of the authorizations or permits from other resource agencies that are necessary before a lessee contracts and mobilizes an offshore survey. If required, State regulatory review of these activities may require that bottom-disturbing activity be distanced from or avoid live bottoms and SAV, which can help reduce impacts to these sensitive areas from site characterization surveys.

The incremental contribution of impacts from all IPFs from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on coastal communities and habitats would be **negligible** because of the relatively small scope and scale of activity expected to occur. In addition, if required, State regulatory review of these activities may require that bottom-disturbing activity be distanced from or avoid live bottoms and SAV, which can help reduce impacts to these sensitive areas from site characterization surveys. The cumulative impacts of activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on coastal communities and habitats would be **moderate to major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on coastal communities and habitats would be **negligible** because of the relatively small scale of the proposed activities following a single lease issuance when compared to existing OCS oil- and gas-related activities and other OCS and non-OCS activities occurring in the baseline environment and expected to occur in the future.

High-End OCS Wind Energy Lease Issuance Scenario

Under the high-end OCS wind energy lease issuance scenario, up to 18 OCS wind energy leases could be issued, resulting in a proportional increase in site characterization and site assessment activities when compared with a single OCS lease issuance analyzed under Alternative B. The potential impacts from bottom disturbance are the same for the high-end OCS wind energy lease issuance scenario as for a single OCS wind energy lease issuance under Alternative B; however, the temporal and spatial extent and amount of potential impacts is also proportionally greater. The overall high-end scenario impacts from OCS wind energy activities under Alternative B on coastal communities and habitats would be **negligible** to **minor** due to the estimated number of samples to be collected under the high-end lease issuance scenario, which would result in localized impacts from which the habitat would be expected to completely recover without remedial or mitigating action. In addition, if required, State regulatory review of these activities may require that bottom-disturbing activity be distanced from or avoid live bottoms and SAV, which can help reduce impacts to these sensitive areas from site characterization surveys. The cumulative impacts of activities expected to take place after issuance of a 18 OCS wind energy leases under Alternative B on coastal communities and habitats would be **moderate to major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, impacts from site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario under Alternative B would be **negligible** because of the relatively small scope and scale of the proposed activities expected to occur under this scenario when compared to existing OCS oil- and gas-related activities and other OCS and non-OCS activities occurring in the baseline environment and expected to occur in the future.

Alternative C (Call Area Excluding the Topographic Features Stipulation Blocks)

Impacts on coastal communities and habitats under Alternative C are expected to be the same as those under Alternative B, which are discussed above, because the exclusions do not spatially overlap with coastal communities and habitats considered for this assessment. The incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on coastal communities and habitats would be **negligible** because of the relatively small scope and scale of activity expected to occur. In addition, if required, State regulatory review of these activities may require that bottom-disturbing activity be distanced from or avoid live bottoms and SAV, which can help reduce impacts to these sensitive areas from site characterization surveys. Under the high-end OCS wind energy lease issuance scenario, the spatial extent of potential impacts to coastal communities and habitats would be proportionally greater, but the overall impacts from site assessment and site characterization activities would be **negligible** to **minor** due to the estimated number of samples to be collected, localized impacts to coastal communities and habitats, and complete recovery. The cumulative impacts of activities expected to take place after issuance of a single and 18 OCS wind energy leases under Alternative C on coastal communities and habitats would be **moderate** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and issuance of 18 OCS wind energy leases under Alternative C on coastal communities and habitats would be **negligible** because of the relatively small scope and scale of the proposed activities following a single lease issuance and issuance of 18 OCS wind energy leases when compared to existing OCS oil- and gas- related activities and other OCS and non-OCS activities occurring in the baseline environment and expected to occur in the future.

4.4.3 Benthic Communities and Habitats

4.4.3.1 Affected Environment Summary

Documented benthic ecosystems in the Gulf of Mexico include muddy soft bottom; oyster reefs; coral and sponge dominant banks (e.g., the Flower Garden Banks); hydrocarbon seeps along the continental margin; and marine canyons, escarpments, and seamounts on the abyssal plain (Briones 2004). Connectivity with areas adjacent to and within the GOM depends on pelagic larval transport by surface currents. Most GOM hard bottom benthic communities are diverse and characterized by high species richness and low abundance, while soft-bottom communities are characterized by low species richness and high abundance. Suspension feeders are generally most abundant in high-energy environments, and deposit feeders are most abundant in low-energy environments in areas with fine-grained, muddy sediments (Snelgrove 1999). For more detail, refer to Chapter 3.4 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a). The analysis for this EA will focus on the hard bottom communities in the GOM.

4.4.3.2 Impact Summary

The approach of this analysis is to focus on the potential IPFs from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases, as well as accidental events and cumulative impacts associated with those activities under each alternative. The potential effects of all IPFs described in **Appendix B** were analyzed, and the IPFs determined to directly impact this resource from site assessment and site characterization activities are discussed below. The potential magnitude for each of these IPFs is provided in **Table 4.4.3-1** to help the reader quickly identify the level of potential impacts for each IPF. In addition, to determine cumulative impacts of the proposed action, the sum of the proposed action plus baseline and future foreseeable activities in the GOM are shown in the table. In addition, for a single OCS wind energy lease issuance and for 18 OCS wind energy lease issuances, the range of the incremental contribution of impacts from all IPFs combined is shown as well as the range of incremental contribution of impacts from all IPFs combined compared to the cumulative impacts. The impact-level definitions are detailed in **Chapter 4.2**, and the analysis supporting these conclusions is discussed in detail in this chapter.

Table 4.4.3-1. Magnitude of Potential Impacts on Benthic Communities and Habitats after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Magnitude of Potential Impact			
Impact Determinations for Baseline Conditions (Past + Present)			
Bottom Disturbance	Negligible to Major		
Overall Baseline Impacts	Negligible to Major		
Incremental Impact Determinations for Site Characterization and Site Assessment Activities			
	Alternative A (No Action)	Alternative B	Alternative C
Range of Impacts for Site Characterization and Site Assessment Activities for a Single OCS Wind Energy Lease and 18 OCS Wind Energy Leases for Each IPF			
Bottom Disturbance			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures		Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures		Negligible	Negligible
Incremental Contribution of Impacts from Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs Compared to the Cumulative Impacts			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures		Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures		Negligible	Negligible
Incremental Contribution of Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs Compared to the Cumulative Impacts			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures		Negligible	Negligible

Magnitude of Potential Impact	
Impact Determinations for Cumulative Activities (Baseline + Future + Site Characterization and Site Assessment Activities)	
Bottom Disturbance	Negligible to Major
Overall Cumulative Impacts	Negligible to Major

Note: Air emissions and pollution, discharges and wastes, noise, coastal land use/modification, lighting and visual impacts, offshore habitat modification/space use, socioeconomic changes and drivers, unintended releases to the environment, response activities, and strikes and collisions were determined to have no or negligible impacts on benthic communities and habitats because of the small size and scope of the Proposed Action in comparison to the cumulative impacts or because the IPF does not interact with benthic communities and habitats and therefore are not considered in further analysis in this EA.

4.4.3.3 Impact Analysis

4.4.3.3.1 Impact Determinations for the Baseline Environment and Ongoing and Future Activities Including Non-OCS Wind Energy Activities

Bottom Disturbance

Regular or chronic anthropogenic activities impact and influence the formation, composition, and persistence of benthic habitats and communities. Bottom-disturbing activities in the Gulf of Mexico region that can alter the natural formation of benthic communities include oil and gas infrastructure installation and use, bottom fishing (i.e., trawling), artificial reef installation, and dredging. For an in-depth analysis on the potential for bottom fishing (trawling) to impact benthic communities and habitats, refer to **Chapter 4.4.4**, Fish and Invertebrates. The other bottom-disturbing activities in the baseline environment that impact benthic communities and habitats are discussed below.

The physical disturbance of the seafloor may result in the destruction of sessile benthic organisms and hard bottom and/or chemosynthetic habitat and soft sediment turbation. Impacts that cause bottom disturbance may be temporary (e.g., anchoring) or more persistent within the environment (e.g., platform or pipeline installation). Potential effects from bottom disturbance may include crushing of hard substrates and structure-forming organisms including corals and sponges, burial of organisms, and scarring of the seafloor. The spatial extent of the seafloor disturbance would depend on the specific activity, local environmental conditions, and physical regime (e.g., water depth, bottom currents, light penetration, etc.) and local habitat and community composition, extent, and health. It is generally assumed that benthic communities associated with unconsolidated soft sediments will recover more quickly than those associated with hard bottom habitat (Dernie et al. 2003).

The type of hard bottom habitat (i.e., topographic features, pinnacles, low-relief features, cold seeps, brine pools, etc.), individual feature size and surface area, distance between features, community structure, species richness, and organism density, among other attributes coupled with the spatial scale and temporal duration of the bottom disturbance, influences the degree of impact and the ability of the local community to recover from the impact. Anthropogenic bottom disturbance is often sufficient to cause loss of species diversity within benthic communities, particularly in the deep sea (summarized in Jones et al. 2006).

Regardless of duration, bottom disturbance causes at a minimum localized, temporary resuspension of sediment (Morgan et al. 2006) and increased turbidity. Some mobile invertebrates may be able to move to avoid the heaviest sediment displacement and highest suspended sediment loads, while sessile invertebrates (e.g., corals and sponges) cannot. In shallow water, sediment particles can reduce light available for photosynthesis. For corals, heavy chronic sedimentation is associated with fewer species, less live coral, lower growth rates, greater abundance of branching forms, reduced recruitment, decreased calcification, decreased net productivity, and slower rates of reef accretion (Rogers 1990). Sedimentation damage to reefs can have cascading effects on reef-associated species (Rogers 1990).

Increased turbidity can reduce feeding efficiency and clogging of filter feeder structures and decrease the success of larval settlement (summarized in Lissner et al. 1991). The impact to filter feeders from bottom disturbance and sediment suspension may result in preferential recolonization by epibenthic deposit feeders, resulting in an overall change of species composition (Jones et al. 2006). Sessile and mobile invertebrate species adapted to living in turbid environments, such as several tall and flexible gorgonian species, may be less affected by increased turbidity. Reduction in available geological or biogenic substrate may also have secondary ecological effects on organisms that use complex structural microhabitats to, for example, lay eggs (Etnoyer and Warrenchuk 2007; Shea et al. 2018).

The effects of bottom disturbance and the overall baseline environmental impacts from non-OCS wind energy activities on benthic communities and habitats are **negligible** to **major** due to the extensive damages that could occur to sensitive benthic habitats, including structure-forming invertebrates. With the application of protective measures, such as those currently in place for OCS oil- and gas-related activities (i.e., avoidance and distancing requirements for bottom-disturbing activities), the impacts to benthic habitats and communities would be reduced to **negligible** to **minor** because of the potential for bottom disturbance to cause localized, adverse impacts to the resource. An additional stressor on the baseline environment is the presence, removal, and/or conversion of artificial hard substrate colonized by sessile invertebrates, which would be likely to result in localized community changes, such as changes in species diversity in the local area (Schroeder and Love 2004). For a detailed analysis of benthic communities and habitat vulnerability to offshore habitat and modification/space use, refer to Chapter 4.4.5.2 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a). However, because the presence of buoys and associated chains and anchors associated with site assessment and site characterization activities is expected to be temporary and create minimal artificial hard substrate that could function as hard bottom habitat for sessile benthic organisms, any potential impacts from offshore habitat and modification are expected to be negligible; therefore, this IPF is not carried forward in the analysis of alternatives. Considering this additional environmental stressor, the overall impacts from non-OCS wind energy activities to the baseline environment would be **negligible** to **major**.

4.4.3.3.2 Impact Determinations for Site Characterization and Site Assessment Activities Expected to Take Place after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario

Alternative A (No Action Alternative)

Under the No Action Alternative, BOEM would not issue any commercial or research OCS wind energy leases in the GOM Call Area, and there would be no effects on benthic communities and habitats attributable to the Proposed Action. Some site characterization surveys (e.g., biological surveys) and off-lease site assessment activities do not require BOEM approval and could still be conducted under Alternative A, but these activities would not be likely to occur without a commercial wind energy lease or grant. The incremental contribution of not issuing a single wind energy lease under Alternative A on benthic communities and habitats would be **none**. In addition, the overall high-end scenario impacts would be **none** because 18 OCS wind energy leases would not be issued in the Call Area. However, benthic communities and habitats in the GOM would continue to be exposed to ongoing and planned activities over the timeframe considered in this EA, such as non-OCS wind energy activities, including activities related to the OCS Oil and Gas Program and Marine Minerals Program.

Alternative B (Call Area)

Single OCS Wind Energy Lease Issuance

Under Alternative B, whole or partial lease blocks containing the Flower Garden Banks National Marine Sanctuary would be excluded from potential leasing and, therefore, would not be subject to site characterization and site assessment activities. However, potentially sensitive hard bottom benthic features and communities outside of the Flower Garden Banks National Marine Sanctuary could potentially be impacted by such activities, which are discussed below.

Site characterization and site assessment activities expected to take place after the issuance of a single OCS wind energy lease within the Call Area include geotechnical/sub-bottom sampling, biological surveys, and the installation and decommissioning of meteorological buoys. These activities can result in bottom disturbances that may adversely impact benthic habitat and communities within the Call Area.

Geotechnical surveys occurring in soft bottom habitats may involve the use of vibracores, piston or gravity cores, deep borings, cone penetrometers, and other forms of bottom-sampling gear, and benthic habitat surveys would involve the use of benthic grabs (e.g., standard Van Veen) and SPI/PV imagery. Sensitive, habitat-forming organisms, such as corals, occupying hard bottom habitats could suffer sublethal to lethal injury if they come into direct contact with the sampling gear. The forthcoming Essential Fish Habitat Assessment to support the ongoing essential fish habitat consultation with the National Marine Fisheries Service for site assessment and site characterization in the Gulf of Mexico contains a detailed description of the geotechnical and biological survey equipment, methodology, and expected footprint of soft-bottom disturbance.

Bottom long-line or vertical line/bandit reel gear (if used for fish surveys) could also damage sensitive, habitat-forming organisms from entanglement or crushing. However, hard bottom features would be largely avoided during such surveys (i.e., bottom trawls, bottom longline gear, and traps) to avoid gear loss/entanglements. If vertical line/bandit gear surveys are conducted (typically over hard bottom habitats), the mainlines and weights would not be intended to contact the bottom, rather, they would be hovered over hard bottom habitat. Any bottom disturbances resulting from the use of vertical line/bandit reel gear would be accidental and are not anticipated to occur.

Installation and decommissioning of meteorological buoys have the potential to disturb the benthic environment. If the anchor and/or anchor chain were to contact hard bottom benthic habitat and associated communities, it could result in crushing or burial of sensitive, habitat-forming invertebrates, like corals, which are known to have slow growth and recovery rates. However, it is expected that meteorological buoys would be installed in soft bottom sediment.

For the reasons discussed above, the incremental contribution of bottom disturbance on benthic communities and habitat from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area under Alternative B would be **negligible** to **minor** because bottom-disturbing activities could result in crushing or burial of sensitive, habitat-forming invertebrates, like corals, which are known to have slow growth and recovery rates. Under this alternative, hard bottom benthic habitat could potentially experience measurable but localized adverse impacts from site characterization and site assessment-related, bottom-disturbing activities. With protective measures applied that distance bottom-disturbing activities from sensitive benthic habitat, site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on benthic communities and habitats is expected to be **negligible**.

The cumulative impacts of activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on benthic communities and habitats would be **negligible** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, site characterization and site assessment activities under Alternative B are expected to have **negligible** to **minor** impacts to benthic communities and habitats as the footprint of potential bottom-disturbing impacts from site characterization and site assessment activities compared with all other similar cumulative impacts within the Call Area is relatively small. If protections are put into place to distance these activities from hard bottom habitats, the impacts of site assessment and site characterization activities compared to the cumulative impacts would be **negligible**.

High-End OCS Wind Energy Lease Issuance Scenario

Under the high-end OCS wind energy lease issuance scenario, up to 18 leases could be issued resulting in a proportional increase in site characterization and site assessment activities when compared with a single lease issuance analyzed under Alternative B. The analysis of potential impacts from bottom disturbance is the same for the high-end OCS wind energy lease issuance scenario as for a single lease issuance under Alternative B (**negligible** to **minor**); however, the spatial extent of potential impacts is proportionally greater. It is expected that site characterization and site assessment activities that result in bottom disturbance would largely avoid areas of the seafloor with identified benthic communities and habitat. If protections are put into place to distance these activities from hard bottom habitats, impacts under Alternative B compared to the baseline would be **negligible**.

The cumulative impacts of activities expected to take place after issuance of 18 OCS wind energy leases under Alternative B on benthic communities and habitats would be **negligible** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, site characterization and site assessment activities under the high-end OCS wind energy lease issuance scenario for Alternative B would have **negligible** to **minor** impacts to benthic habitats and communities as the footprint of potential bottom-disturbing impacts from site characterization and site assessment activities compared with all other similar cumulative impacts within the Call Area is relatively small. If protections are put into place to distance bottom-disturbing activities from hard bottom habitats, the impacts of site characterization and site assessment activities compared to the cumulative impacts would be **negligible**.

Alternative C (Call Area Excluding the Topographic Features Stipulation Blocks)

Under Alternative C, whole or partial lease blocks subject to the Topographic Features stipulation and blocks containing the Flower Garden Banks National Marine Sanctuary would be excluded from potential leasing and, therefore, would not be subject to site characterization and site assessment activities. However, potentially sensitive hard bottom benthic features and communities not subject to topographic features stipulations could potentially be impacted by such activities, the analysis of which is the same as in Alternative B. As with Alternative B, the incremental contribution of site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on benthic communities and habitats is expected to be **negligible** to **minor** because under this alternative, hard bottom benthic habitat could potentially experience measurable but localized adverse impacts from site characterization and site assessment-related, bottom-disturbing activities. Under the high-end OCS wind energy lease issuance scenario, the spatial extent of potential impacts to benthic communities and habitats would be proportionally greater, but the overall impacts from site assessment and site characterization activities would still be **negligible** to **minor**. With protective measures applied, which would distance bottom-disturbing activity from sensitive benthic habitat, site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on benthic communities and habitats is expected to be **negligible** for both a single OCS wind energy lease issuance and for the issuance of 18 OCS wind energy leases.

The cumulative impacts of activities expected to take place after issuance of a single and 18 OCS wind energy leases under Alternative C on benthic communities and habitats would be **negligible** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, site characterization and site assessment activities under Alternative C for both a single OCS wind energy lease issuance and for the issuance of 18 OCS wind energy leases would have **negligible** to **minor** impacts to benthic communities and habitats, as the footprint of potential bottom-disturbing impacts from site characterization and site assessment activities compared with all other similar cumulative impacts within the Call Area is relatively small. If protections are put into place to distance bottom-disturbing activities from hard bottom habitats, the impacts from site characterization and site assessment activities compared to the cumulative impacts would be **negligible** for both a single OCS wind energy lease issuance and for the issuance of 18 OCS wind energy leases.

4.4.4 Fish and Invertebrates

4.4.4.1 Affected Environment Summary

The GOM has a taxonomically and ecologically diverse assemblage of fish and invertebrates due to its unique geologic, oceanographic, and hydrographic features. Felder and Camp (2009) reported that the GOM has a total of 1,541 fish species in 736 genera, 237 families, and 45 orders. Fifty-one of these species are sharks and 42 are comprised of rays and skates (Ward and Tunnell Jr. 2017). The GOM invertebrate assemblages are represented by over 13,000 species in 46 phyla (Felder and Camp 2009) and include recreationally and commercially valuable shellfish such as eastern oyster, blue crab, penaeid shrimp, spiny lobster, and stone crab. Additionally, the number of described species for both GOM fish and invertebrates continues to increase over time due to ongoing exploration of deep-sea ecosystems. For more detail refer to Chapter 3.5 of BOEM's *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a).

4.4.4.2 Impact Summary

The approach of this analysis is to focus on the potential IPFs from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases, as well as accidental events and cumulative impacts associated with those activities under each alternative. The potential effects of all IPFs described in **Appendix B** were analyzed, and the IPFs determined to directly impact this resource from site assessment and site characterization activities are discussed below. The potential magnitude for each of these IPFs is provided in **Table 4.4.4-1** to help the reader quickly identify the level of potential impacts for each IPF. In addition, to determine cumulative impacts of the proposed action, the sum of the proposed action plus baseline and future foreseeable activities in the GOM are shown in the table. In addition, for a single OCS wind energy lease issuance and for 18 OCS wind energy lease issuances, the range of the incremental contribution of impacts from all IPFs combined is shown as well as the range of incremental contribution of impacts from all IPFs combined compared to the cumulative impacts. The impact-level definitions are detailed in **Chapter 4.2**, and the analysis supporting these conclusions is discussed in detail in this chapter.

Table 4.4.4-1. Magnitude of Potential Impacts on Fish and Invertebrates of the OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Magnitude of Potential Impact			
Impact Determinations for Baseline Conditions (Past + Present)			
Bottom Disturbance	Moderate		
Noise	Minor		
Overall Baseline Impacts	Moderate to Major		
Incremental Impact Determinations for Site Characterization and Site Assessment Activities			
	Alternative A (No Action)	Alternative B	Alternative C
Range of Incremental Impacts for Site Characterization and Site Assessment Activities for a Single OCS Wind Energy Lease and 18 OCS Wind Energy Leases for Each IPF			
Bottom Disturbance			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible
Noise			
	None	Negligible to Minor	Negligible to Minor
Impacts for Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible
Incremental Contribution of Impacts from Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs Compared to the Cumulative Impacts			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible
Incremental Contribution of Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs Compared to the Cumulative Impacts			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible

Magnitude of Potential Impact	
Impact Determinations for Cumulative Activities (Baseline + Future + Site Characterization and Site Assessment Activities)	
Bottom Disturbance	Moderate
Noise	Minor
Overall Cumulative Impacts	Moderate to Major

Note: Air emissions and pollution, discharges and wastes, coastal land use/modification, lighting and visual impacts, offshore habitat modification/space use, socioeconomic changes and drivers, unintended releases to the environment, response activities, and strikes and collisions were determined to have no or negligible impacts on fish and invertebrates because of the small size and scope of the Proposed Action in comparison to the cumulative impacts or because the IPF does not interact with fish and invertebrates and, therefore, are not considered in further analysis in this EA.

4.4.4.3 Impact Analysis

4.4.4.3.1 Impact Determinations for the Baseline Environment and Ongoing and Future Activities Including Non-OCS Wind Energy Activities

Bottom Disturbance

Bottom-disturbing activities occurring in the Call Area that are not related to non-OCS wind energy activities include commercial fishing (i.e., bottom trawling for shrimp and oyster dredging), sand mining, sediment dredging and disposal, and OCS oil- and gas-related activities. While the long-term, cumulative impacts of bottom trawling (commercial shrimp fishery) and oyster dredging gear to fish and invertebrates in the GOM are unclear, both cause bottom disturbance and damage to benthic habitats, and they can alter the structure and composition of benthic and epibenthic communities (e.g., fish and invertebrate communities) (Watling and Norse 1998). In soft-sediment habitats, infauna (e.g., annelid and echiuran worms, bivalve mollusks, and amphipod crustaceans) and epifauna (e.g., shrimps, crabs, and some fishes), as well as their burrows and tubes, can be displaced, injured, damaged, and/or buried (Sparks-McConkey and Watling 2001; Watling and Norse 1998). However, it is generally assumed that benthic communities associated with unconsolidated soft sediments would recover more quickly than those associated with hard bottom habitat (Dernie et al. 2003). Trawling also occurs over more structurally complex habitats than soft bottoms, such as low-relief shell-rubble, which are most susceptible to the adverse impacts by bottom trawling (Auster 1998). Bottom trawling also directly affects many species of fish and invertebrates via bycatch mortality (Wells et al. 2008).

While sensitive, hard bottom habitats within the Flower Garden Banks National Marine Sanctuary (FGBNMS) are protected from bottom fishing activities and Coral Habitats of Particular Concern, which are designated by NOAA Fisheries and the Gulf of Mexico Fisheries Management Council on the other Topographic Features, are protected against bottom fishing and anchoring, not all hard bottom habitats in the Call Area are protected from the damaging impacts of bottom trawling. There are scattered hard bottom habitats throughout the Call Area, referred to by BOEM as potentially sensitive biological features (PSBFs), that are encrusted with slow-growing corals. Hard bottom habitats, such as PSBFs, are relied upon by species of fish and invertebrates, and bottom trawling activities occurring directly adjacent to or over these habitats can cause crushing, burial, stress, and mortality to structure forming invertebrates, resulting in overall habitat degradation and indirect impacts to fish and invertebrates relying on these habitats. Recovery of trawled, deepwater hard bottom habitats and associated sessile invertebrates (i.e., deepwater corals) can take months to several decades to recover, if at all, depending on the intensity and frequency of disturbances (Hutchings 2000).

Temporary disturbance of sediments and related increases in turbidity and sedimentation of sessile organisms from bottom trawling, non-OCS wind energy activities (e.g., sediment dredging and disposal), and BOEM-authorized OCS oil- and gas-related activities (e.g., anchoring, drilling, trenching, jetting, pipelaying, dredging, and structure emplacement) can cause a variety of detrimental or beneficial species-specific effects in fish and invertebrates. For analyses of potential impacts resulting from the aforementioned activities, refer to Chapters 4.5.2 and 4.5.3 of BOEM's *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a).

The effects of bottom disturbance to fish and invertebrates from non-OCS wind energy activities occurring in the baseline environment are **moderate** because they result in notable and measurable localized adverse impacts to fish and invertebrates, which is mostly attributable to bottom disturbances and associated mortalities (e.g., bycatch) caused by commercial fishing activities. Mitigations used in the oil and gas industry, such as lease stipulations, conditions of approval, and distance guidance in Notices to Lessees and Operators used to protect sensitive, hard bottom habitats and associated fish and invertebrate communities, avoid or reduce bottom-disturbing impacts from BOEM-authorized activities.

Noise

Underwater noise is introduced into GOM waters through a variety of non-OCS wind energy activities, including recreational boating activities, commercial fishing vessels, cruise ships, cargo vessels, military activities, dredging operations, and in-water construction, which may synergistically interact to affect fish and invertebrates. These sounds can be non-impulsive (e.g., vessel engines and propellors) or impulsive (e.g., pile-driving and airguns) and cumulatively add anthropogenic inputs to the natural underwater soundscape. Effects can range from lethal or recoverable damage to sensitive hearing structures, masking of biologically important signals, temporary or permanent hearing loss, and stimulated behavioral responses (Popper et al. 2014; Popper et al. 2019). The effects of underwater noise on fish and invertebrates from non-OCS wind energy activities occurring in the baseline environment would be **minor** because they result in small, measurable, and localized adverse impacts. Refer to Chapter 4.5.1. of BOEM's *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a) for a detailed analysis of the potential impacts of underwater noise to fish and invertebrates.

The overall baseline environment impacts from non-OCS wind energy activities (those activities that result in bottom disturbance and underwater noise) to fish and invertebrates would be **minor** to **moderate** because they may result in small or notable and measurable localized adverse impacts to fish and invertebrate communities present in the Call Area. Additional stressors in the baseline environment, such as climate change-related effects (e.g., ocean acidification, warming oceans, increased storm activity, sea-level rise and wetland loss) and the formation of large, seasonal hypoxic zones further degrade coastal habitats (e.g., seagrass beds and oyster reefs) and structure forming organisms on hard bottom habitats (e.g., corals and sponges) in the Call Area that can result in significant, indirect impacts to fish and invertebrates. For more information, refer to Chapter 2 of BOEM's *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a). Considering these additional environmental stressors, which can result in notable and measurable local to regional adverse impacts to fish and invertebrate communities, the overall impacts from non-OCS wind energy activities to the baseline environment would be **moderate** to **major**.

4.4.4.3.2 Impact Determinations for Site Characterization and Site Assessment Activities Expected to Take Place after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario

Alternative A (No Action Alternative)

Under the No Action Alternative, BOEM would not issue any commercial or research OCS wind energy leases in the GOM Call Area, and there would be no effects on fish and invertebrates attributable to the Proposed Action. Some site characterization surveys (e.g., biological surveys) and off-lease site assessment activities do not require BOEM approval and could still be conducted under Alternative A, but these activities would not be likely to occur without a commercial wind energy lease or grant. The incremental contribution of impacts from not issuing a single OCS wind energy lease under Alternative A on fish and invertebrates would be **none**. In addition, the overall high-end scenario impacts would be **none** because 18 OCS wind energy leases would not be issued in the Call Area. However, fish and invertebrates in the GOM would continue to be exposed to ongoing and planned activities over the timeframe considered in this EA, such as non-OCS wind energy activities, including activities related to the OCS Oil and Gas Program and Marine Minerals Program.

Alternative B (Call Area)

Single OCS Wind Energy Lease Issuance

Bottom Disturbance

Under this alternative, whole and partial blocks of the FGBNMS would not be available for lease, but blocks with other sensitive benthic features, including topographic features and PSBFs, would be available for lease. Site characterization and site assessment activities expected to take place after the issuance of a single OCS wind energy lease within the Call Area include geotechnical/sub-bottom sampling, biological surveys, and the installation and decommissioning of meteorological buoys. These activities can result in bottom disturbances in both coastal and offshore waters, which may adversely impact fish and invertebrates within the Call Area.

Geotechnical surveys, biological sampling methods, and buoy installation could disturb benthic habitats, which in turn could impact fish and invertebrates that rely on these habitats. Refer to **Chapter 4.4.3** (Benthic Communities and Habitats) for details on the effects of site characterization and site assessment activities on benthic communities and habitats. Impacts, including the crushing and burial of structure-forming organisms on hard bottoms, may result in indirect impacts to fish and invertebrates relying on these habitats for food, protection, or attachment substrate (for other suspension feeders) (Maynou and Cartes 2011). Further, the disturbance stimuli (i.e., survey activity) may result in effects on the behavior of individuals, such as vigilance, fleeing, habitat selection, mating displays, and parental investment, as well as indirect effects to fitness, predation risk, and population or community dynamics (Frid and Dill 2002). Benthic grab samplers used for assessing infauna assemblages are small volume samples that may temporarily displace bottom-feeding fishes and invertebrates (making them more vulnerable to predation), and potentially injure or kill infaunal and epifaunal organisms that contribute to the prey base for demersal species of fish and invertebrates. A similar level of disturbance is to be expected from sampling within inshore transmission cable routes. Bottom trawling, especially repeated trawling over fishing grounds, is well known to damage demersal environments (Collie et al. 1997; Mazor et al. 2021), as well as cause direct mortality to fish and invertebrates captured as bycatch. However, if trawling primarily occurs over soft bottoms, the impacts to fish and invertebrates (both direct and indirect) would be minimal compared to the potential impacts to hard bottoms as soft bottom habitat is ubiquitous in the Call Area and the number of samples are small relative to the available habitat. The seabed would be disturbed locally during the installation and decommissioning of meteorological buoy(s) as a byproduct of anchoring and placement of scour protection. These changes would likely be small in magnitude and limited in spatial scale since the displaced sediments are rapidly diluted as they spread within the water column and only a minimal number of infaunal and epifaunal organisms in soft bottom habitats could be crushed or injured from the installation of buoy anchors. Therefore, buoy installation is not expected to result in detectable impacts to fish and invertebrates.

Due to their ESA-listed status, any mortalities resulting from biological surveys could be problematic for giant manta rays (*Mobula birostris*), Nassau grouper (*Epinephelus striatus*), and oceanic whitetip sharks (*Carcharhinus longimanus*). Giant manta rays are known to frequent and likely utilize topographic features/banks within Topographic Lease Stipulation lease blocks as likely nursery habitats (Childs 2001; Stewart et al. 2018). Nassau groupers are considered rare or transient in the northwestern GOM along Texas, but a first sighting of this species was made in the FGBNMS in September 2006 (Foley et al. 2007). Because whole and partial blocks of the FGBNMS would not be available for leasing under Alternative B, potential impacts to these species would be reduced; however, there are other banks and hard bottom habitats in the area that may be utilized by these species that are not protected under this Alternative (i.e., topographic features or pinnacles). Oceanic whitetip sharks are not expected to be captured by the aforementioned survey methods. The same potential impacts are not expected for ESA-protected Gulf sturgeon or smalltooth sawfish, which are not likely to occur in the Call Area. For more detailed information on these ESA-protected fish species, refer to Chapter 3.5.5.2 of BOEM's *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a).

Overall, the effects of bottom disturbance on fish and invertebrates from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area under Alternative B would be **negligible** to **minor** without the application of protective measures to avoid and distance bottom-disturbing activities from sensitive, hard bottom habitats used by diverse fish and invertebrate communities. Under this alternative, hard bottom-associated fish and invertebrates could potentially experience small, localized adverse impacts from site assessment and site characterization activities that could cause bottom disturbance near or over Topographic Features Stipulation blocks and PSBFs. If protective measures that would require the avoidance of hard bottom habitats (those not already protected under this Alternative) from bottom disturbing activities associated with site characterization and site assessment activities are implemented, the expected impact would be **negligible**.

Noise

Site characterization and site assessment activities expected to take place after the issuance of a single OCS wind energy lease within the Call Area, such as HRG survey equipment, vessel engines, offshore operations and maintenance, and decommissioning of meteorological buoys, can result in underwater sound. Underwater sounds created by anthropogenic activities may impact fish and invertebrates, particularly over hard bottom habitats that are known to house many recreationally and commercially valuable species of fish (e.g., red snapper and groupers), which are generally more sensitive to underwater sound than invertebrates, and are likely locations of multi-species fish spawning aggregations (Grüss et al. 2018).

Of the sources that may be used in HRG surveys, only a handful (e.g., boomers, sparkers, bubble guns, and some sub-bottom profilers, (Crocker and Fratantonio 2016) emit sounds at frequencies that are within the expected hearing range of most fishes and invertebrates. This means that side-scan sonars, multibeam echosounders, and some sub-bottom profilers would not be audible to most fishes, and thus would not affect them. For the sources that are audible, it is important to consider other factors such as source level, beamwidth, and duty cycle. Boomers, sparkers, hull-mounted SBPs, and bubble guns have source levels close to the threshold for injury for pressure-sensitive fishes, so unless a fish was within a few meters of the source, injury is highly unlikely (Crocker and Fratantonio 2016; Popper et al. 2014). Although, behavioral impacts could occur over slightly larger spatial scales and may result in temporary and spatially limited changes in behavior and displacement, which could increase vulnerability to predation and stress (Spiga et al. 2017). The behavioral and displacement effects may be more pronounced over hard bottom habitats where sound propagates more efficiently. Ichthyoplankton (eggs and larvae) and other organisms inhabiting the water column or surface waters are unlikely to be affected by noise unless within a few meters of the source (Popper et al. 2014); therefore, no measurable or detectable impacts to ichthyoplankton assemblages would be expected.

Site characterization and site assessment activities would involve the use of vessels, which introduce sound into the aquatic environment. The cavitation of boat propellors produces low-frequency, nearly continuous sound that is audible by most fishes and invertebrates and could cause acoustic masking. Masking of important biologically relevant sounds has the potential to increase predation, reduce foraging success, and may preclude individuals from finding a mate, thus affecting reproductive success. In deep, offshore waters the sound from vessels is widely dispersed and it is unlikely that fish and invertebrates will be significantly affected by this type of noise. Negative impacts associated with noise from vessel traffic has been primarily observed in shallow, coastal habitats with fish and invertebrate species that have limited to no mobility and are continuously subjected to the sound. The continuous noise from vessels associated with the limited site characterization and site assessment activities under Alternative B would be widely dispersed throughout the lease area, short-term, and not result in measurable impacts to fish and invertebrates.

Overall, the effects of noise on fish and invertebrates from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area would range from **negligible** to **minor** because the activities could result in transient/short-term, small, and localized impacts to fish and invertebrates.

The incremental contribution of impacts from bottom disturbance and noise due to site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B to fish and invertebrates would be **negligible** to **minor** as described above. Alternative B could result in bottom-disturbing and noise-producing activities associated with site characterization and site assessment activities to occur near, on, or over sensitive topographic features/banks and other associated hard bottom habitats. In addition, other sensitive hard bottom features in the Call Area such as PSBFs would be available for lease under this Alternative. If protective measures to distance bottom-disturbing activities from sensitive benthic habitat were implemented to protect all hard bottom habitats and associated fish and invertebrate communities, the incremental impacts above the baseline of site assessment and site characterization activities would be **negligible**.

The cumulative impacts of activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on fish and invertebrates would be **moderate** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, site characterization and site assessment activities under Alternative B would have **negligible** to **minor** impacts to fish and invertebrates due to the limited scale of the proposed activities and associated impacts compared to cumulative activities occurring and expected to occur in the Call Area (e.g., commercial fishing activity, oil- and gas-related activities, military operations, sand mining, climate change-related stressors, and seasonal hypoxic zones). If protective measures are put into place to distance bottom-disturbing activities from all hard bottom habitats (i.e., topographic features/banks and PSBFs located outside of whole or partial lease blocks located within the external boundaries of the FGBNMS), the impacts of site assessment and site characterization activities compared to the cumulative activities occurring and expected to occur in the GOM would be **negligible**.

High-End OCS Wind Energy Lease Issuance Scenario

The potential impacts from bottom disturbances and noise would be limited considering the dispersed and transient nature of impact-producing survey activities, the relatively limited number of surveys that could impact fish and invertebrates, and the dispersed nature of hard bottom habitats and associated fish and invertebrate communities in the Call Area. Under the high-end OCS wind energy lease issuance scenario, up to 18 OCS wind energy leases could be issued, resulting in a proportional increase in site characterization and site assessment activities when compared with a single OCS wind energy lease issuance analyzed under Alternative B. Because whole or partial lease blocks containing the Flower Garden Banks National Marine Sanctuary would be excluded from potential leasing, these OCS blocks would not be subject to site characterization and site assessment activities. However, potentially sensitive hard bottom benthic features and communities outside of the excluded blocks could potentially be impacted by such activities. The impact determinations for Alternative B under the single OCS wind energy lease issuance scenario are not expected to increase under the high-end OCS wind energy lease issuance scenario. As such, the overall effects of bottom-disturbing and noise generating activities associated with site characterization and site assessment activities in the high-end lease issuance scenario under Alternative B is expected to be **negligible** to **minor** because of the widely dispersed and transient nature of impact-producing survey activities, the relatively limited number of surveys that could impact fish and invertebrates, and the dispersed nature of hard bottom habitats and associated fish and invertebrate communities in the Call Area. If protective measures were implemented to distance bottom-disturbing activity from hard bottom habitats and the associated fish and invertebrate communities, the impacts of site assessment and site characterization activities under Alternative B would be **negligible**.

The cumulative impacts of activities expected to take place after issuance of 18 OCS wind energy leases under Alternative B on fish and invertebrates would be **moderate** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, site characterization and site assessment activities from 18 OCS wind energy leases under Alternative B would have **negligible** to **minor** impacts to fish and invertebrates due to the limited scale of the proposed activities and associated impacts compared to existing activities occurring and expected to occur in the Call Area (e.g., commercial fishing activity, OCS oil- and gas-related activities, military operations, sand mining, climate change-related stressors, and seasonal hypoxic zones). If protective measures are put into place to distance bottom-disturbing activities from all hard bottom habitats, the impacts from 18 OCS wind energy leases compared to the cumulative impacts would be **negligible**.

Alternative C (Call Area Excluding the Topographic Features Stipulation Blocks)

Under this alternative, whole and partial Topographic Feature Stipulation Blocks would not be leased. In addition, as with Alternative B, whole and partial blocks of the FGBNMS would not be available for lease. Therefore, all topographic features/banks and other hard bottom habitats and associated fish and invertebrates within Topographic Features Stipulation lease blocks and the exterior boundaries of the FGBNMS would be protected from the impacts associated with site characterization and site assessment activities from a single OCS wind energy lease issuance (refer to Alternative B (Single OCS Wind Energy Lease Issuance in the Call Area), for analyses of how IPFs can impact fish and invertebrates). However, OCS blocks with other hard bottom habitats (i.e., PSBFs) and their associated fish and invertebrate communities present throughout the Call Area would still be available for lease. Consequently, the incremental contribution of impacts for site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C to fish and invertebrates would be **negligible** to **minor** without the application of a protective measure to distance bottom-disturbing activities from sensitive hard bottom habitats. This is due to the potential for small, localized, and measurable adverse impacts to PSBFs and associated fish and invertebrate communities outside of the hard bottom areas not available for lease under Alternative C. The impact determinations for Alternative C under the single OCS wind energy lease issuance scenario are not expected to increase under the high-end lease issuance scenario. As such, the overall effects of bottom-disturbing and noise-generating activities associated with site characterization and site assessment activities in the high-end lease issuance scenario under Alternative C would be **negligible** to **minor** because of the widely dispersed and transient nature of impact-producing survey activities, the relatively limited number of surveys that could impact fish and invertebrates, and the dispersed nature of hard bottom habitats and associated fish and invertebrate communities in the Call Area. If protective measures were implemented to distance bottom-disturbing activity from other hard bottom habitats (outside of the FGBNMS and Topographic Features Stipulation lease blocks) and the associated fish and invertebrate communities, the incremental contribution of impacts for activities related to a single OCS wind energy lease issuance, as well as for the high-end OCS wind energy lease issuance scenario under Alternative C would be **negligible**.

The cumulative impacts of activities expected to take place after issuance of a single and 18 OCS wind energy leases under Alternative C on fish and invertebrates would be **moderate** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, site characterization and site assessment activities under Alternative C would have **negligible** to **minor** impacts to fish and invertebrates for both a single OCS wind energy lease issuance and for the issuance of 18 OCS wind energy leases due to the limited scale of the proposed activities and associated impacts compared to existing activities occurring and expected to occur in the Call Area (e.g., commercial fishing activity, OCS oil- and gas-related activities, military operations, sand mining, climate change-related stressors, and seasonal hypoxic zones). If protective measures are put into place to distance bottom-disturbing activities from all hard bottom habitats, which are important to many fish and invertebrates (i.e., PSBFs outside of whole or partial lease blocks intersecting the exterior boundaries of the FGBNMS and Topographic Features Stipulation lease blocks), the impacts from site assessment and site characterization activities compared to the cumulative impacts would be **negligible** for both a single OCS wind energy lease issuance and for the issuance of 18 OCS wind energy leases.

4.4.5 Marine Mammals

4.4.5.1 Affected Environment Summary

The U.S. Gulf of Mexico marine mammal community is diverse and distributed throughout the northern Gulf of Mexico waters. The GOM's marine mammals include members of the taxonomic order Cetacea, including suborders Mysticeti (i.e., baleen whales) and Odontoceti (i.e., toothed whales), as well as the order Sirenia (i.e., manatee). Twenty-one species of cetaceans and one species of Sirenia regularly occur in the GOM and are identified in the NMFS Stock Assessment Reports (Hayes et al. 2018; 2019; 2021). Habitat-based cetacean density models are found in Roberts et al. (2016). Two cetacean species, the sperm whale and the GOM Rice’s whale, regularly occur in the GOM and are listed as endangered under the ESA. The West Indian manatee is listed as threatened under the ESA and has designated critical habitat in northeastern Florida (*Federal Register* 1976). Further, 19 of the 20 toothed cetaceans (including beaked whales and dolphins) that regularly occur in the GOM are not ESA-listed. However, the Marine Mammal Protection Act protects all marine mammals, ESA-listed or not. NMFS is charged with protecting all cetaceans, while manatees are under the jurisdiction of FWS. For more detail, refer to Chapter 3.7 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a) and the 2020 NMFS BiOp (as amended) (NMFS 2020) and 2021 Amended Incidental Take Statement (ITS) (NMFS 2021).

4.4.5.2 Impact Summary

The approach of this analysis is to focus on the potential IPFs from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases, as well as accidental events and cumulative impacts associated with those activities under each alternative. The potential effects of all IPFs described in **Appendix B** were analyzed, and the IPFs determined to directly impact this resource from site assessment and site characterization activities are discussed below. The potential magnitude for each of these IPFs is provided in **Table 4.4.5-1** to help the reader quickly identify the level of potential impacts for each IPF. In addition, to determine cumulative impacts of the proposed action, the sum of the proposed action plus baseline and future foreseeable activities in the GOM are shown in the table. In addition, for a single OCS wind energy lease issuance and for 18 OCS wind energy lease issuances, the range of the incremental contribution of impacts from all IPFs combined is shown as well as the range of incremental contribution of impacts from all IPFs combined compared to the cumulative impacts. The impact-level definitions are detailed in **Chapter 4.2**, and the analysis supporting these conclusions is discussed in detail in this chapter.

Table 4.4.5-1. Magnitude of Potential Impacts on Marine Mammals after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Magnitude of Potential Impact			
Impact Determinations for Baseline Conditions (Past + Present)			
Noise	Negligible to Major		
Strikes and Collisions	Negligible to Major		
Overall Baseline Impacts	Negligible to Major		
Incremental Impact Determinations for Site Characterization and Site Assessment Activities			
	Alternative A (No Action)	Alternative B	Alternative C
Range of Incremental Impacts for Site Characterization and Site Assessment Activities for a Single OCS Wind Energy Lease and 18 OCS Wind Energy Leases for Each IPF			
Noise			
Without Protective Measures	None	Minor to Moderate	Minor to Moderate

With Protective Measures		Negligible to Minor	Negligible to Minor
Strikes and Collisions			
Without Protective Measures	None	Moderate to Major	Moderate to Major
With Protective Measures		Negligible to Minor	Negligible to Minor
Impacts for Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs			
Without Protective Measures	None	Moderate	Moderate
With Protective Measures		Negligible to Minor	Negligible to Minor
Incremental Contribution of Impacts from Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for all IPFs Compared to the Cumulative Impacts			
Without Protective Measures	None	Minor	Minor
With Protective Measures		Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs			
Without Protective Measures	None	Moderate	Moderate
With Protective Measures		Negligible to Minor	Negligible to Minor
Incremental Contribution of Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for all IPFs Compared to the Cumulative Impacts			
Without Protective Measures	None	Minor	Minor
With Protective Measures		Negligible	Negligible
Impact Determinations for Cumulative Activities (Baseline + Future + Site Characterization and Site Assessment Activities)			
Noise	Negligible to Major		
Strikes and Collisions	Negligible to Major		
Overall Cumulative Impacts	Negligible to Major		

Note: Air emissions and pollution, discharges and wastes, bottom disturbance, coastal land use/modification, lighting and visual impacts, offshore habitat modification/space use, socioeconomic changes and drivers, unintended releases to the environment, and response activities were determined to have no or negligible impacts on marine mammals because of the small size and scope of the Proposed Action in comparison to the cumulative impacts or because the IPF does not interact with marine mammals and, therefore, are not considered in further analysis in this EA.

4.4.5.3 Impact Analysis

4.4.5.3.1 Impact Determinations for the Baseline Environment and Ongoing and Future Activities Including Non-OCS Wind Energy Activities

Noise

Marine mammals in the GOM planning areas are exposed to several sources of anthropogenic noise, including OCS oil- and gas-related activities, maritime activities, dredging, construction, mineral exploration in offshore areas, geophysical (seismic) surveys, sonars, and ocean research activities. Further, these anthropogenic noises are generated by commercial and recreational vessels, aircraft, commercial sonar, military activities, seismic surveys, in-water construction activities, and other human activities. Vessel traffic is recognized as a major contributor to anthropogenic ocean noise, primarily in the low-frequency bands between 10 and 100 hertz (Hz), which overlap with marine mammal hearing ranges and vocalizations (Erbe et al. 2019; McKenna et al. 2013). Noise impacts could be realized in association with seismic airgun surveys and certain military activities (i.e., sonars and explosives). These impacts are expected to be spatially localized and short-term in duration. The biological significance of behavioral responses to underwater noise and the population consequences of those responses are not fully understood (National Research Council 2005; Southall et al. 2007; Southall et al. 2019). Mounting evidence indicates that noise in the marine environment could interfere with communication in marine mammals, a phenomenon called acoustic masking (Clark et al. 2009; Erbe et al. 2016). In addition to masking, elevated ocean noise levels can increase stress in marine mammals (Wright et al. 2007), which in turn can lower reproductive output and increased susceptibility to disease (Kight and Swaddle 2011). The increased noise level may steadily erode marine mammals' abilities to communicate and find food and mates (Clark et al. 2009). For additional details, refer to Chapter 3.7.5.1 of BOEM's *Biological Environment Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a), which is incorporated by reference. The effects of noise on marine mammals from non-OCS wind energy activities occurring in the baseline environment are **negligible** to **major** because of the scope and timing of these activities, and applicable protective measures in place, such as those outlined in the NMFS 2020 GOM BiOp (as amended) and 2021 Amended ITS, Appendix A: Seismic Survey Operation, Monitoring, and Reporting Guidelines, which help reduce noise impacts to marine mammals from OCS oil- and gas-related seismic surveys.

Strikes and Collisions

Vessel strikes have been implicated in injuries and fatalities for several large whale species (Constantine et al. 2015; Laist et al. 2001). Deep-diving whales (e.g., sperm whales) may be more vulnerable to vessel strikes given the longer surface period required to recover from extended deep dives (Laist et al. 2001). Rice's whales spend 90 percent of their time within 39 ft (12 m) of the ocean's surface (Constantine et al. 2015), which could make them vulnerable to collisions with large ships. The vast majority of strikes result from recreational and fishing vessels. Entanglement in marine debris can lead to injury, infection, reduced mobility, increased susceptibility to predation, decreased feeding ability, fitness consequences, and death of marine mammals. Commercial and recreational fishing line and gear that is not disposed of properly can create hazards to marine mammals, such as via entanglement or ingestion (Wells et al. 1998). Marine mammals can either get caught on longline hooks or can be entrained in a net by a shrimp boat or groundfish vessel. There is also the chance of entanglement in buoy lines from crab traps. Entanglement in fishing gear can cause decreased swimming ability, disruption in feeding, life-threatening injuries, and death. Fisheries bycatch of marine mammals has also occurred in the GOM, such as from pelagic longline fisheries and shrimp trawl fisheries (Benaka et al. 2016). For additional details, refer to Chapters 3.7.5.2-3.7.5.4 of BOEM's *Biological Environment Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a), which is incorporated by reference. The effects of strikes and collisions (including entanglement) on marine mammals from non-OCS wind energy activities occurring in the baseline environment are **negligible** to **major** because of the scope and timing of these activities and the applicable protective measures in place such as those outlined in the NMFS 2020 GOM BiOp (as amended) and 2021 Amended ITS, Appendix C: Vessel Strike Avoidance/Reporting and Slack-line Precautions Condition of Approval, which help reduce strike and collision (including entanglement) impacts to marine mammals from OCS oil- and gas-related activities.

The overall baseline environment impacts from non-OCS wind energy activities on marine mammals are **negligible** to **major** because of the scope and timing of these activities, the wide range of marine mammal movements and distribution in the GOM, and applicable protective measures in place, such as those outlined in the NMFS 2020 GOM BiOp (as amended) and 2021 Amended ITS, Appendix A: Seismic Survey Operation, Monitoring, and Reporting Guidelines; Appendix C: Vessel Strike Avoidance/Reporting; and Slack-line Precautions Condition of Approval, which help reduce noise and strike and collision (including entanglement) impacts to marine mammals from OCS oil- and gas-related activities. Additional IPFs that are not detailed above but contribute to baseline environmental impacts to marine mammals include pollution, fisheries interactions, and climate change and ocean acidification. For details on impacts from these factors to marine mammals, refer to Chapters 3.7.5 and 4.7 of the BOEM's *Biological Environment Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a).

4.4.5.3.2 Impact Determinations for Site Characterization and Site Assessment Activities Expected to Take Place after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario

Alternative A (No Action Alternative)

Under the No Action Alternative, BOEM would not issue any commercial or research OCS wind energy leases in the GOM Call Area, and there would be no effects on marine mammals attributable to the Proposed Action. Some site characterization surveys (e.g., biological surveys) and off-lease site assessment activities do not require BOEM approval and could still be conducted under Alternative A, but these activities would not be likely to occur without a commercial wind energy lease or grant. The incremental contribution of impacts from not issuing a single wind energy lease under Alternative A on marine mammals would be **none**. In addition, the overall high-end scenario impacts would be **none** because 18 OCS wind energy leases would not be issued in the Call Area. However, marine mammals in the GOM would continue to be exposed to ongoing and planned activities over the timeframe considered in this EA, such as non-OCS wind energy activities, including activities related to the OCS Oil and Gas Program and Marine Minerals Program.

Alternative B (Call Area)

Single OCS Wind Energy Lease Issuance

Noise

Sound sources from the Proposed Action that have the potential to affect marine mammals include HRG survey equipment, vessel engines, and offshore operations and maintenance activities. The potential for noise impacts from anthropogenic sound sources on marine mammals is highly variable and depends on the specific circumstances of a given situation (Greene Jr. and Moore 1995; Nowacek et al. 2007; Southall et al. 2007; Southall et al. 2019). Furthermore, the same sound source can propagate differently depending on the physical environment. Water-transmitted noise can cause behavioral responses (e.g., avoidance maneuvers), disturbance, masking of sounds, physiological responses (e.g., stress), and hearing impairment (temporary threshold shift or permanent threshold shift) on marine mammals (Ellison et al. 2011; Greene Jr. and Moore 1995). A desktop analysis based on Crocker and Fratantonio (2016) completed by Baker and Howson (2021) concluded that exposure to HRG sources is not likely to result in permanent threshold shift for marine mammals. Vessel noise is transitory and generally does not propagate at great distances from the vessel. Noise from operations and maintenance activities would be localized and temporary. For additional details, refer to Chapter 4.7.1 of BOEM's *Biological Environment Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a), which is incorporated by reference. The effects of noise on marine mammals from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** to **minor** with the application of protective measures, which would appreciably reduce the likelihood of noise impacts on marine mammals by minimizing or eliminating noise exposure and because of the scope, timing, and short-term nature of the proposed activities. Protective measures would include the monitoring of marine mammals close to a survey vessel and delay of acoustic source activation that are within the hearing range of marine mammals when they are detected nearby. Without protective measures applied, the effects of noise on marine mammals would be **minor** to **moderate** because noise exposure may not be minimized for nearby marine mammals.

Strikes and Collisions

Strikes and collisions from the Proposed Action that have the potential to affect marine mammals include vessel strike and entanglement. Marine mammal species of concern for possible vessel strike with all vessels operating at speed include primarily slow-moving species or those that spend extended periods of time at the surface (e.g., Rice's whales) and deep-diving species while on the surface (e.g., sperm whales) (Constantine et al. 2015; Fais et al. 2016; Vanderlaan and Taggart 2007). Vessel strike and entanglement can result in death or injury of marine mammals (Pace 2011). Entangled marine mammals may drown or starve due to being restricted by survey or monitoring gear, suffer physical trauma and systemic infections, and/or be hit by vessels due to an inability to avoid them. If entanglement were to occur there would be irreversible impacts to marine mammals, but those impacts are not expected at the population level. For additional details, refer to Chapter 4.7.8 of BOEM's *Biological Environment Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a), which is incorporated by reference. The effects of strikes and collisions on marine mammals from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** to **minor** with the application of protective measures, which would appreciably reduce the likelihood of impacts from strikes and collisions (including entanglement) on marine mammals by minimizing or eliminating strike and collision risk, and because of the scope, timing, and short-term nature of the proposed activities. Protective measures would require the lessee to monitor the sea surface for protected species, including marine mammals, during vessel transit. Lessee implementation of trash awareness programs would reduce the amount of trash and debris entering the marine environment. Equipment design and monitoring would reduce the potential for entanglement. Without protective measures applied, the effects of strikes and collisions on marine mammals would be **moderate** to **major** because marine mammal monitoring may not occur during vessel transit, trash awareness programs may not be implemented, and equipment design and monitoring may not be implemented.

The incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on marine mammals with the application of protective measures, which would appreciably reduce the likelihood of site assessment and site characterization activity impacts on marine mammals by minimizing or eliminating such interactions, would be **negligible** to **minor** because of the application of the protective measures; the scope, timing, and short-term nature of the proposed activities; and the wide range of marine mammal movements and distribution in the GOM. Without the application of protective measures, the incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on marine mammals would be **moderate** because the potential for impacts from noise and vessel strikes (including entanglement) may not be minimized or eliminated.

The cumulative impacts of activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on marine mammals would be **negligible** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. The relatively small contribution of activities under Alternative B would have impacts that are much less than those attributed to several baseline and future sources of impacts, as described above. When compared to the cumulative impacts, the impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on marine mammals with the application of protective measures, which would appreciably reduce the likelihood of site assessment and site characterization activity impacts on marine mammals by minimizing or eliminating such interactions, would be **negligible** because of the application of the protective measures; the scope, timing, and short-term nature of the proposed activities; and the wide range of marine mammal movements and distribution in the GOM. When compared to the cumulative impacts, the impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on marine mammals without the application of protective measures would be **minor** because the potential for impacts from noise and vessel strikes (including entanglement) may not be minimized or eliminated.

High-End OCS Wind Energy Lease Issuance Scenario

Sound sources from the Proposed Action that have the potential to affect marine mammals include HRG survey equipment, vessel engines, and offshore operations and maintenance activities. Vessel strike and entanglement also have the potential to impact marine mammals. The expected impacts of noise and strikes and collisions on marine mammals for the high-end scenario are similar to those described above for a single OCS wind lease issuance. The effects from noise and strikes and collisions (including entanglement) on marine mammals from site characterization and site assessment activities are expected to take place under the high-end OCS wind energy lease issuance scenario (up to 18 OCS wind energy leases under Alternative B) would be **negligible** to **minor** with the application of protective measures that would appreciably reduce the likelihood of site assessment and site characterization activity impacts on marine mammals by minimizing or eliminating such interactions and because of the scope, timing, and short-term nature of the proposed activities, as well as the wide range of marine mammal movements and distribution in the GOM. Without the application of protective measures, the effects from noise on marine mammals would be **minor** to **moderate**, and the effects of strikes and collisions on marine mammals would be **moderate** to **major** because the potential for impacts from noise and vessel strikes (including entanglement) may not be minimized or eliminated.

The overall high-end scenario impacts from OCS wind energy activities on marine mammals with the application of protective measures that would appreciably reduce the likelihood of site assessment and site characterization activity impacts on marine mammals by minimizing or eliminating such interactions would be **negligible** to **minor** under Alternative B because of the application of the protective measures; the scope, timing, and short-term nature of the proposed activities; and the wide range of marine mammal movements and distribution in the GOM. Without the application of protective measures, the impacts from site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario under Alternative B on marine mammals would be **moderate** because the potential for impacts from noise and vessel strikes (including entanglement) may not be minimized or eliminated.

The cumulative impacts of activities expected to take place after issuance of 18 OCS wind energy lease under Alternative B on marine mammals would be **negligible** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. The relatively small contribution of impacts from Alternative B would be much less than those attributed to cumulative sources, as described above. When compared to the cumulative impacts, the impacts from site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario with the application of protective measures that would appreciably reduce the likelihood of site assessment and site characterization activity impacts on marine mammals by minimizing or eliminating such interactions would be **negligible** under Alternative B because of the application of the protective measures; the scope, timing, and short-term nature of the proposed activities; and the wide range of marine mammal movements and distribution in the GOM. When compared to the cumulative impacts, the impacts from site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario under Alternative B on marine mammals without the application of protective measures would be **minor** because the potential for impacts from noise and vessel strikes (including entanglement) may not be minimized or eliminated.

Alternative C (Call Area Excluding the Topographic Features Stipulation Blocks)

The impacts from Alternative C do not differ from the impacts of Alternative B. The incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on marine mammals with the application of protective measures, which would appreciably reduce the likelihood of site assessment and site characterization activity impacts on marine mammals by minimizing or eliminating such interactions, would be **negligible** to **minor** because of the application of the protective measures; the scope, timing, and short-term nature of the proposed activities; and the wide range of marine mammal movements and distribution in the GOM. Without the application of protective measures, the incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on marine mammals would be **moderate** because the potential for impacts from noise and vessel strikes (including entanglement) may not be minimized or eliminated.

The cumulative impacts of activities expected to take place after issuance of a single and 18 OCS wind energy lease under Alternative C on marine mammals would be **negligible** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. The relatively small contribution of impacts from Alternative C would be much less than those attributed to cumulative sources, as described above. When compared to the cumulative impacts, the impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and issuance of 18 OCS wind energy leases under Alternative C on marine mammals with the application of protective measures, which would appreciably reduce the likelihood of site assessment and site characterization activity impacts on marine mammals by minimizing or eliminating such interactions, would be **negligible** because of the application of the protective measures; the scope, timing, and short-term nature of the proposed activities; and the wide range of marine mammal movements and distribution in the GOM. When compared to the cumulative impacts, the impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and issuance of 18 OCS wind energy leases under Alternative C on marine mammals, without the application of protective measures, would be **minor** because the potential for impacts from noise and vessel strikes (including entanglement) may not be minimized or eliminated.

4.4.6 Sea Turtles

4.4.6.1 Affected Environment Summary

Five ESA-listed sea turtles occur in the GOM, i.e., the loggerhead turtle, green turtle, hawksbill turtle, Kemp's ridley turtle, and leatherback turtle. The Northwest Atlantic Ocean Distinct Population Segment (DPS) of loggerhead turtle and the North Atlantic DPS of green turtle are ESA-listed as threatened (*Federal Register* 2014). Hawksbill turtles, Kemp's ridley turtles, leatherback turtles (proposed threatened as Northwest Atlantic DPS), and breeding populations of green sea turtles in Florida are ESA-listed as endangered. Floating *Sargassum* patches in the CPA and WPA are federally designated under the ESA as critical habitat for loggerhead turtles. The FWS and NMFS share jurisdiction for sea turtles. The FWS has responsibility for monitoring and managing sea turtles (i.e., nesting turtles, eggs, and hatchlings) on beaches, and NMFS has jurisdiction for sea turtles in the marine environment.

The open waters of the GOM are used by the above five sea turtle species at different life phases. Juvenile sea turtles often are found in *Sargassum* mats floating on the surface. Adult sea turtles are found throughout the GOM and feed near the surface, within the water column, and are associated with hard bottom communities, depending on the species of sea turtles and the type of prey being pursued. While different life phases of sea turtles utilize the open waters of the GOM, the use of water bottoms in deeper Gulf waters represent a fraction of sea turtles' habitat use. For more detail on the affected environment and below impact analysis, refer to Chapter 3.6 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a) and the 2018 FWS Biological Opinion (FWS 2018; NMFS 2020), which are incorporated by reference here.

4.4.6.2 Impact Summary

The approach of this analysis is to focus on the potential IPFs from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases, as well as accidental events and cumulative impacts associated with those activities under each alternative. The potential effects of all IPFs described in **Appendix B** were analyzed, and the IPFs determined to directly impact this resource from site assessment and site characterization activities are discussed below. The potential magnitude for each of these IPFs is provided in **Table 4.4.6-1** to help the reader quickly identify the level of potential impacts for each IPF. In addition, to determine cumulative impacts of the proposed action, the sum of the proposed action plus baseline and future foreseeable activities in the GOM are shown in the table. In addition, for a single OCS wind energy lease issuance and for 18 OCS wind energy lease issuances, the range of the incremental contribution of impacts from all IPFs combined is shown as well as the range of incremental contribution of impacts from all IPFs combined compared to the cumulative impacts. The impact-level definitions are detailed in **Chapter 4.2** and the analysis supporting these conclusions is discussed in detail in this chapter.

Table 4.4.6-1. Magnitude of Potential Impacts on Sea Turtles after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Magnitude of Potential Impact	
Impact Determinations for Baseline Conditions (Past + Present)	
Bottom Disturbance	Negligible to Major
Noise	Negligible to Major

Unintentional Releases to the Environment	Negligible to Major		
Strikes and Collisions	Negligible to Major		
Overall Baseline Impacts	Negligible to Major		
Incremental Impact Determinations for Site Characterization and Site Assessment Activities			
	Alternative A (No Action)	Alternative B	Alternative C
Range of Incremental Impacts for Site Characterization and Site Assessment Activities for a Single OCS Wind Energy Lease and 18 OCS Wind Energy Leases for Each IPF			
Bottom Disturbance			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible
Noise			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible
Unintentional Releases to the Environment			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible
Strikes and Collisions			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor
With Protective Measures	None	Negligible	Negligible
Incremental Contribution of Impacts from Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for all IPFs Compared to the Cumulative Impacts			
Without Protective Measures	None	Negligible	Negligible
With Protective Measures	None	Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs			
Without Protective Measures	None	Negligible to Minor	Negligible to Minor

With Protective Measures		Negligible	Negligible
Incremental Contribution of Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs Compared to the Cumulative Impacts			
Without Protective Measures	None	Negligible	Negligible
With Protective Measures		Negligible	Negligible
Impact Determinations for Cumulative Activities (Baseline + Future + Site Characterization and Site Assessment Activities)			
Bottom Disturbance	Negligible to Major		
Noise	Negligible to Major		
Unintentional Releases to the Environment	Negligible to Major		
Strikes and Collisions	Negligible to Major		
Overall Cumulative Impacts	Negligible to Major		

Note: Air emissions and pollution, discharges and wastes, coastal land use/modification, lighting and visual impacts, offshore habitat modification/space use, socioeconomic changes and drivers, and response activities were determined to have no or negligible impacts on sea turtles because of the small size and scope of the Proposed Action in comparison to the cumulative impacts or because the IPF does not interact with sea turtles and, therefore, are not considered in further analysis in this EA.

4.4.6.3 Impact Analysis

4.4.6.3.1 Impact Determinations for the Baseline Environment and Ongoing and Future Activities Including Non-OCS Wind Energy Activities

Bottom Disturbance

Bottom disturbance can be caused by trawling, channel dredging, sand extraction, and construction activities. Bottom disturbance can impact sea turtles when coastal waters with benthic vegetation such as seagrass are destroyed or covered from turbidity generated by bottom disturbance. Many species of sea turtles feed over soft bottoms. Channel dredging or sand extraction may remove prey species with sediment removal locally impacting sea turtle prey abundance and/or distribution on a temporary basis (Conant et al. 2009). Bottom disturbance is ongoing but bottom-disturbing activities from fishing, dredging, sand extraction, and construction activities occur over only a portion of the GOM at a time and are non-continuous. The effects of bottom disturbance on sea turtles from baseline non-OCS wind energy activities are **negligible** to **major**, and the severity of impacts to sea turtles is dependent upon the scope of activity, as well as any protective measures in place, such as those applied by BOEM for OCS oil- and gas-related activities that distance bottom-disturbing activity from live bottoms and reduce impacts to sea turtles by protecting their habitat.

Noise

Sea turtles could be vulnerable to a wide range of noises generated from a variety of activities or equipment that are used in GOM waters. Noise generated from acoustic sources from geophysical surveys, oil and gas drilling activities, and construction activities, including pile driving, dredging, and platform removal with the use of explosives, and vessel noise (Hildebrand 2009) can be detected by sea turtles. Noises generated by these industries and activities are localized and short term. Sea turtle hearing is not well understood, but it is generally accepted that sea turtles can detect sounds between 100 Hz and 2 kilohertz (kHz) (BOEM 2021a). Sea turtle responses to low-frequency sounds are expected to include behavior responses, acoustic masking, temporary hearing loss, permanent hearing loss, and mortality (Baker and Howson 2021). The effects of noise on sea turtles from baseline non-OCS wind energy activities are **negligible** to **major**, and the severity of impacts to sea turtles is dependent upon the scope of activity, as well as any protective measures in place, such as those applied by BOEM for OCS oil and gas geophysical surveys and monitoring during explosive structure removal, that can reduce the impacts of noise on sea turtles.

Unintentional Releases to the Environment

Oil spills may be harmful to sea turtles through direct contact with oil and habitat or prey oiling. Sea turtles exposed to oil or tar balls had compromised respiration, affected skin, and affected blood chemistry and salt gland function (Vargo et al. 1986). Oil can adhere to sea turtles and has been observed on the nostrils, eyes, and esophagus, and was found in the feces of sea turtles exposed during experiments (Vargo et al. 1986). Similar physiological effects and contamination were found in stranded oil-fouled sea turtles (Van Vleet and Pauly 1987; Vargo et al. 1986). Exposure and ingestion of oil can cause changes in respiration, can induce immune responses, and appear to impact biological regulatory systems, all which can negatively impact sea turtles' health (Vargo et al. 1986). Sea turtle exposure to oil can occur on beaches, in marshes, in seagrass habitats, in open waters of the GOM, and in floating *Sargassum* mats. The level of the impact will depend on the amount and duration of the exposure.

Marine trash and debris affect marine habitats worldwide. A comprehensive review of marine debris by Gall and Thompson (2015) reported that sea turtles were among the most common species with documented occurrences of entanglement and ingestion of marine trash and debris. All species of sea turtles were documented to have marine debris entanglement or ingestion interactions (Gall and Thompson 2015). Sea turtle ingestion of plastics may result in lost nutrition, reduced absorption of nutrients, reduction in quality of life, reduction in reproductive capacity, and absorption of plasticizers (Balazs 1984; BOEM 2021a; Gregory 2009). Ingestion of plastics could reduce the health of sea turtles and in more serious cases cause injury or death (Balazs 1984; Gall and Thompson 2015).

The effects of unintentional releases to the environment on sea turtles from baseline non-OCS wind energy activities are **negligible** to **major**, and the severity of impacts to sea turtles is dependent upon the scope and duration of a spill, as well as any protective measures in place, such as those applied by BOEM for OCS oil- and gas-related activities, that can reduce the impacts of unintentional releases of trash and debris to the environment on sea turtles. The level of effects of oil spills would be event specific and greater impacts would occur if the releases happened near critical habitats during periods of sea turtle use.

Strikes and Collisions

Vessel strikes are an ongoing threat to sea turtles. Collisions with commercial and recreational vessels causing sea turtle mortalities are documented in the GOM (Foley et al. 2019; Lutcavage et al. 1997). Sea turtle habitat use in the GOM documented variability by species of surface use but did document surface use of loggerhead sea turtles to average about 11 percent of the time and Kemp's ridley surface use to vary between 23 percent in winter months and 11 percent in summer months (Garrison et al. 2020), which could put sea turtles at risk for vessel strike. Entanglement is another serious threat to sea turtles (Balazs 1984). Vessels operating in the GOM from Federal and State oil and gas programs, recreational and commercial fisheries, commercial shipping, the cruise industry, and the military are all potential sources of vessel strike. Discarded or intact fishing gear, ropes, trawl nets, plastic objects, cloth and parachute anchors are all types of debris that have documented as sources of sea turtle entanglement (Balazs 1984). Intact fishing gear is a documented source of sea turtle deaths (Ehrhart et al. 1990). Balazs' (1984) study of reported entanglements documented that approximately 38 percent of the sea turtles entangled either were dead or subsequently died as a result of the entanglement. Balazs (1984) predicted that turtles at sea that die in the water due to entanglement do not stay afloat long enough to reach shore suggesting that under reporting of entanglement deaths was likely. In addition to discarded trash and debris, fishing bycatch remains a major contributor to sea turtle injury and death (*Federal Register* 2015). The effects of strikes and collisions (including entanglement) on sea turtles from baseline non-OCS wind energy activities are **negligible** to **major**, and the severity of impacts to sea turtles is dependent upon the scope of activity, as well as any protective measures in place, such as vessel strike avoidance and trash and debris awareness protocols applied by BOEM for OCS oil- and gas-related activities, that can reduce the potential of vessel strikes on sea turtles. The scale of activities associated with the baseline are numerous and occur on an ongoing basis, even with protective measures associated with some specific industries and, therefore, vessel strike and entanglement is expected to continue.

The overall baseline environment impacts from non-OCS wind energy activities on sea turtles would be **negligible** to **major** because of the scale and long-term nature of these activities, though not continuous. Many IPFs discussed above are the result of accidental events and, therefore, are not totally preventable. The implementation of protective measures, such as those applied by BOEM for OCS oil- and gas-related activities, may reduce the scope of impacts, but accidental events by their nature cannot be completely avoided. Additional IPFs that are not detailed above but contribute to baseline environmental impacts to sea turtles include coastal development, chronic pollution, and climate change. Coastal development, which can impact nesting beaches, cause light pollution, increase human disturbance, or disrupt sediment transport, is ongoing on the Gulf Coast and is expected to result in long-term impacts on sea turtles. Numerous discharges and wastes enter the waters of the GOM, resulting in chronic pollution. Chronic pollution can impact sea turtle health by stressing sea turtles' immune and endocrine systems or through food web interactions. Climate change can also impact sea turtles negatively due to sea-level rise that can increase inundation of nesting beaches and other sea turtle habitats or increase water temperatures, which may shift prey composition. For additional details on impacts of coast land disturbance, lighting, and climate change to sea turtles, refer to Chapters 4.6.4, 4.6.7, 3.6.6.2, and 3.6.6.5 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a).

4.4.6.3.2 Impact Determinations for Site Characterization and Site Assessment Activities Expected to Take Place after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario

Alternative A (No Action Alternative)

Under the No Action Alternative, BOEM would not issue any commercial or research OCS wind energy leases in the GOM Call Area, and there would be no effects on sea turtles attributable to the Proposed Action. Some site characterization surveys (e.g., biological surveys) and off-lease site assessment activities do not require BOEM approval and could still be conducted under Alternative A, but these activities would not be likely to occur without a commercial wind energy lease or grant. The incremental contribution of impacts from not issuing a single wind energy lease under Alternative A on sea turtles would be **none**. In addition, the overall high-end scenario impacts would be **none** because 18 OCS wind energy leases would not be issued in the Call Area. However, sea turtles in the GOM would continue to be exposed to ongoing and planned activities over the timeframe considered in this EA, such as non-OCS wind energy activities, including activities related to the OCS Oil and Gas Program and Marine Minerals Program.

Alternative B (Call Area)

Single OCS Wind Energy Lease Issuance

Bottom Disturbance

Bottom disturbance from the proposed action may occur from sampling, trawling, and anchoring. Sampling may occur both within the Call Area and outside the Call Area in coastal waters (including estuaries and bays) being evaluated as potential transmission cable line routes. Bottom disturbance would cause direct bottom impacts and could locally increase turbidity. Bottom disturbance may impact both sea turtles and sea turtle habitat. Impacts to sea turtle habitat are discussed in **Chapters 4.4.3** (Benthic Communities and Habitats) and **4.4.2** (Coastal Communities and Habitats). The impacts to sea turtles from bottom disturbance are discussed below.

Site assessment and site characterization activities can cause direct bottom disturbance and increases in turbidity that would be localized and temporary and have the potential to cause a behavior response in sea turtles and displace prey. Juvenile and subadult Kemp’s ridley, green, and loggerhead sea turtles reside and feed in shallow coastal waters of the GOM, including in the coastal waters of Texas and Louisiana (Garrison et al. 2020). Bottom disturbance could temporarily disrupt sea turtle foraging and in shallow coastal waters also disrupt habitat use. Coring in the open waters of the Call Area is unlikely to disturb sea turtles, but coring or other bottom surveys occurring in coastal waters have the potential to disturb juvenile and subadults sea turtles. The installation of meteorological buoys would also result in the temporary placement of anchoring systems with direct bottom disturbance and the generation of turbidity to a minimal area within the Call Area. Impacts would be temporary and within the open waters of the Call Area, and due to the wide distribution of sea turtles in the Call Area, bottom disturbance is unlikely to result in a direct impact to a sea turtle. Within coastal waters, interactions with juvenile or subadult sea turtles would be more likely since these life phases both reside and forage in coastal areas. If SAVs in shallow coastal areas are destroyed during transmission line route characterization, vegetated habitat could be temporarily lost. If SAVs are removed or covered by sediments, it is likely that SAVs would naturally re-establish so impacts would be temporary. The effects of bottom disturbance on sea turtles from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** with the application of protective measures that require the avoidance of vegetated water bottoms during surveys and met buoy installation. Without protective measures in place, the effects of bottom disturbance on sea turtles from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** to **minor**.

Noise

Noise impacts associated with the Proposed Action would include noise from bottom surveying activities from active acoustic sources. Since sea turtle hearing is generally accepted to be between 100 Hz and 2 kHz, only some of the proposed acoustic sources would be within the hearing range of sea turtles (BOEM 2021a). This includes subbottom profilers, such as boomers, sparkers, and bubble guns. The HRG sources evaluated by Crocker and Fratantonio (2016) were analyzed by BOEM (Baker and Howson 2021) through a desktop procedure that identified worst-case disturbance distances for sea turtles. Boomers and bubble guns had a projected worst-case disturbance distance of 40 m (131 ft) and 90 m (235 ft) for sparkers. The analysis concluded that sea turtles may detect these sources if within the disturbance distance, but impacts such as hearing loss were not expected. Baker and Howson (2021) modeled permanent injury noise exposure distances from the mobile HRG sources at a distance of 0 m (0 ft), meaning that for permanent hearing impacts to occur the sea turtle would need to be immediately adjacent to the vessel when boomers, bubble guns, or sparkers were in use (Baker and Howson 2021). Due to their operating frequencies, noise from active acoustic sources of the type proposed for this work are not expected to impair or injure sea turtles. In addition to acoustic sources, sea turtles may also detect noise from small vessels used for surveys and meteorological buoy installation. Noise from small and large vessels occur at low frequencies and within the accepted hearing range of sea turtles (BOEM 2021a).

Noise impacts from acoustic sources and vessels could result in behavior responses, such as avoidance or disturbed feeding, or acoustic masking. When detected, sounds may cause a behavioral response such as avoidance. Acoustic surveys occurring in coastal waters have the potential to disturb juvenile and subadults sea turtles, including Kemp's ridley, green, and loggerhead sea turtles. Behavior responses are expected to be temporary and would occur close to the sound source. The wide distribution of sea turtles would make exposure unlikely. Depending on the type of survey and location, areas could be exposed on a reoccurring basis or, in other cases, an area may be sampled and exposed to noise impacts only one time. Although these surveys may cause temporary impacts to sea turtles, the impacts would occur non-continuously over an extended time period and could result in impacts to individuals or groups in the form of disturbance that could result in a temporary disruption of behavior patterns. The effects of noise on sea turtles from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** with the application of protective measures that would monitor for sea turtles close to survey vessels and delay the activation of acoustic sources that are within the hearing range of the sea turtles when the turtles are detected nearby. This decreases sea turtle exposure to noise generated by acoustic sources. Without protective measures in place, the effects of noise on sea turtles would be **negligible** to **minor** because acoustic source activation may not be delayed if sea turtles are not monitored for presence nearby.

Unintentional Releases to the Environment

Unintentional releases to the environment associated with the issuance of a single OCS wind energy lease and the associated site assessment and site characterization activities may be caused by accidental fuel spills from vessels used for geophysical surveys, geotechnical sampling, or biological surveys. Any offshore fuel spills associated with vessels used for site assessment and site characterization activities would be localized and expected to disperse. Only in those instances where sea turtles were in the immediate vicinity of a spill would any exposure to hydrocarbons and any acute exposure injury be expected to occur. Other unintentional releases to the environment associated with the proposed action include accidental release of trash and debris. Litter, when released in the environment, can be ingested by sea turtles. Sea turtle ingestion of plastics is well documented and may result in lost nutrition, reduced absorption of nutrients, reduction in quality of life, reduction in reproductive capacity, and absorption of plasticizers (Balazs 1984; BOEM 2021a; Gregory 2009). Ingestion of plastics, while not expected, could reduce the health of sea turtles and, in more serious cases, cause injury or death (Balazs 1984). The effects of unintentional releases to the environment on sea turtles expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** with the application of protective measures that educate lessees on the restrictions associated with trash and debris disposal in the marine environment and because of the small scope of activities associated with a single OCS wind energy lease. Without protective measures in place, the effects of unintentional releases to the environment on sea turtles expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** to **minor** because lessees may not know about restrictions for trash and debris disposal in the marine environment.

Strikes and Collisions

Collisions with commercial and recreational vessels causing sea turtle mortalities are documented in the GOM (Lutcavage et al. 1997). While they are at the sea surface, sea turtles are vulnerable to vessel strike, and increased vessel traffic could increase the probability of vessel strike and potential injury or death of sea turtles. A recent study of sea turtle habitat use in the GOM documented variability across species for time spent on the surface. The average surface use of loggerhead sea turtles was approximately 11 percent of the time and Kemp's ridley surface use varied between 23 percent in winter months and 11 percent in summer months (Garrison et al. 2020). Renaud and Williams (2005) documented Kemp's ridley sea turtle use in waters extending along the Texas and Louisiana coastline. Given the scope of the vessel trips associated with the issuance of a single OCS wind energy lease and sea turtle movement in OCS waters and coastal waters, vessel strikes still remain unlikely. However, if vessel strikes do occur, they could cause irreversible impacts to sea turtles, up to and including mortality. Impacts are not expected at the population level.

Entanglement associated with the issuance of a single OCS wind energy lease would be due to biological survey activities such as trawling or passive sampling devices. Depending on the type of biological survey activities, sea turtles could be injured or drowned. If entanglement occurs and there are irreversible impacts to sea turtles, those impacts are not expected at the population level.

Although sea turtles are widely distributed in the Call Area, the small scale of site assessment and site characterization activities in the Call Area make interaction with sea turtles unlikely. The effects of strikes and collisions (including entanglement) to sea turtles expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** with the application of protective measures that would require the lessee to monitor the sea surface for protected species, including sea turtles, during vessel transit. Lessee implementation of trash awareness programs would reduce the amount of trash and debris entering the marine environment. Equipment design and monitoring would reduce the potential for entanglement. Without protective measures in place, the effects of strikes and collisions (including entanglement) to sea turtles expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** to **minor** because the sea surface may not be monitored for sea turtles during vessel transit, lessees may not implement trash awareness programs, and equipment design and monitoring may not be implemented to reduce the potential for entanglement.

The incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on sea turtles would be **negligible** with the application of protective measures and because sea turtles are dispersed throughout the Call Area and may be spatially or temporally separated from activities associated with the lease issuance. Protective measures would avoid or decrease impacts to sea turtle habitat by distancing bottom-disturbing activity from live bottoms. Noise impacts from active acoustic sources or from vessels are temporary and change with vessel movement. Noise impacts from acoustic sources could be reduced with the application of protective measures that delay the start of acoustic sources when sea turtles are in close proximately to the source. Impacts from vessel strike may be reduced by application of measures that require sea surface watches while vessels are underway. The impacts from entanglement or ingestion of trash and debris may be reduced through equipment design and monitoring and through trash awareness training. Without the application of protective measures, the incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on sea turtles would be **negligible** to **minor** because benthic habitat distancing, sea turtle monitoring to reduce strike and noise impacts, acoustic source delay, trash awareness training, and equipment design may not be implemented to reduce impacts to sea turtles.

The cumulative impacts of activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on sea turtles would be **negligible** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, the impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on sea turtles would be **negligible**, with or without the application of protective measures, because of the small contribution of activity from a single OCS wind energy lease and associated site assessment and site characterization activities is much less than those attributed to the cumulative stressors, as described above.

High-End OCS Wind Energy Lease Issuance Scenario

Bottom disturbance, noise, unintentional releases to the environment, and strikes and collisions (including entanglement) could affect sea turtles under the high-end OCS wind energy lease scenario. Under this scenario, the expected impacts of these IPFs on sea turtles are similar to those described above for a single lease issuance, although the intensity and extent of the impacts would increase. The overall high-end scenario impacts from OCS wind energy activities on sea turtles would be **negligible** for Alternative B with the application of protective measures and because sea turtles are dispersed throughout the Call Area and, therefore, may be spatially or temporally separated from activities associated with lease issuance and because of the scope of the activity, even under the high-end scenario, is small. Protective measures would avoid or decrease impacts to sea turtle habitat by distancing bottom-disturbing activity from live bottoms. Noise impacts from acoustic sources and vessels are temporary and likely to decrease with vessel movement. Noise impacts from acoustic sources could be reduced with the application of protective measures that delay the start of acoustic sources when sea turtles are in close proximately to the source. In addition, exposure and ingestion of plastics, which reduces the health of sea turtles and in more serious cases causes injury or death, would be unlikely due to the small scale of activities associated with 18 OCS wind energy leases. The impacts from entanglement or ingestion of trash and debris may be reduced through equipment design and monitoring and through trash awareness training. Similarly, increased vessel traffic would increase the probability of vessel strike, but site assessment and site characterization activities from 18 OCS wind energy leases would only result in a small increase in regional vessel traffic compared to the baseline. Impacts from vessel strike may be reduced by the application of measures that require sea surface watches while vessels are underway. Without protective measures in place, the overall high-end scenario impact from OCS wind energy activities on sea turtles for Alternative B would be **negligible** to **minor** because the protective measures to reduce impacts from bottom disturbance, noise from acoustic sources, unintentional releases to the environment, and vessel strikes may not be implemented to reduce impacts to sea turtles.

The cumulative impacts of activities expected to take place after issuance of 18 OCS wind energy lease under Alternative B on sea turtles would be **negligible** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, the impacts from site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario for Alternative B would be **negligible**, with and without the application of protective measures, and because of the scope and temporary nature of the activities. Although greater than a single OCS wind energy lease, the contribution of 18 OCS wind energy leases and associated site assessment and site characterization activities would be much less intense than impacts from ongoing and future activities in the GOM on sea turtles.

Alternative C (Call Area Excluding the Topographic Features Stipulation Blocks)

The impacts to sea turtles under Alternative C would not differ from the impacts under Alternative B. The benefits of precluding Topographic Feature Stipulation blocks from leasing may provide benefits to sea turtles foraging at these locations by decreasing disturbance caused by site assessment or site characterization activities. However, sea turtle use of these areas is expected to be periodic. The incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on sea turtles, with the application of protective measures, would be **negligible** because the protective measures would reduce impacts from bottom disturbance, noise from acoustic sources, unintentional releases to the environment, and vessel strikes, and because of the small scope and temporary nature of the site assessment and site characterization activities. Without protective measures in place, the incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on sea turtles would be **negligible** to **minor** because the protective measures to reduce impacts from bottom disturbance, noise from acoustic sources, unintentional releases to the environment, and vessel strikes may not be implemented to reduce impacts to sea turtles. The incremental contribution of impacts from Alternative C to sea turtles either with or without protective measures would be indistinguishable from that of Alternative B.

Under the high-end OCS wind energy lease scenario, the expected impacts from site assessment and site characterization activities on sea turtles are similar to those described above for Alternative B, and the overall high-end scenario impact determinations as a result of 18 OCS wind energy leases would be the same as for the Alternative B. The cumulative impacts of activities expected to take place after issuance of a single and 18 OCS wind energy lease under Alternative B on sea turtles would be **negligible** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. When compared to the cumulative impacts, impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and issuance of 18 OCS wind energy leases under Alternative C on sea turtles would be **negligible**, with and without the application of protective measures, because the of the small scope of activities under a single OCS wind energy lease and the amount of associated site assessment and site characterization activities expected to take place is much less than those attributed to several cumulative impacting sources. Although greater than a single OCS wind energy lease, the contribution of 18 OCS wind energy leases and associated site assessment and site characterization activities would be much less intense than impacts from ongoing and future activities in the GOM on sea turtles.

4.4.7 Cultural, Historic, and Archaeological Resources

4.4.7.1 Affected Environment Summary

Archaeological resources are any material remains of human life or activities that are at least 50 years of age and that are capable of providing a scientific or humanistic understanding of past human behavior, cultural adaptation, and related topics through the application of scientific or scholarly techniques, such as controlled observation, contextual measurement, controlled collection, analysis, interpretation, and explanation. These resources include any physical evidence of human habitation, occupation, use, or activity, and further include the site, location, or context in which such evidence is situated (30 CFR § 550.105). The National Historic Preservation Act of 1966, as amended (54 U.S.C. § 300101), includes archaeological resources among potential “historic properties,” defined as any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register of Historic Places, including artifacts, records, and material remains relating to the district, site, building, structure, or object (54 U.S.C. § 300308). Traditional cultural properties and sacred sites also may be designated as historic properties. To be eligible for inclusion on the National Register of Historic Places, a historic property typically must be at least 50 years old; retain the integrity of location, design, setting, materials, workmanship, feeling, and association; and meet at least one of four significance criteria (36 CFR § 60.4). For more detail on cultural, historic, and archaeological resources in the GOM, refer to **Section D.3**, Cultural, Historic and Archaeological Resources, of **Appendix D**.

4.4.7.2 Impact Summary

The approach of this analysis is to focus on the potential IPFs from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases, as well as accidental events and cumulative impacts associated with those activities under each alternative. The potential effects of all IPFs described in **Appendix B** were analyzed, and the IPFs determined to directly impact this resource from site assessment and site characterization activities are discussed below. The potential magnitude for each of these IPFs is provided in **Table 4.4.7-1** to help the reader quickly identify the level of potential impacts for each IPF. In addition, to determine cumulative impacts of the proposed action, the sum of the proposed action plus baseline and future foreseeable activities in the GOM are shown in the table. In addition, for a single OCS wind energy lease issuance and for 18 OCS wind energy lease issuances, the range of the incremental contribution of impacts from all IPFs combined is shown as well as the range of incremental contribution of impacts from all IPFs combined compared to the cumulative impacts. The impact-level definitions are detailed in **Chapter 4.2** and the analysis supporting these conclusions is discussed in detail in this chapter.

Table 4.4.7-1. Magnitude of Potential Impacts on Cultural, Historic, and Archaeological Resources after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Magnitude of Potential Impact	
Impact Determinations for Baseline Conditions (Past + Present)	
Bottom Disturbance	Moderate

Overall Baseline Impacts	Minor to Major		
Incremental Impact Determinations for Site Characterization and Site Assessment Activities			
	Alternative A (No Action)	Alternative B	Alternative C
Range of Incremental Impacts for Site Characterization and Site Assessment Activities for a Single OCS Wind Energy Lease and 18 OCS Wind Energy Leases for Each IPF			
Bottom Disturbance			
Without Protective Measure	None	Minor to Major	Minor to Major
With Protective Measure		Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs			
Without Protective Measure	None	Minor to Major	Minor to Major
With Protective Measure		Negligible	Negligible
Incremental Contribution of Impacts from Site Assessment and Site Characterization Activities for a Single OCS Wind Energy Lease on the Resource for All IPFs Compared to the Cumulative Impacts			
Without Protective Measure	None	Minor to Major	Minor to Major
With Protective Measure		Negligible	Negligible
Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs			
Without Protective Measure	None	Minor to Major	Minor to Major
With Protective Measure		Negligible	Negligible
Incremental Contribution of Impacts for Site Assessment and Site Characterization Activities from 18 OCS Wind Energy Leases for All IPFs Compared to the Cumulative Impacts			
Without Protective Measure	None	Minor to Major	Minor to Major
With Protective Measure		Negligible	Negligible
Impact Determinations for Cumulative Activities (Baseline + Future + Site Characterization and Site Assessment Activities)			
Bottom Disturbance	Moderate		
Overall Cumulative Impacts	Minor to Major		

Note: Air emissions and pollution, discharges and wastes, noise, coastal land use/modification, lighting and visual impacts, offshore habitat modification/space use, socioeconomic changes and drivers, unintended releases to the environment, response activities, and strikes and collisions were determined to have no or negligible impacts on cultural, historic, and archaeological resources because of the small size and scope of the Proposed Action in comparison to the cumulative impacts or because the IPF does not interact with cultural, historic, and archaeological resources and, therefore, are not considered in further analysis in this EA.

4.4.7.3 Impact Analysis

4.4.7.3.1 Impact Determinations for the Baseline Environment and Ongoing and Future Activities Including Non-OCS Wind Energy Activities

Non-OCS wind energy activities that could result in bottom disturbance include, but are not limited to, both OCS and State oil and gas exploration and development, spill response, artificial reefs, dredging related to sand borrowing or navigation channels, commercial fish trawling, military operations, mass wasting events, undersea cables, deepwater ports, recreation, and establishment of anchorage areas, buoys, and moorings. The primary adverse bottom disturbance effects of these activities would be the removal, reorientation, and/or destruction of the artifact assemblage or other physical components of a submerged archaeological site. This, in turn, could result in a loss of archaeological information and inhibit the proper identification and interpretation of the site. If severe enough, this loss of archaeological information may minimize site integrity and preclude a determination of the site's eligibility to the National Register of Historic Places or reverse a previous determination of eligibility.

Any of the above activities conducted under a Federal permit or Federal funding are subject to review under Section 106 of the National Historic Preservation Act, and the lead Federal agency may require a pre-disturbance survey to identify any historic properties within the activity's area of potential effect, and further employ measures to avoid, minimize, or mitigate any adverse effects. Activities occurring on State bottomlands are also subject to State laws and may require further review by the relevant State Historic Preservation Office.

The overall baseline bottom disturbance impacts from non-OCS wind energy activities on cultural, historic, and archaeological resources may be **minor** to **major**, depending on the extent, frequency, and duration of impacts and the unique characteristics of the individual affected resources. Implementation of existing State and Federal cultural resource laws and regulations may reduce the magnitude of overall impacts due to requirements to avoid, minimize, or mitigate project-specific impacts. These State and Federal requirements may not be able to reduce the severity of impacts on some cultural resources due to the unique character of specific resources but would reduce the severity of potential impacts in a majority of cases.

4.4.7.3.2 Impact Determinations for Site Characterization and Site Assessment Activities Expected to Take Place after Issuance of a Single OCS Wind Energy Lease and at the High-End of the OCS Wind Energy Lease Issuance Scenario

Alternative A (No Action Alternative)

Under the No Action Alternative, BOEM would not issue any commercial or research OCS wind energy leases in the GOM Call Area, and there would be no effects on cultural, historic, and archaeological resources attributable to the Proposed Action. Some site characterization surveys (e.g., biological surveys) and off-lease site assessment activities do not require BOEM approval and could still be conducted under Alternative A, but these activities would not be likely to occur without a commercial wind energy lease or grant. The incremental contribution of impacts from not issuing a single wind energy lease under Alternative A on cultural, historic, and archaeological resources would be **none**. In addition, the overall high-end scenario impacts would be **none** because 18 OCS wind energy leases would not be issued in the Call Area. However, cultural, historic, and archaeological resources in the GOM would continue to be exposed to ongoing and planned activities over the timeframe considered in this EA, such as non-OCS wind energy activities, including activities related to the OCS Oil and Gas Program and Marine Minerals Program.

Alternative B (Call Area)

Single OCS Wind Energy Lease Issuance

Site characterization activities include both HRG survey (e.g., shallow hazard, geological, and archaeological surveys), geotechnical, and biological sampling techniques. Geophysical surveys do not come in contact with the seafloor and, therefore, have no ability to impact offshore historic properties. Geotechnical sampling activities, conducted to inform the design and installation of renewable energy structures or cables, disturb the seafloor and, therefore, have the potential to impact historic properties located on or below the seafloor. Coring, sediment grab sampling, fish surveys, and other direct sampling techniques, in addition to anchoring, anchor chain sweep from moored or anchored support vessels, use of jack-up barges, or other equipment used in conducting geotechnical sampling all have the potential for damaging or destroying historic properties located on or under the seafloor. Depending on the unique characteristics of the affected historic property and the severity of physical contact, these potential impacts could be **minor** to **major**. However, these potential impacts can be reduced to **negligible** through the completion of geophysical surveys in the lease area and cable routes consistent with BOEM's *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585*. Geophysical surveys, in part, serve to identify potential offshore historic properties. If geophysical surveys are completed by a lessee prior to conducting geotechnical/biological/sediment sampling, historic properties can be identified and bottom-disturbing activities can be located in areas where historic properties are not present. BOEM would, therefore, require a lessee to conduct geophysical surveys consistent with the *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585* prior to conducting geotechnical and biological sampling, and if a potential offshore historic property is identified, the lessee would be required to avoid it.

Site assessment activities that can cause bottom disturbance include the installation and decommissioning of meteorological buoys and associated vessel anchoring. As with the site characterization activities described above, potential impacts to historic properties from site assessment activities could be **minor** to **major** depending on the unique characteristics of the affected historic property and the severity of the bottom disturbance. Although installation of a meteorological buoy would affect the seafloor, the lessee's SAP must be reviewed by BOEM prior to installation. To assist BOEM in complying with the National Historic Preservation Act and other relevant laws, the SAP must contain a description of the historic properties that could be affected by the activities proposed in the plan (30 CFR § 585.611(a), 30 CFR § 585.611(b)(6)). Impacts on archaeological resources in these activity areas could result in the destruction of all or part of the historic properties or loss of their archaeological context. Should the pre-installation geophysical surveys reveal the possible presence of an archaeological site in an area that may be affected by activities proposed in an SAP, BOEM would likely require the lessee to avoid the potential site or to demonstrate through additional investigations that an archaeological resource either does not exist or would not be adversely affected by the seafloor/bottom-disturbing activities. Site assessment activities have the potential to affect historic properties on or below the seabed. However, acquiring geophysical survey data during initial site characterization activities, combined with existing regulatory measures will reduce the potential for bottom-disturbing activities to damage historic properties. Therefore, when these protective measures are in place, bottom-disturbing impacts on historic properties from site assessment activities would be **negligible** because potential sensitive sites would be avoided.

The incremental contribution of impacts from bottom-disturbing activities on cultural, historic, and archaeological resources from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area would be **negligible** because existing regulatory measures, coupled with the information generated for a lessee's initial site characterization (e.g. geophysical and geotechnical surveys) and presented in the lessee's SAP, make the potential for bottom-disturbing activities to damage historic properties low. Should the protective measures not be applied, the incremental contribution of impacts from bottom-disturbing activities on cultural, historic, and archaeological resources from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease in the Call Area could be **minor** to **major** depending on the unique characteristics of the affected historic property and the severity of the bottom disturbance.

The cumulative impacts of activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on cultural, historic, and archaeological resources would be **minor** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. For the same reason, when compared to the cumulative impacts, potential impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative B on cultural, historic, and archaeological resources, with protective measures applied, would be **negligible** because potential sensitive sites would be avoided. If protective measures are not applied, the impacts from site assessment and site characterization activities expected to take place after issuance of a single OCS wind energy lease in the Call Area, compared to the cumulative impacts, could be **minor** to **major** depending on the unique characteristics of the affected historic property and the severity of the bottom disturbance.

High-End OCS Wind Energy Lease Issuance Scenario

Bottom disturbances and their potential impacts to cultural, historic, or archaeological resources from site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario are identical to those expected under the single OCS wind energy lease issuance scenario. Refer to Alternative B (Single OCS Wind Energy Lease Issuance in the Call Area) for details. Impacts to cultural, historic, or archaeological resources are considered on a site-specific basis due to the unique characteristics of individual historic properties and the corresponding unique cultural, historic, or archaeological significance inherent within each property. Accordingly, there is no variation in the potential for individual resources to be impacted by bottom disturbance activities conducted under either the high-end or single lease scenarios. Therefore, the effects of bottom disturbance on cultural, historic, and archaeological resources from the site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario under Alternative B would be **negligible** because existing regulatory measures, coupled with the information generated for a lessee's initial site characterization (e.g., geophysical and geotechnical surveys) and presented in the lessee's SAP, make the potential for bottom-disturbing activities to damage historic properties low. Should these protective measures not be applied, the bottom disturbance impacts from site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario under Alternative B could be **minor** to **major** depending on the unique characteristics of the affected historic property and the severity of the bottom disturbance.

The cumulative impacts of activities expected to take place after issuance of 18 OCS wind energy lease under Alternative B on cultural, historic, and archaeological resources would be **minor** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. For the same reason, when compared to the cumulative impacts, potential impacts on cultural, historic, and archaeological resources from site characterization and site assessment activities expected to take place under the high-end OCS wind energy lease issuance scenario under Alternative B would be **negligible** because potential sensitive sites would be avoided. If protective measures are not applied, the impacts from site assessment and site characterization activities expected to take place under the high-end OCS wind energy lease issuance scenario under Alternative B, compared to the cumulative impacts, could be **minor** to **major** depending on the unique characteristics of the affected historic property and the severity of the bottom disturbance.

Alternative C (Call Area Excluding the Topographic Features Stipulation Blocks)

For the purposes of this analysis, there is no difference between Alternative C and Alternative B in terms of the potential bottom disturbance impacts to cultural, historic, and archaeological resources (refer to Alternative B (Single OCS Wind Energy Lease Issuance in the Call Area)). Impacts to these resources are considered on a site-specific basis due to the unique characteristics of individual historic properties and the corresponding unique cultural, historic, or archaeological significance inherent within each property. Accordingly, there is no variation in the potential for individual resources to be impacted by bottom disturbance activities conducted under either Alternative C or Alternative B. Therefore, the incremental contribution of impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease under Alternative C on cultural, historic, and archaeological resources would be **negligible** because existing regulatory measures, coupled with the information generated for a lessee's initial site characterization (e.g., geophysical and geotechnical surveys) and presented in the lessee's SAP, make the potential for bottom-disturbing activities to damage historic properties low. Impacts under the high-end OCS wind energy lease issuance scenario would also be **negligible** because existing regulatory measures, coupled with the information generated for a lessee's initial site characterization (e.g., geophysical and geotechnical surveys) and presented in the lessee's SAP, make the potential for bottom-disturbing activities to damage historic properties low. Should these protective measures not be applied, the incremental contribution of impacts from bottom-disturbing activities on cultural, historic, and archaeological resources from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases in the Call Area under Alternative C could be **minor** to **major** depending on the unique characteristics of the affected historic property and the severity of the bottom disturbance.

The cumulative impacts of activities expected to take place after issuance of a single and 18 OCS wind energy lease under Alternative C on cultural, historic, and archaeological resources would be **minor** to **major** because of the existing activities occurring in the baseline environment and expected to occur in the future. For the same reason, when compared to the cumulative impacts, potential impacts from site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases under Alternative C on cultural, historic, and archaeological resources, with protective measures applied, would be **negligible** because potential sensitive sites would be avoided. If protective measures are not applied, the impacts from site assessment and site characterization activities expected to take place after issuance of a single OCS wind energy lease and for the issuance of 18 OCS wind energy leases in the Call Area under Alternative C, compared to the cumulative impacts, could be **minor** to **major** depending on the unique characteristics of the affected historic property and the severity of the bottom disturbance

CHAPTER 5

CONSULTATION AND COORDINATION

5 CONSULTATION AND COORDINATION

This chapter discusses public involvement and consultations in the preparation of this EA, including a summary of public scoping comments and formal consultations.

5.1 PUBLIC INVOLVEMENT

5.1.1 Request for Interest

BOEM published a Request for Interest (RFI) in the *Federal Register* on June 11, 2021, to assess interest in potential offshore wind development on the OCS. The RFI focused on the Gulf of Mexico's WPA and CPA offshore the States of Louisiana, Texas, Mississippi, and Alabama. During the comment period, BOEM convened its first Renewable Energy Task Force Meeting to discuss the RFI and other topics (refer to **Chapter 5.1.2**). The RFI comment period closed on July 26, 2021, and 39 comments were received in response. Through this process, BOEM determined that competitive interest exists for an area identified by the RFI. As such, BOEM will follow the procedures for a competitive lease sale. For more information on renewable energy leasing, refer to **Appendix A**.

5.1.2 Gulf of Mexico Intergovernmental Renewable Energy Task Force Meetings

BOEM held the first Gulf of Mexico Renewable Energy Intergovernmental Task Force (Task Force) meeting on June 15, 2021. The meeting's purpose was to facilitate coordination among Federal, State, local, and Tribal governments regarding the wind energy leasing process on the Gulf of Mexico OCS, establish a common understanding of the role and future activities of the Gulf of Mexico Intergovernmental Renewable Energy Task Force, update the Task Force and stakeholders on recent State activities, and provide opportunities for public input on the topics being considered by the Task Force. During the meeting, the members of the Task Force were introduced and their roles and responsibilities were discussed. The Task Force, other regional representatives, and the public heard presentations about BOEM's Renewable Energy Program, leasing process, overviews of State renewable energy goals, offshore wind jurisdictions, information resources and needs, and the next steps. BOEM also solicited feedback from the Task Force on BOEM's Request for Interest.

A second Task Force meeting was held on February 2, 2022. The purpose of the meeting was to present the potential areas identified in Federal waters offshore the GOM that may be suitable for offshore renewable energy development, and this Task Force provided critical information to the decision-making process. During that meeting, members of the Task Force, other regional representatives, and the public heard updates on the leasing process in the GOM region, including comments received on the Call for Information (Call) (refer to **Chapter 5.1.3**), The Task Force Members participated in member-only breakout sessions to share their agency's/organization's feedback or concerns on the Call Area and environmental review process. The meeting provided another opportunity for public input on topics being considered by the Task Force.

At each Task Force meeting, all attendees were provided the opportunity to raise issues and concerns about the Call. Full summaries of each meeting, associated presentations, and a roster of participants can be found at the following website by clicking on the appropriate tabs at https://www.boem.gov/renewable-energy/state-activities/gulf-mexico-gom-intergovernmental-renewable-energy-task-force.

5.1.3 Call for Information

On October 28, 2021, the Department of the Interior announced that it would publish a Call to further assess commercial interest in wind energy leasing in the GOM. The Call Area is a reduction of the area considered in the RFI and consists of approximately 30 million acres just west of the Mississippi River to the Texas/Mexican border and seaward of the Gulf of Mexico Submerged Lands Act Boundary to the 400-m (1,312-ft) bathymetry contour. The Call was published in the *Federal Register* on November 1, 2021, and triggered a 45-day public comment period ending on December 16, 2021 *(Federal Register* 2021*)*. BOEM received 40 comments in response to the Call. Responses to the Call assisted BOEM in deciding whether and where leases may be issued.

5.1.4 Environmental Assessment Press Release

On January 11, 2022, BOEM announced that it was preparing a Draft EA to consider potential offshore wind leasing in Federal waters of the GOM. This Draft EA considers potential environmental consequences of site characterization activities (i.e., biological, archeological, and geological, as well as geophysical surveys and core samples) and site assessment activities (i.e., installation of meteorological buoys) associated with the issuance of OCS wind energy leases in the Call Area. BOEM solicited input concerning the alternatives and issues to consider in the EA. The comment period was open from January 11 to February 9, 2022, and BOEM received 18 comments from interested parties.

Summary of Scoping Comments

- Many of the comments focused on later phases of the renewable energy development process that will be addressed and available for public comment during the construction and operations phase of any renewable energy development. As such, these comments were considered out of scope and not analyzed in this EA.
- Some comments focused on the identification of WEAs. WEA identification is out of scope and, therefore, these comments are not analyzed in this EA.
- As requested in many comments, this EA considers (among other topics) the impacts of site characterization and site assessment activities, both onshore and offshore in the GOM region; the analysis of impacts on resources in the GOM region; the consideration of essential fish habitat; social and economic impacts from proposed activities; how IPFs affect resources; and the consideration of environmental justice.
- Many of the comments cited broad environmental concerns (including cumulative impacts) or specific concern about impacts on marine wildlife in general or on protected species such as marine mammals (including Rice's whale) and sea

turtles. Others cited concerns about impacts to critical habitats, fish and fisheries, sensitive benthic communities, and pelagic resources. Within the broad category of socioeconomics, comments focused on impacts on fisheries, local jobs, and environmental justice.

- A few comments requested that BOEM consider protective measures including an alternative that does not allow HRG surveys during restricted months, adopt mitigations from sections of other legislation, implement monitoring and response plans, engage in consultations with other Federal agencies, consider buffer and exclusion zones, consider specific analysis methodologies, and suggested the preparation of a programmatic EIS.

5.1.5 Gulf of Mexico Fisheries Workshops

BOEM hosted four, sector-specific Gulf of Mexico Fisheries Workshops on January 19-20, 2022. Stakeholders shared information and discussed issues as BOEM prepared for development of potential WEAs and environmental reviews for offshore wind projects in the GOM. The purpose of the meetings was to collect information that will help avoid, minimize, or mitigate potential impacts of wind energy development on commercial and recreational fisheries and fishing. The meetings were open to the public and offered an opportunity to learn about the renewable energy leasing process, environmental review process, and potential activities in the GOM, as well as shared answers to fisheries-related Frequently Asked Questions. Since this meeting took place during the public scoping period, comments were solicited on the approach, alternatives, and potential impacts to be analyzed in this EA. More information on the meetings can be found online at https://www.boem.gov/renewable-energy/state-activities/gulf-mexico-fisheries-summit.

5.1.6 Area ID Memorandum

An Area ID decision is a required regulatory step under the renewable energy competitive leasing process used to identify areas for environmental analysis and consideration for leasing (refer to 30 CFR § 585.211(b)). The goal of BOEM's Area ID process is to identify the offshore locations that are suitable for leasing. The Area ID decision must take into consideration multiple competing uses and environmental concerns that may be associated with a proposed area's potential for commercial wind energy development. Through the Area ID process, BOEM considers the following non-exclusive list of information sources: comments and nominations received on the RFI and Call; information from the GOM Intergovernmental Renewable Energy Task Force; input from Alabama, Mississippi, Louisiana, and Texas State agencies; input from Federal agencies; comments from stakeholders, including the maritime community, offshore wind developers, and the commercial fishing industry; State and local renewable energy goals; and information on domestic and global offshore wind market and technological trends.

BOEM is leveraging an existing Marine Spatial Planning Analysis Model to identify potential WEAs. Spatial planning and analysis for potential WEAs requires a deep understanding of the relationship between different elements of the environment and ocean use as well as the practical requirements for offshore wind development. This modelling effort is applied to minimize potential conflicts in ocean space, mitigate interactions with other ocean users, and minimize adverse interactions with the environment. A comprehensive, authoritative spatial data inventory was developed, including data layers relevant to national security, natural and cultural resources, industry and operations, fisheries, logistics, and economics. The data holdings were developed through engagement with non-governmental organizations and U.S. Federal and State agencies representing a diverse array of stakeholders. The results of the model could help identify the best areas to support a renewable energy project that balances the competing uses of the GOM.

5.1.7 Other Stakeholder Engagement Opportunities

BOEM attended or presented material at other meetings with the stakeholders listed in **Table 5.1.7-1**. Meeting material, agendas, and other information from those meetings is provided in the applicable website links in **Table 5.1.7-1**, should there be a website with this material available to the public.

Table 5.1.7-1. Additional Stakeholder Engagement Meetings.

Stakeholder Engagement	Date	Applicable Website Links
Gulf States Marine Fisheries Commission	March 17, 2021	https://www.gsmfc.org/meetings.php
National Oceanic and Atmospheric Administration (NOAA)	April 6, 2021	
Department of Defense	April 9, 2021	
The Business Network for Offshore Wind	April 22, 2021	https://www.offshorewindus.org/event/2021-ipf-virtual-expansion/
State of Mississippi	April 2021	
The Business Network for Offshore Wind	May 6, 2021	
Offshore Operators Council Wind Workshop	May 20, 2021	https://www.theooc.org/events/offshore-wind-workshop-1
Gulf of Mexico Fishery Management Council	May 26, 2021	
Tribal Informational Meeting	June 10, 2021	
Louisiana Wind Week	June 21-25, 2021	https://gov.louisiana.gov/index.cfm/page/124
Gulf of Mexico Alliance Offshore Wind Webinar	June 30, 2021	https://gulfofmexicoalliance.org/events/gulf-renewable-energy-exchange-connecting-offshore-wind-to-the-coast/
Louisiana Oyster Task Force Meeting	July 20, 2021	
Louisiana Crab Task Force Meeting	August 3, 2021	https://www.wlf.louisiana.gov/assets/Resources/Publications/Crab_Task_Force/2021/crab_task_force_8_3_21_agenda.pdf
Louisiana Shrimp Task Force Meeting	August 4, 2021	

Stakeholder Engagement	Date	Applicable Website Links
Gulf of Mexico Fishery Management Council	August 25, 2021	https://gulfcouncil.org/wp-content/uploads/P-4-GOM-Renewables-Overview-Staterev3_mac.pdf
Louisiana Finfish Task Force Meeting	August 25, 2021	https://www.wlf.louisiana.gov/assets/Resources/Publications/Finfish_Task_Force/2021/finfish_task_force_agenda_8-25-21.pdf
Reef Fish Shareholders' Alliance	September 10, 2021	
NOAA-National Marine Fisheries Service	September 24, 2021	
Gulf States Marine Fisheries Commission	October 20, 2021	https://www.gsmfc.org/meetings.php
Coasts, Oceans, Ports, and Rivers Institute (COPRI)	October 28, 2021	
National Academy of Engineering	November 5, 2021	
SERPPAS Energy Working Group Meeting	November 10, 2021	
Shrimp Advisory Panel	December 8, 2021	https://gulfcouncil.org/ap/shrimp-ap-december-2021
Fisheries Mitigation Workshop	December 15, 2021	
Gulf of Mexico Fishery Management Council	January 24, 2022	
Professional Landmen's Association New Orleans	February 23, 2022	https://www.planoweb.org/media/46685/executive_night_2022_jan24.pdf
Louisiana Climate Task Force Meeting	March 9, 2022	Recording: https://youtu.be/-K_qVZJ7SVs
Texas General Lands Office Meeting	March 14, 2022	
Gulf States Marine Fisheries Commission	March 16, 2022	https://www.gsmfc.org/meetings.php
Gulf of Mexico Conference	April 25, 2022	https://web.cvent.com/event/f677ed8c-31e0-415c-b600-62b6c02d76a6/websitePage:25eda311-25cb-4895-9a0c-a64be1f4e919

5.1.8 Cooperating Agencies

As part of BOEM's announcement for this Draft EA, BOEM invited other Federal agencies and Tribes to consider becoming Cooperating Agencies in the preparation of this EA. For details on this invitation, refer to BOEM's website at https://www.boem.gov/renewable-energy/state-activities/gulf-mexico-activities. BOEM also indicated that even if a governmental entity is not a Cooperating Agency, it will have opportunities to provide information and comments to BOEM during the public input stages of the NEPA process.

BOEM received a Cooperating Agency request from the USEPA on January 27, 2022, in response to scoping for this EA. In light of the scope of the project, BOEM's own expertise and jurisdiction, and CEQ's guidance regarding Cooperating Agencies, BOEM has decided that the USEPA meets the qualifications to be a Participating Agency on this EA. BOEM sent a response letter to the USEPA on March 16, 2022, designating the USEPA as a Participating Agency and outlining BOEM's and the USEPA's roles and responsibilities. Under this agreement, the USEPA will review preliminary draft copies of sections of the Draft and Final EAs, and BOEM will consider the USEPA's comments during preparation of the Draft and Final EAs. The letter also suggested a meeting between the USEPA and BOEM to begin an open discussion on the future of renewable energy development in the GOM. On May 5, 2022, USEPA responded to BOEM declining the invitation to be a Participating Agency and indicated that USEPA is not required to provide preliminary reviews and comments prior to the release of the Draft EA. USEPA indicated they would review the Draft EA, once published.

In a comment letter dated February 8, 2022, FWS requested to be a Cooperating Agency on this EA. In light of the scope of the project and because of FWS' concerns related to the impacts of construction and operation of wind projects on migratory birds rather than the site assessment and site characterization activities analyzed in this EA, BOEM sent a response letter to FWS on March 16, 2022, indicating that, since BOEM has determined that the Proposed Action would pose negligible impacts to birds, it may not be appropriate for FWS to become a Cooperating Agency on this EA. The letter also suggested a meeting between FWS and BOEM to begin an open discussion on the future of renewable energy development in the GOM. The FWS and BOEM met on March 29, 2022. BOEM presented material on the renewable energy leasing process, WEA identification, the scope of the Draft EA, and the consultation plan. The FWS was invited to provide more comments concerning migratory birds when the Proposed Sale Notice is published and to attend the Task Force meeting planned to discuss the WEAs and provide comments on the Proposed Sale Notice.

During public scoping, in a comment letter dated February 9, 2022, the Texas Parks and Wildlife Department (TPWD) requested scoping meetings with BOEM to discuss key concerns and issues and to cooperatively collaborate with BOEM prior to and during the NEPA coordination and consultation process. BOEM sent an email to TPWD on March 16, 2022, to begin the process of setting up a meeting with TPWD. The TPWD responded on April 14, 2022, with several discussion topics. On May 2, 2022, BOEM met with the TPWD to describe the leasing process, explain the wind energy area identification process, and explain the scope of the EA, as well as answer questions.

5.2 CONSULTATIONS

5.2.1 Endangered Species Act

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §§ 1531 *et seq.*), requires that each Federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a Federal agency may affect a protected species or its critical habitat, that agency is required to consult with either NMFS or FWS, depending upon the protected species that may be affected.

BOEM will consult with FWS and NMFS regarding site assessment and site characterization activities resulting from OCS wind energy leases within the GOM Call Area. BOEM intends to complete these consultations before site assessment and site characterization activities occur. BOEM is developing best management practices (e.g., protocols) with eventual further coordination with NMFS and/or FWS, as appropriate, to minimize or eliminate potential effects from site assessment and site characterization activities to protected species. The best management practices include, but are not limited to, vessel strike avoidance measures, protected species observer visual monitoring, and shutdown and reporting procedures. These practices have been developed through years of conventional energy operation consultations and refined through BOEM's renewable energy program. It is assumed that all lessees will incorporate these best management practices, as required by ESA. All survey plans and site assessment plans will be reviewed by BOEM to ensure inclusion of appropriate avoidance measures. Refer to **Appendix H** for more detail on best management practices and standard operating conditions which, if chosen by the decisionmaker, will be detailed in the Final Sale Notice and applied as lease stipulations or conditions of the SAP.

5.2.2 Marine Mammal Protection Act

To ensure compliance with the Marine Mammal Protection Act per BOEM regulation 30 CFR § 585.801(b), BOEM's lease requirements will stipulate that lease holders must not conduct any activity under their lease that may result in an incidental taking of marine mammals until the appropriate authorization has been issued under the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. §§ 1361 *et seq*). These requirements will be detailed in the Final Sale Notice and applied as lease stipulations or conditions of the SAP.

5.2.3 Magnuson-Stevens Fishery Conservation and Management Act

Pursuant to Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act of 1976, Federal agencies are required to consult with NMFS on any action that may result in adverse effects on essential fish habitat. The NMFS regulations implementing the essential fish habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act can be found at 50 CFR part 600. BOEM and NMFS's Habitat Conservation Division (Southeast Regional Office) have discussed that the appropriate consultation strategy will be jointly determined upon NMFS' review of a BOEM-provided analysis of the potential impacts resulting from the Proposed Action. This strategy will be executed before site assessment and site characterization activities occur. All SOCs chosen by the decisionmaker, based on these consultations, will be detailed in the Final Sale Notice and applied as lease stipulations or conditions of the SAP.

5.2.4 Coastal Zone Management Act

The Coastal Zone Management Act requires that Federal actions that are reasonably likely to affect any land or water use or natural resource of the coastal zone be "consistent to the maximum extent practicable" with relevant enforceable policies of the State's federally approved coastal management program (15 CFR part 930 subpart C). Prior to each proposed OCS wind energy lease sale, BOEM prepares a Consistency Determination (CD) under 15 CFR § 930.36(a) to determine whether issuing leases and site characterization and site assessment activities (including the construction/installation, operation and maintenance, and decommissioning of meteorological [met] buoys) in the GOM Call Area are consistent to the maximum extent practicable with the provisions identified as enforceable by the Coastal Zone Management Programs of each Gulf Coast State along the GOM. To prepare the CDs, BOEM reviews each State's approved Coastal Management Plan and analyzes the potential impacts as outlined in this EA, new information, and applicable studies as they pertain to the enforceable policies of each Coastal Management Plan.

Based on these and other analyses, BOEM's Gulf of Mexico OCS Region's Regional Director makes an assessment of consistency, which is then sent to the States that BOEM determined to have reasonably foreseeable coastal effects in the GOM Call Area. For this EA, BOEM determined that Texas, Louisiana, Mississippi, and Alabama may have reasonably foreseeable coastal effects. BOEM has determined that a proposed OCS wind energy lease sale in the GOM Call Area is not reasonably likely to affect any land or water use or natural resource of Florida's coastal zone because there are several existing facilities within Texas, Louisiana, Mississippi, and Alabama that are located much closer to the GOM Call Area and could support site characterization and site assessment activities. If the State concurs, BOEM can proceed with the proposed lease sale.

BOEM determined that Texas, Louisiana, Mississippi, and Alabama share common coastal management issues and have similar enforceable policies as identified by their respective coastal zone management plans. Depending on the proximity of a lease sale in the GOM Call Area to each state, the similarity of the reasonably foreseeable activities, and the similarity of impacts on environmental and socioeconomic resources and uses within each state, BOEM may prepare a single CD under 15 CFR § 930.36(a) to determine whether issuing a lease for site characterization (surveys) and site assessment activities (including the installation, operation, and decommissioning of meteorological [met] buoys) in the GOM Call Area is consistent with the enforceable policies of the Coastal Management Plans of States deemed to have reasonably foreseeable coastal effects (Texas, Louisiana, Mississippi, and Alabama for this EA) to the maximum extent practicable.

This EA provides the comprehensive data and information required under 30 CFR § 939.39 to support the Bureau of Ocean Energy Management's CD.

5.2.5 Government-to-Government Consultations with Federally Recognized Tribes

BOEM recognizes the unique legal relationship of the U.S. with Tribal governments as set forth in the U.S. Constitution, treaties, statutes, Executive Orders, and court decisions. BOEM is required to consult with federally recognized Tribes if a BOEM action has Tribal implications, defined as any departmental regulation, rulemaking, policy, guidance, legislative proposal, grant funding formula changes, or operational activity that may have a substantial direct effect on an Indian Tribe. In recognition of this special relationship, BOEM is dedicated to conducting meaningful engagement with Tribes regarding agency activities. On January 13, 2021, BOEM sent an official letter to the following federally recognized Native American Tribes with historic and cultural ties to the region under consideration in the EA, inviting their participation in the Gulf of Mexico Intergovernmental Renewble Energy Task Force: Alabama-Coushatta Tribe of Texas; Caddo Nation of Oklahoma; Chitimacha Tribe of Louisiana; Coushatta Tribe of Louisiana; Jena Band of Choctaw Indians; Mississippi Band of Choctaw Indians; Muscogee (Creek) Nation; Poarch Band of Creek Indians; Seminole Nation of Oklahoma; Choctaw Nation of Oklahoma; and Tunica Biloxi Tribe of Louisiana.

On May 28, 2021, BOEM invited the Tribes to a virtual engagement meeting to provide initial information on Gulf of Mexico renewable energy planning, activities, schedules, the purpose of the Task Force, and to answer any questions from Tribes. That meeting was held on June 10, 2021, and was attended by representatives of the Chitimacha Tribe of Louisiana, Jena Band of Choctaw Indians, and Muscogee (Creek) Nation. Following this informational meeting, the Chitimacha Tribe of Louisiana and the Jena Band of Choctaw Indians sent representatives to the first Task Force meeting on June 15, 2021.

On November 18, 2021, BOEM invited these federally recognized Tribes to a government-to-government consultation meeting to discuss the GOM Call Area and development of this Draft EA. The Chitimacha Tribe of Louisiana, Coushatta Tribe of Louisiana, and Choctaw Nation of Oklahoma attended a government-to-government consultation held on January 11, 2022. The Coushatta Tribe of Louisiana subsequently joined the Task Force and sent a representative to the second Task Force meeting on February 2, 2022. Government-to-government consultations will continue with federally recognized Tribes during development of the EA.

5.2.6 National Historic Preservation Act (Section 106)

Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108) and its implementing regulations (36 CFR part 800) require Federal agencies to consider the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation an opportunity to comment. BOEM has determined that issuing commercial or research leases within the GOM Call Area and granting ROWs and RUEs within the region constitutes an undertaking subject to Section 106 of the National Historic Preservation Act (16 U.S.C. § 470f) and its implementing regulations (36 CFR part 800) as the resulting site characterization and site assessment activities have the potential to cause effects on historic properties.

BOEM will consult with the Texas and Louisiana State Historic Preservation Offices and the Advisory Council on Historic Preservation regarding site assessment and site characterization activities resulting from leases within the GOM Call Area. BOEM also will identify potential additional consulting parties including, but not limited to, federally recognized Tribal Nations, State-recognized Tribes, certified local governments, and historic preservation societies and museums regarding the identification of, and potential effects on, historic properties for the purpose of obtaining public comment and input for the Section 106 review (36 CFR § 800.3(f)). These consultations will further seek to develop and implement appropriate requirements on lessees to identify potential historic properties within their lease area and, when applicable, additional measures to avoid, minimize, or mitigate adverse effects to those properties. BOEM intends to complete these consultations before activities occur. Refer to **Appendix H** for more detail on standard operating conditions which, if chosen by the decision-maker, will be detailed in the Final Sale Notice and applied as lease stipulations or conditions of the SAP.

CHAPTER 6

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6 PREPARERS

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APPENDIX A

INTRODUCTION, BACKGROUND, AND DESCRIPTION OF WIND ENERGY LEASING, SITE CHARACTERIZATION, AND SITE ASSESSMENT ACTIVITIES

What is in This Appendix?

- An overview of the site characterization and site assessment framework and intent of this appendix.
- History of wind energy leasing on the Outer Continental Shelf (OCS) and overview of the wind energy production process, beginning with leasing, site characterization, and site assessment activities, through construction and operations to decommissioning.
- Descriptions of the activities associated with wind energy site characterization and site assessment activities.

Key Points

- The Energy Policy Act of 2005 authorized the Bureau of Ocean Energy Management (BOEM) to issue leases, easements, and rights-of-way to allow for renewable energy development on the OCS.
- Beginning in 2010, BOEM began offering leases in the Atlantic Region.
- Since 2016, BOEM has been exploring renewable energy potential in the Gulf of Mexico (GOM). In 2020, BOEM published two studies with the National Renewable Energy Laboratory: one analyzing different renewable energy technologies' feasibility in the GOM (Musial et al. 2020b) and the other a specific evaluation of wind energy in the GOM (Musial et al. 2020a).
- The OCS wind energy leasing process consists of four distinct phases: (1) the planning phase; (2) the leasing phase; (3) the site assessment phase; and (4) the construction and operation phase. BOEM conducts environmental reviews at Phases 2, 3, and 4.
- The phases of OCS wind energy development, site characterization, and site assessment activities are described in this appendix.

A INTRODUCTION, BACKGROUND, AND DESCRIPTION OF WIND ENERGY LEASING, SITE CHARACTERIZATION, AND SITE ASSESSMENT ACTIVITIES

A.0 INTRODUCTION

The Secretary of the Interior (Secretary) has designated the Bureau of Ocean Energy Management (BOEM) as the administrative agency responsible for the administration of energy and mineral exploration and development of the Outer Continental Shelf (OCS). BOEM is responsible for managing the development of the Nation's offshore mineral and energy resources in an environmentally and economically responsible way. BOEM's responsibilities include leasing; plan administration; environmental studies, consultations, and analyses in compliance with the National Environmental Policy Act (NEPA) and other statutes; resource evaluation; economic analysis; and administration of the OCS Oil and Gas, Marine Minerals, and Renewable Energy Programs.

The intent of this appendix is to describe the historical background of wind energy leasing on the OCS, current leasing trends, and the typical phases of wind energy activities following a lease sale. It also provides an overview of the leasing process and descriptions of the potential site characterization and site assessment activities. The Area of Analysis is the area in which OCS wind energy leasing, site characterization, and site assessment would take place and, therefore, the area of potential effect. The Area of Analysis includes the Federal OCS waters of the GOM within BOEM's GOM Call for Information and Nominations (Call), which is located within the Central Planning Area (CPA) and Western Planning Area (WPA) on the OCS portion of the Gulf of Mexico. The GOM Call Area comprises the area located seaward of the Gulf of Mexico Submerged Lands Act boundary, bounded on the east by the north-south line located at 89.858° W. longitude and bounded on the south by the 400-meter (m) (1,312-foot [ft]) bathymetry contour and the U.S. Mexico Maritime Boundary established by the Treaty Between the Government of the United States of America and the Government of the United Mexican States on the Delimitation of the Continental Shelf in the Western Gulf of Mexico Beyond 200 Nautical Miles (U.S.-Mexico Treaty), which took effect in January 2001. BOEM has no jurisdiction in State waters; however, aspects of wind energy leasing, site characterization, and site assessment activities could cross State waters. State waters extend from the coastline outside of estuaries seaward 3 nautical miles (nmi) (3.5 miles [mi]; 5.6 kilometers [km]) from Louisiana, Mississippi, and Alabama, and seaward to 9 nmi (10.4 mi; 16.7 km) from the coastlines of Texas and Florida (**Figure A.0-1**).

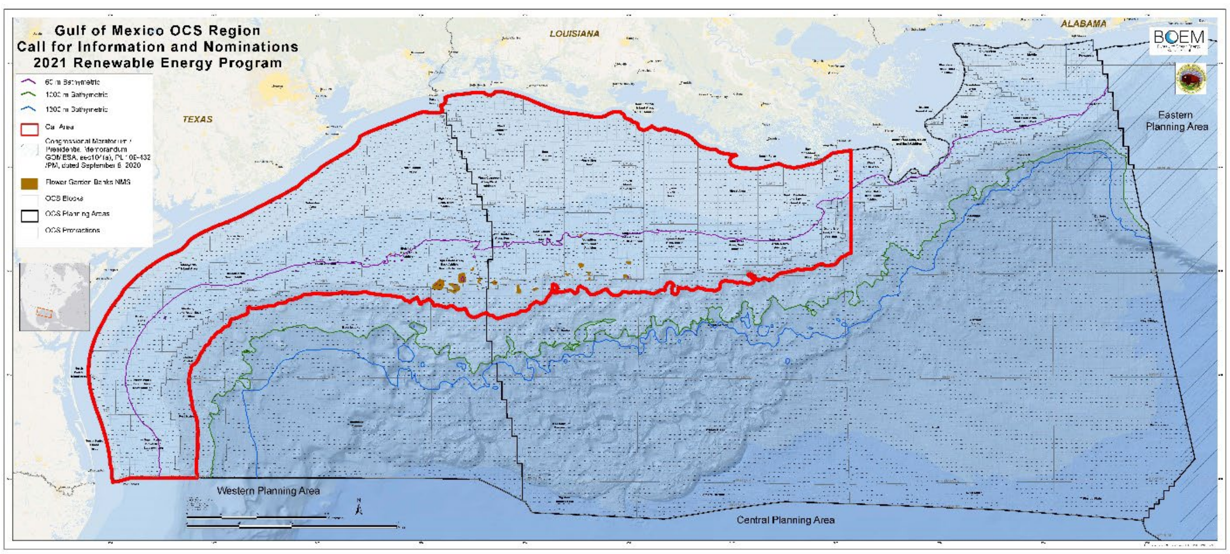

Figure A.0-1. Area of Analysis.

This appendix, in combination with Appendices B, C, and D, will help in understanding the unique and varied resources in the GOM geographic area and in analyzing how they could be affected by any future wind energy leasing, site characterization, and site assessment on the Gulf of Mexico OCS. These appendices describe, in detail, wind energy leasing, and potential site characterization and site assessment activities (**Appendix A**), resulting impact-producing factors (IPFs) (**Appendix B**), environmental setting (**Appendix C**), and baseline conditions and affected environment (**Appendix D**). These appendices aid in focusing the discussion and analysis in future environmental analyses on the most relevant information to consider in making informed decisions. The information provided herein was not analyzed for a specific development scenario but under the assumption that certain activities may transpire following an OCS wind lease sale, should one occur. This appendix does not analyze reasonable activities following any other type of renewable energy leasing (i.e., marine hydrokinetics, marine photovoltaics, etc.).

A.1 HISTORICAL BACKGROUND

Under Executive Order 9633, the Federal Government declared authority of OCS energy and mineral resources in the late 1940s, but its authorization to exploit the mineral resources of the OCS was not firmly established until passage of the Outer Continental Shelf Lands Act (OCSLA) of 1953. In 1953, Congress enacted the Submerged Lands Act and the OCSLA, the latter of which was significantly amended in 1978. The OCSLA defines the OCS as all submerged lands lying seaward of State coastal waters (3 nmi; 3.5 mi; 5.6 km offshore), which are under U.S. jurisdiction. The only exceptions are Texas and the west coast of Florida, where State jurisdiction extends from the coastline to 9 nmi (10.4 mi; 16.7 km) into the Gulf of Mexico. Under the OCSLA, the Secretary is responsible for the administration of mineral exploration and development of the OCS.

The Energy Policy Act of 2005 (EPAct) authorized BOEM to issue leases, easements, and rights-of-way to allow for renewable energy development on the OCS. The EPAct provided a general framework for BOEM to follow when authorizing these renewable energy activities. For example, the EPAct requires that BOEM coordinate with relevant Federal agencies and affected State and local governments, obtain fair return for leases and grants issued, and ensure that renewable energy development takes place in a safe and environmentally responsible manner. In 2009, the U.S. Department of the Interior announced the finalization of regulations governing the Bureau of Ocean Energy Management's OCS Renewable Energy Program (30 CFR part 585). These regulations provide a detailed structure to govern how BOEM manages its Renewable Energy Program, ensure that BOEM meets its statutory obligations, and provide both certainty and flexibility for overseeing the nascent offshore renewable energy industry. A brief history of offshore milestones and legislation through 2019 can be found in **Figure A.1-1**.

As offshore activities expanded in the years following adoption of the OCSLA, environmental awareness was also increasing across the Nation. Responding to this increased awareness, Congress passed NEPA in 1969 and the Coastal Zone Management Act (CZMA) in 1972. In 1978, Congress passed significant amendments to the OCSLA allowing expedited offshore exploration and production in order to achieve national energy goals while also providing for environmental protection and opportunities for State and local governments affected by offshore activity to have their voices heard. These statutes are briefly summarized below and discussed in further detail in the *Gulf of Mexico OCS Regulatory Framework* technical report for the Gulf of Mexico region (BOEM 2020d) and the regulations governing the Bureau of Ocean Energy Management's OCS Renewable Energy Program (30 CFR part 585).

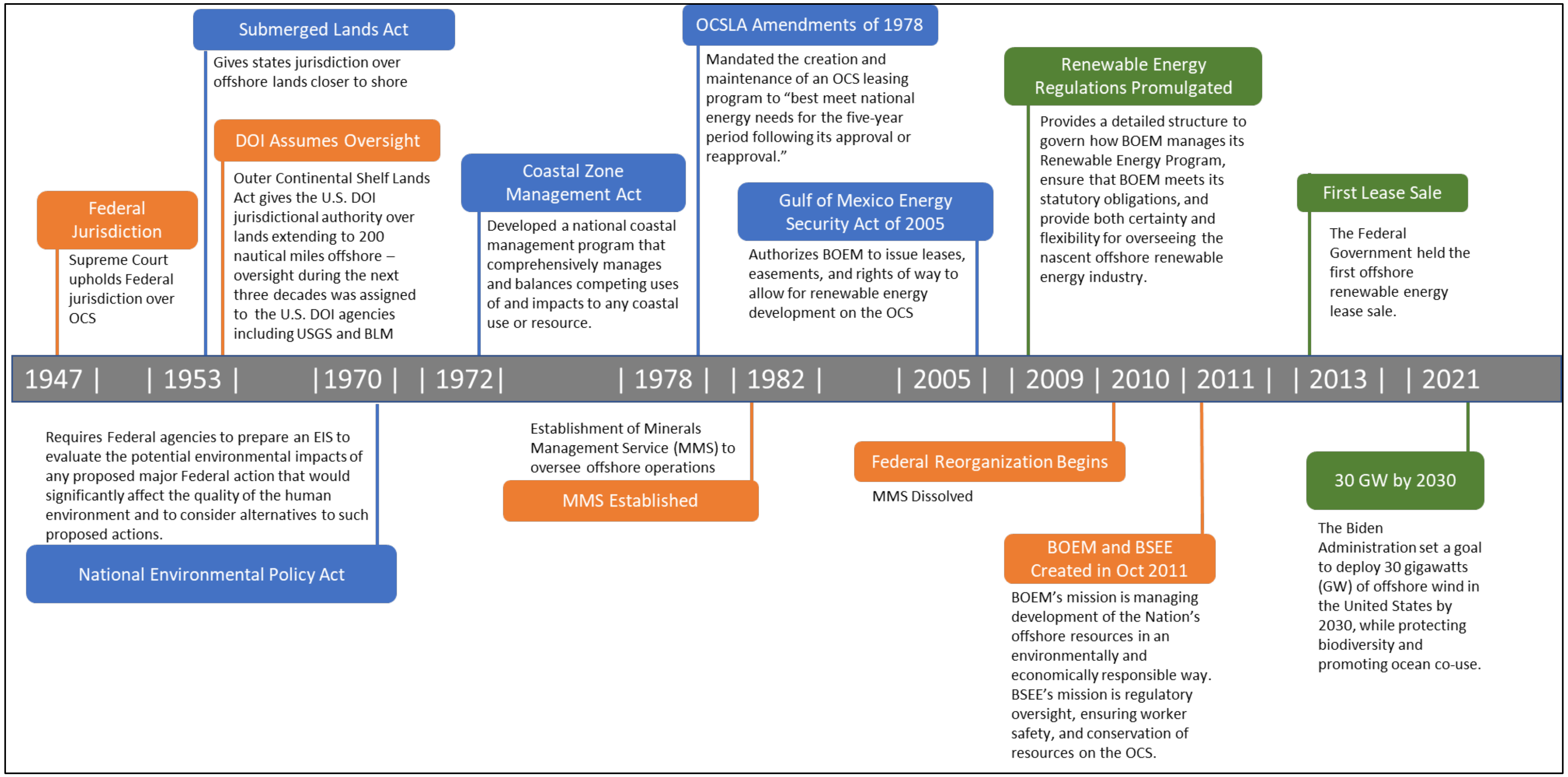

Figure A.1-1. Regulatory History of the OCS Renewable Energy Program.

The NEPA requires that all Federal agencies use a systematic, interdisciplinary approach to protection of the human environment; this approach will ensure the integrated use of the natural and social sciences in any planning and decision-making that may have an impact upon the environment. The NEPA also requires Federal agencies to prepare an environmental impact statement to evaluate the potential environmental impacts of any proposed major Federal action that would significantly affect the quality of the human environment and to consider alternatives to such proposed actions.

- The CZMA was enacted by Congress in 1972 (16 U.S.C. §§ 1451 *et seq.*) to develop a national coastal management program that comprehensively manages and balances competing uses of and impacts to any coastal use or resource. The CZMA Federal consistency regulations require that Federal activities (e.g., OCS leasing) be consistent to the maximum extent practicable with the enforceable policies of a State's coastal management program. The Federal consistency regulations also require that other federally approved activities (e.g., activities requiring Federal permits, such as activities described in OCS plans) be consistent with a State's federally approved coastal management program.

Renewable Energy History on the U.S. Outer Continental Shelf

Since the EPAct (2005) and BOEM's regulations (2009) were enacted, BOEM has worked diligently to oversee responsible renewable energy development. Prior to issuing any leases, BOEM (then the Bureau of Ocean Energy Management, Regulation and Enforcement) developed the "Smart from the Start" wind energy initiative in 2010 for the Atlantic OCS to facilitate siting, leasing, and construction of new projects. BOEM worked with State partners to identify offshore locations that appear most suitable for wind energy development or wind energy areas (WEAs) off the coasts of a number of Atlantic states, including Maryland, Delaware, New Jersey, Virginia, Rhode Island, and Massachusetts. In addition to this initiative, BOEM also established State-Federal Task Forces to assist in developing WEAs and work through issues as they arise, and the Atlantic Offshore Wind Energy Consortium with 11 coastal State governors. Combined, these initiatives spurred the rapid and responsible development of wind energy development on the Atlantic OCS.

The Pacific OCS is the second most active coast in the U.S. in terms of OCS renewable energy development. On the Pacific OCS, BOEM established State-Federal Task Forces in Oregon and California. Oregon led the way with the Intergovernmental Renewable Energy Task Force formation in 2011 and has had eight meetings to plan renewable energy development on the OCS off Oregon. Oregon has a planned marine hydrokinetic research project and is still in the process of identifying a WEA(s). California has more recently begun to plan for renewable energy development on the OCS off its coast. There have been four official meetings of the California Renewable Energy Intergovernmental Task Force beginning in 2016 with a few other outreach efforts as well. The Task Force has identified two distinct WEAs, i.e., a Northern and Central California WEA. On July 29, 2021, BOEM published a Call for Information and Nominations to solicit public input and determine industry interest in developing commercial wind projects at two new areas offshore central California. The new areas are adjacent to the Morro Bay Call Area, originally designated by BOEM in 2018, and have been identified as the Morro Bay Call Area East Extension and Morro Bay Call Area West Extension. BOEM is also advancing with the Federal leasing process for the Humboldt Area offshore northern California, which has now been formally designated as a WEA, for which BOEM is proceeding with an environmental review, as required under NEPA. While the Pacific OCS is still in the planning phase, the number and range of potential projects there indicates the high level of activity and continuation of renewable energy development into the foreseeable future.

Once BOEM established the planning bodies and implementation regulations, they quickly began renewable energy development on the OCS. The first United States OCS commercial wind lease was issued in 2010 as part of the Cape Wind project offshore Massachusetts. Nearly all of the renewable energy leases issued since Cape Wind have been on the Atlantic OCS. As of January 2022, BOEM has 17 commercial and 1 research active wind leases on the Atlantic OCS offshore Delaware, Virginia, Rhode Island, Massachusetts, Maryland, New Jersey, New York, North Carolina, and Florida. BOEM has also granted a marine hydrokinetic lease on the Pacific OCS offshore Oregon. BOEM is also in the planning stages for commercial wind leases on the Pacific OCS offshore California and the Gulf of Mexico OCS.

A.2 OVERVIEW OF THE RENEWABLE ENERGY DEVELOPMENT PROCESS

BOEM's Office of Renewable Energy Programs oversees the development of renewable energy projects on the United States OCS in an economically and environmentally responsible manner. While BOEM's offshore renewable energy portfolio consists of several resources—including ocean wave and ocean current energy—offshore wind energy has garnered the most interest to date. In 2020, BOEM published a study in partnership with the National Renewable Energy Lab to assess the feasibility of different renewable energy technologies in the GOM (Musial et al. 2020b). Through that study, BOEM identified offshore wind energy as the most feasible renewable energy technology for the GOM (Musial et al. 2020a). Therefore, for the purposes of this background document, BOEM will focus on the commercial offshore wind energy development process.

There are a number of forms that a renewable energy development project can take that may require different kinds of authorizations. BOEM issues three different types of leases for renewable energy projects. A commercial lease serves projects that generate energy for sale and distribution. Limited leases support the production of energy but do not result in the production of electricity for sale or distribution beyond a very limited threshold. A research lease is reserved solely for States or Federal agencies conducting renewable energy research activities on the OCS. A developer holding a lease is referred to as a lessee. A lease is an agreement that allows a prospective renewable energy developer to explore, develop, and potentially produce energy from renewable energy resources. Under BOEM's regulations as of 2022, a lease does not authorize any on-site activities; rather, the lease provides the lessee with the exclusive right to submit plans , i.e., a Site Assessment Plan (SAP), Construction and Operations Plan (COP), or General Activities Plan (GAP), for BOEM's review and potential approval. Activities proposed in a plan are subject to BOEM's approval after thorough environmental and technical reviews are conducted.

BOEM also issues two types of grants associated with renewable energy projects. A right-of-way (ROW) grant authorizes the installation of cables, pipelines, and associated facilities that involve the transportation or transmission of electricity or other energy produced from a renewable energy project that is not located on the OCS. Right-of-use (RUE) grants authorize the construction and maintenance of facilities or installations that support the production, transportation, or transmission of electricity or other energy produced from a renewable energy project on the OCS.

For any of the above authorization types (lease or grant), BOEM requires plans be submitted for approval prior to any activities taking place. The SAP describes how the lessee will conduct resource assessment activities, such as the installation of meteorological buoys, and technology testing during the site assessment phase of the commercial lease. BOEM must approve the SAP before the lessee can install site assessment facilities or conduct activities described in the SAP. The COP describes how the lessee will construct and operate a commercial renewable energy project on a commercial lease. The COP includes a description of all planned facilities, as well as a description of proposed construction activities, commercial operations, and conceptual decommissioning plans. BOEM must approve the COP before the lessee can install facilities or conduct commercial activities described in the COP. The GAP describes how the lessee/grantee would construct and operate renewable energy facilities on a limited lease or ROW/RUE grant. The GAP includes a description of construction activities for all planned facilities, associated activities, and conceptual decommissioning plans. BOEM must approve the GAP before the lessee can install facilities or conduct activities described in the GAP. These plans are generated and submitted to BOEM for approval through a multi-stage process that includes environmental reviews.

The OCS renewable energy development process consists of four stages: (1) planning and analysis; (2) leasing; (3) site assessment including site characterization surveys submitted with a SAP; and (4) construction and operations (**Figure A.2-1**). The project's development process begins with the planning phase where the Intergovernmental Renewable Energy Task Force (Task Force) convenes, BOEM publishes a Request for Interest from potential lessees, and WEAs are developed. The leasing phase encompasses the lease sale, lease issuance, and utilizing the site for plan submission. The site assessment phase begins when the SAP is submitted to BOEM. Once approved, the lessee may then carryout the activities authorized in the plan, such as surveys (geological and geophysical, archaeological, biological, etc.) and installation of met-ocean testing equipment. Finally, the construction and operations phase begins with the submission of a construction and operations plan and continues through the approval of that plan, design and installation of wind energy infrastructure, operation of the wind farm, and ends with the decommissioning of the wind farm.

BOEM conducts environmental reviews at all of the stages outlined below (**Figure A.2-1** and **Sections A.2.1-A.2.4**). These environmental reviews include site-specific analysis under NEPA at each subsequent stage of activity, as well as evaluations and coordination with other agencies under such acts as the CZMA, Endangered Species Act, National Historic Preservation Act (NHPA), Magnuson-Stevens Fishery Conservation and Management Act, Migratory Bird Treaty Act, and Marine Mammal Protection Act.

1 Planning and Analysis

- Identify suitable areas to be considered for wind energy project leases through collaborative, consultative, and analytical processes, including using the BOEM Intergovernmental Renewable Energy Task Force, public information meetings, and input from State and Federal agencies, federally recognized Tribes, and other stakeholders.

2 Leasing

- BOEM issues a commercial wind energy lease.
- Gives lessee exclusive right to seek BOEM approval for the development of the leasehold.
- Lease does not grant the lessee the right to construct any facilities; the lease grants the right to use the lease area to develop its plans, which must be approved by BOEM before the lessee can move on to the next stage of the process (see 30 CFR §§ 585.600 and 585.601).

3 Site Assessment

- Lessee has 1 year after lease execution to submit a SAP, which contains a lessee's detailed proposal for the construction and/or installation of meteorological towers and/or buoys.
- Allows lessee to install and operate site assessment facilities for a specified term.
- BOEM must approve a SAP before lessee conducts site assessment activities on the leasehold.
- BOEM may approve, approve with modification, or disapprove a lessee's SAP (see 30 CFR §§ 585.605-585.618).
- Once BOEM approves a SAP, a lessee has 5 years to complete site characterization and site assessment activities. A lessee would conduct surveys to support COP submittal during the site assessment term.

4 Construction and Operations

- Six months prior to the end of the 5-year site assessment term, a lessee submits a COP, which contains a detailed plan for the construction and operation of a wind energy project on the lease.
- BOEM approval of a COP is a precondition to the construction of any wind energy facility on the OCS.
- After the preparation of a site- and project-specific NEPA document, BOEM may approve, approve with modification, or disapprove a lessee's COP (see 30 CFR §§ 585.620-585.638).
- If approved, the lessee is allowed to construct and operate wind turbine generators and associated facilities for a term for 25 years.

Figure A.2-1. Phases of BOEM's Wind Energy Planning/Authorization Process.

A.2.1 Planning and Analysis Phase

The planning and analysis phase seeks to identify suitable areas for wind energy leasing consideration through collaborative, consultative, and analytical processes that engage stakeholders, Tribes, and State and Federal government agencies. This is the phase when BOEM begins environmental compliance reviews and consultations with Tribes, States, and natural resource agencies.

A.2.1.1 Intergovernmental Renewable Energy Task Forces

To help inform BOEM's planning and leasing process, BOEM has established Intergovernmental Renewable Energy Task Forces in states that have expressed interest in development of offshore renewable energy. These Task Forces consist of representatives from federally recognized tribes, Federal agencies, States, and local governments. The role of each Task Force is to collect and share relevant information that would be useful to BOEM during its decision-making process. The Task Forces are neither a decision-making nor an approval body, the Secretary of the Interior remains the ultimate decision maker. BOEM's Task Forces serve as forums to coordinate planning; solicit feedback; educate about BOEM's processes, permitting, and statutory requirements; and exchange scientific and other information. Task Force meetings have helped identify areas of significant promise for offshore development and provided early identification of, and steps toward resolving, potential conflicts. To date, BOEM Intergovernmental Task Forces have been established in California, Delaware, Florida, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Rhode Island, South Carolina, and Virginia. BOEM is prioritizing a regional approach in establishing Task Forces like the Gulf of Mexico Intergovernmental Renewable Energy Task Force which include the States of Alabama, Louisiana, Mississippi, and Texas.

A.2.1.2 Request for Interest

The EPAct requires BOEM to issue leases on a competitive basis, unless it determines that there is no competitive interest in the proposed lease. Therefore, the first step in the wind leasing process is for BOEM to issue a Request for Interest (RFI) in the *Federal Register*. Whether the initiation of the leasing process is from an unsolicited request or through BOEM, the RFI is intended to help BOEM determine if there is competitive interest in a potential lease area. BOEM will consider information received in response to a RFI to determine whether there is competitive interest for scheduling lease sales and issuing leases. If BOEM determines that competitive interest exists, the process moves forward with a Call for Information and Nominations (**Section A.2.1.3**). If competitive interest is not found, then BOEM can proceed with a noncompetitive leasing process (**Section A.2.2.4**).

A.2.1.3 Call for Information and Nominations

After BOEM has determined that competitive interest exists, it publishes in the *Federal Register* a Call for Information and Nominations (Call) for leasing in specified areas. The Call solicits public input on areas of interest or concern and specifically solicits industry interest on areas that should be considered for leasing. In this document, BOEM may suggest areas to be considered by the respondents for leasing and/or request comments on areas that should receive special consideration and analysis; geological conditions (including bottom hazards); archaeological sites on the seabed or nearshore; multiple uses of the proposed leasing area (including navigation, recreation, and fisheries);

and other socioeconomic, biological, and environmental information. The comment period following issuance of a Call is 45 days.

A.2.1.4 Area Identification

After the Call, BOEM completes and announces its Area Identification (Area ID), which determines the discrete area that will be considered for leasing and for further environmental analysis. BOEM does this in consultation with appropriate Federal agencies, States, local governments, affected Indian Tribes, and other interested parties. BOEM may consider for lease those areas nominated in response to the RFI and Call or discussed through the Task Force, together with other areas that BOEM determines are appropriate for leasing. BOEM will evaluate the potential effect of leasing, site characterization, and site assessment activities on the human, marine, and coastal environments, and develop measures through consultation to mitigate adverse impacts on the environment, including lease stipulations. BOEM may hold public hearings on the environmental analysis after appropriate notice.

Based on information gathered from the Task Force and responses to the RFI and Call, BOEM will also identify the proposed action to be analyzed in the NEPA document. BOEM publishes the Area ID decision in a press release and on its website.

A.2.2 Leasing Phase

The leasing phase results in the issuance of a commercial wind energy lease. Leases may be issued either through a competitive or noncompetitive process. A commercial lease gives the lessee the exclusive right to subsequently seek BOEM's approval for the development of the leasehold. The lease does not authorize any on-site activities; rather, the lease grants the lessee the exclusive right to submit its plans, which must be approved by BOEM before the lessee can move on to the next stage of the process. Prior to holding a renewable energy lease sale, BOEM must ensure that all necessary reviews and/or opportunities for public input have taken place under the OCSLA, CZMA, and NEPA.

A.2.2.1 Sale Notices

Proposed Sale Notice

The Proposed Sale Notice (PSN), which is published in the *Federal Register*, describes the timing, size, and location of a proposed renewable energy lease sale and includes the terms and conditions proposed for the lease sale. The PSN publication typically coincides with publication of the Draft Environmental Assessment (EA) so that comments received on the PSN can be incorporated into the Final EA, as applicable. The PSN is the first public document stating the proposed time and location of the proposed lease sale with the terms and conditions, as well as the recommended mitigating measures. Section 19 of the OCSLA (43 U.S.C. § 1345) requires BOEM to solicit input on the size, timing, and location of lease sales from governors of the affected states. BOEM sends the PSN to the governors of affected states requesting their recommendations on the proposed lease sale's size, timing, and location. The governors have 60 days to submit their recommendations to BOEM. The PSN will include, or describe the availability of information pertaining to the items below.

(1) Area available for leasing.

(2) Proposed and final lease provisions and conditions including, but not limited to

 (a) lease size,

 (b) lease term,

 (c) payment requirements,

 (d) performance requirements, and

 (e) site-specific lease stipulations.

(3) Auction details including

 (a) bidding procedures and systems;

 (b) minimum bid;

 (c) deposit amount;

 (d) the place and time for filing bids and the place, date, and hour for opening bids;

 (e) lease award method; and

 (f) bidding or application instructions.

(4) Official BOEM lease form to be used or a reference to that form.

(5) Criteria BOEM will use to evaluate competing bids or applications and how the criteria will be used in decision-making for awarding a lease.

(6) Award procedures, including how and when BOEM will award leases and how BOEM will handle unsuccessful bids or applications.

(7) Procedures for appealing the lease issuance decision.

(8) Execution of the lease instrument.

Final Sale Notice

BOEM will publish a Final Sale Notice (FSN) in the *Federal Register* at least 30 days before a lease sale is held. The publication of the FSN coincides with publication of the Final EA and Finding of No Significant Impact (FONSI), if applicable. The FSN incorporates the relevant comments from the PSN and provides the finalized information regarding the lease sale as mentioned above.

A.2.2.2 NEPA Process

Each lease sale requires a NEPA evaluation, which concludes with the issuance of a FONSI or a Record of Decision (ROD), if significant impacts are expected, at least 30 days prior to the actual lease sale. The FONSI or Record of Decision informs the FSN Decision as outlined above. The process below outlines BOEM's current NEPA process for a renewable energy lease sale.

Notice to Stakeholders and Public Scoping

Similar to the leasing process under the OCSLA, the NEPA process for a lease sale is typically initiated and conducted in parallel with the development of the lease sale. BOEM's approach for this EA is to analyze the entire GOM Call Area, rather than using the Area Identification (Area ID) process to identify WEA's followed by preparation of an EA covering only those areas to be considered for potential leasing. As such, BOEM announced a notice to stakeholders to prepare a region-specific EA in conjunction with the Call. The notice to stakeholders is accompanied with a minimum 30-day comment period, which can be extended at the discretion of the agency. BOEM may also hold one or more public scoping meetings in communities that could be affected if leasing or development were to occur. The purpose of the notice to stakeholders is to solicit input on the relevant issues, alternatives, mitigating measures, and analytical tools available so that they can be incorporated into the EA.

Draft Environmental Assessment

Following the notice to stakeholders and public comment period, BOEM develops the Draft EA. The EA analyzes the potential impacts of routine and non-routine activities associated with the issuance of a lease, site characterization activities, and site assessment activities for the proposed alternatives, along with the concerns identified during internal and external scoping. The objective of the analysis is to estimate the nature, severity, and duration of impacts that might occur and to compare the impacts of the various alternatives for a proposed lease sale. The EA typically incorporates technical aids such as this appendix; studies sponsored by BOEM, as well as other government and academic institutions; consultation documents; and other peer-reviewed literature. Once the EA is completed, a notice to stakeholders is announced by BOEM, along with a minimum 30-day public comment period, which can be extended at the discretion of the agency. During the public comment period, BOEM will solicit public input through various techniques that could include any or all of the following: social media; press releases; newspaper ads; conferences; mailing lists; and/or public meetings or "open-house" style forums (virtual or in-person as prudent). Comments received on the PSN will also be considered and incorporated, as applicable (refer to **Section A.2.2.1**).

Final Environmental Assessment

The Final EA addresses public comments received during the comment period for the Draft EA and includes a summary of all comments and BOEM's responses. After the comments on the Draft EA are reviewed, BOEM revises the document to correct technical errors and update the analysis based on stakeholder input and any other relevant new information that became available since publication of the Draft EA. Once completed, the Final EA is published with a FONSI, if applicable.

Finding of No Significant Impact

If BOEM determines through its analysis and stakeholder input that no significant impacts will occur following the proposed action or a chosen alternative, it will issue a FONSI. Under the 2020 updated Council on Environmental Quality regulations for implementing NEPA, the EA should strive to be completed in approximately 1 year, absent approval from agency senior leadership. The FONSI should also be signed at least 30 days prior to the actual lease sale.

A.2.2.3 Holding the Lease Sale and Acquiring a Lease

No less than 30 days after the FSN is published in the *Federal Register*, BOEM conducts the competitive lease sale. The lease sale can take many formats (described in 30 CFR § 585.220) and will be described in the Proposed and Final Sale Notices in detail. The winning bidder will be subject to final confirmation following determination of bid adequacy. Typically, immediately following the lease sale, the winning bidder may, if certain conditions are met, have 1 hour to be able to revoke their winning bid. The conditions necessary are if the second highest bidder is a government body and the winning bidder requested the ability to revoke their bid prior to the lease sale.

If the bid is not revoked, a panel convenes to verify the lease sale results and the winner is announced. The Department of Justice then has up to 30 days for an antitrust review of the lease sale results. Once cleared, BOEM will send three copies of the lease to be executed. The winning bidder has 10 business days to post financial assurance, pay any outstanding balance of its bonus bid (i.e., winning monetary bid minus applicable non-monetary credits and bid deposit), and sign and return the three executed lease copies. Once BOEM has received the lease copies and verified that all other required materials have been received, BOEM will make a final determination regarding its issuance of the lease and will execute the lease if appropriate.

An executed lease grants the lessee the exclusive right, subject to obtaining the necessary approvals, including but not limited to those required under the Federal Energy Regulatory Commission hydrokinetic licensing process, and complying with all provisions of the regulations to submit to BOEM a SAP and COP proposing development of the leasehold. The lease does not authorize any activity within the lease area. Following lease issuance, a lessee would conduct surveys and, if authorized to do so pursuant to an approved SAP, install meteorological measurement devices to characterize the site’s environmental and socioeconomic resources and conditions and to assess the wind resources in the proposed lease area. A lease confers on the lessee the right to one or more project easements without further competition for the purpose of installing gathering, transmission, and distribution cables; pipelines; and appurtenances on the OCS as necessary for the full enjoyment of the lease.

A.2.2.4 Non-Competitive Leasing

When only one developer has indicated interest in developing a given site, and BOEM determines that there is no competitive interest in a lease, BOEM may issue a lease or grant noncompetitively. This process requires BOEM to review the lease request after completing a consistency certification, environmental analysis, and consultations with affected Federal agencies, State and local governments, and Indian Tribes. Once BOEM's review is completed, they may offer a lease. If the developer signs the lease, they would be bound by all terms and conditions set forth in the lease. The developer then has three options to continue development: submit an SAP; submit a COP; or submit a combined SAP/COP, which are described in the sections below.

A.2.3 Site Assessment Phase

The site assessment phase includes the submission of a Site Assessment Plan (SAP), which contains the lessee's detailed proposal for the activities they propose to conduct under their SAP, such as the installation of meteorological buoys on the leasehold. The lessee's SAP must be approved by BOEM before it conducts these site assessment activities on the leasehold. BOEM may approve, approve with modifications, or disapprove a lessee's SAP. It is also during this phase that the lessee would conduct site characterization surveys and studies (e.g., avian, marine mammal, and archaeological) on their lease. The following sections describe the activity associated with site characterization and site assessment for a renewable energy development that could potentially occur in the Gulf of Mexico should a lease sale occur and a lease be executed. General descriptions of the activities are discussed here; more detailed descriptions and the potential resulting IPFs are discussed in **Appendix B**.

The SAP is a detailed description of the planned site characterization and site assessment activities. The SAP requires lessees submit descriptions of the overall project design and structural design, fabrication, and installation plans for each of the facilities in the project, including decommissioning and site clearance procedures. Additionally, the SAP must include a description of the safety, prevention, and environmental protection measures,administrative and financial information, and any additional information required by BOEM. For example, BOEM requires the results of several types of surveys, including geotechnical, shallow hazards, geological, archaeological, and biological (i.e., live bottoms, hard bottoms, topographic features, fish, marine mammals, sea turtles, and birds). For a complete listing of the SAP requirements, refer to 30 CFR § 585.610.

The surveys required for the SAP assist the developer in proper siting and design of the site assessment infrastructure to be used. Geotechnical surveys guide the design of the foundation for the potential structures by analyzing the seafloor sediment and subsurface structure. Shallow hazard surveys identify shallow faults, gas seeps or shallow gas, slump blocks or sediments, hydrates, and ice scour of seafloor sediments; and they inform any potential effects on the project. A geological survey report describes any seismic activity at the project site, fault zones, seabed subsidence, and the extent and geometry of faulting attenuation effects of geologic conditions at the project site. Archaelogical surveys provide a description of any historic and pre-historic archaelogical resources at the project site as well as required by the NHPA. Biological surveys and studies help to inform the potential impacts of the site characterization and site assessment activities, as well as help determine the environmental baseline of the project area for future environmental reviews. These surveys provide developers with the necessary data to plan, design, and assess the impacts of their site assessment infrastructure. For a complete description of the survey requirements, refer to 30 CFR §§ 585.610 and 585.611.

Site assessment infrastructure is commonly meterological buoys. Meteorological buoys are anchored at fixed locations and regularly collect observations from many different atmospheric and oceanographic sensors. To obtain meteorological data, scientific measurement devices consisting of anemometers, vanes, barometers, and temperature transmitters are mounted either directly on the buoy or on instrument support arms. In addition to conventional anemometers, light detection and ranging (LiDAR) , sonic detection and ranging (SODAR), and coastal ocean dynamic applications radar (CODAR) devices may be used to obtain meteorological data. To measure the speed and direction of ocean currents, Acoustic Doppler Current Profilers (ADCPs) would most likely be installed on each meteorological buoy. A meteorological buoy could also accommodate environmental monitoring equipment such as bird and bat monitoring equipment (e.g., radar units and thermal imaging cameras), acoustic monitoring equipment for marine mammals, data logging computers, power supplies, visibility sensors, water measurement equipment (e.g., temperature and salinity), communications equipment, material hoist, and storage containers. These sensors and instruments provide the lessee with the environmental data required to properly plan and design their wind energy development. The developer's plans are detailed in the COP, which is submitted to BOEM for review and potential approval before the developer can begin construction.

A.2.4 Construction and Operations Phase

The construction and operations phase consists of the submission of a Construction and Operations Plan (COP), which is a detailed plan for the construction and operation of a wind energy project on the lease. The COP describes the developer's construction, operations, and conceptual decommissioning plans under the commercial lease, including onshore and support facilities and all anticipated project easements. BOEM conducts environmental and technical reviews of the COP and decides whether to approve, approve with modications, or disapprove the COP.

In order to develop their COP, lessees must make critical evaluations of the proposed site(s) of the planned facility(ies) through surveys that will inform the design of their project. Shallow hazard surveys identify shallow faults, gas seeps or shallow gas, slump blocks or sediments, hydrates, and ice scour of seafloor sediments; and inform any potential effects on the project. A geological survey report describes any seismic activity at the project site, fault zones, seabed subsidence, and the extent and geometry of faulting attenuation effects of geologic conditions at the project site. Archaelogical surveys provide a description of any historic and pre-historic archaelogical resources at the project site, as required by the NHPA. Biological surveys and studies help inform the potential impacts of the construction and operation activities, as well as help determine the environmental baseline of the project area for environmental analysis. Geotechnical surveys include *in situ* testing, boring, and sampling to investigate the stratigraphic and engineering properties of the sediment that may affect the foundations or anchoring systems for the planned facility(ies) and to provide the relevant geotechnical data required for design. The complete requirements of the COP surveys are described in 30 CFR § 585.626. The results of these surveys are combined with additional project information and other environmental certifications to form the COP.

The COP also contains comprehensive reports of all aspects of the project. This information consists of detailed descriptions of the overall project design and structural design, fabrication and installation plans for each of the facilities, cables, and pipelines in the project, and decommissioning and site clearance procedures. All of the safety, prevention, and environmental protection measures must be described, as well listing all chemicals used, and solid and liquid wastes. The COP also contains descriptions of all support vessels and operating procedures, administrative and financial information, and any additional information required by BOEM. Prior to the end of the lease term, the developer must submit a plan to decommission facilities. These detailed reports give BOEM the necessary information to make an informed decision on whether or not to approve the project. For a complete listing of the COP requirements, refer to 30 CFR § 585.626.

Lessees must submit with their COP detailed information to assist BOEM in complying with NEPA and other relevant laws. The COP must describe those resources, conditions, and activities that could be affected by the proposed activities or that could affect the activities proposed in the COP. Generally, the COP must describe hazard information (i.e., meteorology, oceanography, sediment transport, geology, and shallow geological or manmade hazards); water quality; biological resources (including threatened or endangered species and sensitive biological resources or habitats); archaeological resources; social and economic resources; coastal and marine uses; consistency certification from any affected coastal states; and any other resources, conditions, and activities as identified by BOEM. The required information is described fully in 30 CFR § 585.627.

A.2.4.1 General Activities Plan

In place of a COP, lessees will submit a General Activities Plan (GAP) when developing a renewable energy project under a limited lease or grant. A GAP describes the proposed construction, activities, and conceptual decommissioning plans for all planned facilities, including testing of technology devices and onshore and support facilities that will be constructed and used for the project, including any project easements for the assessment and development of a limited lease or grant. The GAP contains much of the same information as the COP, but there are some differences, such as geotechnical survey requirements, site assessment description, or ROW, RUE, or limited lease grant stipulations. Some information is only required if BOEM deems the project to be complex or significant, such as descriptions of the construction and operation concept, cables and pipelines, operating procedures and systems; certified verification agent nominations for reports; a construction schedule; and any other information as requested by BOEM. The full description of GAP requirements can be found in 30 CFR §§ 585.645 and 585.646.

A.3 Wind Energy Leasing, Site Characterization, and Site Assessment Activity

The purpose of this section is to describe the activities that could occur following OCS wind energy leasing, site characterization, and site assessment. These activities would occur during the

Site Assessment Phase (refer to **Section A.2.3**, Site Assessment Phase) after the processes described in **Sections A.2.1 and A.2.2** (Planning and Analysis Phase, and Leasing Phase, respectively) have been completed. Refer to **Section A.2** (Overview of the Renewable Energy Development Process) for more information on the different phases of renewable energy development.

The activities and events described in this section are categorized into routine activities and accidental events. **Section A.3.2** describes routine activities associated with lease issuance, site characterization activities, and approval of site assessment activities. Site characterization activities include shallow hazards, geological, geotechnical, archaeological, and biological surveys. Site assessment activities include the installation, operation, and decommissioning of data collection devices (i.e., meteorological buoys) under an approved SAP. **Section A.3.3** describes accidental events, which are non-routine and low probabitlity, that could occur during routine activities.

This document does not consider construction and operation of any commercial wind energy facilities on a lease or grant, which would be evaluated separately if a lessee submits a COP (refer to **Section A.2.4**, Construction and Operations Phase). The activities described are based on historical information and future general assumptions about the estimated amounts, timing, and potential locations within the Area of Analysis described in **Section A.0**, Introduction. This section is intended only to describe the types of activities that could occur during site characterization and site assessment. Project-specific activities and methodologies will be detailed in a project's SAP.

A.3.1 Assumptions for Wind Energy Leasing, Site Characterization, and Site Assessment Activities

Assumptions for wind energy leasing, site characterization, and site assessment activities are described in **Table A.3.1-1** below. Unless otherwise noted, these assumptions are based on the requirements of the renewable energy regulations at 30 CFR part 585, BOEM's guidance for lessees, previous lease applications and plans that have been submitted to BOEM, and previous EAs prepared for similar activities.

Table A.3.1-1. Assumptions for Foreseeable Activities.

Overall Assumptions
A wind energy lease would be located in an area within the GOM Call Area (Figure A.0-1).
BOEM would develop and analyze standard operating conditions, lease stipulations, and other guidance specific to a proposed RFI, Call Area, WEA, or lease sale area in their environmental analysis before an OCS wind energy lease would be executed.
BOEM would issue up to 18 leases, which would average 80,000 acres each (in areas large enough to accommodate these leases).
BOEM would likely issue more than one lease, but no more than 6-8 leases per sale, for a WEA greater than 80,000 acres.
A lessee would install 1-2 buoys per lease.
There will be two export cable corridors per lease.

Overall Assumptions
A backbone transmission system with offshore converter collector platforms (platforms located within the export cable corridors) could be granted an easement.
Surveying and Sampling Assumptions
Site characterization surveys would likely begin within 1 year following execution of a lease (based on the likelihood that a lessee would complete the majority of site characterization prior to installing a meteorological buoy). Site characterization surveys would then continue on an intermittent basis for the following 5 years leading up to the preparation and submittal of the Construction and Operations Plan.
Lessees would likely survey the entire lease area during the 5-year site assessment term to collect the required geophysical and geotechnical information for siting of commercial facilities (wind turbines). The surveys may be completed in phases, with the meteorological buoy areas likely to be surveyed first. The estimated area of impact from geotechinical and benthic survey activities range from 0.1 m^2 to 10 m^2 (1.08 ft^2 to 107.64 ft^2) per buoy site.
Sub-bottom sampling (e.g., cone penetration test, vibracores, grab samples, etc.) of the GOM Call Area or lease area would require a sub-bottom sample at every potential wind turbine location (which would occur only in a portion of a GOM Call Area where structural placement is allowed) and one sample per kilometer of export cable corridor. Sampling would also be conducted at locations where an offshore collector and/or converter platforms are proposed. The amount of effort and vessel trips required to collect the geotechnical samples vary greatly by the type of technology used to retrieve the sample. Benthic sampling could also include nearshore, estuarine, and submerged aquatic vegetation habitats along a potential export cable corridor.
Installation, Decommissioning, and Operations and Maintenance Assumptions
Meteorological buoy installation and decommissioning would each likely take approximately 1 day.
Meteorological buoy installation would likely occur in Year 2 after a lease execution, and decommissioning would likely occur in Year 6 or Year 7 after a lease execution.
Assumptions for Generation of Noise
The following activities and equipment would generate noise: The high-resolution geophysical survey equipment and vessel engines during site characterization surveys and meteorological buoy(s) installation, operations and maintenance, and decommissioning.

Details on the level of noise generated from the high-resolution geophysical (HRG) survey equipment are described in **Appendix B**, Issues and Impact-Producing Factors.

A.3.2 Routine Activities

A.3.2.1 Site Characterization Surveys

BOEM's regulations require that the lessee provide the results of a number of surveys with its SAP (30 CFR §§ 585.610-585.611). BOEM refers to these surveys as "site characterization" activities. **Table A.3.2-1** describes the types of site characterization surveys, the types of equipment and/or method used, and which resources the survey information would be used to inform.

Assumptions for these surveys are based on BOEM guidelines that provide recommendations to lessees for acquiring the information required for a SAP under 30 CFR §§ 585.610-585.611. BOEM has also published *Guidelines for Information Requirements for a Renewable Energy Site Assessment Plan (SAP)* (BOEM 2019a), which is available at http://www.boem.gov/Final-SAP-Guidelines/. The survey guidelines are listed below and can be found at http://www.boem.gov/Survey-Guidelines/. Although several of these survey guidelines are specific to renewable energy development on the

Atlantic OCS, some of the information would also be applicable to renewable energy development in the Area of Analysis on the Gulf of Mexico OCS. As mentioned in **Table A.3.1-1**, BOEM would develop and analyze standard operating conditions, lease stipulations, and other guidance specific to a proposed area in their environmental analysis before an OCS wind energy lease would be executed.

- *Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585* (BOEM 2020b)
- *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585* (BOEM 2020a)
- *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2019b)
- *Guidelines for Providing Avian Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2020c)
- *Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 Subpart F* (BOEM 2019d)
- *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2019c)
- *Guidelines for Submission of Spatial Data for Atlantic Offshore Renewable Energy Development Site Characterization Surveys* (BOEM 2013)

Table A.3.2-1. Survey Assumptions.

Survey Type	Survey Equipment and/or Method	Resource Surveyed or Information Used to Inform
High-resolution geophysical (HRG) surveys	Side-scan sonar, sub-bottom profiler, magnetometer, multi-beam echosounder	Shallow hazards[1], archaeological[2], bathymetric charting, benthic habitat
Geotechnical/sub-bottom sampling[3]	Vibracores, deep borings, cone penetration tests (CPTs)	Geological[4]
Biological[5]	Grab sampling, benthic sled, underwater imagery/sediment profile imaging	Benthic habitat
	Aerial digital imaging; visual observation from boat or airplane	Avian
	Ultrasonic detectors installed on survey vessels used for other surveys	Bat
	Visual observation from boat or airplane	Marine fauna (marine mammals and sea turtles)
	Direct sampling of fish and invertebrates	Fish

Survey Type	Survey Equipment and/or Method	Resource Surveyed or Information Used to Inform

[1] 30 CFR § 585.610(b)(2)
[2] 30 CFR §§ 585.610(b)(3), 585.611(b)(6)
[3] 30 CFR § 585.610(b)(1)
[4] 30 CFR § 585.610(b)(4)
[5] 30 CFR § 585.610(b)(5)

In these guidelines, BOEM provides recommendations of survey methods that BOEM expects would yield site characterization information sufficient to allow the agency to consider approving a SAP. For the purposes of this document, BOEM assumes that the lessee would employ these methods to acquire the information required under 30 CFR §§ 585.610-585.611. To ensure that marine mammal and sea turtle data are appropriately collected, biological surveys for marine mammals and sea turtles will not occur at the same time as HRG surveys, as the noise produced by the HRG surveys may affect sighting rates. BOEM's *Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 Subpart F* is intended to provide lessees guidance on the type of information that will be needed if inadequate information exists. Lessees are encouraged to coordinate closely with BOEM to ensure appropriate survey design and methods are used.

A.3.2.1.1 High-Resolution Geophysical Surveys

The purpose of HRG surveys are to acquire geophysical shallow hazards information, including information to determine whether shallow hazards will impact seabed support of the infrastructure, to obtain information pertaining to the presence or absence of archaeological resources, and to conduct bathymetric charting.

Side-scan sonars, sub-bottom profilers, magnetometers, and multi-beam echosounders may be used during HRG surveys and could add noise to the underwater environment. The types of equipment that will be used during these surveys are described in **Table A.3.2-2**, and their acoustic information is presented in **Table B.4.1-1** in **Section B.4.1** of **Appendix B** (Issues and Impact-Producing Factors).

The line spacing for HRG surveys would vary depending on the data collection requirements of the different HRG survey types as shown in **Table A.3.2-2**. However, the same vessel (or group of vessels) following the smallest line spacing could conduct many of the surveys necessary to acquire relevant data at the same time. For example, surveys for shallow hazards and archaeological resources could be conducted at the same time using the finer line spacing required for archaeological resource assessment (30 meters [m]; 98 feet [ft]). Tie-in lines would be run perpendicular to the track lines at a line spacing of 150 m (492 ft), which would result in 926 km (575 mi [500 nmi]) of HRG surveys per OCS block. The *Gulf of Mexico OCS Proposed Geological and Geophysical Activities: Western, Central, and Eastern Planning Areas; Final Programmatic Environmental Impact Statement* estimated it would take approximately 150 hours to survey one OCS lease block using this method, assuming an average vessel speed of 4.5 knots (5.2 miles per hour) (BOEM 2017c).

Assuming the lessee follows BOEM's guidelines to meet the geophysical data requirements at 30 CFR §§ 585.610-585.611, BOEM anticipates that the surveys will be undertaken using the equipment to collect the required data as described in **Table A.3.2-2**. Equivalent technologies to those shown in these tables could be used but would undergo additional environmental review to determine if their potential impacts are similar to those analyzed for the equipment described in this document or relevant EA.

Table A.3.2-2. High-Resolution Geophysical Survey Equipment and Methods.

Equipment Type	Data Collection and/or Survey Types	Description of the Equipment	Line Spacing
Bathymetry/depth sounder (multi-beam echosounder)	Bathymetric charting	A depth sounder is a microprocessor-controlled, high-resolution, survey-grade system that measures precise water depths in both digital and graphic formats. The system would be used in such a manner as to record with a sweep appropriate to the range of water depths expected in the survey area. This analysis assumes the use of multi-beam bathymetry systems, which may be more appropriate than other tools for characterizing a WEA containing complex bathymetric features or sensitive benthic habitats, such as hard bottom areas.	The lessee would likely use a multi-beam echosounder at a line spacing appropriate to the range of depths expected in the survey area.
Magnetometer	Collection of geophysical data for shallow hazards and archaeological resources assessments	Magnetometer surveys would be used to detect and aid in the identification of ferrous or other objects having a distinct magnetic signature. The magnetometer sensor is typically towed as near as possible to the seafloor and is anticipated to be no more than approximately 6 m (20 ft) above the seafloor.	For the collection of geophysical data for shallow hazards assessments, (including magnetometer, side-scan sonar, and sub-bottom profiler systems) BOEM recommends surveys at a 150-m (492-ft) line spacing. And For the collection of geophysical data for archaeological resources assessments (including magnetometers,
Side-scan sonar	Collection of geophysical data for shallow hazards and archaeological resources assessments	This survey technique is used to evaluate surface sediments, seafloor morphology, and potential surface obstructions (MMS 2007b). A typical side-scan sonar system consists of a top-side processor, tow cable, and towfish with transducers (or "pingers") located on the sides, which generate and record the returning sound that travels through the water column at a known speed. BOEM assumes	

Equipment Type	Data Collection and/or Survey Types	Description of the Equipment	Line Spacing
		that the lessee would use a digital dual-frequency, side-scan sonar system with 300- to 500-kHz frequency ranges or greater to record continuous planimetric images of the seafloor.	side-scan sonar, and all sub-bottom profiler systems), BOEM recommends surveys at a 30-m (98-ft) line spacing.
Shallow and medium (seismic) penetration sub-bottom profilers	Collection of geophysical data for shallow hazards and archaeological resources assessments and to characterize subsurface sediments	Typically, a high-resolution CHIRP System sub-bottom profiler is used to generate a profile view below the bottom of the seabed, which is interpreted to develop a geologic cross-section of subsurface sediment conditions under the track line surveyed. Another type of sub-bottom profiler that may be employed is a medium penetration system such as a boomer, bubble pulser, or impulse-type system. Sub-bottom profilers are capable of penetrating sediment depth ranges of 3 m (10 ft) to greater than 100 m (328 ft), depending on frequency and bottom composition.	

CHIRP = Compressed High Intensity Radar Pulse; kHz = kilohertz.

Increased vessel presence and traffic during HRG surveys could result in several IPFs, including noise, air emissions, routine vessel discharges, and lighting from vessels. For more information on these IPFs, refer to **Appendix B**.

A.3.2.1.2 Geotechnical/Sub-bottom Sampling

Geotechnical surveys are performed to assess the suitability of shallow sediments to support a structure foundation (i.e., gather information to determine whether the seabed can support foundation structures) or transmission cables under operational and environmental conditions that could potentially be encountered (including extreme weather events), as well as to document the sediment characteristics necessary for design and installation of all structures and cables. The *Gulf of Mexico OCS Proposed Geological and Geophysical Activities: Western, Central, and Eastern Planning Areas; Final Programmatic Environmental Impact Statement* (BOEM 2017c), which is hereby incorporated by reference, provides an overview of the geotechnical sampling techniques and devices (such as bottom-sampling devices, vibracores, deep borings, and cone penetration tests [CPTs]). Samples for geotechnical evaluation are typically collected using shallow-bottom coring and surface sediment sampling devices taken from a survey vessel or drilling vessel. The information obtained from these samplings will be used to inform the lessee in preparation of the COP and subsequent facility design and installation plans that are submitted to BOEM. Likely methods to obtain samples to analyze physical and chemical properties of surface sediments are described in **Table A.3.2-3**. These methods may result in bottom disturbance as a result of physical seafloor sampling.

Table A.3.2-3. Geotechnical/Sub-bottom Sampling Survey Methods and Equipment.

Survey Method	Use	Description of the Equipment and Methods
Bottom-sampling devices	Penetrating depths from a few centimeters (cm) to several meters (m)	A piston core or gravity core is often used to obtain samples of soft surficial sediments. Unlike a gravity core, which is essentially a weighted core barrel that is allowed to free-fall into the water, piston cores have a "piston" mechanism that triggers when the corer hits the seafloor. The main advantage of a piston core over a gravity core is that the piston allows the best possible sediment sample to be obtained by avoiding disturbance of the sample (MMS 2007b) . Shallow-bottom coring employs a rotary drill that penetrates through several feet (ft) of consolidated rock. Drilling will produce low-intensity, low-frequency sound through the drill string. The above sampling methods do not use high-energy sound sources (Continental Shelf Associates Inc. 2004; MMS 2007b).
Vibracores	Obtaining samples of unconsolidated sediment may, in some cases, also be used to gather information to inform the archaeological interpretation of features identified through the HRG survey (BOEM 2020a)	Vibracore samplers typically consist of a core barrel and an oscillating driving mechanism that propels the core barrel into the sub-bottom. Once the core barrel is driven to its full length, the core barrel is retracted from the sediment and returned to the deck of the vessel. Typically, cores up to 6 m (20 ft) long with 8 cm (3 inch [in]) diameters are obtained, although some devices have been modified to obtain samples up to 12 m (40 ft) long (MMS 2007b; USACE 1987). The estimated maximum disturbance area is 3 m^2/sample. If anchoring occurs, the estimated maximum bottom disturbance area would be 10 m^2/sample.
Deep borings	Sampling and characterizing the geological properties of sediments at the maximum expected depths of the structure foundations (MMS 2007b)	A drill rig is used to obtain deep borings. The drill rig can be mounted on a jack-up barge supported by four "spuds" that are lowered to the seafloor. Although, an anchored or dynamically positioned vessel could also be used. Geologic borings can generally reach depths of 30-61 m (100-200 ft) within a few days (based on weather conditions). The acoustic levels from deep borings can be expected to be in the range of 118-145 decibels (dB) at a frequency of 120 hertz (Hz), which would be below the 160-dB threshold established by the National Marine Fisheries Service to protect marine mammals (Erbe and McPherson 2017).

Survey Method	Use	Description of the Equipment and Methods
Cone penetration test (CPT)	Supplement or use in place of deep borings (BOEM 2020b)	A CPT rig could be mounted on a jack-up barge similar to that used for the deep borings. Although, an anchored or dynamically positioned vessel could also be used. The top of a CPT drill probe is typically up to 8 cm (3 in) in diameter, with connecting rods less than 15 cm (6 in) in diameter. The estimated maximum disturbance area is 4 m^2/sample.

Geotechnical/benthic sampling of a leased area would require a sample at every potential wind turbine location (which would only occur in the portion of a leased area where structural placement is allowed) and one sample per kilometer of export cable corridor. The area of seabed disturbed by individual sampling events (e.g., collection of a core or grab sample) is estimated to range from 1 to 10 m^2 (11 to 108 ft^2) (BOEM 2014a; Fugro Marine GeoServices Inc 2017). Some vessels require anchoring for brief periods using small anchors; however, some deployments for this sampling work could involve a boat having dynamic positioning capability (i.e., no seafloor anchoring impacts).

The CPTs and bore holes are often used together because they provide different data on sediment characteristics. A CPT provides a fairly precise stratigraphy of the sampled interval, plus other geotechnical data, but it does not allow for capture of an undisturbed soil sample. Bore holes can provide undisturbed samples but are most effectively used in conjunction with CPT-based stratigraphy so that sample depths can be pre-determined. A CPT is suitable for use in clay, silt, sand, and granule-sized sediments, as well as some consolidated sediment and colluvium. Bore hole methods can be used in any sediment type and in bedrock. Vibracores are suitable for extracting continuous sediment samples from unconsolidated sand, silt, and clay-sized sediment up to 33 ft (10 m) below the seafloor.

The U.S. Army Corps of Engineers' (USACE) Nationwide Permit (NWP) Program (USACE 2021) was developed to streamline the evaluation and approval process for certain types of activities that have only minimal adverse impacts, both individually and collectively, on the aquatic environment. Most site characterization and site assessment activities under the Proposed Action would be covered by the USACE's NWP Numbers 5 and 6, which were developed under Section 404 of the Clean Water Act and Section 10 of the River and Harbors Act. The NWP 5 covers the placement of scientific measurement devices, including tide gages, water recording devices, water quality testing and improvement devices, meteorological stations (which would include meteorological buoys), and similar structures. The NWP 6 addresses survey activities such as core sampling, seismic exploratory operations, plugging of seismic shot holes and other exploratory-type bore holes, exploratory trenching, soil surveys, sampling, and historic resources surveys. Most site characterization surveys that require seafloor disturbance would be authorized by an NWP 6. An individual permit may be required from USACE if the proposed survey activities do not meet the terms and conditions of the NWP or if USACE determines that the survey activities will result in more than minimal adverse effects on the aquatic environment.

The amount of effort and vessel trips required to collect the geotechnical samples varies greatly by the type of technology used to retrieve the sample.

- Vibracore samples would most likely be advanced from a single small vessel (approximately 45 ft [14 m]).
- The CPT sampling would depend on the size of the CPT; it could be advanced from a medium vessel (approximately 65 ft [20 m]), a jack-up barge, a barge with a four-point anchoring system, or a vessel with a dynamic positioning system. Each barge would likely include a support vessel.
- Geologic borings would be advanced from a jack-up barge, a barge with a four-point anchoring system, or a vessel with a dynamic positioning system. Each barge would likely include a support vessel.

As with HRG surveys, increased vessel presence and traffic during geotechnical surveys could result in several IPFs, including noise, air emissions, routine vessel discharges, and lighting from vessels. Additionally, bottom disturbance may occur as a result of geotechnical surveys due to physical sampling methods and vessels that utilize anchors. For more information on these IPFs, refer to **Appendix B**.

A.3.2.1.3 Biological Surveys

Under BOEM's regulations, the SAP must describe biological resources that could be affected by the activities proposed in the plans or that could affect the activities proposed in the plans (refer to 30 CFR § 585.611(b)(3)).

To support development of these plans, three primary categories of biological resources would need to be characterized using appropriate existing information or vessel and/or aerial surveys of the proposed lease area: (1) benthic habitats; (2) avian and bat resources; and (3) marine fauna. Likely survey methods and timing are listed in **Table A.3.2-4** and are further described below.

Table A.3.2-4. Biological Survey Types and Methods.

Biological Survey Type	Survey Method	Timing
Benthic habitat	Bottom sediment/fauna sampling using standard benthic van veen grabs (0.1 m^2/sample) and underwater imagery/sediment profile imaging(4 m^2/sample). One benthic sample is assumed to occur at each meteorological buoy site and every kilometer along a export cable corridor. If anchoring occurs, the estimated maximum bottom disturbance area would be 10 m^2/sample.	Concurrent with geotechnical/sub-bottom sampling

Biological Survey Type	Survey Method	Timing
Avian	Visual surveys from a boat.	10 OCS blocks per day (Thaxter and Burton 2009); monthly for 2-3 years
	Plane-based aerial surveys.	2 days per month for 2-3 years
Bats	Ultrasonic detectors installed on survey vessels being used for other biological surveys.	Monthly for 3 months per year
Marine fauna (marine mammals, fish, and sea turtles)	Plane-based and/or vessel surveys; may be concurrent with other biological surveys but will not be concurrent with any geophysical or geotechnical survey work.	2 years of survey to cover spatial, temporal, and inter-annual variance in the area of potential effect

Increased vessel presence and traffic during biological surveys could result in several IPFs, including noise, air emissions, routine vessel discharges, and lighting from vessels. Some biological surveys may be conducted from an aircraft (e.g., avian and bat surveys) and, if conducted, will result in aircraft noise, lighting, and emissions. Additionally, bottom disturbance may occur as a result of benthic habitat and fisheries surveys due to physical sampling methods. For more information on these IPFs, refer to **Appendix B**.

Benthic Habitat Surveys

Samples collected from the geotechnical sampling of shallow sediments and information from geophysical surveys would help identify sensitive benthic habitats. These surveys would acquire information suggesting the presence or absence of exposed hard bottoms of high, moderate, or low relief; hard bottoms covered by thin, ephemeral sand layers; and submerged aquatic vegetation or macro-algae, all of which are key characteristics of sensitive benthic habitat. There are two protocol surveys emphasized within BOEM's *Benthic Habitat Survey Guidelines* (BOEM 2019b): a Sediment Scour and/or Deposition Survey and a Benthic Community Composition Survey. The first involves particle size analysis or sediment-profile imaging and multi-beam/interferometric bathymetry (with the collection of backscatter data). The second requires benthic imagery (i.e., underwater video or still imagery of sediment bottom type) as well as physical sampling using one of the following methods:

- Hamon grab (hard bottom);
- Van Veen grab (soft sediment); and/or
- benthic sled.

BOEM believes that these surveys may be conducted concurrently with other geophysical sampling and/or biological surveys and that the lessee would not need to conduct separate biological surveys to delineate benthic habitats. However, if the benthic surveys, geological and geophysical surveys, or other information identify the presence of sensitive benthic habitats on a leasehold, then further investigations would likely be necessary.

Avian Surveys

If avian surveys are required, BOEM anticipates that 2-3 years of surveys would be necessary to document the distribution and abundance of bird species within a potential lease area. This survey timeframe is based on the *Guidelines for Providing Avian Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2020c), which indicates that the lessee must document the spatial distribution of avian resources in the areas proposed for development, incorporating both seasonal and inter-annual variation. Historically, avian data have been collected using a combination of boat and aerial surveys. Boat surveys could be completed in a single day for approximately 10 OCS blocks when subsampling 10 percent of the area, which is standard practice (Thaxter and Burton 2009). A monthly sampling interval for boat-based surveys represents an upper limit of survey frequency; therefore, 2-3 years of surveying at monthly intervals would be anticipated using one or a combination of methods.

Although both boat-based and aerial surveys using visual observers have been used in the past, including for offshore wind baseline studies in the United States (Geo-Marine Inc. 2010a; 2010b; Paton et al. 2010), these methodologies have been largely replaced by aerial digital imaging surveys in Europe because of reduced observer effects, higher statistical and scientific validity of the data, and the ability to conduct surveys at altitudes above the rotor swept zone of commercial marine wind turbine rotors (Rexstad and Buckland 2009; Thaxter and Burton 2009) and are less likely to flush birds than in traditional low-flying aerial surveys.

Bat Resource Surveys

Bats use echolocation with species-specific characteristics when orienting through space, and ultrasonic detectors are a cost-effective method for monitoring multiple bat species on a large spatial scale. Ultrasonic detectors are portable and can be easily installed on survey vessels being used for other biological surveys. BOEM assumes that bat acoustic surveys would be conducted during migration periods.

Marine Fauna Surveys

The lessee is required to characterize the marine fauna (i.e., marine mammals, sea turtles, and fish species) occurring within its lease area and include this information in its plan submissions (30 CFR § 585.610(b)(5) and 30 CFR § 585.611(b)(3). The lessee may use existing information if the information meets plan requirements. If biological information is not available or does not meet plan requirements for the lease area, data gaps or special circumstances may need to be addressed and filled by survey work (BOEM 2019c) over a period of 2 years, but perhaps longer depending upon data needs in the area of potential effect. Regional-scale efforts to collect biological information in the GOM, including the National Oceanic and Atmospheric Administration (NOAA)/BOEM GOM Marine Assessment Program for Protected Species, may aid in providing data to support site characterization. The results of such studies could be used to determine whether additional surveys would be necessary to document marine mammal, fish, or sea turtle resources in the leased area prior to submitting a plan.

BOEM anticipates that any vessel or aerial traffic associated with marine fauna surveys would not markedly add to current levels of traffic within a leased area.

A.3.2.1.4 Surveying of Potential Export Cable Route

During site characterization, a lessee would likely survey a potential transmission cable route (for connecting future wind turbines to an onshore power substation) from the lease area to shore using HRG survey methods. The HRG survey grids for a proposed export cable route to shore would likely occur over a 300-m-wide to 1,000-m-wide (108-ft-wide to 3,280-ft-wide) corridor centered on the potential transmission cable location to allow for all anticipated physical disturbances and movement of the proposed cable, if necessary. BOEM is also including survey activity in its scenario to support a “backbone” transmission system. This system is a coordinated and shared transmission system that runs parallel to shore and is capable of servicing multiple connections to the onshore grid from a single offshore line. This infrastructure has the potential to streamline the number of onshore grid tie-ins and may allow efficient delivery of power to multiple grids. BOEM is currently partnering with the National Renewable Energy Laboratory to study this infrastructure through The Atlantic Offshore Wind Transmission Study, which will evaluate multiple pathways to offshore wind goals through coordinated transmission solutions along the U.S. Atlantic Coast in the near term (by 2030) and long term (by 2050) under various combinations of electricity supply and demand while supporting grid reliability and resilience and ocean co-use. The information provided by this study will help guide the use of backbone transmission systems in the GOM.

A lessee would be required to submit detailed information on the proposed cable route(s) and wind turbine locations within their COP; per COP guidelines (BOEM 2020e), BOEM encourages lessees to coordinate with other subsea cable operators when planning cable routes. BOEM would then analyze the proposed route(s) and location(s) in a project-/site-specific environmental document.

Increased vessel presence and traffic during HRG surveys could result in several IPFs, including noise, air emissions, routine vessel discharges, and lighting from vessels. For more information on these IPFs, refer to Appendix B.Operational Waste Associated with Site Characterization.

Operational wastes would be generated from all vessels associated with site characterization and site assessment. Requirements for management and disposal of bilge and ballast waters, solid waste (trash and debris), and sanitary/domestic wastes are described in detail in the *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 Multisale Environmental Impact Statement* (BOEM 2017b) and summarized in the *Gulf of Mexico OCS Lease Sale: Final Supplemental Environmental Impact Statement 2018* (BOEM 2017a). BOEM assumes that these requirements would be followed as part of routine vessel discharges and hereby incorporates these documents by reference. For more information on the routine vessel discharges IPF, refer to **Appendix B**.

The U.S. Environmental Protection Agency (USEPA) regulates discharges incidental to the normal operation of all non-recreational, non-military vessels greater than 79 ft (24 m) in length into U.S. waters, under Section 402 of the Clean Water Act. The USEPA requires that eligible vessels obtain coverage under the National Pollutant Discharge Elimination System Vessel General Permit (VGP). A separate, streamlined permit is available for vessels less than 79 ft (24 m) (Small Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels Less than 79 Ft). Typical discharges eligible for coverage under the VGP include deck runoff, graywater (from showers, sinks, laundry facilities, etc.), bilgewater, and ballast water. The discharge of any oil or oily mixtures within bilgewater is prohibited under 33 CFR § 151.10; however, discharges may occur in water depths greater than 12 nmi (22 km; 14 mi) from shore if the oil concentration is less than 100 parts per million, and bilge/oily water separator effluent is covered for discharge under the final 2013 USEPA VGP. Although ballast water is less likely to contain oil, it is subject to the same discharge limits as bilgewater (33 CFR § 151.10). Ballast water, which is used to maintain stability of the vessel, may be pumped from coastal or marine waters when necessary and is usually stored in separate compartments not contaminated with oil. Ballast water is subject to the U.S. Coast Guard (USCG) Ballast Water Management Program to prevent the spread of aquatic nuisance species.

The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by BOEM (30 CFR §585.105(a)) and USCG (International Convention for the Prevention of Pollution from Ships [MARPOL], Annex V, Public Law 100-220 [101 Stat. 1458]). The Act to Prevent Pollution from Ships is a U.S. Federal law that allows USCG to implement the provisions of MARPOL (33 U.S.C. §§ 1901-1915). The Act of Prevent Pollution from Ships applies to all U. S. flagged ships in U.S. and international waters and to all foreign flagged vessels operating in navigable waters of the United States, or while at port under U.S. jurisdiction.

A.3.2.2 Site Assessment Activities and Data Collection Structures

No site assessment activities, which would include installation of meteorological buoys, can take place on a lease until BOEM has approved a lessee's SAP (30 CFR § 585.600(a)). Previous EAs for commercial wind lease issuance on the Atlantic OCS contained lease stipulations and terms and conditions of SAP approval, which required the lessee to submit a SAP survey plan that included contacting the appropriate USCG District regarding issuance of a local notice to mariners and obtaining a Private Aids to Navigation (PATON) permit for any meteorological buoy installed. The previous step, will trigger notification of NOAA to update nautical charts with these new offshore objects. Once approved, site assessment activities could occur over a 5-year period from the date of the lease. This document assumes that a lessee would install a data collection device (i.e., meteorological buoy) within its lease area to assess the wind resources and ocean conditions.

The following information is broad enough to address the range of data collection devices that may be installed under an approved SAP. The actual buoy type and anchoring system would be included in a detailed SAP submitted to BOEM, along with the results of site characterization surveys, prior to installation of any device(s).

A.3.2.2.1 Meteorological Buoy and Anchor System

A lessee could install meteorological buoys. BOEM assumes that a lessee would install a maximum of two buoys over the proposed lease area. These meteorological buoys would be anchored at fixed locations and regularly collect observations from many different atmospheric and oceanographic sensors. Buoys may be equipped with generators holding approximately 250 gallons of fuel. The *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts: Revised Environmental Assessment* (BOEM 2014b) evaluated various meteorological buoy and anchor systems, including hull type, height, and anchoring methods. The NOAA has successfully used boat-shaped hull buoys (known as Naval Oceanographic and Meteorological Automated Devices [NOMAD]) and the newer Coastal Buoy and Coastal Oceanographic Line-of-Sight (COLOS) buoys for weather data collection for many years (**Figure A.3.2-1**).

The choice of hull type used usually depends on its intended installation location and measurement requirements. To ensure optimum performance, a specific mooring design is produced based on hull type, location, and water depth (National Data Buoy Center 2012). For example, a smaller buoy in shallow coastal waters may be moored using an all-chain mooring. On the OCS, a larger discus-type or boat-shaped hull buoy may require a combination of a chain, nylon, and buoyant polypropylene materials designed for many years of ocean service (National Data Buoy Center 2020).

Discus-shaped, boat-shaped, and spar buoys (**Figures A.3.2-2, A.3.2-3, and A.3.2-4**, respectively) are the buoy types that would most likely be adapted for offshore wind data collection. A large discus-shaped hull buoy has a circular hull ranging between 33 and 40 ft (10 and 12 m) in diameter and is designed for many years of service (National Data Buoy Center 2012). The boat-shaped hull buoy is an aluminum-hulled buoy that provides long-term survivability in severe seas (National Data Buoy Center 2012).

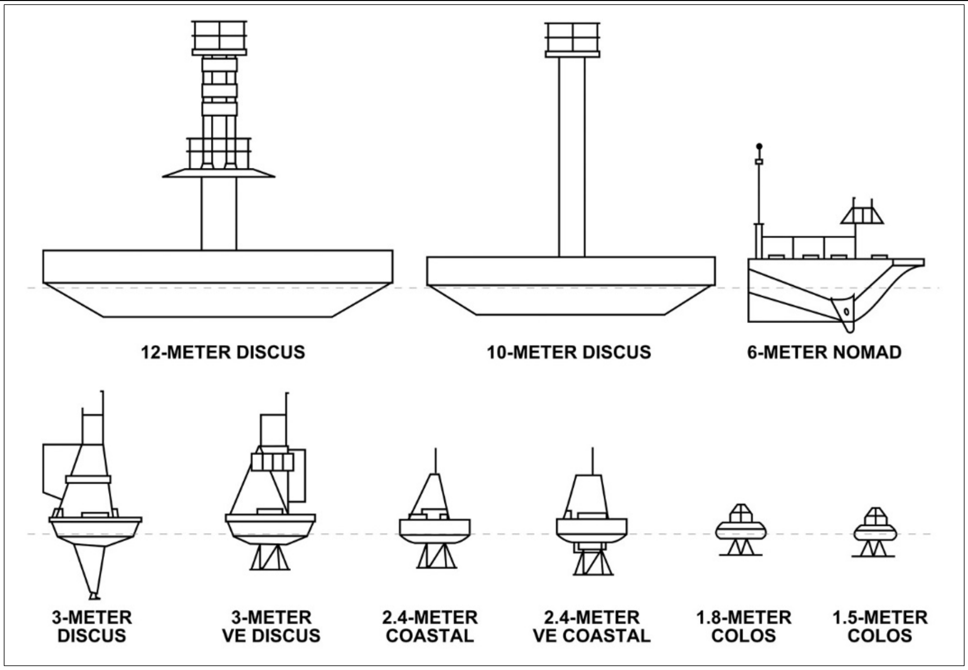

Figure A.3.2-1. Buoy Schematic (Source: (National Data Buoy Center 2020).

Figure A.3.2-2. 10-Meter Discus-Shaped Hull Buoy (Source: (National Data Buoy Center 2012).

Figure A.3.2-3. 6-Meter Boat-Shaped Hull Buoy (Source: (National Data Buoy Center 2012).

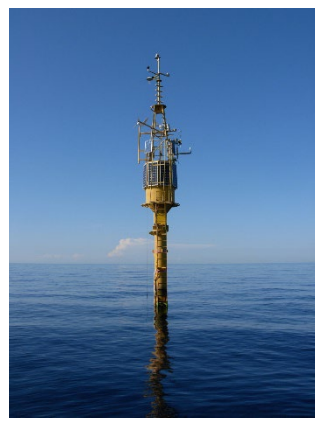

Figure A.3.2-4. Spar Buoy (Source: (Consiglio Nazionale delle Ricerche 2018).

Some deep ocean moorings have operated without failure for more than 10 years (National Data Buoy Center 2012). The spar-type buoy can be stabilized through an on-board ballasting mechanism approximately 60 ft (18 m) below the sea surface. Approximately 30-40 ft (9-12 m) of the spar-type buoy would be above the ocean surface, where meteorological and other equipment would be located. Tension legs attached to a mooring by cables have been implemented for one spar-type buoy in Federal waters offshore New Jersey.

The IPFs associated with meteorological buoy installation, operation and maintenance, and decommissioning (including site clearance) may include vessel traffic, noise and lighting, air emissions, and routine vessel discharges. Bottom disturbance and habitat degradation may also occur as a result of meteorological buoy anchoring and installation. The presence of the buoy may act as a fish aggregating device attracting fish and other species (e.g., birds) to the buoy location. Entanglement in buoy or anchor components is another possible IPF. For more information on these IPFs, refer to **Appendix B**.

Installation

Buoys would typically take approximately 1 day to install (**Table A.3.2-5**).

Table A.3.2-5. Spar-Type Buoy Installation Process.

Installation Phases	Maximum Area of Disturbance	Transport Method	Total Time of Installation
Phase 1 – Deployment of clump anchor	484 ft^2	barge	1 day
Phase 2 – Deployment of the spar buoy and connection to the clump anchor with mooring chain	784 ft^2	barge	2 days

Source: (Tetra Tech EC Inc. 2010).

Installation – Onshore Activity

Onshore activity (i.e., fabrication, staging, or launching of crew/cargo vessels) related to the installation of buoys is expected to use existing ports that are capable of supporting this activity. The meteorological buoy could also be fabricated at various facilities or at inland facilities in sections and then shipped by truck or rail to the port staging area. Refer to **Section A.3.2.3**, Port Facilities, for information pertaining to existing ports and industrial areas that would likely be used for meteorological buoys. No expansion of existing facilities would be expected.

Installation – Offshore Activity

Boat-shaped and discus-shaped buoys are typically towed or carried aboard a vessel to the installation location. Once at the location site, the buoy would be either lowered to the surface from the deck of the transport vessel or placed over the final location, and then the mooring anchor dropped. A boat-shaped buoy in shallower waters may be moored using an all-chain mooring, while a larger discus-type buoy would use a combination of chain, nylon, and buoyant polypropylene materials (National Data Buoy Center 2012). Based on previous proposals, anchors for boat-shaped or discus-shaped buoys would weigh about 6,000-8,000 pounds (2,721-3,628 kilograms) with a footprint of about 6 ft^2 (0.5 m^2) and an anchor sweep of about 370,260 ft^2 (34,398 m^2). After installation, the transport vessel would likely remain in the area for several hours while technicians configure proper operation of all systems. Transport and installation vessel anchoring is anticipated to be completed within 1 day for these types of buoys (Fishermen's Energy of New Jersey LLC 2011).

For the Garden State Offshore Energy project, a spar-type buoy equipped with light detection and ranging (LiDAR) was towed 23 mi (37 km) offshore New Jersey to the installation location by a transport vessel after assembly at a land-based facility. A barge-based crane lifted the buoy into the water where divers secured it to a 230-ton clump anchor by four tethers made of steel cables (Deepwater Wind 2016). Approximately 40 ft (12 m) of the buoy was visible above the water line. The maximum area of disturbance to benthic sediments occurs during anchor deployment and removal (e.g., sediment resettlement or sediment extrusion) for this type of buoy.

Operation and Maintenance

Monitoring information transmitted to shore would include systems performance information, such as battery levels and charging systems output, the operational status of navigation lighting, and buoy positions. Additionally, all data gathered via sensors would be fed to an on-board radio system that transmits the data string to a receiver onshore (Tetra Tech EC Inc. 2010). On-site inspections and preventative maintenance (i.e., marine fouling, wear, or lens cleaning) are expected to occur on a monthly or quarterly basis. Periodic inspections for specialized components (i.e., buoy, hull, anchor chain, or anchor scour) would occur at different intervals but would likely coincide with the monthly or quarterly inspection to minimize the need for additional boat trips to the site.

Because limited space on the buoy would restrict the amount of equipment requiring a power source, this equipment may be powered by small solar panels or wind turbines; however, diesel generators may be used, which would require periodic vessel trips for refueling.

Decommissioning

Decommissioning is basically the reverse of the installation process. Equipment recovery would be performed with the support of a vessel(s) equivalent in size and capability to that used for installation. For small buoys, a crane-lifting hook would be secured to the buoy. A water/air pump system would de-ballast the buoy into the horizontal position. The mooring chain and anchor would be recovered to the deck using a winching system. The buoy would then be transported to shore by a barge.

Buoy decommissioning is expected to be completed within 1 day. Buoys would be returned to shore and disassembled or reused in other applications.

A.3.2.2.2 Meteorological Buoy Equipment

Meteorological Data Collection

To obtain meteorological data, scientific measurement devices consisting of anemometers, vanes, barometers, and temperature transmitters would be mounted either directly on the buoy or on instrument support arms. In addition to conventional anemometers, LiDAR, sonic detection and ranging (SODAR), and coastal ocean dynamic applications radar (CODAR) devices may be used to obtain meteorological data. LiDAR is a ground-based, remote-sensing technology that operates via the transmission and detection of light, and recently, floating LiDAR (FLiDAR) is being used to collect meteorological data offshore of Europe. SODAR is also a ground-based, remote-sensing technology;

however, it operates via the transmission and detection of sound. CODAR devices use high-frequency surface wave propagation to remotely measure ocean surface waves and currents.

Ocean Monitoring Equipment

To measure the speed and direction of ocean currents, ADCPs would most likely be installed on each meteorological buoy. An ADCP is a remote-sensing technology that transmits sound waves at a constant frequency and measures the ricochet of the sound wave off fine particles or zooplankton suspended in the water column. The ADCPs may be mounted independently on the seafloor or attached to a buoy. A seafloor-mounted ADCP would most likely be located near the meteorological buoy (within approximately 500 ft [152 m]) and would be connected by a wire that is hand-buried within the seafloor.

A typical ADCP has 3-4 acoustic transducers that emit and receive acoustical pulses from different directions, with frequencies ranging from 300 to 600 kHz (kilohertz), with a sampling rate of 1-60 minutes. A typical ADCP is about 1-2 ft (0.3-0.6 m) tall and 1-2 ft (0.3-0.6 m) wide. Its mooring, base, or cage (surrounding frame) would be several ft wider.

Other Equipment

A meteorological buoy could also accommodate environmental monitoring equipment, such as bird and bat monitoring equipment (e.g., radar units, thermal imaging cameras), acoustic monitoring equipment for marine mammals, data logging computers, power supplies, visibility sensors, water measurement equipment (e.g., temperature and salinity), communications equipment, material hoist, and storage containers.

A.3.2.3 Port Facilities

Specific ports that would be used by the lessee would be determined in the future and primarily by proximity to the lease blocks, capacity to handle the proposed activities, and/or established business relationships between port facilities and the lessee.

A.3.2.3.1 Survey, Buoy Installation, Operations, and Maintenance Ports

Installation of a meteorological buoy could be supported by smaller ports since areas to stage large bottom-founded components are not needed. Surveying and operations and maintenance activities could also be supported by smaller ports because these types of activities can use smaller vessels and do not need access to fabrication and storage yards for large infrastructure. Vessels used for these activities are anticipated to be approximately 65-100 ft (20-30 m) in length. These smaller ports would serve as staging areas and crew/cargo launch sites for the survey and operations and maintenance vessels.

A.3.2.4 Vessel Traffic

This document assumes that vessels associated with site assessment (e.g., installation of meteorological buoys) would not trend to larger staging ports, while vessels associated with site characterization activities (e.g., surveys) would use whatever port is convenient.

Vessel traffic associated with site characterization surveys and site assessment activities would vary depending on the timing, size, and location of a potential lease area. BOEM provides an estimate of vessel trips, vessel survey line kilometers, and other relevant information in **Chapter 3** and **Appendix E** of this EA.

A.3.2.4.1 Vessel Traffic Associated with Site Characterization

The majority of site characterization surveys are vessel-based and would require several vessel trips to a potential lease area. These vessel trips would be spread over multiple seasons as a result of weather and sea-state conditions, the location of a potential lease area, the time needed to complete each required survey, and the availability of vessels and required personnel.

In previous EAs for commercial wind lease issuance on the Atlantic OCS, BOEM assumed that lessees would conduct surveys in the most efficient manner, which may involve 24-hour surveying; however, because inclement weather and equipment failure can result in delays, BOEM also estimated the number of vessel round trips based on a conservative scenario of a 10-hour survey day (daylight hours minus transit time to and from the site) resulting in a single round trip per day. Therefore, the number of vessel round trips that a lessee may undertake would likely fall within the range of the fewest estimated trips associated with 24-hour surveying and the maximum estimated trips associated with 10-hour survey days. Although the analyses in these EAs were specific to commercial wind lease issuance and site characterization surveys on the Atlantic OCS, much of the information could be applied to similar activities that could occur on the Gulf of Mexico OCS.

A.3.2.4.2 Vessel Traffic Associated with Site Assessment

Vessel trips would be required during installation, decommissioning, and routine maintenance of buoys. These vessel trips may be spread over multiple construction seasons as a result of weather and sea-state conditions, the time to assess suitable site(s), the time to acquire the necessary permits, and the availability of vessels, workers, and components. BOEM anticipates that buoy installation would likely occur in Year 2 after lease execution, would likely remain in place during the 5-year site assessment term (Years 2 through 6 after lease execution), and would likely be decommissioned the year after the end of the 5-year site assessment term (Year 7 after lease execution).

Based on previous SAPs submitted to BOEM for site assessment activities on the Atlantic OCS, meteorological buoys would typically take 1-2 days for one vessel to install and 1-2 days for one vessel to decommission. Maintenance trips may occur monthly to quarterly for each buoy.

A.3.3 Accidental Events

BOEM believes the following are the most reasonably foreseeable non-routine events and hazards that could occur during data collection activities: (1) recovery of lost equipment; (2) strikes and collisions between the site assessment structure[1] or associated vessels and other marine vessels or marine life; and (3) spills from collisions or during generator refueling.

A.3.3.1 Unintentional Releases into the Environment

A.3.3.1.1 Spills

A spill of petroleum product could occur as a result of hull damage from collisions (vessel-to-vessel and vessel-to-structure), accidents during the maintenance or transfer of offshore equipment and/or crew, or due to natural events (i.e., strong waves or storms). The amount of petroleum product that could be released by a marine vessel involved in a collision would depend on (1) the type of vessel, (2) the vessel size, (3) construction of the vessel (e.g., double-hulled cargo and/or bunker tanks), (4) the severity of the collision, and (5) the velocity of the vessel and angle of approach at the time of the impact (Bejarano et al. 2013). From 2010 to 2020, the average spill size for vessels other than tank ships and tank barges was 114 gallons (432 liters) (USCG 2011). Should a spill from a vessel associated with site characterization surveys or site assessment activities occur, BOEM anticipates that the average volume would be similar. Diesel generators may be used to power the equipment on meteorological buoys; therefore, minor diesel fuel spills could occur during refueling of generators. Diesel fuel is lighter than water and may float on the water's surface or be dispersed into the water column by waves. Diesel would be expected to dissipate very rapidly, evaporate, and biodegrade within a few days (MMS 2007a). For its Port Ambrose Project application, Liberty Natural Gas used NOAA's Automated Data Inquiry for Oil Spills (ADIOS) (an oil weathering model) to verify this potential impact (USCG 2015). Based on the NOAA ADIOS model, predicted dissipation of a maximum spill of 2,500 barrels (105,000 gallons) is rapid, and the amount of time it took to reach concentrations of less than 0.05 percent varied between 0.5 and 2.5 days, depending on ambient wind (USCG 2015). Depending on the amount of diesel contained within generators on a meteorological buoy, the Bureau of Safety and Environmental Enforcement (BSEE) may require lessees to prepare and implement a spill response plan.

Model results of a 2013 study on the potential environmental consequences of hazardous material spills from wind energy facilities[2] estimated that the spills most likely to occur would release a volume of up to several hundred gallons (Bejarano et al. 2013). The consequence analysis of the study predicted that small spills releasing up to several hundred gallons could occur once per month from vessel collisions, but the probability of a catastrophic spill[3] would be very low (occurring approximately once in over 1,000 years). The most likely types of releases from vessel collisons near

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[1] Also referred to as a "meteorological structure."

[2] The study focused on the installation and operation of hypothetical wind energy facilities within a Call Area in North Carolina and two WEAs (Maryland and Rhode Island/Massachusetts).

[3] In Bejarano et al. (2013), a catastrophic spill is categorized as a spill involving oil totaling 129,000 gallons or more or a chemical release totaling 29,000 gallons or more.

wind energy facilities are anticipated to result in minimal, temporary environmental consequences limited to the vicinity of the point of release, and the probability of these types of releases is very small (Bejarano et al. 2013). These results reflect spill scenarios for activities related to full-scale wind energy facilities, not the site characterization surveys and site assessment activities addressed by this document. The activities associated with site characterization surveys and site assessment activities would entail much lower spill volumes than estimated by the 2013 study. However, the minimal, temporary environmental consequences predicted for wind energy facility spills illustrates the low probability and anticipated impact of spills from activities associated with site characterization and site assessment.

The extent, duration, and potential effects of a spill would depend on the severity of the accident, the amount of corrosion or structural failure during a collision, the degree and rate of outflow of pollutant, the type of material spilled, meteorological conditions, and the length of time before a spill is noticed, equipment is repaired, and the speed with which cleanup occurred. Vessels are expected to comply with USCG requirements relating to prevention and control of oil spills (Title I of the Oil Pollution Act of 1990 and Title VI of the Coast Guard and Maritime Transportation Act of 2006). Additionally, the National Oil and Hazardous Substance Pollution Contingency Plan (DOE 1994), or National Contingency Plan (NCP), provides the Federal Government with a template for responding to discharges of oil and releases of hazardous substances. The NCP has resulted in the development of a national response capability to promote coordination among the hierarchy of responders and contingency plans implemented across the Nation. The NCP, required by Section 11(d) of the Clean Water Act, with the latest revisions finalized by Section 4201 of the Oil Pollution Act of 1990, establishes Federal on-scene coordinators within USCG and USEPA. The NCP also establishes the National Response Team, chaired by a USEPA representative and vice-chaired by a representative from USCG.

A.3.3.1.2 Trash and Debris

Marine debris originates from both land-based and ocean-based sources (USEPA 2017). Some of the sources of land-based marine debris are beachgoers, storm-water runoff, landfills, solid waste, rivers, floating structures, and ill-maintained garbage bins. Land-based marine debris also comes from combined sewer overflows and typically includes medical waste, street litter, and sewage. Ocean-based sources of marine debris include galley waste and other trash from ships, recreational boaters, fishermen, and offshore industries. Commercial and recreational fishers produce trash and debris by discarding plastics (e.g., ropes, buoys, fishing line and nets, strapping bands, and sheeting), wood, and metal traps. Some trash items, such as glass, pieces of steel, and drums with chemical or chemical residues, can be a health threat to local water supplies and as a result to biological, physical, and socioeconomic resources, to beachfront residents, and to users of recreational beaches. Refer to **Appendix C** for more information on marine trash and debris.

A.3.3.2 Strikes and Collisions

Vessel strikes are a result of vessels colliding with a resource or habitat, and vessel collisions are a result of vessels colliding with other vessels, aircraft, or structures. Meteorological buoys located in a potential lease area could pose a risk to vessel navigation. A collision between a ship and a meteorological buoy could result in the loss of the entire facility and/or the vessel, as well as loss of life and spillage of petroleum product. The vessel damage to the buoy hull could cause it to lose its buoyancy and sink, or it could damage the equipment or its supporting structure. Because a buoy would protrude from the ocean surface only 30-40 ft (9-12 m), an airplane striking a buoy is unlikely.

Vessels associated with site characterization and site assessment activities could collide with other vessels, resulting in damages, petroleum product spills, or capsizing. Vessel strikes and collisions are unlikely assuming vessel operator adherence to the Coast Guard Navigation Rules and Regulations (i.e., Rules of the Road[4]). Additional routing measures, such as safety fairways, and traffic separation schemes control traffic also help minimize risk. Airplane strikes and collisions are also considered unlikely. BOEM anticipates that aerial surveys would not be conducted during periods of storm activity because the reduced visibility conditions would not meet visibility requirements for conducting the surveys, and flying at low elevations would pose a safety risk during storms and times of low visibility. Risk of collisions with a meteorological buoy for vessels would be further reduced by USCG-required marking and lighting.

Historical data support the conclusion that the number of potential collisions resulting in damage to property and equipment would be small. Collision incident data were reviewed for the years 2007 through 2020 for the Gulf of Mexico and Pacific regions (BSEE 2022b), which contain many fixed structures on the OCS, such as oil and gas platforms. The collision data, which were recorded over a 13-year period and are available at https://www.bsee.gov/stats-facts/offshore-incident-statistics, reported 185 collisions in the Gulf of Mexico and Pacific regions. For those data, some of the most commonly reported causes of the allisions and collisions include human error, weather-related causes, equipment failure on the vessels, and navigational aids not working on the structures (BSEE 2022a).

A.3.3.3 Response Activities

A.3.3.3.1 Spill Response

As described above in **Section A.3.3.3**, spills of petroleum products are possible. The most likely would be spills of diesel fuel from vessel collisions or leakage from generators on site assessment infrastructure. These spills are expected to remain relatively small, and diesel is known to dissipate rapidly. An acceptable response is to allow the spill to degrade naturally, if the dissipation will occur without assistance. If the spill cannot be expected to evaporate on its own quickly, then there are multiple response strategies for diesel spills (NOAA 2017). In the amounts of potential diesel

[4] More information is available at www.navcen.uscg.gov/?pageName=navRulesContent.

spills related to renewable energy activities, using sorbent booms and pads could also be likely responses for larger spills.

A.3.3.3.2 Recovery of Lost Equipment

Equipment used during site characterization and site assessment activities (e.g., towed HRG survey equipment, CPT components, grab sampler, buoys, lines, and cables) could be accidentally lost during survey operations. Additionally, it is possible (although unlikely) that a meteorological buoy could disconnect from the clump anchor. In the event of lost equipment, recovery operations may be undertaken to retrieve the equipment. Recovery operations may be performed in a variety of ways depending on the equipment lost. A commonly used method for retrieval of lost equipment that is on the seafloor is through dragging grapnel lines (e.g., hooks and trawls). A single vessel deploys a grapnel line to the seafloor and drags it along the bottom until it catches the lost equipment, which is then brought to the surface for recovery. This process can result in significant bottom disturbances as it requires dragging the grapnel line along the bottom until it hooks the lost equipment, which may require multiple passes in a given area. In addition to dragging a grapnel line along the bottom, after the line catches the lost equipment, it will drag all the components along the seafloor until recovery.

Where lost survey equipment is not able to be retrieved because it is either small or buoyant enough to be carried away by currents or is completely or partially embedded in the seafloor (e.g., a broken vibracore rod), a potential hazard for bottom-tending fishing gear may occur, and additional bottom disturbance may occur. A broken vibracore rod that cannot be retrieved may need to be cut and capped 1-2 m (3-6 ft) below the seafloor. For the recovery of lost survey equipment, BOEM would work with the lessee/operator to develop an emergency response plan. Selection of a mitigation strategy would depend on the nature of the lost equipment, and further consultation may be necessary. The IPFs associated with recovery of lost survey equipment may include vessel traffic, noise and lighting, air emissions, and routine vessel discharges from a single vessel. Bottom disturbance and habitat degradation may also occur as a result of recovery operations. For more information on these IPFs, refer to **Appendix B**.

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APPENDIX B

ISSUES AND IMPACT-PRODUCING FACTORS

What is in This Appendix?

- A description of resulting issues and impact-producing factors (IPFs) that could potentially affect the physical, biological, and human environment as a result of a wind energy lease issuance.
- The IPFs are grouped into the following "issue" categories:
  - Air Emissions and Pollution (**Section B.1**);
  - Discharges and Wastes (**Section B.2**);
  - Bottom Disturbance (**Section B.3**);
  - Noise (**Section B.4**);
  - Coastal Land Use/Modification (**Section B.5**);
  - Lighting and Visual Impacts (**Section B.6**);
  - Offshore Habitat Modification/Space Use (**Section B.7**);
  - Socioeconomic Changes and Drivers (**Section B.8**); and
  - Accidental OCS Wind Energy Leasing, Site Characterization, and Site Assessment Related IPFs (**Section B.9**).

Key Points

- Each IPF category could occur during any phase of Outer Continental Shelf (OCS) wind energy leasing, site characterization, and site assessment activities described in **Appendix A,** and both OCS wind energy leasing, site characterization, and site assessment-related activities, and non-OCS wind energy leasing, site characterization, and site assessment-related activities can contribute to one or multiple IPF categories.
- The IPFs described in this appendix are derived from historical information and trends; however, specific scenario estimates regarding future OCS wind energy leasing and development activities is NOT included.
- Programmatic issues and processes (e.g., climate change) and their influence on the various IPF categories are acknowledged throughout this appendix and are described in greater detail in **Appendix C**, which describes the regional setting of the Gulf of Mexico (GOM).

B ISSUES AND IMPACT-PRODUCING FACTORS

B.0 IMPACT-PRODUCING FACTORS AND CONTRIBUTING ACTIVITIES OR PROCESSES

The Bureau of Ocean Energy Management's (BOEM's) interdisciplinary team of subject-matter experts apply knowledge and experience to develop cause and effect relationships between the categories of impact-producing factors described below and a wide variety of physical, biological, cultural, and socioeconomic resources in the OCS and adjacent coastal areas addressed in **Chapter 4** of this environmental assessment (EA).

For the purposes of this EA, the activities described are based on historical information and future general assumptions about the estimated amounts, timing, and potential locations of routine activities associated with the issuance of an OCS wind energy lease, site characterization surveys (i.e., biological, geological, geotechnical, and archaeological surveys), and site assessment activities (i.e., meteorological buoy deployment, operation, and decommissioning) within the area of analysis. This assessment does not utilize more specific information attained from modeling site characterization and site assessment scenarios. It also does not intend to estimate the impact levels (e.g., the context and intensity) of any effects from potential future OCS wind energy leasing and related activities. These levels would be defined and considered in more detail in a future National Environmental Policy Act (NEPA) analysis for OCS wind energy leasing, site characterization, and site assessment-related activities in the GOM, which would incorporate this document. There are, however, general impact-producing factors typical of offshore wind energy that manifest regardless of activity levels and where such activity occurs. This appendix aims to disclose those potential effects, as well as potential effects from other past, present, or future activities in or near the Gulf of Mexico OCS, in order to better inform the issues and resources that should be analyzed further in any future NEPA analysis, consultation, or other environmental assessments associated with wind energy leasing, site characterization, and site assessment.

B.0.1 Impact-Producing Factor Definitions and Categories

An IPF is the outcome or result of any proposed activities with the potential to positively or negatively affect physical, biological, cultural, and/or socioeconomic resources. These IPFs are grouped into “issue” categories based on BOEM’s extensive history of previous and ongoing wind energy leasing, site characterization, and site assessment activities in the Atlantic and OCS oil- and gas-related activities in the GOM. Both OCS and non-OCS wind energy leasing, site characterization, and site assessment-related activities can contribute to one or multiple IPF categories.

B.0.1.1 Impact-Producing Factor Categories

The following IPF categories were identified:

- **air emissions and pollution** associated with offshore and onshore activity (**Section B.1**);
- **discharges and wastes** associated with offshore and onshore activity (**Section B.2**);
- **bottom disturbance** associated with geotechnical sampling, infrastructure emplacement, and removal (**Section B.3**);
- **noise** from high-resolution geophysical [HRG] surveys, ship and aircraft traffic, construction, and decommissioning (**Section B.4**);
- **coastal land use/modification** associated with infrastructure emplacement and vessel traffic (**Section B.5**);

- **lighting and visual impacts** of the physical presence of infrastructure and vessel and aircraft traffic (**Section B.6**);
- **offshore habitat modification/space use** associated with infrastructure emplacement and removal and multiple-use areas on the seabed, in the water column, at the sea surface, or in the airspace (**Section B.7**);
- **socioeconomic changes and drivers** associated with variables like job loss and creation, public perceptions, etc. (**Section B.8**); and
- **accidental events** that include spills (such as diesel fuel), accident response associated with spills or unintended releases in the environment, and collisions and strikes (**Section B.9**).

Each IPF category could occur onshore or offshore during site characterization surveys or site assessment activities associated with OCS wind energy leasing.

Table B.0.1-1. OCS Wind Energy Leasing, Site Characterization, and Site Assessment Impact-Producing Factors by Impact-Producing Factor Category and Development Phase

Impact-Producing Factor Category	Site Characterization Surveys	Site Assessment Activities
Air Emissions and Pollution	Vehicles and equipment, onshore Vessels Aircraft	Vehicles and equipment, onshore Construction and decommissioning equipment, offshore Vessels Diesel engines used to power met buoy(s)
Discharges and Wastes	Onshore point and non-point sources Vessels	Onshore point and non-point sources Vessels Suspended particles during construction and decommissioning
Bottom Disturbance	Geotechnical/sub-bottom sampling Biological surveys	Construction and decommissioning of met buoy(s) Suspended sediment during construction and decommissioning Vessel and met buoy anchoring
Noise	Vehicles and equipment, onshore HRG survey equipment Vessel engines Survey aircraft	Vehicles and equipment, onshore Construction (including pile driving), operations and maintenance, and decommissioning, offshore Vessel engines
Coastal Land Use/Modification	Port utilization Port expansion	Port utilization Port expansion
Lighting and Visual Impacts	Lighting from structures, onshore Lighting from vessels (above water) Lighting from underwater survey equipment (e.g., benthic imaging)	Lighting from structures, onshore Lighting from vessels (above water) Lighting from met buoy(s) (above water)
Offshore Habitat Modification/Space Use	Vessel traffic	Vessel traffic Presence of structures

Impact-Producing Factor Category	Site Characterization Surveys	Site Assessment Activities
Socioeconomic Changes and Drivers	Temporary increases in employment, onshore and offshore	Temporary increases in employment, onshore and offshore
Unintentional Releases into the Environment	Fuel Spills Trash and Debris	Fuel spills Trash and debris
Response Activities	Spill response Recovery of lost equipment	Spill response Recovery of lost equipment
Strikes and Collisions	Collisions, vessel strikes, and entanglement	Collisions, vessel strikes, and entanglement

HRG = high-resolution geophysical; met = meteorological

Each IPF category could occur during any phase of wind energy leasing, site characterization, and site assessment activities described in **Section A.3** of **Appendix A** (Wind Energy Leasing, Site Characterization, and Site Assessment Activity).

OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs. These are IPFs that generally occur during wind energy leasing, site characterization, and site assessment activities. The operations are broken down by phase and include site characterization surveys and site assessment activities and data collection devices as discussed in **Section A.3.2** of **Appendix A** (Routine Activities). These activity descriptions would apply to any future OCS wind energy leasing, site characterization, and site assessment-related activities.

Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs. These are non-OCS wind energy leasing, site characterization, and site assessment-related past, present, and reasonably foreseeable future cumulative IPFs occurring within the same geographic range of the Area of Analysis and timeframes as the aforementioned OCS wind energy leasing, site characterization, and site assessment-related-activities. These other activities are those that are considered independent of OCS wind energy leasing and reasonably expected regardless of whether OCS wind energy leasing and associated activities occur. BOEM attempted to include all reasonably foreseeable future activities regardless of what agency (Federal or non-Federal) or person undertakes such activities. These other related stressors or activities are described within each IPF category under the subheading “Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related Activities.”

Accidental OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs. Through BOEM’s decades of experience with offshore industrial development, it is reasonable to assume that accidents would occur. Types of accidental events include releases into the environment (e.g., fuel spills or trash and debris), accident response activities (e.g., spill response or recovery of lost equipment), and vessel strikes (e.g., allisions [vessels striking fixed structures], collisions [vessel to vessel and/or vessel striking a marine animal]). Reasonably foreseeable accidental events associated with OCS wind energy leasing, site characterization, and site assessment-related activities are discussed in **Section A.3** of **Appendix A**.

B.1 AIR EMISSIONS

Criteria Air Pollutants and Other Air Pollutants

The Clean Air Act (CAA) Amendments of 1990, require the U.S. Environmental Protection Agency (USEPA) to set the National Ambient Air Quality Standards (NAAQS) for six common air pollutants of concern called "criteria air pollutants." The USEPA identified the following criteria air pollutants: carbon monoxide (CO); lead (Pb); ozone (O_3); nitrogen dioxide (NO_2); particulate matter (PM); and sulfur dioxide (SO_2). For PM, particulate matter 10 micrometers or less in aerodynamic diameter (PM_{10}) and particulate matter 2.5 micrometers or less in aerodynamic diameter ($PM_{2.5}$) are of most concern for health reasons as they can transport over long distances and can be inhaled into the lungs (USEPA 2019a).

There are numerous air pollutants; however, nitrogen oxides (NO_x), sulfur oxides (SO_x), PM, Pb, CO, volatile organic compounds (VOCs), and ammonia (NH_3) contribute, whether directly or through chemical reactions, to increased levels of the NAAQS criteria air pollutants and are commonly controlled through laws and regulations. For more information on laws and regulations pertaining to OCS air emissions, refer to BOEM's *Gulf of Mexico OCS Regulatory Framework* technical report (BOEM 2020). Other air pollutants of concern that are discussed in this appendix include hazardous air pollutants (HAPs) and greenhouse gases (GHGs).

B.1.1 OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

Routine activities associated with OCS wind energy leasing, site characterization, and site assessment that could potentially affect air quality include (1) use of survey vessels (i.e., geological and geophysical [G&G] and biological), (2) use of construction vessels, (3) use of support vessels, (4) onshore heavy and light duty vehicles, (5) onshore construction equipment, (6) offshore facility operation engines, and (7) the decommissioning of a meteorological buoy(s). These routine activities result in air pollutant emissions. Emissions of air pollutants would occur during site characterization surveys and site assessment activities. **Table B.1.1-1** lists the source types and related equipment that are sources of emissions.

Table B.1.1-1. Sources of Emissions from OCS Wind Energy Leasing, Site Characterization, and Site-Assessment Activities.

Source Type	Source Type of Emissions	Potential Air Pollutants
Vessels (surveys [geophysical, geotechnical, biological], construction, and operation and maintenance, decommissioning)	Diesel or gasoline engines	PM, CO, SO_2, NO_x, NH_3, VOCs, Pb, GHGs, and some HAPs
Onshore Vehicles and Equipment (heavy duty trucks, personal vehicles, and construction equipment)		
Meteorological Buoy Operation (diesel engines)		

CO = carbon monoxide; GHG = greenhouse gas; HAP = hazardous air pollutants; NH_3 = ammonia; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; PM = particulate matter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Under the Outer Continental Shelf Lands Act (OCSLA), OCS sources from BOEM-authorized activities that may affect the air quality of any state are regulated by BOEM for the Western and Central Planning Areas (WPA and CPA) (areas of the OCS west of the 87.5° longitude). The USEPA, under Section 328 of the Clean Air Act Amendments of 1990 (40 CFR part 55) for all areas of the OCS east of the 87.5° longitude, regulates OCS sources that may affect the air quality of any state. The activities associated with OCS wind energy leasing, site characterization, and site assessment would include a meteorological buoy(s); any vessels used to construct, service, or decommission that buoy(s); and seafloor boring activities.

The CAA, as amended, requires the USEPA to set NAAQS for six common air pollutants of concern called "criteria air pollutants." The criteria air pollutants are carbon monoxide (CO), lead (Pb), ozone (O_3), nitrogen dioxide (NO_2), particulate matter (PM), and sulfur dioxide (SO_2). The OCSLA provides the Secretary of the Interior (Secretary), acting through BOEM, with the responsibility to ensure "compliance with the NAAQS"; however, the plain language also states that the Secretary's authority to regulate is limited to "activities authorized under this [Act]" that "significantly affect the air quality of any State." For instance, the OCSLA itself does not require or permit the operation of vessels in support of activities under a lease.

The OCSLA's provisions on air quality provide the Secretary a much narrower authority to regulate when compared with the breadth of those authorities granted to the USEPA in the CAA. Under later amendments to the CAA, the CAA Amendments of 1990, Section 328 of the CAA clearly outlines the separate and distinct jurisdictional authority of the USEPA, limiting the applicability of the USEPA's regulatory authority only to specific areas of the OCS in consultation with the Secretary (42 U.S.C. § 7627). BOEM has air quality jurisdiction in the GOM west of 87.5° longitude, which encompasses the entire WPA and most of the CPA.

BOEM's regulatory authority under Section 5(a) of the OCSLA is focused on the six criteria air pollutants for which the USEPA has defined NAAQS in accordance with the requirements of the CAA. The amount of any given criteria pollutant that may affect any State is influenced by two factors, the direct air emission and dispersion of the criteria pollutant and the formation of a criteria pollutant caused by the air emissions of other pollutants. Those air pollutants that contribute to the formation of a criteria air pollutant are known as precursor air pollutants. Historically, the precursor air pollutant that BOEM has regulated (in addition to those precursor air pollutants that are themselves also criteria air pollutants) is volatile organic compounds.

For OCS air emission sources located east of 87.5° longitude and within 25 miles (mi) (40 kilometers [km]) of the State's seaward boundaries, the USEPA's regulations for these OCS areas are specified in 40 CFR part 55. For OCS air emission sources located east of 87.5° longitude and more than 25 mi (40 km) from the State's seaward boundaries, the USEPA's regulations for these OCS areas are specified in the State Implementation Plans in 40 CFR part 52. For OCS air emission sources related to activities authorized under the OCSLA and located west of 87.5° longitude, BOEM's regulations for these OCS areas are specified in 30 CFR part 550. Other air emission sources that are not authorized under the OCSLA may be subject to other Federal laws and regulations.

B.1.2 Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

This section discusses and provides emission estimates for natural and anthropogenic sources that are not associated with OCS wind energy leasing, site characterization, and site assessment activities. These sources are divided and analyzed based on their occurrence offshore or onshore.

B.1.2.1 Offshore Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related Sources

Routine activities associated with OCS oil and gas that could potentially affect air quality include (1) use of G&G survey vessels, (2) use of drilling and production and associated vessels, (3) use of support helicopters, (4) pipelaying operations, (5) flaring and venting, and (6) decommissioning of facilities and pipelines. These routine activities result in air pollutant emissions. Emissions of air pollutants from these activities would occur during exploration, development, production, installation, and decommissioning activities. **Table B.1.2-1** lists the phase types and related equipment that are sources of emissions.

Table B.1.2-1. Sources of Emissions from OCS Oil- and Gas-Related Activities.

Phase Type	Source Type of Emissions	Potential Air Pollutants
Geological and Geophysical Surveys (including ancillary activities)	Diesel or gasoline engines	PM, CO, SO_2, NO_x, NH_3, VOCs, Pb, GHGs, and some HAPs
Exploration	Diesel or gasoline engines; fugitives (i.e., leaks from equipment components); losses from flashing (i.e., unrecovered gas); mud degassing; natural gas engines; natural gas, diesel, or dual fuel turbines; pneumatic controllers; and pneumatic pumps	PM, CO, SO_2, NO_x, NH_3, VOCs, Pb, GHGs, and some HAPs
Development	Diesel or gasoline engines; fugitives (i.e., leaks from equipment components); losses from flashing (i.e., unrecovered gas); mud degassing; natural gas engines; natural gas, diesel, or dual fuel turbines; pneumatic controllers; and pneumatic pumps	PM, CO, SO_2, NO_x, NH_3, VOCs, Pb, GHGs, and some HAPs
Production	Diesel or gasoline engines; fugitives (i.e., leaks from equipment components); losses from flashing (i.e., unrecovered gas); mud degassing; natural gas engines; natural gas, diesel, or dual fuel turbines; pneumatic controllers; pneumatic pumps; amine units; boilers/heaters/burners; cold vents; glycol dehydrator units; loading operations (i.e., losses of vapors from tanks); and storage tanks	PM, CO, SO_2, NO_x, NH_3, VOCs, Pb, GHGs, and some HAPs
Decommissioning, Abandonment, and Removal Operations	Diesel or gasoline engines	PM, CO, SO_2, NO_x, NH_3, VOCs, Pb, GHGs, and some HAPs

CO = carbon monoxide; GHG = greenhouse gas; HAP = hazardous air pollutants; NH_3 = ammonia; NO_2 = nitrogen dioxide; Pb = lead; PM = particulates matter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Overall, the OCS oil- and gas-related CAP and CPAP emissions reported in 2017 decreased from year 2014 and 2011 emission inventories.

The *Year 2017 Emissions Inventory Study* used activity data and USEPA-approved emission factors compiled in USEPA's AP-42, "Fifth Edition Compilation of Air Pollutant Emissions Factors," to calculate emissions (USEPA 2020b). An emission factor is "a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant" (RTI International 2007). Uncertainties associated with emission inventories could arise due to facilities that did not report (Wilson et al. 2019) emission factors.

Wilson et al. (2019) reported OCS oil- and gas-related source emissions per air pollutant listed in **Table B.1.2-2**. The highest criteria air pollutant (CAP) and criteria precursor air pollutant (CPAP) emissions were reported from natural gas engines and support vessels, while the lowest CAP and CPAP emissions were reported from diesel and gasoline engines used for drilling, combustion flares, and mud degassing. Overall, the OCS oil- and gas-related CAP and CPAP emissions (except for Pb and NH_3, which are unknown) reported in year 2017 decreased in comparison with year 2014 and 2011 emission inventories (Wilson et al. 2019).

In addition to CAPs and CPAPs, there are 187 HAPs that could cause cancer or other adverse human health effects (USEPA 2020e). Of those 187 HAPs, 28 were identified (**Table B.1.2-2**) as being emitted by offshore sources (Wilson et al. 2019). The highest HAP emissions were reported from OCS oil and gas support vessels and glycol dehydrators, while the lowest HAP emissions were reported from helicopters, boilers, and pneumatic pumps (Wilson et al. 2019).

As for the GHGs, the three major air pollutants include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The highest GHG emissions were reported from natural gas, diesel, and duel-fuel turbines; cold vents; and support vessels, while the lowest GHG emissions were reported from mud degassing and amine units (Wilson et al. 2019). The OCS oil and gas GHG emissions reported in year 2017 for CO_2, CH_4, and N_2O decreased in comparison with year 2014 and 2011 emission inventories.

Table B.1.2-2. Air Emissions from OCS Oil- and Gas-Related Sources in 2017 (Wilson et al. 2019).

Air Pollutant Type	Air Pollutant	Total Amount (tons per year) of OCS Oil- and Gas-Related Sources*
CAP	CO	59,435.0000
CAP	Pb	0.1518
CAP/CPAP	NO_x	84,266.0000
CAP	PM_{10}	1,706.0000
CAP	$PM_{2.5}$	1,656.0000
CPAP	NH_3	19.0000
CAP	SO_2	1,410.0000

Air Pollutant Type	Air Pollutant	Total Amount (tons per year) of OCS Oil- and Gas-Related Sources*
CPAP	VOC	39,886.0000
HAP	2,2,4-Trimethylpentane	9.8302
HAP	Acenaphthene	0.0103
HAP	Acenaphthylene	0.0158
HAP	Acetaldehyde	182.9700
HAP	Anthracene	0.0158
HAP	Arsenic	0.0320
HAP	Benz(a)anthracene	0.0171
HAP	Benzene	233.4850
HAP	Benzo(a)pyrene	0.0031
HAP	Benzo(b)fluoranthene	0.0062
HAP	Benzo(g,h,l)perylene	0.0039
HAP	Benzo(k)fluoranthene	0.0031
HAP	Beryllium	0.0002
HAP	Cadmium	0.2444
HAP	Chromium	0.5134
HAP	Chrysene	0.0030
HAP	Ethylbenzene	18.9490
HAP	Fluoranthene	0.0094
HAP	Fluorene	0.0210
HAP	Formaldehyde	764.6400
HAP	Indeno(1,2,3-c,d)pyrene	0.0062
HAP	Naphthalene	1.0300
HAP	Hexane	767.9900
HAP	Mercury	0.2301
HAP	Phenanthrene	0.0240
HAP	Pyrene	0.0167
HAP	Toluene	228.1820
HAP	Xylenes	104.1020
GHG	CO_2	10,091,006.0000
GHG	CH_4	187,910.0000
GHG	N_2O	303.0000

*short tons
CAP = criteria air pollutant; CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide;
CPAP = criteria precursor air pollutant; GHG = greenhouse gas; HAP = hazardous air pollutant;
N_2O = nitrous oxide; NH_3 = ammonia; NO_2 = nitrogen dioxide; NO_x = nitrogen oxides; Pb = lead;
PM_{10} = particulate matter 10 micrometers or less in aerodynamic diameter particulate matter;
$PM_{2.5}$ = particulate matter 2.5 micrometers or less in aerodynamic diameter particulate matter;
SO_2 = sulfur dioxide; VOC = volatile organic compound.

Other offshore sources of air pollution not associated with OCS oil- and gas-related activities that cause degradation to the air quality come from natural (biogenic and geogenic) and anthropogenic sources. Natural offshore sources include, but are not limited to, lightning, sea salt, bacterial processes, and natural oil seeps. Anthropogenic offshore sources include, but are not limited to, commercial vessels (including cruise ships and lightering services), military vessels and aircraft, commercial and recreational fishing vessels, and the Louisiana Offshore Oil Port.

The *Year 2017 Emissions Inventory Study* reported offshore non-OCS oil- and gas-related source emissions per air pollutant listed in **Table B.1.2-3** (Wilson et al. 2019). The offshore non-OCS oil- and gas-related source that contributes the most CAP and CPAP emissions was reported from commercial marine vessels. The offshore non-OCS oil- and gas-related sources with the lowest CAP and CPAP emissions included military vessels and biogenic/geogenic sources. Other air pollutants of concern from offshore non-OCS oil- and gas-related sources include HAPs and GHGs. The offshore non-OCS oil- and gas-related source with the highest levels of HAP emissions was commercial marine vessels. The offshore non-OCS oil- and gas-related sources with the lowest or no HAP emissions included commercial and recreational fishing, U.S. Coast Guard (USCG) activities, and biogenic/geogenic sources. The offshore non-OCS oil- and gas-related sources with the highest levels of GHG emissions were commercial marine vessels and natural (biogenic and geogenic) sources. The offshore non-OCS oil- and gas-related sources with the lowest levels of GHG emissions were commercial and recreational fishing, and USCG activities (Wilson et al. 2019).

Table B.1.2-3. Air Emissions from Offshore Non-OCS Oil- and Gas-Related Sources in 2017 (Wilson et al. 2019).

Air Pollutant Type	Air Pollutant	Total Amount (tons per year) from Offshore Non-OCS Oil- and Gas-Related Sources*
CAP	CO	20,418.000
CAP	Pb	0.456
CAP/CPAP	NO_x	164,681.000
CAP	PM_{10}	3,087.000
CAP	$PM_{2.5}$	2,867.000
CPAP	NH_3	48.000
CAP	SO_2	5,281.000
CPAP	VOC	27,612.000
HAP	2,2,4-Trimethylpentane	1.680
HAP	Acenaphthene	0.010
HAP	Acenaphthylene	0.020
HAP	Acetaldehyde	130.870
HAP	Anthracene	0.020
HAP	Arsenic	0.280
HAP	Benz(a)anthracene	0.020
HAP	Benzene	35.640
HAP	Benzo(a)pyrene	0.010
HAP	Benzo(b)fluoranthene	0.010
HAP	Benzo(g,h,I)perylene	0.010
HAP	Benzo(k)fluoranthene	0.010
HAP	Beryllium	0.001
HAP	Cadmium	0.020

Air Pollutant Type	Air Pollutant	Total Amount (tons per year) from Offshore Non-OCS Oil- and Gas-Related Sources*
HAP	Chromium	0.380
HAP	Chrysene	0.004
HAP	Ethylbenzene	8.430
HAP	Fluoranthene	0.010
HAP	Fluorene	0.030
HAP	Formaldehyde	267.550
HAP	Indeno(1,2,3-c,d)pyrene	0.010
HAP	Naphthalene	0.830
HAP	Hexane	23.170
HAP	Mercury	0.000
HAP	Phenanthrene	0.030
HAP	Pyrene	0.020
HAP	Toluene	13.480
HAP	Xylenes	20.220
GHG	CO_2	9,943,805.000
GHG	CH_4	1,940.000
GHG	N_2O	2,466.000

*short tons
CAP = criteria air pollutant; CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CPAP = criteria precursor air pollutant; GHG = greenhouse gas; HAP = hazardous air pollutant; N_2O = nitrous oxide; NH_3 = ammonia; NO_2 = nitrogen dioxide; NO_x = nitrogen oxides; Pb = lead; PM_{10} = particulate matter 10 micrometers or less in aerodynamic diameter particulate matter; $PM_{2.5}$ = particulate matter 2.5 micrometers or less in aerodynamic diameter particulate matter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

B.1.2.2 Onshore Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related Sources

Onshore sources of air pollution from non-OCS wind energy leasing, site characterization, and site assessment-related activities include power generation, industrial processing, manufacturing, refineries, waste disposal, pesticides, fertilizers, commercial and home heating, and motor vehicles. Natural sources include, but are not limited to, lightning, volcanos, pollen, dust, and other biogenic and geogenic sources.

The most recent year 2017 national emissions inventory (USEPA 2020a) reported the Gulf Coast States' (i.e., Alabama, Florida, Louisiana, Mississippi, and Texas) onshore source emissions per air pollutant (**Table B.1.2-4**). The onshore sources that contribute the most CAP and CPAP emissions were reported from on-road light-duty vehicles, diesel heavy-duty vehicles, aircraft, road dust, biomass activities, vegetation and soil, livestock waste, fertilizer, and coal combustion. The onshore sources with the lowest CAP and CPAP emissions were fuel combustion from natural gas, wildfires, and solvents. Overall, the onshore CAP and CPAP emissions for the Gulf Coast States reported in year 2017 decreased in comparison with year 2014.

Other air pollutants of concern from onshore sources can also include HAPs and GHGs. Of the 187 HAPs, 28 were reported (**Table B.1.2-4**) to be consistent with the HAPs reported from offshore sources. The onshore sources with most HAP emissions were wildfires, electricity generation, on-road light-duty vehicles, industrial processes, and vegetation and soil. The onshore sources with the lowest HAP emissions were industrial pulp and paper processes, and solvents. Overall, the onshore HAP emissions for the Gulf Coast States reported in year 2017 decreased in comparison with year 2014. The onshore sources with the most GHG emissions were reported from industrial processes (e.g., power plants, waste, and chemical processes), on-road light-duty vehicles, and diesel heavy-duty vehicles. The onshore sources with the lowest GHG emissions included solvents and industrial biomass and natural gas boilers. Overall, the onshore GHG emissions for the Gulf Coast States reported in year 2017 increased in comparison with year 2014.

Table B.1.2-4. Air Emissions from Onshore Sources of the Five Gulf Coast States in 2017 (database query of the 2017 National Emissions Inventory) (USEPA 2020a).

Air Pollutant Type	Air Pollutant	Total Amount (tons per year) from Onshore Sources*
CAP	CO	11,501,737.00
CAP	Pb	110.00
CAP/CPAP	NO_x	2,420,897.00
CAP	PM_{10}	2,878,592.00
CAP	$PM_{2.5}$	852,146.00
CPAP	NH_3	670,723.00
CAP	SO_2	691,774.00
CPAP	VOC	10,158,903.00
HAP	2,2,4-Trimethylpentane	24,475.27
HAP	Acenaphthene	38.68
HAP	Acenaphthylene	124.62
HAP	Acetaldehyde	131,240.38
HAP	Anthracene	97.42
HAP	Arsenic	8.18
HAP	Benz(a)anthracene	94.73
HAP	Benzene	35,006.12
HAP	Benzo(a)pyrene	29.83
HAP	Benzo(b)fluoranthene	6.53
HAP	Benzo(g,h,I)perylene	89.86
HAP	Benzo(k)fluoranthene	40.25
HAP	Beryllium	1.66
HAP	Cadmium	5.26
HAP	Chromium	40.74
HAP	Chrysene	92.83
HAP	Ethylbenzene	11,158.63
HAP	Fluoranthene	141.24
HAP	Fluorene	86.93
HAP	Formaldehyde	206,447.00
HAP	Indeno(1,2,3-c,d)pyrene	53.98
HAP	Naphthalene	8,407.94
HAP	Hexane	23,712.05
HAP	Mercury	6.82

Air Pollutant Type	Air Pollutant	Total Amount (tons per year) from Onshore Sources*
HAP	Phenanthrene	314.03
HAP	Pyrene	209.96
HAP	Toluene	78,421.47
HAP	Xylenes	45,744.29
GHG	CO_2	1,440,338,474.00
GHG	CH_4	1,460,404.00
GHG	N_2O	63,779.00

*short tons
CAP = criteria air pollutant; CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CPAP = criteria precursor air pollutant; GHG = greenhouse gas; HAP = hazardous air pollutant; N_2O = nitrous oxide; NH_3 = ammonia; NO_2 = nitrogen dioxide; NO_x = nitrogen oxides; Pb = lead; PM_{10} = particulate matter 10 micrometers or less in aerodynamic diameter particulate matter; $PM_{2.5}$ = particulate matter 2.5 micrometers or less in aerodynamic diameter particulate matter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

B.2 Discharges and Wastes

B.2.1 OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

Routine wind energy leasing, site characterization,- and site assessment-related activities that have the potential to adversely affect water quality include operational wastes and discharges from survey vessels and vessels servicing the buoy(s) (i.e., bilge water, ballast water, sanitary waste, and debris). Bilge and ballast water discharges may contain small amounts of petroleum-based products and metals, and as such are regulated and may be prohibited within 12 nautical miles (nmi) (14 mi; 24 km) of the shore. Any vessels conducting surveys or servicing a buoy(s) are likely to be equipped with holding tanks for sanitary waste and would not discharge untreated sanitary waste within State or Federal waters. The instrumentation used for site characterization is self-contained, so there should be no discharges from instruments aboard the survey vessels that would impact water quality.

The USEPA regulates discharges incidental to the normal operation of all non-recreational, non-military vessels greater than 79 feet (ft) (24 meters [m]) in length into U.S. waters under Section 402 of the Clean Water Act. The USEPA requires that eligible vessels obtain coverage under the National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VPG). A separate, streamlined permit is available for vessels less than 79 ft (24 m) (Small Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels Less than 79 ft). Typical discharges eligible for coverage under the VPG include deck runoff, graywater (from showers, sinks, laundry facilities, etc.), bilgewater, and ballast water. The discharge of any oil or oily mixtures within bilgewater is prohibited under 33 CFR § 151.10; however, discharges may occur in waters greater than 12 nmi (14 mi; 22 km) from shore if the oil concentration is less than 100 parts per million, and bilge/oily water separator effluent is covered for discharge under the final 2013 USEPA Vessel General Permit. Although ballast water is less likely to contain oil, it is subject to the same discharge limits as bilgewater (33 CFR § 151.10). Ballast water, which is used to maintain stability of the vessel, may be pumped from coastal or marine waters when necessary and is usually stored in separate compartments not contaminated with oil. Ballast water is subject to the USCG Ballast Water Management Program to prevent the spread of aquatic nuisance species.

The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by the Bureau of Safety and Environmental Enforcement (BSEE) (30 CFR § 250.300) and USCG (International Convention for the Prevention of Pollution from Ships [MARPOL], Annex V, Public Law 100-220 [101 Stat. 1458]). The Act to Prevent Pollution from Ships is a U.S. Federal law that allows USCG to implement the provisions of MARPOL (33 U.S.C. §§ 1901-1915). The Act to Prevent Pollution from Ships applies to all U.S. flagged ships in U.S. and international waters and to all foreign flagged vessels operating in navigable waters of the United States or while at port under U.S. jurisdiction.

Impacts to water quality could occur during installation and decommissioning, with water quality returning to its original state during operation of the buoy(s) and after decommissioning.

Most site characterization and site assessment activities would be covered by the U.S. Army Corps of Engineers' Nationwide Permit (NWP) Numbers 5 and 6, which were developed under Section 404 of the Clean Water Act and Section 10 of the River and Harbors Act to provide a streamlined evaluation and approval process for certain activities that have minimal adverse impact, both individually and cumulatively, on the environment. The NWP 5 covers the placement of scientific measurement devices, including tide gages, water recording devices, water quality testing and improvement devices, meteorological stations, and similar structures. The NWP 6 covers a variety of survey activities including core sampling, seismic exploratory operations, plugging of seismic shot holes and other exploratory-type bore holes, exploratory trenching, soil surveys, sampling, and historic resources surveys.

B.2.2 Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment Related IPFs

This chapter describes the routine wastes (often referred to as operational wastes) and discharges that are permitted or regulated by BOEM, BSEE, and/or other Federal and State agencies. Water pollution associated with OCS oil- and gas-related activities in the Gulf of Mexico is permitted by the USEPA through the NPDES general permits in support of the Clean Water Act. Refer to BOEM's *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 Multisale Environmental Impact Statement* (2017-2022 GOM Multisale EIS) (BOEM 2017a; 2017b) and BOEM's *Gulf of Mexico OCS Regulatory Framework* technical report (BOEM 2020) for more information about the Clean Water Act and BOEM and BSEE's permitting and approval processes pertaining to water quality and OCS oil- and gas-related discharges and wastes.

B.2.2.1 OCS Oil- and Gas-Related Activities

The primary operational wastes and discharges generated during offshore oil and gas exploration and development are drilling fluids, drill cuttings, various waters (e.g., bilge, ballast, fire, and cooling), deck drainage, sanitary wastes, and domestic wastes. During production activities, additional waste streams include produced water, produced sand, and well-treatment, workover, and completion fluids. Minor additional discharges occur from numerous sources. These discharges may include desalination unit discharges, blowout preventer fluids, boiler blowdown discharges, excess cement slurry, several fluids used in subsea production, and uncontaminated freshwater and salt water. Although not routine, and not permitted or regulated by BOEM, BSEE, and/or other Federal and State agencies, accidental oil spills and other types of unintended releases that can occur as a result of existing or future oil and gas operations in the GOM are addressed separately in **Section B.2.2.1.14**. Refer to the 2017-2022 GOM Multisale EIS (BOEM 2017a; 2017b) for detailed descriptions of the following discharges and wastes.

B.2.2.1.1 Drilling Muds and Cuttings

Drilling fluids (also known as drilling muds) and cuttings represent a large quantity of the discharge generated by drilling operations. Drilling fluids are used in rotary drilling to remove cuttings from beneath the bit, control well pressure, cool and lubricate the drill string and its bit, and seal the well. Drill cuttings are the fragments of rock generated during drilling and carried to the surface with the drilling fluid. Drilling discharges of muds and cuttings are regulated by the USEPA through the NPDES permitting process.

B.2.2.1.2 Production-Treating Chemicals

Several chemicals, serving various functions, are used in offshore oil and gas production systems and pipelines. Production-treating chemicals can be classified into 14 functional categories. **Table B.2.2-1** lists these categories, describes the function of each, and shows some of the generic types of chemical used in each.

Table B.2.2-1. Production-treating Chemicals: Codes, Functional Categories, Descriptions, and Material Types.

Code	Functional Category	Description	Material Types Used
P-B	Biocides	Chemicals used to control the growth of bacteria that can generate hydrogen sulfide and cause corrosion and bacteria that produce slime and biomass	Quaternary amine salt and amine acetate, aldehydes, tetrakis hydroxymethyl phosphonium sulfate (THPS), sodium hypochlorite
P-CI	Corrosion inhibitors	Used to prevent or minimize internal corrosion in offshore production systems	Amides/Imidazolines, amines and amine salts, quaternary ammonium salts, nitrogen heterocyclics
P-SI	Scale inhibitors	Used to prevent water-formed scales (calcium carbonate, barium sulfate, and strontium sulfate)	Phosphate esters, phosphonates, polymers
P-EB	Emulsion breakers	Used to destabilize water in oil emulsions to make oil saleable.	Oxyalkylated resins, polyglycol esters, alkyl aryl sulfonates
P-RB	Reverse breakers	Used to de-stabilize oil in water dispersions and facilitate gravity	Polyamines, polyamine quaternary compounds

		separation. Used to reduce the interface tension, allowing the oil droplets to coalesce into large drops.	
P-A	Antifoams	Used to de-stabilize foam in the separation of gas and liquids in separators. Used to reduce foaming of water during de-oxygenation for waterfloods.	Silicones, polyglycol esters
P-CF	Coagulants, flocculants	Used to make small solids agglomerate so that they can be separated by filtration or flotation. Applied to the removal of solids from injection water and to improve oil removal for overboard discharge.	Aluminum sulfate, other metal compounds, polymeric amides
P-S	Surfactants	Used to remove small amounts of oil or grease from the platform and/or equipment.	Alkyl aryl sulfonates, ethoxylated alkyl phenols
P-TC	Paraffin treating chemicals	Used to prevent solid organic deposits from depositing on the walls of the piping and equipment. Also includes solvents for removing such deposits.	Hydrocarbon polymers, solvents
P-SA	Solvents and additives	Used as carriers in the various chemical formulations. Hydrocarbon solvents are used for those chemicals meant to reach the oil phase. Alcohols and glycols are used as mutual solvents in both water-soluble and oil-soluble formulations.	Naphtha, light aromatic naphtha, heavy aromatic naphtha, kerosene, ethylene glycol, other low molecular weight glycols, methanol, isopropanol
P-OS	Oxygen scavengers	Used to remove oxygen from waterflood water.	Sodium bisulfite, ammonium bisulfite
P-HIC	Hydrate inhibition chemicals	Used to control the formation of gas hydrates in gathering piping systems.	Methanol, ethylene glycol
P-DC	Dehydration chemicals	Used to remove water vapor from natural gas.	Triethylene glycol
P-SC	Sweetening chemicals	Used to remove carbon dioxide and hydrogen sulfide from natural gas.	Proprietary products; the most common systems are monoethanolamine (MEA) or diethanolamine (DEA)

B.2.2.1.3 Produced Waters

Produced water is brought up from the hydrocarbon-bearing strata along with produced oil and gas. It is the largest volume waste stream from oil and gas production. This waste stream can include formation water; injection water; well-treatment, completion, and workover compounds added downhole (including flowback water); and compounds used during the oil and water separation process. Formation water (brine) originates in the permeable sedimentary rock strata and is brought up to the surface commingled with the oil and gas. Injection water is water that was injected to enhance oil production and is used in secondary oil recovery. Flowback fluid (or water) is fluid that has been returned uphole after being injected into the formation for stimulation purposes. This includes water and chemicals used for hydraulic fracturing practices, as that would be considered a stimulation practice.

In addition to the added chemical products, produced water contains chemicals that have dissolved into the water from the geological formation where the water was stored. The amount of dissolved solids can be more concentrated than is found in seawater. Produced water may contain inorganic and organic chemicals and radionuclides known as technologically enhanced naturally occurring radioactive materials (226Ra and 228Ra). The composition of the discharge can vary greatly in the amounts of organic, inorganic, and radioactive compounds.

B.2.2.1.4 Well Treatment, Completion, and Workover Fluids

Well treatment fluids are chemicals applied during the oil and gas extraction process to dehydrate produced oil or treat the associated produced water for reuse or disposal. Well completion fluids are used to displace any residual drilling fluid and protect formation permeability, and workover fluids are used to maintain or improve existing well conditions and production rates on wells that have been in production. Well treatment, completion, and workover (TCW) fluids include corrosion and scale inhibitors, bactericides, paraffin solvents, demulsifiers, foamers, defoamers, and water treatment chemicals (Boehm et al. 2001), as well as brines to regulate formation pressure and acids to increase the permeability of the formation.

The USEPA Regions 4 and 6 allow the discharge of well TCW fluids if they meet the conditions of the respective NPDES permit. These regions prohibit the discharge of TCW fluids with additives containing priority pollutants (which can be found in Appendix A of 40 CFR part 423). The TCW fluids commingled with produced waters have technology-based and water quality-based limits, and TCW fluids not commingled with produced waters discharged have technology-based effluent limits. Both of these waste streams, when discharged as permitted, do not cause a significant adverse impact to the marine environment in the GOM. Detailed descriptions of well TCW fluids can be found in the 2017-2022 GOM Multisale EIS (BOEM 2017a; 2017b) and the joint industry study on well TCW effluents (AECOM and Marine Ventures International 2021).

B.2.2.1.5 Production Solids and Equipment

As defined by the USEPA in the discharge guidelines (USEPA 1993), produced sands are slurried particles, which surface from hydraulic fracturing, and the accumulated formation sands and other particles including scale, which are generated during production. This waste stream also includes sludges generated in the produced-water treatment system, such as tank bottoms from oil/water separators and solids removed in filtration. The guidelines do not permit the discharge of produced sand, which must be transported to shore and disposed of as nonhazardous oil-field waste according to State regulations. Estimates of total produced sand expected from a platform are from 0 to 35 barrels (bbl)/day according to the USEPA (1993). A variety of solid wastes are generated, including construction/demolition debris, garbage, and industrial solid waste. No equipment or solid waste from a facility may be disposed of in marine waters.

B.2.2.1.6 Bilge, Ballast, and Fire Water

Bilge, ballast, and fire water all constitute minor discharges generated by offshore oil and gas production activities, which are allowed to be discharged to the ocean, as long as the USEPA's guidelines are followed. Ballast water is untreated seawater that is taken on board a vessel to maintain stability. Ballast water contained in segregated ballast tanks never comes into contact with either cargo oil or fuel oil.

Offshore drilling rigs and the offshore production facilities used to process oil have special fire protection requirements. Fire water is defined in the USEPA general permits as excess seawater or freshwater that permits the continuous operation of fire control pumps, as well as water released during the training of personnel in fire protection. Fire control system test water is seawater, sometimes treated with a biocide that is used as test water for the fire control system on offshore platforms. This test water is discharged directly to the sea as a separate waste stream (USEPA 1993). As well, fire protection can also include a barrier of water that is sometimes used during flaring to provide protection between flaring systems and personnel, equipment, and facilities. The USEPA Regions 4 and 6 general permits allow for the discharge of fire water that meets their specified limitations. The requirements include regulations and monitoring for treatment chemicals, discharge rate, free oil, and toxicity.

B.2.2.1.7 Cooling Water

Cooling water is defined as water used for contact or noncontact cooling, including water used for equipment cooling, evaporative cooling tower makeup, and dilution of effluent heat content. Cooling water is typically discharged at the site in accordance with NPDES permit requirements and any other requirements in accordance with Sections 301, 306, or 316(a) of the Clean Water Act. Seawater is drawn through an intake structure on the drilling rig, ship, or platform to cool power generators and other machinery, and produced oil or water. Drillship cooling water structures have been noted to intake 16-20 million gallons/day while semisubmersibles have been noted to intake 2 to over 10 million gallons/day from a water depth >400 ft (122 m) from the water's surface (USEPA 2006). However, newer semisubmersible units were noted to have an intake capacity of 35 million gallons/day. Not all intake water is necessarily used as cooling water; some may be used for ballast water, cleaning, firewater, and testing. Organisms may be killed through impingement or entrainment. When fish and other aquatic life become trapped against the screen at the entrance to the cooling water intake structure through the force of the water being drawn through the intake structure, it is termed impingement. When eggs and larvae are sucked into the heat exchanger and eventually discharged from the facility, it is termed entrainment (CSA Ocean Sciences Inc. and LGL Ecological Research Associates Inc. 2014; LGL Ecological Research Associates Inc. 2009).

The Clean Water Act, Section 316(b) Phase III, established categorical regulations for offshore oil and gas cooling water intake structures. The NPDES permits for USEPA Regions 4 and 6 all include cooling water intake structure requirements. The USEPA Regions 6 and 4 general permits began incorporating these requirements in 2007 and 2010, respectively, for new facilities that began construction after July 17, 2006, and that take in more than 2 million gallons/day of seawater, of which more than 25 percent is used for cooling (USEPA 2012b; 2017a). The requirements have several tracks depending on whether the facility is a fixed or non-fixed facility and whether it has a sea chest intake or not. Some of the requirements include cooling water intake structure design requirements to meet a velocity of <0.5 ft (0.2 m) per second, construction to minimize impingement and/or entrainment, entrainment monitoring, recordkeeping, and completion of a source water biological study.

B.2.2.1.8 Deck Drainage

Deck drainage includes all wastewater resulting from platform washings, deck washings, rainwater, and runoff from curbs, gutters, and drains, including drip pans and work areas on facilities engaged in field exploration, drilling, well production, and well treatment in the oil and gas industry. The USEPA's general guidelines for deck drainage require that no free oil be discharged, as determined by visual sheen. The quantities of deck drainage vary greatly depending on the size and location of the facility. An analysis of 950 GOM platforms during 1982-1983 determined that deck drainage averaged 50 bbl/day/platform (USEPA 1993). The deck drainage is collected, the oil is separated, and the water is discharged to the sea.

B.2.2.1.9 Treated Domestic and Sanitary Wastes

Domestic wastes originate from sinks, showers, laundries, and galleys. Sanitary wastes originate from toilets. For domestic waste, no solids or foam may be discharged. In addition, the discharge of all food waste within 12 nmi (14 mi; 22 km) from the nearest land is prohibited. In sanitary waste, floating solids are prohibited. Facilities with 10 or more people must meet the requirement of total residual chlorine >1 milligrams per liter and must maintain as close to this concentration as possible. There is an exception in the general permits for the use of marine sanitation devices.

In general, a typical manned platform would discharge 35 gallons/person/day of treated sanitary wastes and 50-100 gallons/person/day of domestic wastes (USEPA 1993). It is assumed that these discharges are rapidly diluted and dispersed.

B.2.2.1.10 Miscellaneous Discharges

Miscellaneous discharges include all other discharges not already discussed that may result during oil and gas operations. Miscellaneous wastes may include desalination unit discharge, blowout preventer fluid, boiler blowdown, excess cement slurry, uncontaminated freshwater and saltwater, and miscellaneous discharges at the seafloor, such as subsea wellhead preservation and production control fluid, umbilical steel tube storage fluid, leak tracer fluid, and riser tensioner fluids. These discharges are regulated by the U.S. Environmental Protection Agency's NPDES permits, with some variation between regions. In all cases, no free oil shall be discharged with the waste. The discharge of freshwater or seawater that has been treated with chemicals is permitted providing that the prescribed discharge criteria are met. Under the USEPA Region 6 general permit, unmanned facilities may discharge uncontaminated water through an automatic purge system without monitoring for free oil.

B.2.2.1.11 Onshore Disposal of Wastes Generated from OCS Oil and Gas Facilities

Most wastes, other than produced water and water-based drilling muds and cuttings, are regulated by the USEPA and must be transported to shore or reinjected downhole. Additionally, wastes may be disposed of onshore if they do not meet permit requirements or because onshore disposal is economically advantageous. Wastes that are typically transported to shore include produced sand, aqueous fluids such as wash water from drilling and production operations, technologically enhanced naturally occurring radioactive materials such as tank bottoms and pipe scale, industrial wastes, municipal wastes, and other exploration and production wastes (Dismukes 2010). Most oil-based fluid muds and some synthetic-based fluid (SBF) muds are recycled. If the physical and chemical properties of muds degrade, they may be disposed of or treated and reused for purposes other than drilling, instead of being recycled. Different reuses of treated muds include, among others, fill material, daily cover material at landfills, aggregate or filler in concrete, and brick or block manufacturing. The oil-based fluid cuttings are disposed of onshore or are injected onsite (USEPA 2000a). Both USEPA Regions 4 and 6 permit the discharge of SBF-wetted cuttings provided the cuttings meet the criteria with regard to percent of SBF retained, polycyclic aromatic hydrocarbon content, biodegradability, and sediment toxicity. Drill cuttings contaminated with hydrocarbons from the reservoir fluid must be disposed of onshore or reinjected.

The USEPA allows treatment, workover, and completion fluids to be commingled with the produced-water stream if the combined produced-water/treatment, workover, and completion discharges pass the toxicity test requirements of the NPDES permit. Spent treatment, workover, and completion fluid is stored in tanks on tending workboats or is stored on platforms and later transported to shore on supply boats or workboats. Once onshore, the treatment, workover, and completion wastes are transferred to commercial waste-treatment facilities and disposed of in commercial disposal wells.

Operators are prohibited in the GOM from discharging any produced sands offshore. Cutting boxes (15- to 25-bbl capacities), 55-gallon steel drums, and cone-bottom portable tanks are used to transport the solids to shore via offshore service vessels. A general rule of thumb is that roughly 1 barrel of produced sand is generated for every 2,000 barrels of oil produced and approximately 1-55 barrels per completion or workover operation (USEPA 1993). Of 224 production facilities in the GOM surveyed by the USEPA, 37 facilities reported generating produced sand, collectively averaging 74 barrels (USEPA 1996). Both Texas and Louisiana have State oversight of exploration and production waste-management facilities (Veil 2015).

B.2.2.1.12 Onshore Disposal and Storage Facilities Supporting OCS-Generated Operational Wastes

Existing solid-waste disposal infrastructure is adequate to support both existing and projected offshore oil and gas drilling and production needs. However, the OCS oil- and gas-related waste disposal to onshore facilities is an impact-producing factor that could affect onshore waste disposal facilities and land use if a new facility needs to be constructed to meet the level of offshore wastes coming to shore. The industry trend has been toward innovative methods to handle wastes to reduce the potential for environmental impacts, e.g., hydrocarbon recovery/recycling programs, slurry fracture injection, treating wastes for reuse as road base or levee fill, and segregating waste streams to reduce treatment time and improve oil recovery. The volume of OCS waste generated is closely correlated with the level of offshore drilling and production activity (Dismukes 2011; Dismukes et al. 2007).

B.2.2.1.13 Discharges from Onshore Support Facilities

The Clean Water Act establishes conditions and permitting for discharges of pollutants into the waters of the United States under the NPDES and gives the USEPA the authority to implement pollution control programs such as setting wastewater standards for industry and setting water quality standards for all contaminants in surface waters. Accordingly, the USEPA regulates all waste streams generated from OCS oil- and gas-related activities through permits issued by the USEPA region that has jurisdictional oversight.

The primary onshore facilities needed to support offshore oil- and gas-related activities include service bases, helicopter hubs at local ports/service bases, construction facilities (i.e., platform fabrication yards, pipeyards, and shipyards), processing facilities (i.e., refineries, gas processing plants, and petrochemical plants), and terminals (i.e., pipeline shore facilities, barge terminals, and tanker port areas). Water discharges from these facilities are from either point sources, such as a pipe outfall, or nonpoint sources, such as rainfall run-off from paved surfaces. The USEPA or USEPA-authorized State program regulates point-source discharges as part of the NPDES. Facilities would be issued general or individual permits that limit discharges specific to the facility type and the waterbody receiving the discharge. Other wastes generated at these facilities would be handled by local municipal and solid-waste facilities, which are also regulated by the USEPA or a USEPA-authorized State program.

B.2.2.1.14 Unintentional Releases into the Environment Associated with BOEM's OCS Oil and Gas Program

Oil Spills

Although hydrocarbon spills are accidental, not routine, and not proposed as part of any action, BOEM has included information on OCS oil and gas program-related spills due to the potentially important environmental impacts. The National Reseach Council (2003) computed petroleum hydrocarbon inputs into North American marine waters for several major categories. The results show that three activities – extraction, transportation, and consumption – are the main sources of anthropogenic petroleum hydrocarbon pollution in the sea.

As a consequence of activities related to the exploration, development, production, and transportation of OCS oil and gas, historical trends in the GOM region demonstrate that the possibility for accidental releases exists. Input through public scoping meetings, Federal and State agency consultation and coordination, and industry and nongovernmental organizations' comments indicate that stakeholders have concerns about oil spills and the resulting consequences they pose to the environment. Although oil spill occurrence cannot be predicted, its likelihood can be estimated using spill rates derived from historical data and projected volumes of oil production and transportation. The following sections discuss aspects of oil spills relevant to potential oil and gas exploration and development activities in OCS planning areas along the Gulf Coast.

Fairly soon after oil is spilled in an ocean environment, physical and chemical processes (i.e., weathering) begin affecting and modifying the oil. Some oil compounds will weather by evaporation, dispersion into water, or bacterial degradation, while others will not, such as polycyclic aromatic hydrocarbons. Different crude oils have different chemical compositions that are governed primarily by the geologic conditions under which they were formed, migrated, and accumulated. These conditions can result in oil from a given location or geologic formation having a unique chemical composition, including specific compounds that help experts distinguish one crude oil from another. Collectively, the physical and chemical changes determine the transport and fate of an oil spill. Transport denotes the processes that move the oil from place to place either horizontally or vertically and is strongly affected by the currents and winds. The horizontal movement is accomplished by advection, spreading, dispersion, and entrainment. Vertical motion is mainly accomplished through dispersion, entrainment, and vortex-type currents, sinking, overwashing, partitioning, and sedimentation.

The fate and transport of oil and gas after a spill differs. Oils may sink, become entrained in the water column, or surface. The chemical nature of the oil also changes over the course of a spill from evaporation, emulsion, dissolution, and oxidation. The moment oil reaches the surface, it begins to evaporate as the aromatic compounds and the remaining heavier compounds react to other environmental conditions (i.e., sun, wind, waves, and currents). Natural gas may remain submerged and be degraded by bacteria prior to reaching the surface, depending on the depth of the spill. The same bacteria produce mucus that may attach to oil droplets and cause marine oil snow that then settles to the seafloor (NOAA 2016).

Chemical Spills

Chemical and synthetic-based drilling fluids are used in offshore oil and gas drilling and production activities, and may be accidentally spilled into the environment due to equipment failure, weather (i.e., wind, waves, and lightning), collision, and human error.

Chemicals are stored and used to condition drilling muds during production and in well completions, stimulation, and workover procedures. The relative quantity of their use is reflected in the largest volumes spilled. Well completion, workover, and treatment fluids, including zinc bromide, are the largest quantities used and are typically the largest accidental releases. Zinc bromide is of particular concern because it is persistent (nondegradable) and is comparatively toxic. A study of chemical spills from OCS oil- and gas-related activities in the GOM determined that only two chemicals could potentially impact the marine environment – zinc bromide and ammonium chloride (Boehm et al. 2001). Ammonium chloride dissolves in seawater and undergoes several transformations to produce ammonia, which is toxic to fish and other marine life. Other common chemicals spilled include methanol and ethylene glycol, which are used in deepwater operations where gas hydrates tend to form due to cold temperatures. These alcohol-based chemicals are nonpersistent (degradable) and exhibit comparatively low toxicity.

The SBF has typically been used since the mid-1990s for the deeper well sections because SBF has superior performance properties. The synthetic oil used in SBF is relatively nontoxic (compared to crude oil) to the marine environment and has the potential to biodegrade. However, SBF is considered more toxic than water-based fluid, and spills of SBF are categorized separately from water-based fluid releases. Accidental riser disconnections can result in the release of large quantities of drilling fluids like SBFs.

Pipeline, Umbilical, or Jumper Failures

Significant sources of damages to OCS pipeline infrastructure can be caused by corrosion, physical pipeline stress due to location, mass sediment movements and mudslides that can exhume or push the pipelines into another location, and accidents due to weather or impacts from anchor drops or boat collisions. Pipelines that carry two-phase fluids (i.e., oil-gas and gas-condensate) are more prone to corrosion than single-phase fluids. Crude with high water vapor and sulfur content, and gas with high sulfur, CO_2, and water vapor content are corrosive, and the lower the flow pressure, the more corrosive the impact. Seafloor resistivity, water salinity, and seabed composition may promote corrosive activity and affect the probability of active corrosion. Pipelines that are inactive for a long period of time may not maintain their catholic protection (Mélot et al. 2009) and are more exposed to natural disturbances (e.g., hurricanes, slope failures, etc.), stress-induced motions, and third-body impacts.

Long unsupported pipelines subjected to strong bottom currents would experience vortex-induced vibrations, which substantially increase pipeline fatigue. Two potential causes for pipeline failure are regional-scale hydrodynamic forces and vortex-induced vibrations. Hydrodynamic forces are of most concern to pipelines with multiple unsupported spans. In conjunction with strong episodic events, these pipelines may experience lateral instability and movement. Although the effects of hydrodynamic forces warrant attention, vortex-induced vibrations are perhaps of greatest concern.

Hurricanes can be a destructive force involved in pipeline failures. Numerous pipelines were damaged after the 2004-2008 hurricanes passing through the CPA and WPA in the Gulf of Mexico. Following the 2004, 2005, and 2008 hurricane seasons in the GOM, BOEM commissioned studies to examine the failure mechanisms of offshore pipelines (Atkins et al. 2007; Atkins et al. 2006; Energo Engineering 2010). Much of the reported damage was riser or platform-associated damage, which typically occurs when a platform is toppled or otherwise damaged. While many pipelines were damaged, few resulted in a spill >50 bbl.

The largest spills in the GOM were typically due to pipeline movements, mudslides, anchor drops, and collisions of one type or another. Most pipeline damage occurs in shallow water (<200 ft; 61 m) because of the potential for increased impacts of the storm on the seabed in shallow water, the relative density of pipelines, or the age and design standards of the pipeline or the platforms to which the pipelines are connected. The future impact of hurricanes on damage to pipelines is uncertain. As part of the evacuation process during a hurricane, offshore personnel activate the applicable shut-in procedure, which can frequently be accomplished from a remote location. This involves closing the subsurface safety valves located below the surface of the ocean floor to prevent the release of oil or gas. During previous hurricane seasons, the shut-in valves functioned 100 percent of the time, efficiently shutting in production from wells on the OCS and protecting the marine and coastal environments. Shutting-in oil and gas production is a standard procedure conducted by industry for safety and environmental reasons (BSEE 2018). As oil production shifts from shallow to deeper water, there may be a consolidation of pipeline utilization.

In the GOM, lack of awareness of the precise location of the pipeline has been a major contributing factor to accidents involving pipelines. An OCS-related spill ≥1,000 bbl would likely be from a pipeline accident; the median spill size is estimated to be 2,200 bbl for rig/platform and pipeline activities.

Losses of Well Control

All losses of well control are required to be reported to BSEE. In 2006, BOEM and BSEE's predecessor (the Minerals Management Service) revised the regulations for loss of well control incident reporting, which were further clarified in Notice to Lessees and Operators (NTL) No. 2010-N05, "Increased Safety Measures for Energy Development on the OCS." Operators are required to document any loss of well control event, even if temporary, and the cause of the event by mail or email to the addressee indicated in the NTL. The operator does not have to include kicks that were controlled, but the operator should include the release of fluids through a flow diverter (a conduit used to direct fluid flowing from a well away from the drilling rig). The current definition for loss of well control is as follows:

- uncontrolled flow of formation or other fluids (the flow may be to an exposed formation [an underground blowout] or at the surface [a surface blowout]);
- uncontrolled flow through a diverter; and/or
- uncontrolled flow resulting from a failure of surface equipment or procedures.

Not all loss of well control events would result in a blowout as defined above, but it is most commonly thought of as a release to the human environment. A loss of well control could occur during any phase of development, i.e., exploratory drilling, development drilling, well completion, production, or workover operations. A loss of well control could occur when improperly balanced well pressure results in sudden, uncontrolled releases of fluids from a wellhead or wellbore (Neal Adams Firefighters Inc. 1991; PCCI Marine and Environmental Engineering 1999).

There are several options that can be attempted to control a well blowout. Common kill techniques include (1) bridging, (2) capping/shut-in, (3) capping/diverting, (4) surface stinger, (5) vertical intervention, (6) offset kill, and (7) relief wells (Neal Adams Firefighters Inc. 1991). Although much has been learned about well control as a result of the *Deepwater Horizon* explosion, oil spill, and response, if a deepwater subsea blowout occurs in the future, it is still likely that an operator would be required to immediately begin to drill one or more relief wells to gain control of the well. This may be required whether or not this is the first choice for well control because a relief well is typically considered the ultimate final solution for regaining well control in such circumstances. Although it can take months, the actual amount of time required to drill the relief well depends upon the following: (1) the depth of the formation below the mudline; (2) the complexity of the intervention; (3) the location of a suitable rig; (4) the type of operation that must be terminated in order to release the rig (e.g., may need to complete a casing program before releasing the rig); and (5) any problems mobilizing personnel and equipment to the location.

Blowout Preventers

A blowout preventer (BOP) is a device with a complex of choke lines and hydraulic rams mounted atop a wellhead designed to close the wellbore with a sharp horizontal motion that can cut through or pinch shut well casing and sever tool strings (**Figure B.2.2-1**). The BOPs were invented in the early 1920s and have been instrumental in ending dangerous, costly, and environmentally damaging oil gushers on land and in water. The BOPs have been required for OCS oil and gas operations from the time offshore drilling began in the late 1940s.

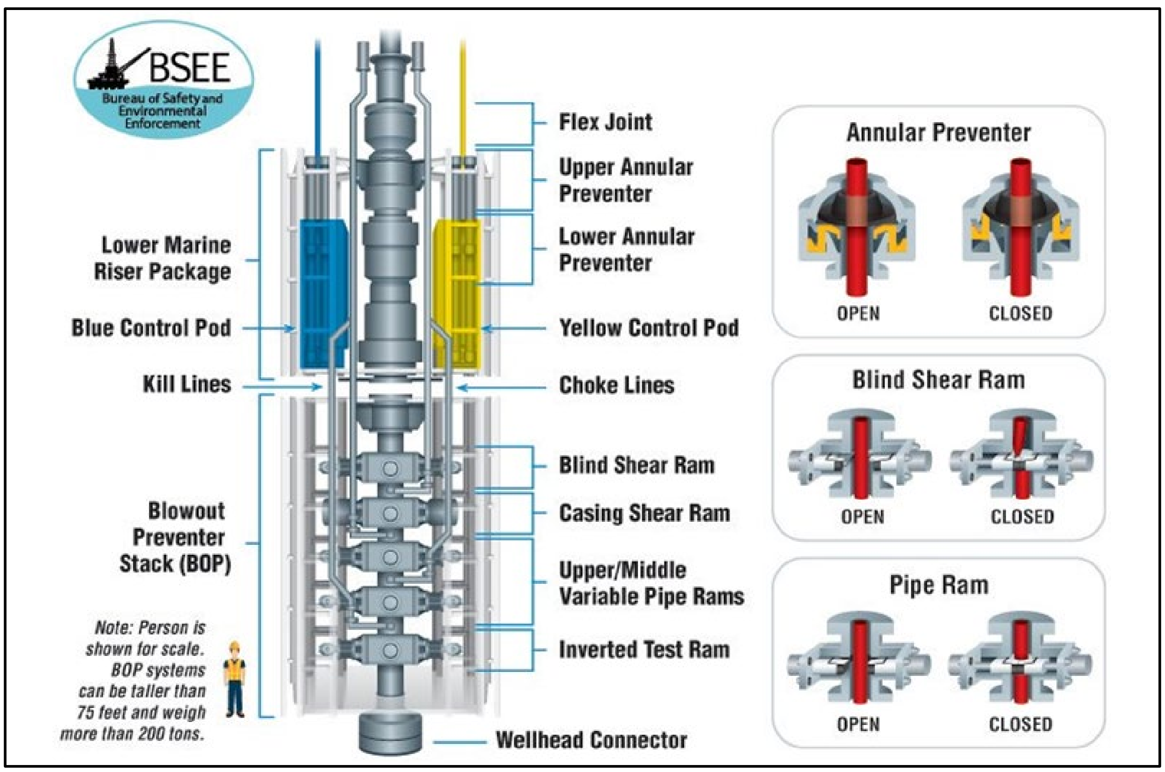

Figure B.2.2-1. Example Diagram of a Blowout Preventer.

The BOPs are actuated as a last resort upon imminent threat to the integrity of the well or the surface rig. For cased wells, in a normal situation, the hydraulic ram may be closed if oil or gas from an underground zone enters the wellbore and destabilizes it. By closing a BOP, usually by redundant surface-operated and hydraulic actuators, the drilling crew can prevent explosive pressure release and allow control of the well to be regained by balancing the pressure exerted by a column of drilling mud with formation fluids or gases from below.

Because BOPs are important for the safety of the drilling crew, as well as the rig and the wellbore itself, BOPs are regularly inspected, tested, and refurbished. As part of the post-*Deepwater Horizon* explosion, oil spill, and response regulations and inspection program, BSEE issued NTL No. 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources," which became effective on November 8, 2010. This NTL applies only to operators conducting operations using subsea or surface BOPs on floating facilities. It explains that lessees and operators submit a statement signed by an authorized company official with each application for a well permit, indicating that they will conduct all of their authorized activities in compliance with all applicable regulations, including the Increased Safety Measures Regulations. The NTL also informs lessees that BSEE will be evaluating whether or not each operator has submitted adequate information demonstrating that it has access to and can deploy surface and subsea containment resources that would be adequate to promptly respond to a blowout or other loss of well control. The NTL notifies the operator that BSEE intends to evaluate the adequacy of each operator to comply in the operator's current oil-spill response plan; therefore, there is an incentive for voluntary compliance. The NTL lists the type of information that BSEE would review as follows:

- subsea containment and capture equipment, including containment domes and capping stacks;
- subsea utility equipment, including hydraulic power, hydrate control, and dispersant injection equipment;
- riser systems;
- remotely operated vehicles;
- capture vessels;
- support vessels; and
- storage facilities.

B.2.2.2 Non OCS Oil- and Gas-Related Activities

B.2.2.2.1 Potentially Polluting Shipwrecks

There are thousands of shipwrecks in U.S. waters. Some of the vessels involved in those wrecks are likely to contain oil, as fuel and possibly cargo, and may eventually result in pollution to the marine environment. Warships and cargo vessels sunk in wartime may also contain munitions, including explosives and chemical warfare agents, which may pose a continued threat because of their chemical composition. The National Oceanic and Atmospheric Administration (NOAA) maintains a large database of shipwrecks, dumpsites, navigational obstructions, underwater archaeological sites, and other underwater cultural resources (NOAA 2013). This internal database, Resources and Undersea Threats, includes approximately 20,000 shipwrecks in U.S. waters. Shipwrecks in the Resources and Undersea Threats database were ranked to identify the most ecologically and economically significant, potentially polluting wrecks in U.S. waters for inclusion in the Remediation of Underwater Legacy Environmental Threats Program (NOAA 2013). Under this Program, wrecks are ranked based on age, size, hull material, type, location, historical information on the vessel, engineering analysis, archaeological site formation, whether they are currently leaking, and modeling of the trajectory, fate, and consequences of an oil release from a shipwreck. The NOAA identified 87 priority wrecks (13 in the Gulf of Mexico) on the 2012 Remediation of Underwater Legacy Environmental Threats Program (those with the highest probability of discharge). Of these, 53 sank during an act of war and 34 sank as a result of collision, fire, grounding, storms, or other causes.

Priority wrecks located in the Gulf of Mexico include *R.W. Gallagher*, which contains 80,855 bbl of Bunker C fuel oil, located about 40 mi (64 km) south of Terrebonne Parish, Louisiana, and *Joseph M. Cudahy*, which contains 77,444 bbl of crude and lubricating oil, located about 65 mi (105 km) northwest of Key West, Florida (**Figure B.2.2-2**). The NOAA Wreck Oil Removal Program provides for the removal of oil from priority wrecks, where feasible.

Another shipwreck of note is *Tank Barge DBL 152*, which, on November 11, 2005, struck the submerged remains of a pipeline service platform in West Cameron Block 229 (about 50 mi [80 km] southeast of Sabine Pass, Texas). The platform had previously collapsed during Hurricane Rita. The barge was carrying a cargo of approximately 119,793 bbl of a blended mixture of low-API gravity oil (i.e., heavy oil, likely to sink). A portion of the oil was released at the point of impact, which sank to the seafloor. The barge was towed toward shallow water to facilitate salvage; however, it grounded and capsized approximately 12 mi (19 km) to the west-northwest, releasing additional oil to the seafloor. An estimated 45,846 bbl of oil were released during the incident, of which about 2,355 bbl were recovered by divers. In January 2006, recovery of additional oil was deemed infeasible and cleanup operations were discontinued, leaving approximately 43,491 bbl of oil unrecovered on the seafloor (NOAA 2013).

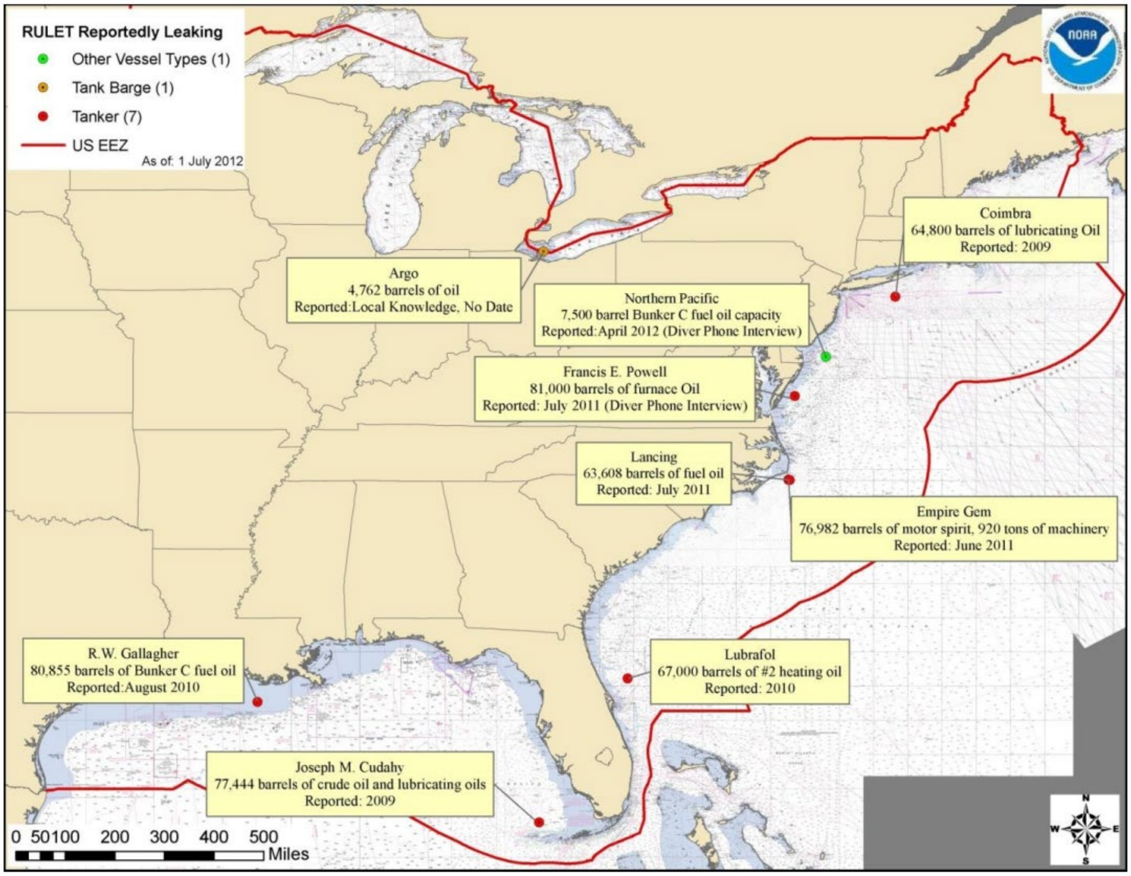

Figure B.2.2-2. Shipwrecks in NOAA's Database along the Gulf of Mexico and Atlantic Coasts That Reportedly are Leaking or Have Oil in the Overheads (EEZ = Exclusive Economic Zone) (NOAA 2013).

B.2.2.2.2 Natural Seeps

A natural petroleum seep is a natural leak of crude oil and gas that migrates up through the seafloor and ocean depths. These seeps are very common in the GOM and are discussed further in **Section C.3.3**. of **Appendix C**.

B.2.2.2.3 Discharges Associated with Military Activities

The U.S. Department of Defense (DOD) conducts training, testing, and operations in offshore operating and warning areas, undersea warfare training ranges, and special use of restricted airspace on the OCS. The U.S. Navy uses the airspace, sea surface, subsurface, and seafloor of the OCS for events ranging from instrumented equipment testing to live-fire exercises. The U.S. Air Force conducts flight training and systems testing over extensive areas on the OCS. The U.S. Marine Corps' amphibious warfare training extends from offshore waters to the beach and inland. Military operations within military warning areas (MWAs) and Eglin Water Test Areas (EWTAs) vary in types of missions performed and their frequency of use. Such missions may include carrier maneuvers, missile testing, rocket firing, pilot training, air-to-air gunnery, air-to-surface gunnery, minesweeping operations, submarine operations, air combat maneuvers, aerobatic training, and instrument training.

Between the years of 1995 and 1999, Eglin Air Force Base in Florida conducted nearly 39,000 training flights per year in the eastern GOM. Potential impacts from these activities are discussed in the *Eglin Gulf Test and Training Range, Final Programmatic Environmental Assessment* (Science Applications International Corporation 2002). These military activities may result in marine impacts from chaff, fuel releases, flares, chemical materials, and debris.

Chaff, which is composed of short, very fine aluminum fibers similar in appearance to human hair, metalized glass fiber, or plastic, is dispensed by military aircraft as a countermeasure to distract radar-guided missiles from their targets. Chaff could temporarily increase the turbidity of the ocean's surface when released during military training activities. The fibers would be dispersed farther by sea currents as they float and slowly sink toward the bottom at varying rates based on dispersion by currents and dilution rates. The U.S. Navy (2018), however, concluded that chemical alteration of water and sediment from decomposing chaff is not likely. Additionally, based on the dispersion characteristics of chaff, it is likely that marine animals would occasionally come in direct contact with chaff fibers while either at the water's surface or while submerged, but such contact would be inconsequential (U.S. Navy 2018). The end-caps and pistons would sink; however, some may remain at or near the surface if it were to fall directly on a dense *Sargassum* mat. The expended material could also be transported long distances before becoming incorporated into the bottom sediments. Several Navy training and testing activities introduce potentially harmful chemicals into the marine environment, principally flares and propellants for rockets, missiles, and torpedoes. Properly functioning flares, missiles, rockets, and torpedoes combust most of their propellants, leaving benign or readily diluted soluble combustion byproducts (e.g., hydrogen cyanide). Operational failures allow propellants and their degradation products to be released into the marine environment (U.S. Navy 2018).

During in-flight emergencies, fuel may be released in the air or a fuel tank may be jettisoned and impact the surface. Drones may also be shot down and release fuel upon surface impact. Fuel dumping by aircraft rarely occurs. Navy aircrews are prohibited from dumping fuel below 6,000 ft (1,828 m), except in an emergency situation. Above 6,000 ft (1,829 m), the fuel has enough time to completely vaporize and dissipate and would, therefore, have a negligible effect on the water below. A study performed by the Science Applications International Corporation (2002) indicated that 735 gallons of fuel released from an aircraft at a 5,000-ft (1,524-m) altitude resulted in approximately 99 percent evaporation before the fuel hit the surface. Additionally, jet fuel generally evaporates from the surface of water within 24 hours and, consequently, does not persist in the marine environment.

Flares may be ejected from aircraft to confuse and divert enemy heat-seeking or heat-sensitive missiles and may also be used to illuminate surface areas during nighttime operations. Solid flare and pyrotechnic residues may contain, depending on their purpose and color, aluminum, magnesium, zinc, strontium, barium, boron, chromium, cadmium, and nickel, as well as perchlorates. Hazardous constituents in pyrotechnic residues are typically present in small amounts or low concentrations and are bound in relatively insoluble compounds. Because flares are designed to burn completely, only a small amount of waste falls to the sea surface. The Air Force Air Armament Center characterizes the impact to water from flares to be less than the natural concentrations of magnesium found in the GOM (Science Applications International Corporation 2002).

The Air Force Air Armament Center confirmed that chemical materials are introduced into the marine environment through drones, gun ammunition, missiles, chaff, flares, smokes, and obscurants but concluded that potential chemical contamination concentrations were extremely low and not likely to impact marine species (Science Applications International Corporation 2002).

Debris may be released into the GOM as a result of military activities, including ordnance and shrapnel deposits from bombs and missiles, drones, chaff and flare cartridges, and intact inert bombs. This debris generally falls into the major categories of aluminum, steel, plastic, concrete, and other components (i.e., copper and lead) and originates largely from inert bombs, missiles, and downed drones (Science Applications International Corporation 2002).

B.2.2.2.4 Historical Chemical Weapon Disposal

After World War I, chemical weapons were routinely disposed of in the world's oceans, including the GOM. Most of the activities occurred during World War II and continued until 1970. In some instances, conventional explosives and radiological wastes were dumped along with chemical weapons. The DOD published at least two reports on these activities, one in 2001 entitled *Off-shore Disposal of Chemical Agents and Weapons Conducted by the United States*, which was the basis of a 2007 Congressional Research Service Report entitled *U.S. Disposal of Chemical Weapons in the Ocean: Background and Issues for Congress* (Bearden 2007). Chemical weapons disposed of contained hydrogen cyanide, arsenic trichloride, cyanogen chloride, lewisite, tabun, sarin, and venomous agent x nerve gas. The degree of risk from weapons leaking chemical agents into seawater depends on numerous factors. The extent to which an agent is diluted and the duration of exposure determine whether there is potential for harm. For example, most nerve agents are soluble and dissolve in water within several days. Less soluble agents still degrade over time as a result of hydrolysis. However, certain agents are less susceptible to hydrolysis, allowing them to remain in harmful forms for longer periods. For example, sulphur mustard in liquid or solid form turns into an encrusted gel when released in seawater. In this form, it can persist for many years before degrading (Bearden 2007). Refer to **Section B.7.2.2.8**, Ocean Dumping, for more information on the known locations for munition disposal sites in the Gulf of Mexico.

Army records document several instances of mustard and phosgene bombs being disposed of in the Gulf of Mexico, originating from New Orleans, Louisiana, and Mobile, Alabama. Chemical weapons disposed of in other locations, and potentially in the Gulf of Mexico, contained hydrogen cyanide, arsenic trichloride, cyanogen chloride, lewisite, tabun, sarin, and venomous agent x nerve gas, as reported in a Report to Congress (Bearden 2007). Six former explosives dumping areas are noted on NOAA's chart of the Gulf of Mexico (NOAA 2015b) and likely contain disposed chemical weapons. These include two areas offshore Texas (about 65 nmi [75 mi; 120 km] southeast of Aransas Pass and about 100 nmi [115 mi; 185 km] south of Galveston); two areas offshore Louisiana (both about 35-40 nmi [42-46 mi; 65-74 km] south of the mouth of the Mississippi River); one area offshore

Alabama (about 70 nmi [81 mi; 130 km] southeast of Mobile Bay); and one offshore Florida (about 130 nmi [150 mi; 241 km] west of Tampa Bay).

The Marine Protection, Research, and Sanctuaries Act of 1972, also known as the Ocean Dumping Act, was promulgated to regulate ocean dumping and to set aside certain areas as national marine sanctuaries. Section 101 of the Act (33 U.S.C. § 1411) prohibits ocean dumping, except as authorized by permit issued by the USEPA pursuant to Section 102 (33 U.S.C. § 1412). Section 102 specifically states that radiological, chemical, and biological warfare agents, high-level radioactive waste, and medical waste would not be permitted for ocean disposal after 1972.

B.2.2.2.5 Historical Industrial Waste Dumping

Prior to 1972, certain offshore locations of the United States were used for the disposal of various industrial wastes and low-level radioactive wastes. Although no complete records exist of the volumes and types of materials disposed in ocean waters in the United States prior to 1972, several reports indicate a vast magnitude of historic ocean dumping (USEPA 2020c). For example, a 1970 Report to the President from the Council on Environmental Quality on ocean dumping described that, in 1968, the following were dumped in the ocean in the United States: 38 million tons of dredged material (34% of which was polluted); 4.5 million tons of industrial wastes; 4.5 million tons of sewage sludge (significantly contaminated with heavy metals); and 0.5 million tons of construction and demolition debris. The USEPA records indicate that almost 34,000 containers of radioactive wastes were dumped at three ocean sites off the East Coast of the United States from 1951 to 1962.

In 1973, the USEPA permitted two interim industrial waste disposal sites in the Gulf of Mexico pursuant to Section 102 of the Marine Protection, Research, and Sanctuaries Act, the charting of which has been maintained by NOAA. Disposal Site A, located within the WPA, is situated on the upper part of the Texas-Louisiana continental shelf, about 125 nmi (144 mi; 232 km) south of Galveston, Texas. Disposal Site B is located in the CPA off the western side of the Mississippi Delta about 60 nmi (75 mi; 120 km) south of the mouth of the Mississippi River. The National Academy of Sciences' report, *Assessing Potential Ocean Pollutants* (National Research Council 1975), provides additional information about these sites.

Section 102 of the Ocean Dumping Act of 1972 (33 U.S.C. § 1412) authorizes the issuance of permits for ocean disposal of certain waste streams and requires that the USEPA determine that such dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities. The USEPA's Final Ocean Dumping Regulations and Criteria, published in January 1977, listed 14 interim municipal and industrial waste disposal sites that have since been phased out of use, with the last industrial dumper activity taking place in 1988 (USEPA 1991). Gulf of Mexico sites included the Galveston Site, the Mississippi River Site, and the Gulf Incineration Site, amongst others. Questions remain about the potential short- and long-term effects of toxic compounds accumulating in deepwater sediments. With the Ocean Dumping Act of 1972 prohibiting new dumpers from commencing disposal of industrial waste, the ocean dumping of industrial waste in the GOM effectively ended in 1988 (USEPA 1991).

B.2.2.2.6 Dredged Material Disposal

Dredged material is described in 33 CFR part 324 as any material excavated or dredged from navigable waters of the United States. Materials from maintenance dredging are primarily disposed of offshore on existing dredged-material disposal areas and in ocean dredged-material disposal sites (ODMDSs). Additional dredged-material disposal areas for maintenance or new project dredging are developed as needed and must be evaluated and permitted by the U.S. Army Corps of Engineers (USACE) and relevant State agencies prior to construction. The ODMDSs are regulated by the USEPA under the Clean Water Act and Marine Protection, Research, and Sanctuaries Act (also called the Ocean Dumping Act).

There are two primary Federal environmental statutes governing dredged material disposal. The Ocean Dumping Act governs transportation for the purpose of disposal into ocean waters. Section 404 of the Clean Water Act governs the discharge of dredged or fill material into U.S. coastal and inland waters. The USEPA and USACE are jointly responsible for the management and monitoring of ocean disposal sites. The responsibilities are divided as follows: (1) the USACE issues permits under the Clean Water Act and Marine Protection, Research, and Sanctuaries Act; (2) the USEPA has lead for establishing environmental guidelines/criteria that must be met to receive a permit under either statute; (3) permits for ODMDS disposal are subject to USEPA review and concurrence; and (4) the USEPA is responsible for designating ODMDSs.

If funds are available, the USACE uses dredge materials beneficially for restoring and creating habitat, for beach nourishment projects, and for industrial and commercial development. The applicant would need funds to cover the excess cost over the least cost environmentally acceptable alternative. The material must also be suitable for the particular beneficial use. Virtually all ocean dumping that occurs today is maintenance dredging of sediments from the bottom of channels and bodies of water in order to maintain adequate channel depth for navigation and berthing.

The USACE maintains an Ocean Disposal Database website with the amount of dredged material deposited at each offshore site, with the largest site in the GOM identified as the New Orleans District. Based on data from 1996 through 2013, the New Orleans District dredges an average of 78 million cubic yards of material annually during maintenance dredging of Federal navigation channels. Excluding dredged material that is unsuitable for beneficial use (~17.7 million cubic yards) or too remote from coastal Louisiana (~19 million cubic yards), approximately 38 percent (15.8 million cubic yards) of the material dredged is used beneficially (USACE 2014). The remaining 62 percent of the total material dredged yearly by the USACE's New Orleans District is disposed of at placement areas regulated under Section 404 of the Clean Water Act, at ODMDSs, or is stored in temporary staging areas located inland (e.g., the Pass a Loutre Hopper Dredge Disposal Site at the head of the Mississippi River's main "birdfoot" distributary channel system).

Evaluation of dredged material for ocean disposal under the Marine Protection, Research, and Sanctuaries Act relies largely on biological (bioassay) tests. The ocean testing manual, commonly referred to as the Green Book (USEPA and USACE 1991), provides national guidance for determining the suitability of dredged material for ocean disposal. Benthic and water-column impacts of dredged material disposal are evaluated prior to disposal through analysis of representative samples of the material to be disposed, unless the sand source is previously characterized. Sample evaluation may include physical analysis (i.e., grain size, total solids, and specific gravity) and chemical analysis for priority pollutants (i.e., metals, semivolatile and volatile organic compounds, PCBs, and pesticides).

BOEM anticipates that, over the next 70 years, the amount of dredged material disposed of at ODMDSs will fluctuate generally within the trends established by the USACE's district offices. Between 2009 and 2018, the New Orleans District has averaged about 9.87 million cubic yards (yd^3) (7.55 million m^3) of material dredged per year disposed of at ODMDSs, while the Mobile District has about one-quarter of that quantity, or 3.75 million yd^3 (2.87 million m^3) (USACE 2020c). Quantities disposed of at ODMDSs may decrease as more beneficial uses of dredged material onshore are identified and evaluated.

B.2.2.2.7 Land-Based Discharges and Nonpoint Source Pollution

Most aquatic pollutants result from agricultural or urban runoff or discrete point source wastewater discharges from industrial sites or sewage plants and are released to streams, rivers, bays, and estuaries. Nonpoint source pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and ground waters. Both discrete point sources and nonpoint sources make their way to the open ocean where they are prevalent stressors for marine life. Toxins directly harm the organisms that ingest them, but they can also have impacts further up the food chain through biomagnification, the process in which chemicals are passed to higher trophic levels through predation. Therefore, although filter-feeding benthic organisms may be the first to encounter toxic chemicals, these compounds can also contaminate predatory fish, marine mammals, and seabirds.

As authorized by the Clean Water Act, the NPDES permit program controls water pollution by regulating point sources on land that discharge pollutants into waters of the United States. Point sources are discrete conveyances (outfalls) such as pipes or manmade ditches that may contain process water flows and/or precipitation from impervious surfaces. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states (USEPA 2020d). An NPDES permit is typically a license for a facility to discharge a specified amount of a pollutant into a receiving water under certain conditions. Permits may also authorize facilities to process, incinerate, landfill, or beneficially use sewage sludge. These permits help regulate the amount of water pollution that is allowed to be discharged into the waters of the United States.

The Clean Water Act does not provide a detailed definition of nonpoint sources. Rather, they are defined by exclusion, i.e., nonpoint-source pollution refers to any source of water pollution that is not covered by the Clean Water Act's Section 502(14) definition of "point source." Typically nonpoint-source pollution comes from drainage, runoff, precipitation, seepage, atmospheric deposition, or hydrologic modification. There is no clearly discernible source, but rather, as stormwater runoff flows over and through the ground, it carries with it various pollutants (natural and manmade) and then is ultimately delivered to wetlands, ground waters, coastal waters, rivers, and lakes. Many sources have been identified by the USEPA; particularly relevant to OCS oil- and gas-related activities are oil, grease, and toxic chemicals from energy production. These types of pollutants can have negative effects on fisheries, wildlife, recreation, and water supplies. Nonpoint-source pollution is recognized by many states as a major contributor to water quality problems, though specific effects can vary and be difficult to assess. Other types of nonpoint-source pollution unrelated to OCS oil- and gas-related activities include excess fertilizers, insecticides, and herbicides from residential areas and agricultural lands; bacteria and nutrients from livestock, faulty septic systems, and pet wastes; sediment from crops, forest lands, construction sites, and eroding streambanks; atmospheric deposition and hydromodification; and salt from irrigation practices and acid drainage from abandoned mines or other sources (USEPA, 2018). Nutrients are elements that are essential to both plant and animal growth, including nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S) and silicon (Si). Excess nutrients can cause excessive algae growth, which can lead to hypoxia and indirect effects to fisheries, wildlife, recreation, and water supplies (refer to **Section C.3.2** of **Appendix C**).

The NPDES program includes periodic characterization of outfall flow to limit pollutants entering surface water. The Mississippi River basin drains 41 percent of the 48 contiguous states of the United States. The basin covers more than 1,245,000 mi^2 (3,224,535 km^2) and includes all or parts of 31 states and two Canadian provinces (USACE 2020b). Nonpoint-source contributions to the Mississippi River from erosion, uncontained runoff, and groundwater discharge are primary sources of freshwater, sediment, suspended solids, organic matter, and pollutants (including nutrients, heavy metals, pesticides, oil and grease, and pathogens). As a result, water quality in coastal waters of the northern GOM is highly influenced by seasonal variation in river flow. The Mississippi River introduces approximately 3,680,938 bbl of oil and grease per year from land-based sources (National Reseach Council (2003); **Section C.3.2** of **Appendix C**) into the waters of the Gulf of Mexico. Nutrients carried in waters of the Louisiana and Texas rivers contribute to seasonal formation of hypoxic zones (**Section C.3.2** of **Appendix C**) on the Louisiana and Texas shelf.

Urban and Suburban Sources

The following overview of urban and suburban sources is summarized from the National Science and Technology Council and Committee on Environment and Natural Resources (2003), unless otherwise noted. Urban and suburban sources include point sources from municipal and industrial treatment plants and nonpoint sources from septic systems, storm sewers and combined sewer overflows, and lawn and landscape care. Municipal wastewater treatment plants are the primary point-source discharge of nutrients to waterways in the United States, though industrial sources are also significant in some basins. In the 1990s, most sewage in the United States received secondary treatment, designed to lower the discharge of labile organic matter that contributes to “biological oxygen demand” (National Reseach Council 2000).

In some United States cities, sanitary wastes and stormwaters are served by the same combined sewer system while others have septic systems (i.e., onsite/decentralized wastewater treatment systems). Consequently, some nutrients entering sewage treatment plants originate from fossil fuel sources and lawn fertilizer washed off streets and lawns in rainstorms (National Reseach Council 2000). Most of the time, all of the combined sewage and stormwater goes to a sewage treatment plant, but heavy rains may cause pipes to fill and induce overflows and outfalls into coastal waters. The nutrient inputs from storm sewers and combined sewer overflows are not well quantified for any major urban area, but they are probably less than the input from sewage effluent (National Reseach Council 1993; 2000).

A well-designed and maintained septic system is effective for containing pathogens and phosphorus; however, they can be a significant source of nutrient inputs to coastal waters (National Reseach Council 2000). For example, the USEPA identified septic system leakage as a contributor to approximately 9 percent of Gulf Coast beach advisories for 2007 (USEPA 2012a). A variety of other activities by homeowners and urban residents can generate nutrient pollution. In particular, garden and lawn care activities can result in significant inputs of nutrients to area waterways by nonpoint-source pathways, such as runoff.

Agricultural Sources

The following overview of agricultural sources is summarized from the National Science and Technology Council and Committee on Environment and Natural Resources (2003), unless otherwise noted. Agricultural sources of nutrients come from leaching and runoff from agricultural lands and from animal agriculture. Agricultural fertilizer use in the United States grew rapidly from 1961 until 1980, declined somewhat after 1980, and has been rising steadily since 1985 (Howarth et al. 2002; National Reseach Council 2000).

Certain agricultural management practices, such as tile drainage, can accelerate the loss of nutrients, usually nitrogen, from agricultural lands to streams. This “short circuits” the flow of groundwater by draining the top of the water table into underground drainage tile lines and ditches. It also promotes the conversion of organic nitrogen and ammonia, which are relatively immobile forms of nitrogen, into nitrate, which is very mobile. The drained water, which may contain high concentrations of nitrate (Zucker et al. 1998), flows into nearby streams and rivers and may eventually empty into the GOM where it can contribute to eutrophication and hypoxia (refer to **Section C.3.2** of **Appendix C**).

Animal wastes, particularly from large feeding operations, contribute significantly to the level of nutrients in coastal waters, and the production of animal protein continues to increase, in part driven by a steady increase in the per capita meat consumption of Americans (Howarth et al. 2002). Wastes from concentrated animal feeding operations tend to be handled in one of two ways: they are spread onto agricultural fields or they are held in lagoons. Some operations are also beginning to compost animal wastes (National Reseach Council 2000). Animal manure can be considered a fertilizer, and recycling of this organic waste to agricultural fields is seen as desirable. In practice, however, it is difficult to apply manure with uniformity over a field and also to ensure uniform delivery of nutrients appropriate to crop needs because of the variability of nutrient release from the applied manure (National Reseach Council 2000). Also, since most manure in the United States is transported less than 10 mi (16 km), it means fields near animal feeding operations can be over fertilized and cause associated groundwater and downstream aquatic ecosystem pollution (National Reseach Council 2000).

Atmospheric Sources

The following overview of atmospheric sources is summarized from the Committee on Environment and Natural Resources (National Science and Technology Council and Committee on Environment and Natural Resources 2003), unless otherwise noted. Air pollution is also discussed above in **Section B.1**. Atmospheric nitrogen emissions come from two major sources: stationary (i.e., power plants) and mobile (i.e., cars, trucks, buses, and other internal combustion engines). It can deposit onto land or water surfaces during rain showers (i.e., wet deposition) and as dry deposition. The NO_x emissions are major contributors to acid rain, as well as significant contributors to nutrient pollution in coastal waters. The atmospheric deposition of nitrogen from fossil fuel combustion is a major input to virtually all of the coastal rivers and bays along the eastern seaboard and Gulf of Mexico (Paerl et al. 2002). Refer to **Section B.1** for more information on NO_x emission amounts.

B.2.2.2.8 Trash and Debris

Marine debris originates from both land-based and ocean-based sources (USEPA 2017b). Some of the sources of land-based marine debris are beachgoers, storm-water runoff, landfills, solid waste, rivers, floating structures, and ill-maintained garbage bins. Land-based marine debris also comes from combined sewer overflows and typically includes medical waste, street litter, and sewage. Ocean-based sources of marine debris include galley waste and other trash from ships, recreational boaters, fishermen, and offshore oil and gas exploration and production facilities. Commercial and recreational fishers produce trash and debris by discarding plastics (e.g., ropes, buoys, fishing line and nets, strapping bands, and sheeting), wood, and metal traps. Some trash items, such as glass, pieces of steel, and drums with chemical or chemical residues, can be a health threat to local water supplies and as a result to biological, physical, and socioeconomic resources, to beachfront residents, and to users of recreational beaches.

B.2.2.2.9 Recreational and Commercial Fishing, Boating, and Diving

Recreational and commercial fishing, boating, and diving are prevalent in the GOM. Fishing, boating, and diving can lead to discharges such as sewage, food waste, ground waste, metal traps, and plastics (e.g., ropes, buoys, fishing line and nets, strapping bands, and sheeting). However, various laws and regulations serve to limit waste discharges; the U.S. Coast Guard summarizes these requirements (USCG 2018). For example, there are limitations on where, and at what distances from shore, certain wastes can be discharged. Ocean Conservancy (2017) provides information regarding the impacts of discharges from recreational vessels, as well as information regarding best practices for recreational boaters.

B.2.2.2.10 Unintentional Hydrocarbon Spills not Associated with OCS Oil- and Gas-Related Activities

Non-OCS wind energy leasing, site characterization, and site assessment-related hydrocarbon spills that are not a result of activities associated with the Bureau of Ocean Energy Management's OCS Oil and Gas Program include the loss of petroleum products as a result of the extraction-, transportation-, and refinery-related activities from State oil and gas leases offshore Louisiana and Texas. The major sources of petroleum hydrocarbon discharges into the marine waters by transportation activities, including non-OCS wind energy leasing, site characterization, and site assessment-related sources that are not a result of activities associated with the Bureau of Ocean Energy Management's OCS Oil and Gas Program, are tank vessel spills, operational discharges from cargo washings, coastal facilities spills, and gross atmospheric deposition of VOC releases from tankers. Non-OCS wind energy leasing, site characterization, and site assessment-related offshore spills that are not a result of activities associated with the Bureau of Ocean Energy Management's OCS Oil and Gas Program are possible during the extensive maritime barging and tankering operations that occur in offshore waters of the GOM. Spills from transportation activities include a wide variety of petroleum products (not just crude oil), each of which behaves differently in the environment and may contain different concentrations of toxic compounds.

Consumption-related sources of petroleum releases to the marine environment include land-based sources (i.e., river discharge and runoff), two-stroke vessel discharge, non-tank vessel spills, operational discharges, gross atmospheric deposition, and aircraft dumping. Releases that occur during the consumption of petroleum, whether by individual car and boat owners, non-tank vessels, or run-off from increasingly paved urban areas, contribute the vast majority of petroleum introduced to the environment through human activity. Nearly 85 percent of the 29 million gallons of petroleum that enter North American ocean waters each year as a result of human activities comes from land-based runoff, polluted rivers, and aircraft. Land runoff and two-stroke engines account for nearly three quarters of the petroleum introduced to North American waters from activities associated with petroleum consumption, activities almost exclusively restricted to coastal waters. Unlike other sources, inputs from consumption occur almost exclusively as slow chronic releases. The estimates for land-based sources of petroleum are the most poorly documented, and the uncertainty associated with the estimates range over several orders of magnitude. On occasion, aircraft carry more fuel than they can safely land with, so fuel is jettisoned into offshore marine waters. The amount of 1,120 bbl (160 tonnes) of jettisoned fuel per year was estimated for the GOM.

Tables B.2.2-2 and B.2.2-3 provide the National Reseach Council (2003) estimates of hydrocarbon inputs into marine waters.

Table B.2.2-2. Average Annual Inputs of Petroleum Hydrocarbons to Coastal Waters of the Gulf of Mexico, 1990-1999 (Source: (National Reseach Council 2003).

Inputs	Western Gulf of Mexico		Eastern Gulf of Mexico	
	(tonnes)	(bbl)	(tonnes)	(bbl)
Extraction of Petroleum				
Platform Spills	90	630	trace[1]	trace
Atmospheric Releases (VOCs)	trace	trace	trace	trace
Permitted Produced-Water Discharges	590	4,130	trace	trace
Sum of Extraction Inputs	680	4,760	trace	trace
Transportation of Petroleum				
Pipeline Spills	890	6,230	trace	trace
Tank Vessel Spills	770	5,390	140	980
Coastal Facilities Spills[2]	740	5,180	10	70
Atmospheric Releases (VOCs)[3]	trace	trace	trace	trace
Sum of Transportation Inputs[4]	2,400	16,800	160	1,120
Consumption of Petroleum				
Land-Based Sources[5]	11,000	77,000	1,600	11,200
Recreational Vessels	770	5,390	770	5,390
Vessel >100 GT (spills)	100	700	30	210
Vessel >100 GT (operational discharges)	trace	trace	trace	trace
Vessel <100 GT (operational discharges)	trace	trace	trace	trace
Deposition of Atmospheric Releases (VOCs)	90	630	60	420
Aircraft Jettison of Fuel	N/A	N/A	N/A	N/A
Sum of Consumption	12,000	84,000	2,500	17,500

[1] Trace indicates <70 barrels (10 tonnes).

[2] Coastal facility spills do not include spills in coastal waters related to exploration and production spills or spills from vessels. The category “Coastal Facilities” includes aircraft, airport, refined product in coastal pipeline, industrial facilities, marinas, marine terminals, military facilities, municipal facilities, reception facilities, refineries, shipyards, and storage tanks.

[3] Volatization of light hydrocarbons during tank vessel loading, washing, and voyage.

[4] Sums may not match.

[5] Inputs from land-based sources during consumption of petroleum are the sum of diverse sources. Three categories of wastewater discharge are summed: municipal; industrial (not related to petroleum refining); and petroleum refinery wastewater. Urban runoff is included. It results from oil droplets from vehicles washing into waterways from parking lots and roads, and the improper disposal of oil-containing consumer products.

GT = gross tons; N/A = not available; VOCs = volatile organic compounds.

Table B.2.2-3. Average Annual Inputs of Petroleum Hydrocarbons to Offshore Waters of the Gulf of Mexico, 1990-1999 (Source: (National Reseach Council 2003).

Inputs	Western Gulf of Mexico		Eastern Gulf of Mexico	
	(tonnes)	(bbl)	(tonnes)	(bbl)
Natural Sources				
Seeps	70,000	490,000	70,000	490,000
Extraction of Petroleum				
Platform Spills	50	350	trace[1]	trace
Atmospheric Releases (VOCs)	60	420	trace	trace
Permitted Produced-Water Discharges	1,700	11,900	trace	trace
Sum of Extraction	1,800	12,600	trace	trace
Transportation of Petroleum				
Pipeline Spills	60	420	trace	trace
Tank Vessels Spills	1,500	10,500	10	70
Atmospheric Releases (VOCs)	trace	trace	trace	trace
Sum of Transportation	1,600	11,200	10	70
Consumption of Petroleum				
Land-Based Consumption[2]	N/A	N/A	N/A	N/A
Recreational Vessel Consumption[3]	N/A	N/A	N/A	N/A
Vessel >100 GT (spill)	120	840	70	490
Vessel >100 GT (operational discharges)	25	175	trace	trace
Vessel <100 GT (operational discharges)	trace	trace	trace	trace
Deposition of Atmospheric Releases (VOCs)	1,200	8,400	1,600	11,200
Aircraft Jettison of Fuel	80	560	80	560
Sum of Consumption[4]	1,400	9,800	1,800	12,600

[1] Trace indicates <70 barrels (10 tonnes).
[2] Limited to coastal zone.
[3] Limited to within 3 miles (5 kilometers) of the coast.
[4] Sums may not match.
GT = gross tons; N/A = not available; VOCs = volatile organic compounds.

B.3 BOTTOM DISTURBANCE

B.3.1 OCS Wind Energy Leasing, Site Characterization, and Site Assessment Related IPFs

Bottom disturbance can be caused by routine activities associated with site characterization and site assessment, including geotechnical/sub-bottom sampling, anchor emplacement and mooring, scour control system (if employed), and installation of a meteorological buoy(s). Because sonar, sub-bottom profiling, magnetometry, and benthic imaging (e.g., video) involve remote sensing of the seafloor, these site characterization activities would not physically alter the benthos.

Physical sampling methods, such as grab samplers, benthic sleds, bottom cores, deep borings, and cone penetration tests, would result in bottom disturbance in the immediate area sampled. The physical bottom sampling footprint for each collection is anticipated to be on the order of 0.1 to 10 m^2(1.08 to 107.64 ft^2) per sample in surficial area.

The emplacement of structures disturbs small areas of the sea bottom beneath or adjacent to the structure. The seafloor beneath a structure would endure direct physical contact within the footprint of the infrastructure. Impacts would vary in direct proportion to the surface area and mass of the specific equipment emplaced but would include crushing and compaction of substrate beneath the object and turbidity in the water column from object placement. For example, the placement of a meteorological tower steel jacket foundation and scour control system would have a greater area of impact than placement of a meteorological buoy(s). **Section A.3.2.2** of **Appendix A** describes the different structures that could be installed during site assessment-related activities and the estimated amount of surface area that could be disturbed.

The seabed would be disturbed locally during installation and decommissioning of a meteorological buoy(s) as a byproduct of anchoring and placement of scour protection devices. These changes would likely be small in magnitude and limited in spatial scale since the displaced sediments are rapidly diluted as they spread within the water column. The area over which the sediment settles, and the thickness of the deposition, depends on bottom topography, sediment density, and currents.

B.3.2 Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related Activities

B.3.2.1 OCS Oil- and Gas-Related Activities

Bottom disturbance can be caused by activities associated with offshore oil and gas exploration and production. The largest impact-producing factors include drilling, infrastructure and anchor emplacement, and infrastructure removals. Based on current industry practice and the application of lease stipulations, NTLs, and other regulatory requirements, it is anticipated that wells would be drilled on soft seabed and that sensitive benthic features on hard bottoms or with topographic relief will be avoided.

B.3.2.1.1 Drilling

Drilling fluids (also known as drilling muds) and cuttings represent a large quantity of the discharge generated by drilling operations. Drilling an exploration well typically produces approximately 2,000 metric tons of combined drilling fluid and cuttings, though the total mass may vary widely for different wells (Neff 2005). The cuttings released when the initial borehole of a well is drilled splay onto the seafloor near the borehole and are typically found within 100 m (328 ft) of the wellsite (Continental Shelf Associates Inc. 2006). This is typically the thickest deposit of cuttings on the seafloor. Once the borehole is deep enough to insert a riser, rather than dispose of the cuttings at the seafloor, the cuttings are transported from the well, vertically through a riser, and up to a drilling rig. The way the cuttings are released from the drilling rig (surface release or bottom shunting) would result in substantial differences in the dispersal on the seafloor. Cuttings discharged at the sea surface tend to disperse in the water column and are distributed at low concentrations over a larger area of seafloor (Continental Shelf Associates Inc. 2004a). The portion of the water column in which the cuttings are released may experience increased turbidity during drilling activity. Refer to **Figure B.3.2-1** for an example of surface cutting release and seafloor accumulation of cuttings. The majority of cuttings discharged at the sea surface are likely to be deposited within 820 ft (250 m) of the well, although deposits have been located several hundred meters to about a kilometer from a deepwater well (Continental Shelf Associates Inc. 2006). There are numerous studies about splays from various areas around the world (International Association of Oil and Gas Producers 2003; Neff et al. 2000; USEPA 2000b). The splay size and pattern on the seafloor differ from one location to the next and vary by well depth (which controls the total volume of cuttings available for disbursement), water depth, drilling fluid type (cuttings from oil-based or synthetic mud are taken to shore for disposal), and currents. A typical splay is not in a uniform circular shape but rather in the shape of a fan that is influenced by prevailing currents and the fall rate of drill cuttings. Cuttings typically settle to the seafloor in a patchy distribution (Continental Shelf Associates Inc. 2004b). Surface-released cuttings are usually not higher than about 1 ft [0.3 m] within a splay around a well and rarely accumulate to thicknesses of about 1 m (3 ft) immediately adjacent to the well (Zingula and Larson 1977).

On topographic feature lease blocks, lease stipulations require that cuttings be shunted to the seafloor through a structurally sound downpipe attached to a drill rig that terminates an appropriate distance, but no more than 10 m (33 ft) from the bottom (BOEM NTL No. 2009-G39) to focus the settlement and accumulation of cuttings away from sensitive benthic features with topographic relief.

The chemical content of drilling muds and cuttings (and, to a lesser extent, produced waters) may contain hydrocarbons and trace metals including heavy metals, elemental sulfur, and radionuclides (Kendall and Rainey 1990; Trefry et al. 1995).

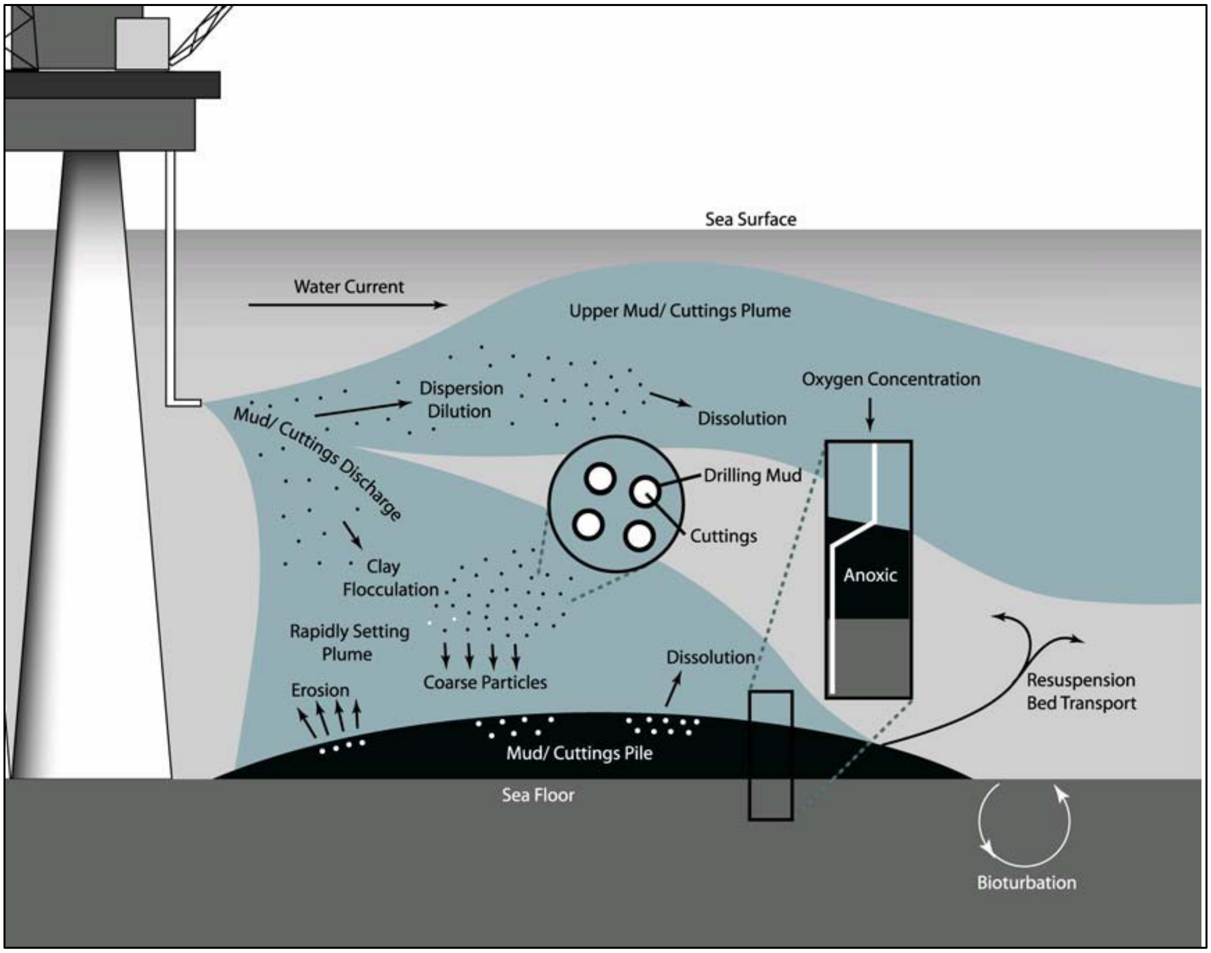

Figure B.3.2-1. Example of Cuttings Being Discharged from a Platform (Continental Shelf Associates Inc. 2006).

B.3.2.1.2 Infrastructure, Anchor Emplacement, and Anchoring

Structures or vessels and their associated anchors that may facilitate oil and gas exploration and production include mobile offshore drilling units (i.e., jack-ups, semisubmersibles, and drillships); pipelines; fixed surface, floating, and subsea production systems (i.e., manifolds and sleds); floating production storage and offloading (FPSO); barges; and service vessels. The emplacement of structures disturbs small areas of the sea bottom beneath or adjacent to the structure. The seafloor beneath a structure would endure direct physical contact within the footprint of the infrastructure. Impacts would vary in direct proportion to the surface area and mass of the specific equipment emplaced but would include crushing and compaction of substrate beneath the object and turbidity in the water column from object placement or pile driving. For example, the placement of a large bottom-founded platform would have a much greater area of impact than placement of a small umbilical cable. If mooring lines are anchored to the sea bottom, areas around the structure could also be directly affected by their emplacement and mooring line swing along the seafloor. The area of disruption on the seafloor would be within the swing arc, which is formed by anchor lines scraping across the bottom within the range of the anchoring system configuration.

B.3.2.1.3 Infrastructure Removal

Production Structures with Fixed Bases

Once production is complete, structures placed on the OCS must be decommissioned and removed. Routine structure-removal activities such as support vessel and barge anchoring, pre-severing operations (jetting around legs of the structure), severing operations (explosive and non-explosive severing of the structure), post-severing operations (standard or sectioned lift and load of structure), site clearance activities (trawling), and reefing of portions of the removed structure could contribute to localized bottom disturbance. Sediment disturbance would occur over a limited area of seafloor over a time period of less than a week to about a month for the most extensive removal projects (MMS 2005).

The anchors from support vessels and barges used in the structure-removal process may impact the seafloor. Vessel anchors and chains or the legs of a jack-up barge can crush and compact the substrate beneath their footprint. Anchors and anchor chains can drag over the seafloor while the vessel swings at anchor. The size of the affected area would depend on water depth, anchor and chain sizes, chain length, method of placement, wind, and current.

If a structure is completely removed, the base is typically cut at least 5 m (15 ft) below the mudline, using explosive or non-explosive severance methods. Non-explosive severing involves cutting tools operated by divers or remotely operated vehicles (ROVs) either inside or outside of the pile, and explosive severance devices involve explosive charges that are deployed inside the pile.

Some decommissioned structures could be converted to artificial reefs. The structures may be partially removed, toppled in place, or fully removed and brought to a pre-approved reef site. Partially removed in place means the bottom portion of the platform would remain in place while the top portion (generally above 85-ft [26-m] water depth) would either be recycled or reefed. There would still be some seafloor impacts from support vessels, pre-severing operational impacts, severing impacts, and site clearance. If the platform is reefed at a predetermined reef site, the seafloor near the existing structure could endure support vessel impacts, pre-severing operational impacts, severing impacts, and site-clearance impacts. The structure would then be towed by a derrick barge to the predetermined reef site. The seafloor in the set down location would be physically disturbed, as well as areas that could encounter drag scars from jacket towing (MMS 2005).

Production Structures with Mooring Systems

Some of the mooring systems used in deepwater operations have quick-disconnect technology built into their designs. Using several varieties of exploding bolts, electromechanical couplings, and/or hydraulic-actuated connections, these release mechanisms can be controlled from a surface vessel and triggered on short notice. Following severance, ROVs fully recover the mooring system, including the lines, cables, and chains from the seafloor to return the seafloor to its original condition and prevent a future hazard to commercial fishing gear and navigation (MMS 2005). In addition, the moorings that hold the topsides in place need to be removed from the seafloor.

Gravity-based structures may cause significant stress to lifting equipment during removal and may need to undergo excavation prior to lifting. If a small amount of excavation is needed, handheld diver or ROV-mounted suction or jetting tools may be used (Small 2016). If large-scale excavation is necessary, it may require mass-flow excavation or high-pressure water jetting. Suction caissons and anchors may be removed in the reverse way they were installed, using overpressure in place of suction. Additional excavation or explosive removal may be necessary as well. Piles are cut below the seabed and remain in place. Drag anchors, and their associated chains, can be removed with an anchor handling vessel by applying tension in the opposite direction than was used when the anchor was set (Small 2016). All of these techniques used in the removal of mooring equipment can cause seafloor crushing, turbidity, and resultant settling of sediment out of the water column. The amount of sediment suspended would be dependent on the amount of excavation, depth of excavation, type of excavation, amount of overpressure used, size of the drag anchor, and distance the drag anchor may have been pulled along the seafloor.

In situations where the mooring system disconnects were not employed or become disabled, structures may be removed using either explosive or non-explosive severance devices. Mechanical cutters such as wheel and guillotine saws, hydraulic shears, and diamond wire cutters can be deployed using ROVs, allowing the cuts to be performed as close to the anchors as possible. In much the same way, small explosive shaped-charge devices can be positioned onto the mooring targets by ROVs. These external cutters are generally designed with hydraulic/electric actuators and hinge systems that allow the shaped charge to be "clamped" over the target and then detonated after the ROV is removed to a safe distance. Together, these effective severing methods and the deep-diving capabilities of the ROVs allow for full recovery of the lines/cables/chains following severance (MMS 2005). The seafloor impacts associated with explosive severance are discussed in "Production Structures with Fixed Bases" above. The impacts from non-explosive severance would be limited in scope and only occur where the seafloor may have been touched or where sediment was disturbed as a result of the cutting activity.

Pipelines and Other Appurtenances

While production structures are generally removed, it is anticipated that pipelines and multiple appurtenances or types of equipment (e.g., subsea systems: pipeline end modules, subsea tie-in, pipeline end terminals, umbilical lines, etc.) would not be removed from the seafloor if they do not constitute a hazard (obstruction) to navigation and commercial fishing operations, unduly interfere with other uses of the OCS, or have adverse environmental effects, as allowed under certain conditions in 30 CFR § 250.1750. From 2009 to 2019, roughly 11,500 mi (18,507 km) of pipeline was decommissioned; approximately 98 percent of which was abandoned in place in accordance with the requirements at 30 CFR § 250.1006, while the other 2 percent was removed. **Figure B.3.2-2** illustrates the general location of these decommissioned pipelines.

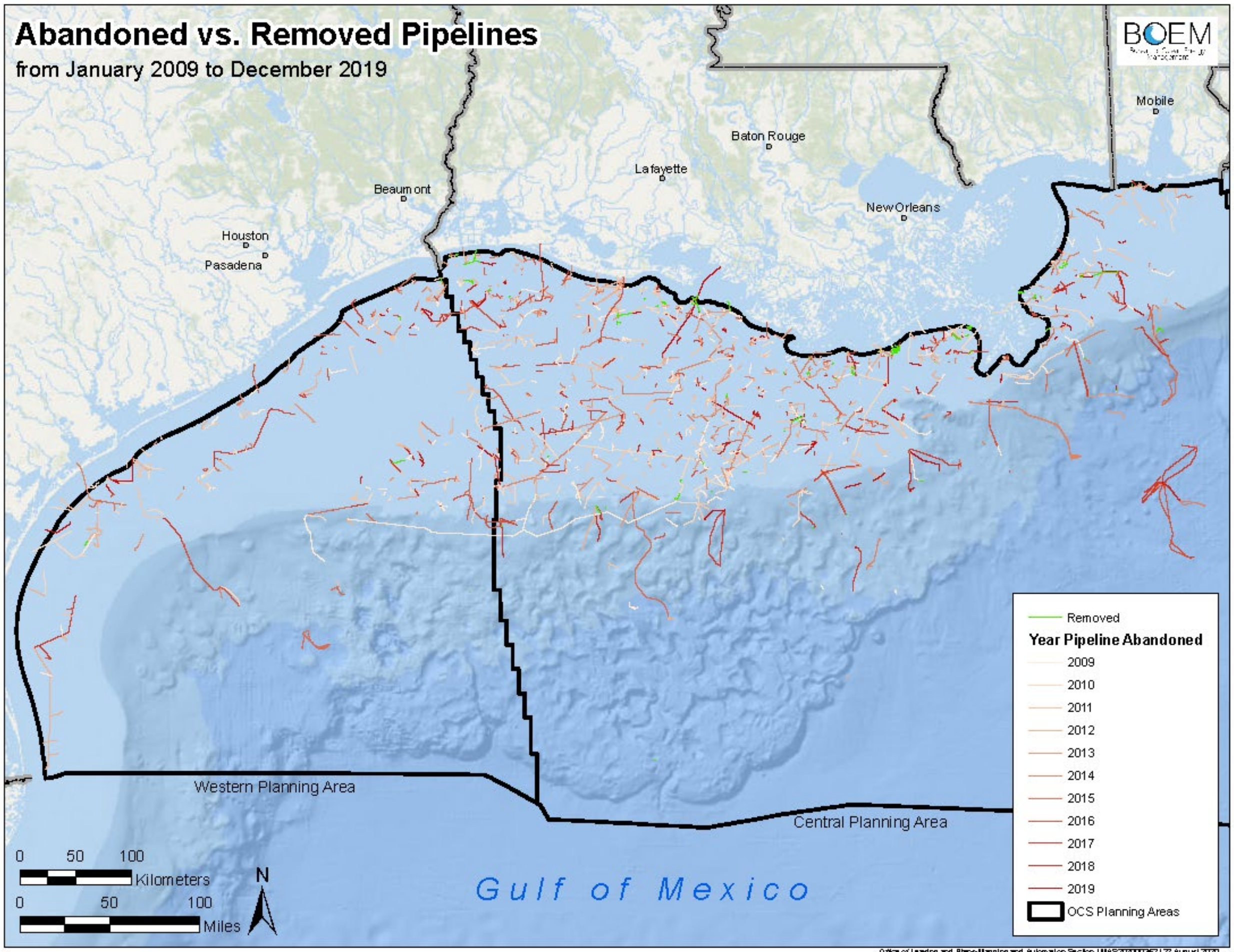

Figure B.3.2-2. Pipelines Removed and Abandoned in Place from 2009 to 2019 (NOTE: Pipeline segments are magnified to improve visibility and are not to scale.).

At the end of its useful life, or because of a catastrophic event such as a hurricane, an offshore pipeline may be decommissioned in place, which normally involves cleaning the line by pigging and flushing or flushing alone (with approval by BSEE's Regional Field Operations Regional Supervisor), cutting the pipeline endpoints, and then plugging and burying each endpoint below the seabed or covering the endpoints with a concrete mattress. Verification of the pipeline cleaning would be based upon flush water quality checks that often rely on visual verification and the absence of hydrocarbon sheen. Measurements by instrumentation may also be used. Flush water is typically pumped down disposal wells at the platform if wells are available, processed for disposal, or shipped to an approved disposal site (Kaiser 2017).

Pipelines that make landfall may be removed through the surf zone and capped. The onshore pipeline may be removed completely or some sections may be abandoned in place due to their transition through a sensitive environment. The pipeline end seaward of the surf zone is capped and jetted down 3 ft (1 m) below the mudline by divers. Pipeline crossings may be an obstacle to decommissioning, particularly if the pipeline to be decommissioned crosses under a live production pipeline. Localized seafloor disturbance (turbidity and sedimentation) could occur in the surf zone if the pipeline is fully removed or where the end is jetted below the seafloor.

B.3.2.2 Non-OCS Oil- and Gas-Related Activities

Seafloor disturbance caused by activities that are not part of BOEM's oil and gas program can occur from anchoring, buoys, or moorings; military operations; State oil and gas activities; artificial reefs; dredging and trawling; and mass wasting events.

B.3.2.2.1 Anchoring, Buoys, and Moorings

Non-OCS wind-, oil-, and gas-related vessels (e.g., activity related to BOEM's Marine Minerals Program, military activity, pleasure vessels, recreational and commercial fishermen, and dive boats) frequently anchor to hold a vessel on location. Anchors "bite" into the seafloor in order to secure a vessel in place and work best in areas of soft seafloor sediment. Anchor chain lengths should be about seven times the water depth to hold the vessel securely, without the anchor slipping along the seafloor as the wind and waves move the vessel at the sea surface (**Figure B.3.2-3**) (USCG 2010). Anchors do not grip well on hard substrates and tend to slide along the hard bottom substrate as a vessel drifts at the water's surface.

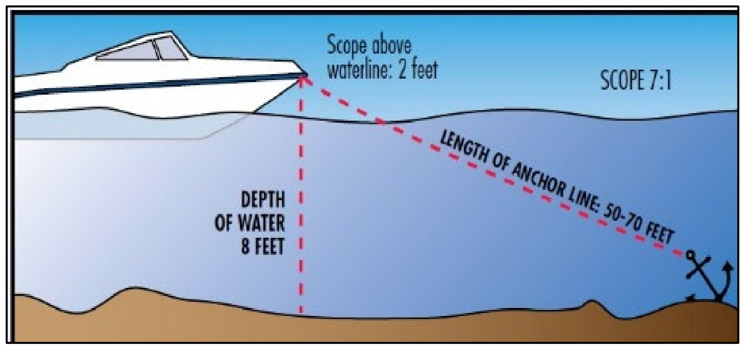

Figure B.3.2-3. Vessel Anchors and Chains That Can Cause Seafloor Disturbance (USCG 2010).

Buoys or moorings are attached to the seafloor by permanent anchors. Vessels can secure to buoys or moorings to hold position (**Figure B.3.2-4**) (Evans 2009; NOAA et al. 2009). Buoy or mooring fields can be found outside harbors for cargo ships to tie before heading into a port; in smaller ports or harbors for recreational vessels or small commercial vessels to moor; in locations that are marked for fishing, diving, or other recreation; or marking avoidance areas such as reefs, fishing nets, or scientific equipment. Buoys and moorings are typically found on soft seafloor rather than hard substrate because it is easier to attach or drive an anchor into soft sediment than rock.

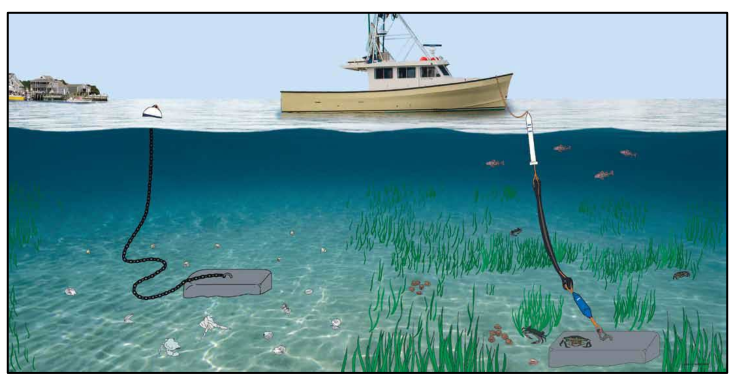

Figure B.3.2-4. Example of Anchoring Buoys/Moorings on the Seafloor (NOAA et al. 2010).

The bottom disturbance caused by anchors, buoys, or moorings includes crushing and compaction of substrate beneath the vessel anchor or mooring foundation. The dropping of an anchor on the seafloor can cause turbidity in the water column. If an anchor does not grip the seafloor when it is set, the anchor could scour the seafloor if it is dragged by the motion of the attached vessel. Moorings can be attached to the seafloor by large seafloor foundations or buried piles or foundations. Piles and buried foundations could be jetted or pounded into the seafloor, which could cause suspended sediment and turbidity, followed by sediment deposition in the area of disturbance. In the small footprints where a mooring is attached to the seafloor, there is a permanent change in substrate from soft seabed to hard structure (**Figure B.3.2-5**) (Morissey et al. 2018; Poppe et al. 2007). Although most anchoring occurs in soft sediment, where anchors grip best, severe damage can occur if anchors are placed over hard seafloor, such as coral habitat, where corals can be crushed or broken, or in submerged vegetation beds, where seagrasses could be torn and physically removed from the seabed.

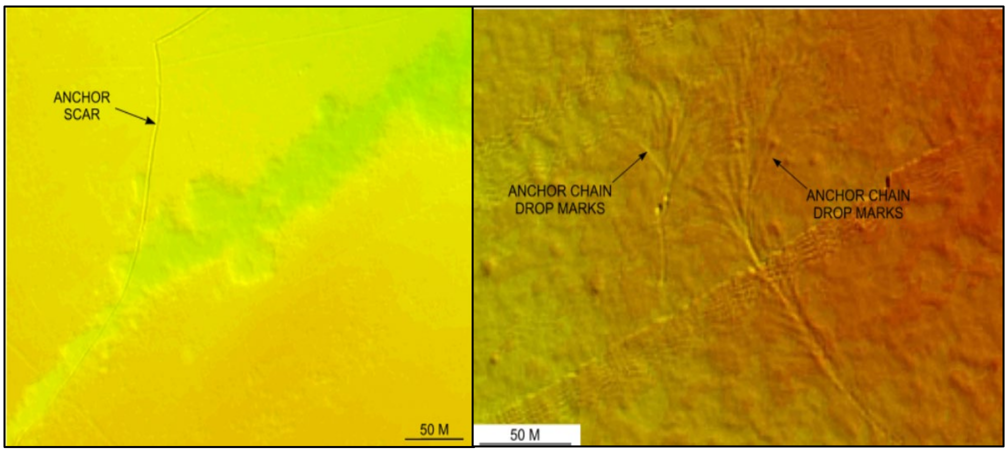

Figure B.3.2-5. Examples of Chain and Anchor Scars on the Seafloor from Vessel Anchoring (Poppe et al. 2007).

The areas around the vessel anchors or bottom-founded mooring base could also be directly affected if anchor or mooring chains drag over the seafloor. Mooring chains need to be long enough to account for tidal differences as well as vessel movement, which can result in the chain scraping the seafloor at low tide or when a vessel swings. Chain scours may create a circular scar around the anchor due to tidal movement and wind direction. The size of the scar would depend on water depth and chain length. Areas with mooring fields are susceptible to seafloor erosion from repeated chain scour. Sediment grain size can change, and anoxia (lack of oxygen) can occur in sediments surrounding moorings as a result of chain sweep. Fine sediments that may have accumulated contaminants from moored vessels may be suspended in the water column as a result of chain sweep, can create turbidity in the water column, travel with currents, and distribute contaminants to other areas of seafloor as the sediment falls out of suspension (Morissey et al. 2018).

Large international cargo vessels often attach to commercial anchorage moorings outside of harbors or in rivers for safety reasons. There they can await a pilot familiar with local waters who can navigate the vessel to port or they can await a security boarding, vessel inspection, or maintenance. Anchorages may occur in State or Federal waters. Impacts from stationary moorings would be similar to those impacts described in the paragraphs above but would have a larger footprint of seafloor disturbance due to the larger moorings necessary to hold commercial ships in place. Sometimes areas of seafloor near ports are labeled on navigational charts as “anchorage areas” and are locations where large cargo vessels may drop their own anchor to hold location. The seafloor disturbance that would occur in these anchorage areas would include crushing and compaction of the seafloor beneath the anchors, as well as seafloor scour from anchor chain drag. Turbidity could also occur in the anchorage areas from anchor placement and chain scour. Refer to **Section B.3.2.1.2** for more details on impacts associated with anchor placement.

B.3.2.2.2 Military Operations

The DOD conducts training, testing, and operations in offshore operating and warning areas, at undersea warfare training ranges, and in special use or restricted airspace on the OCS. The U.S. Navy utilizes the airspace, sea surface, subsurface, and seafloor of the OCS for events ranging from instrument and equipment testing to live-fire exercises. The U.S. Air Force conducts flight training and systems testing over extensive areas on the OCS. The U.S. Marine Corps may conduct amphibious warfare training extending from offshore waters to the beach and inland. For more information and the locations of military operations on the Gulf of Mexico OCS, refer to **Section B.7.2.2.5**.

Many of the operations and training exercises conducted by the military can result in seafloor disturbance. Activities can include the following: live-fire testing and training; torpedo testing; weapons testing; live ordnance release and impact activities; live underwater ordnance detonation operations; mine neutralization operations; torpedo firing exercises; dynamic submarine, surface ship, and helicopter anti-submarine warfare exercises; anti-submarine warfare instrumented training on seabed; bomb dropping exercises; and mine warfare testing and training. The exercises can require underwater cables on the seafloor, permanently installed instruments and tracking devices on the seafloor, hydrophone arrays located on the seabed, and towed bodies that can be anywhere in the water column from surface to near the bottom in water depths of 100-1,000 ft (30-305 m). As a result of these exercises, there may be unexploded ordnances on the seafloor (DOD 2010).

Explosions on or near the seabed can result in large craters on the seafloor. The sediment forced from the crater could cause turbidity in the surrounding water column, followed by sediment deposition on the seafloor. The size of the crater and amount of displaced sediment would be dependent on the size of the blast. Instruments attached to the seafloor could crush or compact the sediment beneath their foundations. Any vessels that anchor during military operations could also crush or compact sediment beneath the anchor footprint. The area of impact would be directly related to the footprint of the instrumentation or anchor attached to the seafloor. For a description of impacts that could occur from instrument emplacement or anchoring, refer to the impacts discussed in **Sections B.3.2.1.2 and B.3.2.2.1**.

B.3.2.2.3 State Oil and Gas Activities

All of the five Gulf Coast States have had some historical oil and gas exploration activity and, with the exception of Florida and Mississippi, all currently allow production of oil and gas in State waters. The coastal infrastructure that supports the OCS Oil and Gas Program also supports State oil and gas activities.

State oil and gas infrastructure consists of the wells that extract hydrocarbon resources, facilities that produce and treat the raw product, pipelines that transport the product to refineries and gas plants for further processing, and additional pipelines that transport finished product to points of storage and final consumption. The type and size of infrastructure that supports production depends upon the size, type, and location of the producing field, the time of development, and the life cycle stage of operations. The seafloor impacts associated with State oil and gas production are the same as those that occur for offshore oil and gas production (refer to **Section B.3.2.1**) and include localized crushing, turbidity, and sedimentation.

Texas

According to the Railroad Commission of Texas, since 2010 cumulative total State offshore production of oil was reported at over 42.70 billion barrels (Railroad Commission of Texas 2020a) and offshore gas production totals were reported at over 4.21 billion cubic feet (Bcf) (Railroad Commission of Texas 2020b). Texas was the leading crude-oil producing state in the Nation in 2013 and exceeded production levels even from the Federal offshore areas (Energy Information Administration 2014b).

The Lands and Minerals Division of the Texas General Land Office holds lease sales for oil and gas on State lands, and the Texas General Land Office manages Texas State resources for the benefit of public education. The Texas General Land Office generally holds lease sales every 4 months in January, April, July, and October. The Texas General Land Office's Mineral Leasing Division uses a sealed bid process for the leasing of State lands. BOEM expects that Texas would conduct regular oil and gas lease sales in State waters during the next 70 years, although the lease sales' regularity could differ from current practices.

Louisiana

Oil production in Louisiana began in 1902, with the first oil production in the coastal zone in 1926. Southern Louisiana produces mostly oil and northern Louisiana produces mostly gas. Oil and gas production in Louisiana State waters has decreased since 2013 to a level of 2.81 million barrels of oil in 2021 and 8.76 million cubic feet of gas in 2021 (Louisiana Department of Natural Resources 2022a; 2022b).

Louisiana's leasing procedure is carried out by the Petroleum Lands Division of the Office of Mineral Resources within the Louisiana Department of Natural Resources (Louisiana Mineral and Energy Board 2015). BOEM expects that Louisiana would conduct regular oil and gas lease sales in State waters during the next 70 years.

Mississippi

At present, Mississippi only has an onshore oil and gas leasing program; however, it is expected that the State would start issuing leases for offshore activity in State waters in the near future. In 2004, the Mississippi Legislature limited offshore natural oil and gas exploration to areas located predominantly south of the barrier islands. On December 19, 2011, the Mississippi Development

Authority published draft regulations; the public comment period closed on January 20, 2012 (Mississippi Development Authority 2011). However, recent efforts to open Mississippi State waters for G&G and leasing activities have been challenged in court (Davis 2014).

Development of an offshore oil and gas leasing program in Mississippi State waters during the next 70 years is reasonably foreseeable.

Alabama

The State Oil and Gas Board of Alabama is the regulatory agency of the State of Alabama with statutory authority over oil and gas development. In Alabama between 1987 and 2018, a total of 3.943 trillion cubic feet of gas and 764,270 barrels of oil were produced in State waters (Alabama Oil and Gas Board 2018). Alabama has no established schedule of lease sales. The limited number of blocks in State waters has resulted in the State not holding regularly scheduled lease sales. The last lease sale was held in 1997. BOEM does not expect Alabama to institute a lease sale program in the near future, although there is at least a possibility of a lease sale in State waters during the next 70 years.

Florida

The Florida Department of Environmental Protection's Mining Mitigation and Delineation Program is the permitting authority for the exploration and production of oil and gas in Florida.

A total of 19 wells were drilled in Florida State waters from 1947 to 1983 (Lloyd 1991). Offshore exploratory drilling in Federal waters of the Eastern Planning Area (EPA) included six wells completed in 1988 and 1989; one of these was the discovery in the Destin Dome Area and was classified by the Federal Government as a producible field (Lloyd 1991). In July 1990, all offshore drilling activity in Florida State waters was prohibited and the State's policy on offshore oil and gas drilling changed. In 2006, the Gulf of Mexico Energy Security Act (GOMESA) enacted a moratorium on OCS oil- and gas-related activities off the western coast of Florida. On September 8, 2020, President Trump issued a Presidential Memorandum extending that moratorium another 10 years from July 1, 2022, to June 30, 2032 (Trump 2020). Since 1989, the Florida State Legislature has prohibited new leasing off Florida in the EPA.

With current State policy and regulations prohibiting oil and gas exploration and development in State waters, BOEM does not expect Florida to institute a lease sale program in the near future. If State policy and regulations change and the moratorium is allowed to expire, the potential for a lease sale in State waters could be a possibility during the next 70 years.

State Pipeline Infrastructure

The existing pipeline network in the Gulf Coast States is the most extensive in the world and has unused capacity (Cranswick 2001). The network carries oil and gas onshore and inland to refineries and terminals, and a network of pipelines distributes finished products such as diesel fuel or gasoline to and between refineries and processing facilities onshore (Peele et al. 2002). Expansion of this network is projected to be primarily small-diameter pipelines to increase the interconnectivity of the existing network and a few major interstate pipeline expansions. However, there is spare capacity in the existing pipeline infrastructure to move oil and gas to market, and deepwater ports can serve onshore facilities, including intrastate as well as interstate pipelines. Refer to **Table B.3.2-1** for a list of pipeline landfalls.

Table B.3.2-1. OCS Pipeline Landfalls Installed from 1996 to 2022.

Segment Number	Year of Installation*	Product Type	Size (in)	Company	State
10631	1996	Oil	24	Equilon Pipeline Company LLC	LA
12470	1996	Oil	24	Manta Ray Gathering Company LLC	LA
11217	1997	Gas	30	Enbridge Offshore	LA
11496	1997	Oil	12	ExxonMobil Pipeline Company	LA
11952	2000	Oil	18-20	ExxonMobil Pipeline Company	TX
14470	2004	Oil	10	Chevron USA Inc.	LA
13972	2004	Oil	24	Manta Ray Gathering Company LLC	TX
13987	2004	Oil	24	Manta Ray Gathering Company LLC	TX
13534	2005	Oil	30	BP Pipelines (North America)	LA
13534	2005	Oil	30	Mardi Gras Endymion Oil Pipeline Co.	LA
17108	2007	Gas/Condensate	16	Stone Energy Corporation	LA
17691	2009	Gas/Oil	8	Stone Energy Corporation	LA
19159	2015	Water Injection	12	Cantium, LLC	LA

*Year when the initial hydrostatic test occurred.

Source: (Smith, official communication, 2022).

B.3.2.2.4 Artificial Reefs

The use of artificial reefs to enhance fisheries along the U.S. coastline was documented as early as the mid-19th century (Christian et al. 1998; McGurrin et al. 1989; Stone 1974). For nearly 200 years, purpose-built structures (e.g., wooden huts, cinder block reefs, and concrete pyramids) and obsolete materials (e.g., decommissioned vessels and damaged concrete pipe) have been intentionally deposited in estuarine and marine environments to add bottom relief, attract fishes, and improve angler access and success. As a result of research into the potential benefits and adverse impacts resulting from specific artificial reef designs, materials, and siting, the National Artificial Reef Plan was developed and revised in 2007 to provide guidance to artificial reef coordinators, fisheries managers, and other parties on recommended siting, construction, management, and monitoring of artificial reefs. The Secretary of the Army, through the USACE, is responsible for the artificial reef permitting process and for coordination of the appropriate State and Federal agencies (NOAA 2007). The Wallop-Breaux Amendment provided increased Federal funding to State agencies for sport fish restoration, contributing to the National Fisheries Enhancement Act's objectives through support of habitat enhancement projects, research, and monitoring (Christian et al. 1998).

Offshore oil and gas platforms have been contributing hard substrate to the GOM since the 1930s, and fishermen quickly found fishing success was enhanced in the vicinity of OCS oil- and gas-related structures (LUCON Company 1999; Mississippi Department of Marine Resources 2019; Wilson et al. 1987). By the late-1970s some artificial reef advocates and recreational fishermen had begun viewing the decommissioning and removal of OCS oil- and gas-related structures as a lost opportunity. The increased interest and participation in fishing at offshore oil and gas platforms and national support for effective artificial reef development coincided with research and fisheries management efforts, which led to passage of the National Fishing Enhancement Act of 1984 and the development of the first National Artificial Reef Plan. In 1987, Louisiana published a State artificial reef plan that specifically addressed the need to support public interest through development of artificial reef planning areas and the addition of decommissioned OCS platforms as artificial reef substrate (Wilson et al. 1987). Texas' Artificial Reef Act of 1989 explicitly identified decommissioned platforms as the preferred substrate for the construction of artificial reefs (Stephan et al. 1990). Currently, all five Gulf Coast States have active artificial reef programs, which develop and manage artificial reefs on the Federal OCS. The seafloor impact associated with artificial reef creation is the physical crushing of the substrate below the objects used as reefs. Reefs, however, are not sited in sensitive habitat and seafloor locations where oil and gas platforms are to be used, as the habitat is investigated prior to placing the reef material to ensure that it does not harm sensitive habitat.

The OCSLA and implementing regulations establish decommissioning obligations for lessees, including the removal of platforms. The Rigs-to-Reefs Program provides a means by which lessees may request a waiver to the removal requirement. Since the first Rigs-to-Reefs conversion, approximately 11 percent of the platforms decommissioned from the Gulf of Mexico OCS have been redeployed within designated State artificial reefs. Scientific and public interest in the ecology of offshore structures and the potential benefits of contributing hard substrate to a predominantly soft bottom environment have led to increased emphasis on the development of artificial reefs. The current paradigm posits oil and gas structures act as both fish-attracting and production-enhancing devices, depending upon the species (Carr and Hixon 1997; Dance et al. 2011; Gallaway et al. 2009; Shipp and Bortone 2009). However, determination of specific and cumulative impacts resulting from the construction of artificial reefs within permitted areas is very difficult. As recommended by the National Artificial Reef Plan (NOAA 2007), well-defined objectives, clear management strategies, and long-term monitoring are critical elements of an artificial reef program and are necessary if managers intend to use artificial reefs as a fisheries management tool.

B.3.2.2.5 Dredging

OCS Sand Borrowing

BOEM's Marine Minerals Program identifies sediment resources mainly for coastal restoration. BOEM has issued leases and agreements for sand, sediment, and gravel projects along the Gulf Coast. Typically, the borrow areas are located in water depths of 9-18 m (30-60 ft) in close proximity to the coast (approximately 3-8 nmi [3.5-9.2 mi; 5.6-14.8 km]), but current technology can reach 30 m (98 ft).

Figure B.3.2-6. Seafloor Disturbance from a Trailing Suction Hopper Dredge (TSHD). (The TSHD components include a draghead (1), on the end of a large suction pipe (2) through which large centrifugal pumps transport the dredged material as a slurry to the hopper (3) from where it is later discharged either through bottom doors (4) or pumped (5) through a pipeline from the bow.) (Michel et al. 2013).

The most common type of dredge used offshore for beach restoration is the trailing suction hopper dredge (**Figure B.3.2-6**) (Michel et al. 2013). Trailing suction hopper dredges are self-propelled and are therefore able to traverse an expansive area within a borrow site. Dredge cut depths are approximately 2 ft (0.6 m). This type of dredge uses suction to obtain seafloor sediment and stores the material in the hull of the ship. The sediment is agitated into a water and sediment slurry via water jets and/or "teeth" located on the underside of the draghead, which is secured to the vessel with a dragarm. Sediment is hydraulically excavated from the seafloor via the draghead and pumped through the dragarm into the ship's hull or "hopper." Coarse sediment settles to the bottom of the hopper, and a water and fine sediment slurry is released into the water column via "overflow." Turbidity in the water column can result from the overflowing process as well as sediment disturbance near the draghead. The suspended sediment eventually falls out of the water column and settles on the seafloor. Once the hull is full, the vessel either dumps the sediment in a previously authorized site through doors in the bottom of the hull, pumps the sediment through a pipeline onto the beach, or disperses the sand through the air onto the beach (Continental Shelf Associates International Inc. et al. 2009; Michel et al. 2013).

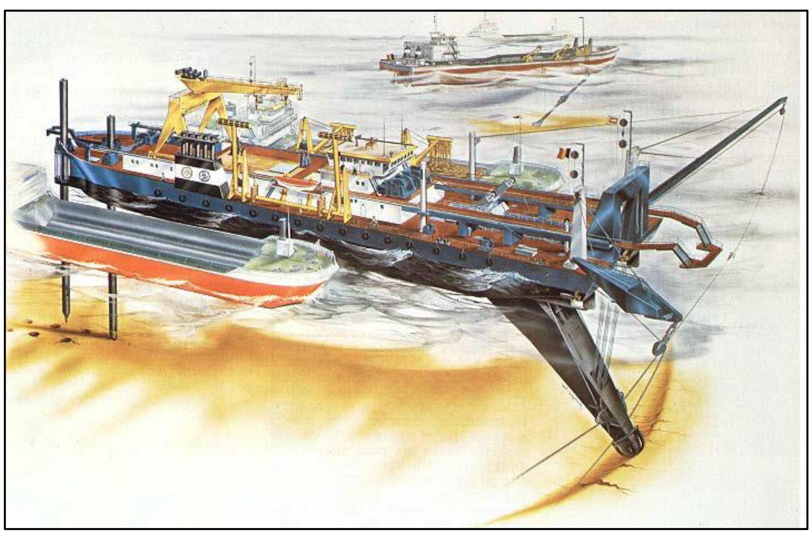

Figure B.3.2-7. Example of a Cutter Suction Dredge (Frabotta 2012).

A cutterhead suction dredge (**Figure B.3.2-7**) (Frabotta 2012) excavates material from the seafloor by creating a slurry that is pumped into a pipeline and transported to the disposal site. The cutterhead swings in an arc and creates a slurry as it scours the seafloor, and a suction mouth vacuums the slurry off the seafloor. Cutterhead dredge operations are not mobile and, therefore, excavate deeper cuts into the seafloor than the trailing suction hopper dredge, resulting in a smaller, but deeper, overall footprint of seafloor impact. This type of dredge operation can result in high turbidity levels in the area because a large percentage of the slurry may not be suctioned by the dredge. The disturbed sediment can eventually fall out of suspension and settle to the seafloor in uneven rows or piles (Michel et al. 2013). Additional turbidity is created when the dredge stops pumping, and the slurry can backflow out of the suction mouth (Continental Shelf Associates International Inc. et al. 2009). The cutterhead suction dredges use side anchors and spuds, which are frequently repositioned, to allow the dredge to be repositioned (Michel et al. 2013). The placement of anchors and spuds can disturb, compact, and crush the seafloor beneath their footprint, and chains and wires that drag along the seafloor as the dredge moves can create turbidity. Because dredging occurs in soft sediment, impacts from the dredge would not be expected for sensitive hard bottom benthic communities. In addition, surveys conducted before dredging activity occurs would ensure that anchors or spuds are not placed on sensitive hard bottoms.

Dredging results in the direct removal of the seafloor sediment in a localized area. When the sediment is removed, the seabed topography is temporarily altered. The dredged footprint may refill at rates depending on site-specific conditions, normally with a slow deposition of fine particulates due to reduced current velocity at the bottom of the pit (Continental Shelf Associates International Inc. et al. 2009). Turbidity can occur from the cutting of the seafloor, anchor and spud placement, chains dragging on the seafloor, backflow and inefficiency of dredges, and overflow of hulls used to store sediment. Turbidity can also occur when the sediments are transferred to the beach or intermediate transfer equipment. Because sediment sources used for beach nourishment are sandy material, the sand grains tend to settle out of the water column fairly rapidly after disruption (Continental Shelf Associates International Inc. et al. 2009). The distance sediment travels in the water column before it settles will depend on local currents and sediment grain size. The resultant grain size profile of the borrow area and nourished beach area may be different from the pre-dredge and nourishment profiles as finer grained sediments may be washed out of the area through the dredging and nourishing process (Smith et al. 2019). BOEM applies a range of best management practices and mitigation measures to minimize environmental impacts; the particular suite of measures depends on each project, its setting, and the nearshore area.

Prior to dredging, geophysical and geological seafloor surveys are conducted to identify suitable borrow sites. Borrow sites are located on sandy seafloor and restrictions are put in place to avoid hard bottom habitat. The greatest seafloor disturbance would be from bottom sampling and sediment coring. A core or grab sample is estimated to disturb up to 1-9 ft^2 (0.009-0.84 m^2) of seafloor (BOEM 2014). Sediment would be physically removed from the seafloor as well as temporarily suspended in the water column as a result of the bottom sampling. Anchors of sampling vessels could also compact sediment in the area, although dynamically positioned vessels may also be used. Suspended sediment could extend beyond the sampling area and settle out of the water column nearby.

U.S. Army Corps of Engineers' Navigation Channel Dredging

In accordance with the Rivers and Harbors Act of 1899, the USACE is responsible for the regulation of activities involving dredging, the disposal of dredged materials, and the modification of navigable waterways (Latham et al. 2017). Dredging is a permitted activity. Compensatory mitigations (i.e., on-site enhancement, off-site enhancement, restoration, and/or preservation credits for unavoidable resource impacts), operational controls, regulations, and best management practices are regularly used for dredging associated with port modifications (Whitney III et al. 2016).

Channels are kept deep and wide enough through dredging for safe movement of ships from deep ocean waters to the more than 200 deepwater harbors where imports are unloaded and exports loaded. Dredging, performed primarily by the Corps of Engineers at navigation channels and by Port Authorities at harbors, takes place in five major areas, and the materials removed differ in consistency and placement options:

- main approaches (approach channel in ocean) – dredged material is composed primarily of sand;
- bar channels (sandbars at inlets) – dredged material is composed primarily of coarse-grained sand;
- entrance channels (to harbors) – dredged material is composed primarily of sand to fine-grained silt and clay;
- berthing areas (harbors/ports) – dredged material is composed primarily of silt and some sand; and
- inland waterways (intracoastal waterways and river channels) – dredged material is composed primarily of silt and sand.

The operation and expansion of ports can result in increased dredging (Whitney III et al. 2016). Dredging may be needed for channel access and/or quayside improvements related to potential port modifications (Whitney III et al. 2016). Port operations and growth depend on channel depth, which determines the ship size able to safely transit through a port (Dismukes 2014). Channel depth also affects the breadth of turning basins and terminal-side water depths (Dismukes 2014). Some ports need to be dredged to allow cargo to transit in the most safe, cost-effective, and efficient manner (Dismukes 2014). Periodic and annual dredging removes several hundred million cubic yards of silt, sand, and gravel (Dismukes 2014). Overall, about 10-15 percent of dredged material requires special handling, while the remaining 85 percent is available for beneficial use (USACE 2020a). Of this available sediment, approximately 30-35 percent is currently used beneficially to deliver environmental, economic, and social benefits (USACE 2020a).

Maintenance dredging on Federal navigation channels is performed on an as-needed basis. Typically, the USACE schedules surveys every 2 years on each navigation channel under its responsibility to determine the need for maintenance dredging. Dredging cycles may be from 1 to as many as 11 years from channel to channel and from channel segment to channel segment. The USACE is charged with maintaining all larger navigation channels in the GOM region. The USACE dredges millions of cubic meters of material per year in the cumulative activities area. Some shallower port-access channels may be deepened over the next 10 years to accommodate deeper draft vessels. Construction and maintenance dredging of rivers and navigation channels can furnish sediment for a beneficial purpose, a practice the USACE calls beneficial use of dredge materials program. In recent years, dredged materials have been sidecast to form new wetlands using the beneficial use of dredge materials program. Dredging from the USACE uses similar vessels and methods as described for "OCS Sand Borrowing" above. Impact-producing factors associated with the dredging of navigation channels include decrease in sediment deposition on downdrift landforms because the sediment supply is physically removed, bottom sediment disturbance via turbidity, the resuspension of pollutants, and sediment deposition. Impacts from navigation channel dredging related to coastal disturbance are described in **Section B.5.2.2.4**.

B.3.2.2.6 Commercial Fishing

Commercial fish trawling and shellfish dredge operations typically take place in nearshore waters and are limited to depths in which their gear can reach, typically less than 200 m (656 ft). Typically, trawl and dredge fishing occur over sandy and muddy seafloor in order to prevent damage to commercial fishing gear. Because these gears are mobile, their impacts can cover large areas of seafloor. The major seafloor impacts associated with these fishing gears include seafloor scouring, turbidity, and sedimentation.

Commercial fishing dredges are made up of a steel frame box or bag-shaped device used to target benthic sessile species such as bivalve mollusks (i.e., clams, oysters, scallops, and mussels). Oyster dredges are pulled behind or alongside fishing vessels over an oyster reef (**Figure B.3.2-8**). They typically measure about 3 ft (1 m) wide and weigh about 120 pounds (54 kilograms) (VanderKooy 2012). Oyster dredges consist of a metal frame with teeth that scrape the oyster reef to dislodge oysters and a bag behind the metal frame to catch the oysters that are dislodged (**Figure B.3.2-8**). The dredge is deployed, towed until it is filled with oysters, retrieved, and redeployed for another catch. Oyster dredges typically navigate in a circular pattern over the oyster reefs while they fish (VanderKooy 2012). Oyster dredge operation primarily causes bottom scouring, suspended sediment and turbidity, and sediment accumulation as the sediment falls out of suspension. Oysters can also be harvested using hand tongs or rakes (**Figure B.3.2-8**). Tonging is done in shallow water, as the handles of the tongs are only 14-16 ft (4-5 m) long (VanderKooy 2012). Tonging is less destructive of the oyster reefs and seafloor than dredging.

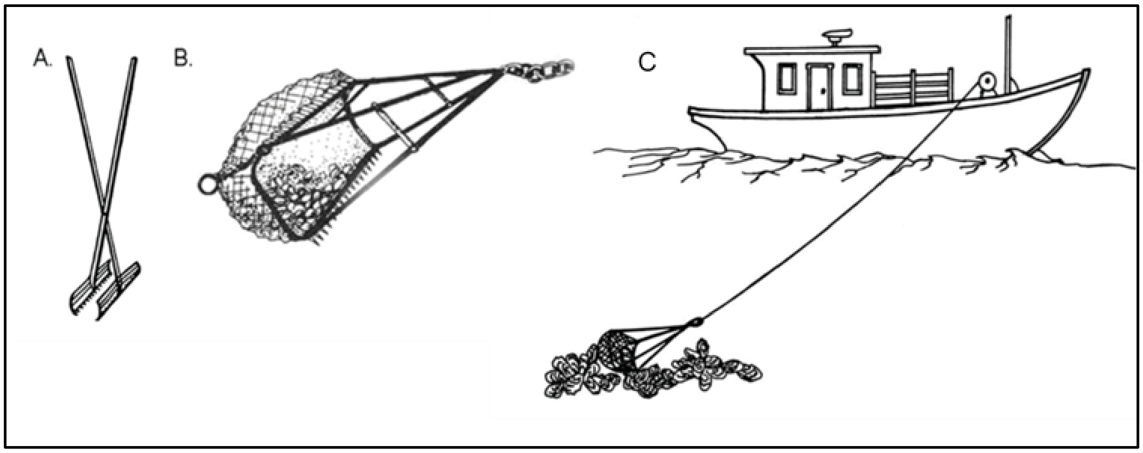

Figure B.3.2-8. Examples of Oyster Fishing in the Gulf of Mexico. Oysters can be harvested using tongs (A) or with a dredge (B) that is towed behind a vessel (C) (VanderKooy 2012).

Trawls are large bag-shape nets constructed with natural fibers or synthetic materials that are rectangular or polygon in shape (mouth openings). Trawls are towed at specific water depths (surface, mid-water, or bottom) depending on the target species. Trawls are classified by their function, bag construction, or method of maintaining the mouth opening (Stevenson et al. 2004). Trawls that cause the greatest environmental effects are the bottom trawls because they disturb the seafloor.

Bottom trawls are designed to be towed along the seafloor to catch a variety of demersal fish and invertebrate species (in the Gulf of Mexico, shrimp are the primary target for trawl fisheries but a few bycatch species have commercial value as well, i.e., Gulf and southern flounder, and butterfish). A funnel-shaped net is towed over the seafloor, and large "doors" on either side of the trawl hold the net open as the trawl "fishes" (Churchill 1989). The net and doors drag along the seafloor, scouring the seafloor and creating turbidity as it fishes. Some trawls use rollers or "tickle chains" that drag on the seafloor and chase fish into the net (Churchill 1989). Refer to **Figure B.3.2-9** for an example of a bottom otter trawl.

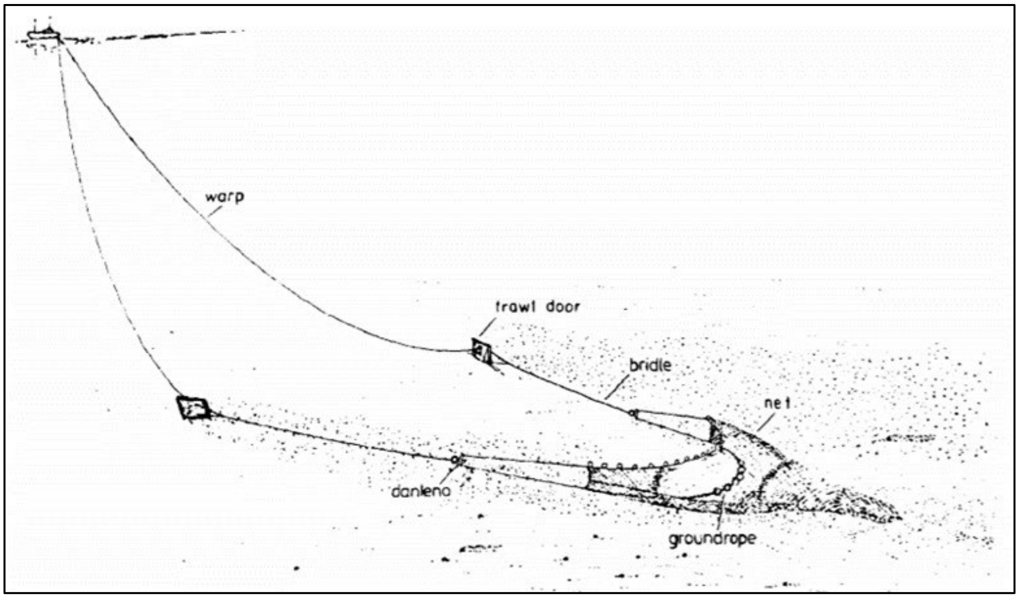

Figure B.3.2-9. Example of a Bottom Otter Trawl (Churchill 1989).

Bottom trawlers target areas of soft seafloor sediment in order to prevent snagging nets on hard bottoms and features elevated from the seafloor. Any accidental trawling on hard bottoms could result in snagged nets, overturned boulders, and the physical removal of benthic organisms associated with the hard bottom habitat. Because trawling generally takes place on soft sediment, this fishing activity can result in seafloor scouring and temporarily high levels of turbidity as a net passes. Trawling experiments showed suspended sediment plumes from trawls to reach 3.0-3.5 m (9.8-11.5 ft) in height and 4.5-6.0 m (14.8-19.9 ft) in width at a distance 50 m (164 ft) astern of the trawl doors (Churchill 1989). The suspended sediment is temporary and will fall out of suspension after the disturbance has stopped. The sediment may travel some distance, depending on surrounding currents.

Trawling and dredging from commercial fishing and other activities can repeatedly and regularly affect the water column, seabed, and associated communities. Commercial fishing can potentially occur anywhere in favored areas where it is not temporarily or permanently excluded (i.e., in areas where there are no surface or bottom obstructions). Virtually all commercial trawl fishing is performed in water depths less than 200 m (656 ft). Churchill (1989) has measured near-bottom total suspended solids to be up to 1,500 milligrams per liter as a result of trawling operations. Seafloor conditions found in some areas may result in re-suspension of upwards of a cubic yard of sediment into the water column for every foot of trawling.

B.3.2.3 Mass Wasting Events (Mudslides)

Mass wasting events are downslope movements of seafloor material, or underwater landslides. They can occur as a result of gravity, an earthquake, or waves produced during a hurricane. Some can travel hundreds of kilometers downslope and move large volumes of sediment, powerful enough to break undersea communication cables and destroy offshore oil and gas platforms; however, most are not this intense. Mass movement can occur in a range of forms, from solid block movement (material moves downslope in a solid mass) to turbulent flow (material moves downslope in a fluidlike mass), depending on the amount of water in the sediment. Submarine landslides occur most often on seafloors where there are thick accumulations of soft sediment, slopes are steep, and environmental loads are high. In the Gulf of Mexico, the type of environment supportive of submarine landslides is active river deltas on the continental shelf, submarine canyons and deep-sea fan systems, and the continental slope (Schwab et al. 1993). Slope failures in the eastern Gulf of Mexico have left large scarps along the West Florida Slope, resulting in areas of instability, which are particularly dangerous for OCS oil and gas development (Schwab et al. 1993). The carbonate sediments in this area can become unstable along gentle gradients. Farther west in the Gulf of Mexico, where rapid sedimentation has occurred as a result of the outflow of the Mississippi River, and below which salt domes have been deformed by the weight of the overlying sediment, mass wasting and submarine landslides have occurred. A major submarine landslide occurred in the East Breaks Area in the northwestern GOM. The landslide covers an area of 2,250 km^2 (869 mi^2), beginning in 200 m (656 ft) of water at the shelf edge and flowing downhill in two lobes. One lobe extends 70 km (43 mi) downslope to a depth of 1,350 m (4,429 ft) , while the other lobe extends 110 km (68 mi) downslope to a depth of 1,300 m (4,265 ft). Both lobes continue downslope in finger-like projections to a depth of 1,600 m (5,249 ft) (Schwab et al. 1993).

A mass wasting event in a submarine canyon would begin following a triggering event with the sediment accumulated at the head of a canyon moving downslope as a coherent block and incorporating water as it moves downslope. As more water is incorporated, a diluted cloud of sediment, called a turbidity current, is created and can flow for long distances at high velocities. The deposition of the mass movement results in a deep-sea fan of sediments. Mass wasting events that occur on the open continental slope are most likely a result of seismic activity, as the gradient on the continental slope is not very steep (Schwab et al. 1993) (**Figure B.3.2-10**). Submarine landslides typically travel 2-4 km (1.2-2.5 mi) (although they have traveled up to 380 km [2,361 mi]), are typically 1-2 km (0.6-1.2 mi) wide (but have reached 50 km [31 mi] wide), and can have a thickness of sediment from 10-650 m (33-2,133 ft) (Schwab et al. 1993).

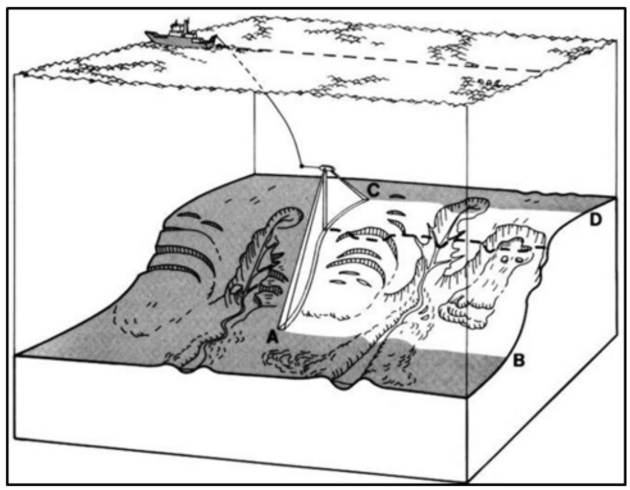

Figure B.3.2-10. Example of Different Mass Wasting Events on the Seafloor (Schwab et al. 1993).

B.4 NOISE

"Noise" is considered unwanted sound that can disturb routine behavioral patterns and life functions (e.g., communication and feeding), and cause annoyance or physical injury.

Acoustic sources can be described by their sound characteristics. For the regulatory process, they are generally divided into two categories: (1) impulsive (e.g., lightning strikes, explosives, airguns, and impact pile drivers) and (2) non-impulsive (e.g., sonars and vibratory pile drivers). Currently, there is no universally accepted definition for what constitutes an impulsive sound, but they are generally understood to be powerful sounds with relatively short durations, broadband frequency content, and rapid rise times to peak levels. In general, these sound characteristics have been observed to be more physiologically damaging to marine mammals than non-impulse sounds with equivalent pressures and energies (Southall et al. 2007), and therefore, are examined with a different and more protective set of acoustic threshold criteria.

Configuration of an acoustic source also directly affects how that source will transfer energy into the marine environment. Impulsive and non-impulsive sound sources can also be characterized as controlled or non-controlled. Sound produced by controlled anthropogenic sources (e.g., hydrophones, airguns, and speakers) take their basic sound-producing characteristics from these individual components, but beam patterns (e.g., large-scale 3D patterns of projected acoustic energy) are restrained by configuration of the source array itself. (The equivalent in the visual environment is that a lightbulb defines the color and brightness of the light produced, but reflectors and lenses in a flashlight determine how the light is broadcast outward.) Under a controlled source, adjustments to timing and amplitudes of the signal produced by each individual source element can refine and steer the beam pattern within the constraint dictated by the array configuration. Another type of source, called non-controlled (e.g., radiation pattern of sound from a driven pile as the shock wave travels down its length), also may exhibit some beam-forming and steering, but most unintended sound sources (e.g., cavitation and vessel thrusters) radiate in an approximately omnidirectional fashion.

One final consideration, especially for controlled anthropogenic sources, is the difference between point and distributed sources. Some sources that are physically smaller (i.e., completely contained within a sphere with a 1-m [3-ft] diameter) can be considered point sources. However, most other sources (e.g., an airgun array, which may be tens of meters in width and length) are distributed sources. For a distributed source, a receiver must be some distance away from the source in order to perceive it acoustically as a single, or point, source. (Closer to the source, a receiver gathers many signals from all separate components of the source. The receiver is then considered in the "near-field.") Once a receiver is beyond this range and can interpret the signal as a point source, it is considered in the source's "far-field."

This distinction between near-field and far-field is a particularly important one for distributed sources such as airgun arrays. This is because the most severe potential impacts to animals generally occur near the source, and a correct understanding and assessment of these impacts requires a correct understanding of the sound field in the near-field. If a receiver (i.e., animal) is in the near-field of an airgun array, then it would receive energy from all individual sources (e.g., individual airguns) in that array. But the closest individual source would tend to be the dominant source, with other individual sources in the array making smaller contributions to the overall received sound level. Because these additional contributions would be delayed in time (due to the physical geometry and the time differences required for sound travel from individual sources to the receiver) and may not be in phase (i.e., peak pressures may not arrive simultaneously or "in-phase"), these contributions would seldom sum to the maximum energy of the overall signal and may actually result in diminishing some of the signal. In this way, near-field sound of the real array would always be less than that modeled for a theoretical point source. In effect, estimating the near-field sound field around an assumed point source is conservative because it would always be greater than the actual values in the near-field.

Propagation

Once a sound source is characterized (i.e., sound levels at very close proximity to the source are understood), the next step is to consider how acoustic energy emitted from the source propagates (or spreads). How sound from a particular source propagates is a function of the characteristics of the source and properties of the medium through which it travels (in this case, water). There are four basic physical processes that affect sound propagation.

- **Spreading:** The average energy on the surface of an acoustic wavefront decreases as the wavefront expands over time.
- **Absorption:** Loss of acoustic energy to heat energy as sound propagates through the ocean. The rate of this energy loss is related directly to the distance sound has traveled and its frequency: absorption increases with distance and frequency.
- **Refraction:** Bending of a sound wave as it changes speed in the ocean. Sound speed changes in water as a function of variations in temperature, salinity, and hydrostatic pressure. In general, sound speed increases with increasing temperature, salinity, hydrostatic pressure, and/or water depth. Sound velocity can also change horizontally in the ocean due to the presence of different water masses, currents, and eddies. For example, the Gulf Stream is usually much warmer than waters that it is passing through, and sound speed in the Gulf Stream varies accordingly. Sound will bend towards areas promoting lower sound speeds.
- **Reflection:** Sound is deflected off the interface between two media having differing sound speed properties. This happens at the air/sea and water/sediment interfaces of the ocean. It can also occur when discrete objects (like air bubbles or fish air bladders) occur in the water column or the biota inhabiting the water column.

Given these variables, predicting the exact propagation of sound in the oceans is nearly impossible without detailed knowledge of the acoustic environment parameters (i.e., all local conditions that influence acoustic propagation and ambient noise conditions). However, the acoustic community has worked for many decades to understand and quantify these parameters. Today, many important parameters required to predict propagation have been identified and have been mapped well enough to support representative propagation modeling in most U.S. waters.

Reverberation

Reverberation is another standard acoustic analysis term with a precise meaning and definition that is not always used accurately in the policy realm. Standard technical usage of the term revolves around the scattering of sound from an acoustic source from numerous scatterers throughout the water column and at the ocean's surface and bottom. The combined return from these scatterers is called reverberation.

B.4.1 OCS Wind Energy Leasing, Site Characterization, and Site Assessment Related IPFs

As described in **Table A.3.1-1** in **Appendix A**, the following activities and equipment would generate noise: HRG survey equipment and vessel engines during site characterization surveys and meteorological buoy(s) installation, operations and maintenance, and decommissioning in association with site assessment.

The HRG survey methods and equipment are described in **Table A.3.2-2** in **Appendix A** and **Section A.3.2.1.1**, High-Resolution Geophysical Surveys, of **Appendix A**. Acoustic information presented in **Table B.4.1-1** is representative of the types of equipment that may be used during site characterization surveys, for which sound characteristics are known from field measurements (Crocker and Fratantonio 2016). Although these representative sources are based on the highest reported power settings and source levels reported, the actual equipment to be used could have frequencies and source levels below or above those indicated in **Table B.4.1-1.**

Table B.4.1-1. High-Resolution Geophysical Survey Equipment and Their Acoustic Characteristics.

HRG Equipment Categories	SL PK (dB re 1 µPa m)	SL SPL (dB re 1 µPa m)	SL SEL (dB re 1 µPa m)	Main Pulse Frequency (kHz)	Pulse Duration (seconds)	PPS	Beamwidth (degrees)
Medium Penetration							
Boomers (proxy: AA251Boomer Plate)	216	207	176	4.3	0.0008	1	72
Sparkers (proxy: AA Dura-spark)	225	214	188	2.9	0.0022	6	Omni
Bubble Guns	204	198	173	1.1	0.0033	8	Omni
Shallow Penetration							
SBP (proxy: EdgeTech 512i)	185	180	159	6.3	0.0087	8	80
SBP (proxy: Knudsen 3202)	214	209	193	3.3	0.0217	4	83

Parametric							
Innomar, SES-2000 Medium-100	N/A	232	N/A	85	0.0035	40	5
Echosounders							
Reson Seabat 7111 Multibeam Echosounder	228	224	185	100	0.00015	20	160
Reson Seabat T20P Multibeam Echosounder	223	220	184	>200	0.000254	50	150
Echotrac CV100 Single-beam Echosounder	197	194	163	>200	0.000711	20	7
Side-Scan							
Klein 3900 Side-scan Sonar	226	220	179	>200	0.000084	unreported	1.3
Ultra-Short Baseline							
AA, Easytrak Nexus 2	193	192	N/A	18	0.0010	2	150
iXblue, IxSea GAPS Beacon System	N/A	188	N/A	8	0.0010	1	Omni

μPa = micropascal; CHIRP = Compressed High-Intensity Radiated Pulse; dB = decibels; HRG = high-resolution geophysical; kHz = kilohertz; N/A = not applicable; PK = Zero-to-peak sound pressure level; PPS = pulses per second; re = referenced to; SBP = sub-bottom profiler; SEL = sound exposure level; SL = source level; SPL = Root-mean-square sound pressure level.

Source: Highest reported source levels reported in Crocker and Fratantonio (2016) or manufacturer specifications for equipment categories that may be used for offshore wind site characterization surveys and modified as necessary based on manufacturer specifications or standard operating configurations.

Vessel noise is a combination of narrow-band (tonal) sounds, usually in frequency bands <500 Hertz (Hz), and some broadband sound. Primary sources of vessel noise are propeller cavitation, propeller singing, and propulsion; other sources include auxiliaries, flow noise from water dragging along the hull, and bubbles breaking in the vessel's wake (Greene Jr. and Moore 1995). Large vessels produce sounds; vessels that use dynamic positioning for station keeping employ thrusters to maintain position and produce higher sound levels. Representative source levels for dynamically positioned vessels range from 184 to 190 dB re 1 μPa at 1 m, with a primary amplitude frequency <600 Hz (Blackwell and Greene Jr. 2003; Kyhn et al. 2011; McKenna et al. 2012).

Nearly all G&G activities would be conducted from ships. The G&G survey vessels would contribute to overall noise by transmitting noise through air and water. Vessel noise is a combination of narrow-band (tonal) and broadband sound (Greene Jr. and Moore 1995). Tones typically dominate up to approximately 50 Hz. The majority of broadband sound energy is restricted to frequencies below 100-200 Hz, but broadband sounds may include sound energy at frequencies as high as 100 kilohertz.

The primary sources of vessel noise are the propeller and machinery. Ship-generated noise at frequencies <50 Hz is dominated by sound produced by propeller cavitation, which results from high thrust loading and non-uniform inflow of water into a propeller (Wright 2008). Some propellers may produce a high-pitched noise, often referred to as propeller singing, within the practical frequency range of approximately 10-1,200 Hz. The audible range of singing, however, can be as high as 12,000 Hz (HydroComp Inc. 2003).

Primary sources of machinery noise include diesel-powered propulsion engines and ship service engines (Wright 2008). Other sources of noise include auxiliaries, flow noise from water dragging along the hull, and bubbles breaking in the wake (Greene Jr. and Moore 1995). Propeller cavitation usually is the dominant noise source. The intensity of noise from support vessels is approximately related to ship size and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladen vessels. For a given vessel, relative noise tends to increase with speed. Ship noise radiates asymmetrically, with stern aspect noise levels higher than bow aspect levels by 5-10 decibels (dB) (McKenna et al. 2012). Broadband source levels for most small ships (a category that would include seismic survey vessels and support vessels used when drilling continental offshore strategic test wells or shallow test wells) are anticipated to be in the range of 170-180 dB re 1 μPa at 1 m (Greene Jr. and Moore 1995).

Although it is more likely that a jack-up barge would be used, a dynamic positioning vessel with ducted propellers may be used for aspects of the foundation installation for a meteorological tower. The ducted propellers' thrusters were modeled for a project offshore of Virginia (BOEM 2015) and measured during the installation of the Block Island Wind Farm transmission cable (Stantec Consulting Inc. and JASCO Applied Sciences Inc. 2016). For both projects, the sound source level was 177 dB (RMS) at 3 ft (1 m).

Fixed-wing aircraft could be used for biological surveys and generate noise from their engines, airframe, and propellers. The dominant tones generally are below 500 Hz (Greene Jr. and Moore 1995). Greene Jr. and Moore (1995) reported that received sound pressure levels (in water) from aircraft flying at altitudes of 152 m (499 ft) were 109 dB re 1 μPa for a Bell 212 helicopter and 101 dB re 1 μPa for a small fixed-wing aircraft. Helicopters are approximately 10 dB louder than fixed-wing aircraft of similar size (Greene Jr. and Moore 1995) and are not likely to be utilized for biological surveys. Penetration of aircraft noise into the water is greatest directly below the aircraft with much of the sound being reflected and not penetrating the water (Greene Jr. and Moore 1995). The duration of underwater sound from passing aircraft is much shorter in water than air; for example, a helicopter passing at an altitude of 152 m (499 ft) that is audible in the air for 4 minutes may be detectable underwater for only 38 seconds at 3-m (10-ft) depth and for 11 seconds at 18-m (59-ft) depth (Greene Jr. and Moore 1995).

B.4.2 Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

B.4.2.1 OCS Oil- and Gas-Related Activities

A variety of G&G surveys are conducted in support of OCS oil- and gas-related activities to (1) obtain data for exploration and production, (2) aid in siting offshore structures (e.g., production platform), (3) identify possible seafloor or shallow depth geologic hazards, and (4) locate potential archaeological resources and potential hard bottom habitats for avoidance. Such data are also used to ensure the proper use and conservation of OCS energy resources and the receipt of fair market value for the leasing of public lands. In general, routine noise-generating activities include the following:

- deep-penetration seismic airgun surveys (2D, 3D, 4D, ocean-bottom nodal, and azimuth multi-vessel surveys);
- airgun HRG surveys that are used to investigate the shallow subsurface for geohazards (also known as shallow hazard surveys) and that are used during initial site evaluation, drilling rig emplacement, and platform or pipeline design and emplacement;
- electromagnetic surveys, deep stratigraphic and shallow test drilling, and various remote-sensing methods;
- non-airgun HRG surveys similar to those used to support OCS wind energy leasing, site characterization, and site assessment-related activities; and
- geological and geotechnical seafloor sampling similar to those used to support OCS wind energy leasing, site characterization, and site assessment-related activities.

BOEM's Resource Evaluation Program oversees G&G data acquisition and permitting activities pursuant to regulations at 30 CFR parts 550 and 551. The G&G activities for oil and gas exploration are authorized on the basis of whether or not the proposed activities occur

- before leasing takes place (prelease), which can occur over leased and unleased blocks for areawide data acquisition, or
- on an existing lease (postlease or ancillary activity) authorized by OCS plan approvals, plan revisions, or by a requirement for notification of BOEM before certain onlease activities are undertaken. Ancillary G&G activities are most commonly used to assess well and reservoir productivity.

Further detailed information on each of the specific G&G survey types and descriptions can be found in Appendix F of the *Gulf of Mexico OCS Proposed Geological and Geophysical Activities: Western, Central, and Eastern Planning Areas; Final Programmatic Environmental Impact Statement* (BOEM 2017c) and are summarized below.

Noise levels from project-related survey and survey support vessel traffic would be spatially restricted to discrete survey areas or OCS lease blocks and of relatively short-term duration. It is predicted that additional vessel traffic would contribute to elevated local ambient noise levels during surveys; however, it is expected that these levels would dissipate quickly with distance from the source.

Noise from drilling and production operations includes strong tonal components at low frequencies (<500 Hz), including infrasonic frequencies in at least some cases (Greene Jr. and Moore 1995). Machinery noise can be continuous or transient and can be variable in intensity. Noise levels vary with the type of drilling rig and water depth. Drillships produce the highest levels of underwater noise because the hull containing the rig generators and drilling machinery is well coupled to the water. In addition, dynamically positioned drillships use thrusters to maintain position and are constantly emitting engine and propeller noise. Jack-up rigs are at the other end of the spectrum because they are supported by metal legs with only a small surface area in contact with the water, the drilling machinery is located on decks well above the water, and there is no propulsion noise. Semisubmersibles are intermediate in noise level because the machinery is located well above the water, but the pontoons supporting the structure have a large surface area in contact with the water. Sound source levels vary, depending upon the drilling structure: drilling from islands and caissons generates sound source levels of 140-160 dB re 1 μPa-m, with frequencies of 20-1,000 Hz; drilling from bottom-founded platforms generates received sound levels of 119-12,760 dB re 1 μPa-m, with frequencies of 5-1,200 Hz; and drilling from vessels generates sound source levels of 154 191 dB re 1 μPa-m, with frequencies of 10-10,000 Hz.

Helicopters are a potential source of aircraft noise during the drilling of continental offshore strategic test and shallow test wells. It is expected that well drilling activities would be supported by a helicopter making one round trip daily between the drilling rig and onshore support base. The Helicopter Safety Advisory Conference's recommended practice states that helicopters should maintain a minimum altitude of 750 ft (229 m) while in transit offshore and a maximum of 500 ft (152 m) while working between platforms and drilling rigs (HSAC 2010). These helicopters also follow the Federal Aviation Administration's minimum of 360 ft (110 m) altitude over "coastal game reserves" (bird strike issues), cruising altitudes for easterly and westerly headings, and altitude restrictions over certain offshore fields, and the operators' contractual guidelines. Helicopters would likely be expected to follow these recommendations and restrictions as applicable, weather permitting. Helicopters could also be used for transporting supplies and/or crew changes.

While rare, sometimes airborne magnetic and airborne gravity surveys are conducted by fixed-wing aircraft and look for deep crustal structure, salt-related structure, and intra-sedimentary anomalies. Aeromagnetic surveys are typically done as a supplement to deep-penetration seismic surveys. A typical aeromagnetic survey would require 1-3 months to complete.

Noise would be generated during explosive and non-explosive structure removal. Vessel and helicopter traffic would also occur in the vicinity of the platform undergoing decommissioning. Which severing tool the operators and contractors use takes into consideration the target size and type, water depth, economics, environmental concerns, tool availability, and weather conditions. A summary of the different severing tools available in the GOM can be found in *Structure-Removal Operations on the Gulf of Mexico Outer Continental Shelf* (MMS 2005).

B.4.2.2 Non-OCS Oil- and Gas-Related Activities

Noise in the ocean is the result of both natural and anthropogenic sources. Natural sources of noise include sounds produced by animals and processes such as wind-driven waves, rainfall, and storms.

Human-generated (anthropogenic) contributions to the ocean's soundscape have steadily increased in the past several decades. This increase is largely driven by a worldwide increase in oil and gas exploration and the amount of vessel traffic using the GOM, including sources not related to oil and gas operations such as tourism, commercial shipping, naval operations (e.g., military sonars, communications, and explosions), fishing (e.g., pingers used in fisheries to prevent animals getting caught in nets), research (e.g., air-guns, sonars, telemetry, communication, and navigation), and other activities such as construction (e.g., pile driving) and recreational boating (**Table B.4.2-1**; Hildebrand (2009). Anthropogenic sources, such as vessel noise, are a chronic contribution to local and global soundscapes. Other anthropogenic sources affect marine life on a more restricted temporal and spatial scale but often produce high sound energies and may pose immediate health risks to marine wildlife. Many anthropogenic sounds are produced intentionally as part of active data gathering effort using sonar, depth sounding, and seismic surveys.

Table B.4.2-1. Typical Sources of Anthropogenic Noise.

Sound Source	Activity Description	Source Level (dB re 1 μPa at 1 m)	Bandwidth Δ = 10 dB (Hz)	Pulse Duration(s)
Ship Shock Trial (10,000-pound explosive)	Military test to determine the strength of a ship using live explosives near the ship	304	0.5-50	2
Torpedo MK-46 (98-pound explosive)	Military test of live ammunition	289	10-200	0.1
Air-gun Array	Used during seismic surveys	260	5-300	0.03
53C ASW Sonar	Used for military surveillance	235	2,000-8,000	2
SURTASS LFA Sonar		235	100-500	6-100
Multibeam Sonar Deepwater EM 122	Sonar and imagers used by civilians and commercial ships	245	11,500-12,500	0.01
Multibeam Sonar Shallow EM 710		232	70,000-100,000	0.002
Sub-bottom Profiler SBP 120		230	3,000-7,000	0.1
Seal Bombs (2.3-g charge)	Small explosive charges detonated by fishermen to deter seals and sea lions from competing for fish	205	15-100	0.03
Acoustic Harassment Device	Used to keep marine mammals away from fishing gear or aquaculture facilities	205	8,000-30,000	0.15-0.5
Acoustic Deterrent Device		150	5,000-160,000	0.2-0.3

Sound Source	Activity Description	Source Level (dB re 1 μPa at 1 m)	Bandwidth Δ = 10 dB (Hz)	Pulse Duration(s)
Cargo Vessel (173-m length, 16 knots)	Noise from the engines of commercial shipping vessels	192	40-100	Continuous
Acoustic Telemetry SIMRAD HTL 300	Used for underwater communications, remote vehicle command and control, diver communications, underwater monitoring and data logging, trawl net monitoring, and other applications requiring underwater wireless communications	190	25,000-26,500	Continuous
Small Boat Outboard Engine (20 knots)	Noise from recreational vessels or possibly oil- and gas-related service vessels	160	1,000-5,000	Continuous
Operating Windmill Turbine	Noise from renewable resources, such as turbines	151	60-300	Continuous

Source: Hildebrand (2009).

B.5 COASTAL LAND USE/MODIFICATION

Land use encompasses six general categories: transportation, recreation, agriculture, residential, commercial, or industrial uses. Coastal infrastructure, for the purposes of BOEM's analysis, refers specifically to onshore wind energy-related infrastructure that provides support for offshore OCS wind energy leasing, site characterization, and site assessment-related activities. As opposed to land use, this type of coastal infrastructure serves as both an impact-producing factor *for* other resources and also as a resource that is impacted by OCS and non-OCS wind energy leasing, site characterization, and site assessment-related activities. Coastal infrastructure supports other interests that are unrelated to OCS wind energy leasing, site characterization, and site assessment-related activities, such as State oil and gas activities, OCS oil- and gas-related activities, commercial entities, and recreational uses.

The following sections discuss wind energy leasing, site characterization, and site assessment-related and other human-induced activities that can affect existing land-use patterns and/or physically alter coastal habitats or shorelines. Offshore wind energy leasing, site characterization, and site assessment activities affect various onshore areas because of the various industries involved and because of the complex supply chains for these industries. Many of these impacts could occur in counties and parishes along the GOM region.

B.5.1 OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

The impact of wind energy leasing, site characterization, and site assessment-related activities on land use requirements primarily relate to the increase in port activity required to meet the demands for fabrication, construction, transportation, and installation of wind energy structures. The majority of this activity could utilize the existing onshore infrastructure industry that supports oil and gas exploration, production, and development activities on the OCS. This expansive onshore infrastructure industry includes large and small companies providing an array of services from construction facilities, service bases, and waste disposal facilities to crew and supply transportation.

Increased vessel traffic associated with site characterization surveys and the construction, operation, and decommissioning of a meteorological buoy(s) would be anticipated as a result of wind energy leasing. BOEM assumes that one or two survey vessels could be active in a leased area at any given time during site characterization. While meteorological buoy installation, operations, and decommissioning activities are being conducted, BOEM anticipates there could be 2-3 vessels in a leased area at any given time (due to vessels needed to tow and assist in buoy placement, or a specialized jack-up vessel used to perform routine maintenance). The additional vessel traffic increases the potential for interference with other marine uses in the area.

B.5.2 Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

B.5.2.1 OCS Oil- and Gas-Related Activities

Offshore oil and gas activities affect various onshore areas because of the various industries involved and the complex supply chains for these industries. Many of these impacts occur in counties and parishes along the GOM region. BOEM aggregates 133 GOM counties and parishes into 23 Economic Impact Areas (EIAs) based on economic and demographic similarities among counties/parishes (Varnado and Fannin 2018). **Figure B.5.2-1** depicts a map of these EIAs. Much of the analysis below focuses on these EIAs since many of the issues related to OCS oil and gas leasing in the GOM would be concentrated in these EIAs. These EIAs also serve as consistent units for which to present economic and demographic data.

Oil and gas exploration, production, and development activities on the OCS are supported by an expansive onshore infrastructure industry that includes large and small companies providing an array of services from construction facilities, service bases, and waste disposal facilities to crew, supply, and product transportation, as well as processing facilities. It is an extensive and mature system providing support for both offshore and onshore oil and gas activities in the GOM region (**Figure B.5.2-2**). The extensive presence of this coastal infrastructure is not subject to rapid fluctuations and results from long-term industry trends. Existing oil and gas infrastructure is expected to be sufficient to handle development associated with a proposed action. Should there be future oil and gas leasing, some expansion at current facilities could potentially be needed, the land in the analysis area is sufficient to handle such development.

Activities and factors associated with coastal infrastructure include service bases, gas processing plants, pipeline landfalls, navigation channels, and waste disposal facilities. **Section B.2.2.1.12** addresses onshore waste disposal. While no single proposed lease sale is projected to substantially change existing OCS-related service bases or require any additional service bases, it could contribute to the use of existing service bases. Sufficient land exists to construct a new gas processing plant but, given that spare capacity at existing facilities is sufficient to satisfy new gas production, the need to construct a new facility would possibly materialize only toward the end of the lifecycle of a future lease sale (approximately 50 years based on historical trends). While a lease sale and subsequent oil and gas activity would contribute to the continued need for maintenance dredging of existing navigation channels, a mature network of navigation channels already exists in the analysis area; therefore, new navigation channel construction as a direct result of a future lease sale is not likely (Dismukes 2011).

BOEM continuously collects new data and monitors changes in infrastructure demands in order to support scenario projections that reflect current and future industry conditions. The scenario projections outlined below reflect the already well-established industrial infrastructure network in the GOM region and fluctuations in OCS oil- and gas-related activity levels. To prevent underestimating potential effects, BOEM makes conservative infrastructure scenario estimates; therefore, a projection of between 0 and 1 is more likely to be 0 than 1. The following sections provide the current trends, or outlook scenario projections, for the varied infrastructure categories. The primary sources for the information on coastal infrastructure and activities presented here are BOEM's Gulf of Mexico Office's fact books: (1) *OCS-Related Infrastructure in the Gulf of Mexico Fact Book* (The Louis Berger Group Inc. 2004); (2) *Fact Book: Offshore Oil and Gas Industry Support Sectors* (Dismukes 2010); and (3) *OCS-Related Infrastructure Fact Book; Volume I: Post-Hurricane Impact Assessment* (Dismukes 2011) and *Volume II: Communities in the Gulf of Mexico* (Kaplan et al. 2011).

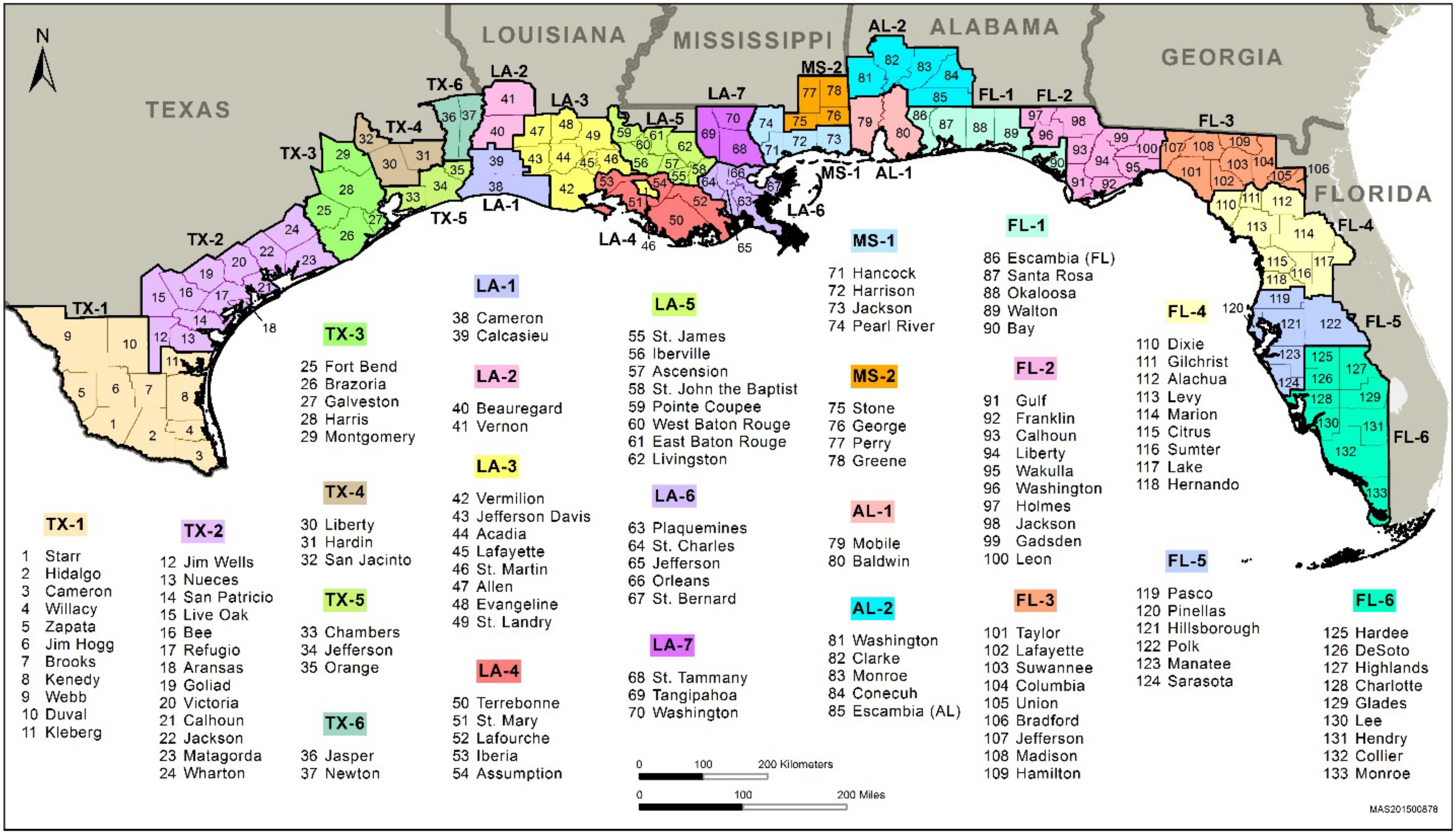

Figure B.5.2-1. Economic Impact Areas in the Gulf of Mexico Region.

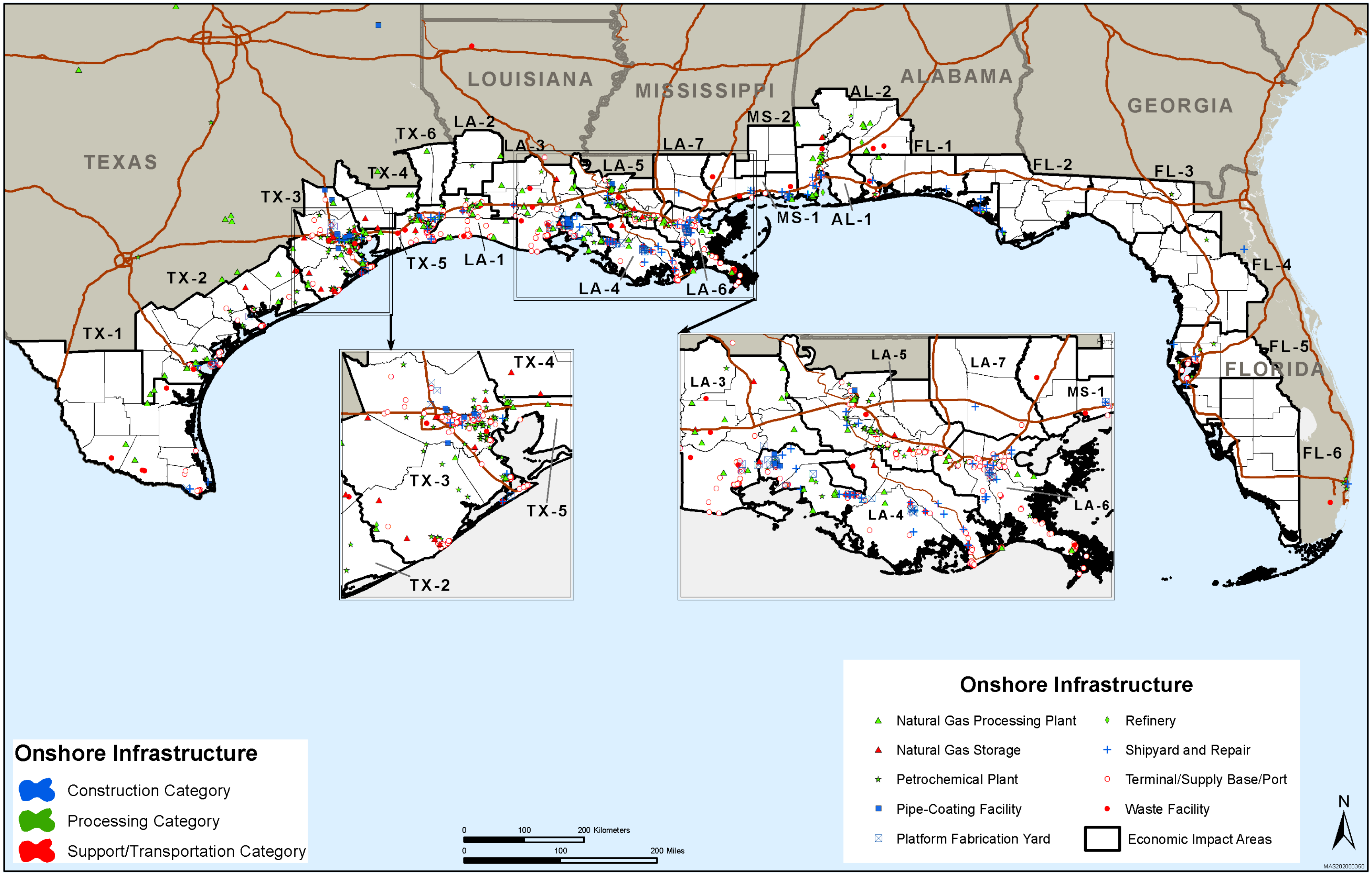

Figure B.5.2-2. Onshore Infrastructure (Sources: (Dismukes 2010; 2011).

B.5.2.1.1 Construction Facilities

Platform Fabrication Yards

Facilities where platforms (and drilling rigs) are fabricated are called platform fabrication yards. Most platforms are fabricated onshore and then towed to an offshore location for installation. When an oil and/or gas discovery occurs, an exploratory drilling rig would be either replaced with, or converted to, a production platform assembled at the site using a barge equipped with heavy lift cranes. As oil prices fluctuate, platform fabrication yards adjust accordingly. When oil prices are low, they diversify their operations into other marine-related activities or scale back on the overall scope of their operations. The variety of diversification strategies may include drilling rig maintenance and re-builds, barge or vessel fabrication, dry-docking, or equipment survey.

The existing fabrication yards do not operate as “stand alone” businesses; rather, they rely heavily on a dense network of suppliers of products and services. Also, since a vast network of existing fabrication yards has been historically evolving in the GOM region for many decades, the emergence of new fabrication yards is relatively low compared to regions with less existing infrastructure. There are 52 platform fabrication yards in the analysis area, with the highest concentration in Louisiana at 37, followed by Texas at 13. Given the large size of offshore platforms, fabrication yards necessarily span several hundred acres. The location of platform fabrication yards is tied to the availability of a navigable channel sufficiently large enough to allow the towing of bulky and long structures, such as offshore drilling and production platforms. Thus, platform fabrication yards are located either directly along the Gulf Coast or inland along large navigable channels, such as the Intracoastal Waterway.

Shipbuilding and Shipyards

There are several kinds of shipyards throughout the Gulf Coast region that build and repair all manner of vessels, many of which are not related to OCS oil- and gas-related activities. These marine vessels are perhaps the most important means of transporting equipment and personnel from onshore bases and ports to offshore drilling and production structures. The shipbuilding and repair industry has struggled over the last few decades. Since the mid-1990s, there has been some industry stabilization, but the outlook for shipbuilding and shipyards is uncertain. The industry is overly dependent on military contracts and faces numerous economic challenges, such as the lack of international competitiveness, workforce development challenges, availability of capital, and the lack of research and development funding. In the GOM region, there is a direct correlation between OCS oil- and gas-related activities and the demand or opportunities for expanding shipbuilding and offshore support vessels. There are many shipyards located within the analysis areas.

Pipe-Coating Facilities and Yards

Pipe-coating plants generally receive manufactured pipe by rail or water at either their plant or pipe yard depending on their inventory capabilities. At the plant, pipes that transport oil and gas are coated on the interior and exterior to protect from corrosion and abrasion. There are 18 pipe-coating plants in the analysis areas. Pipe-coating facilities receive manufactured pipe, which they then coat the surfaces of with metallic, inorganic, and organic materials to protect from corrosion and abrasion and to add weight to counteract the water's buoyancy. Two to four sections of pipe are then welded at the plant into 40-ft (12-m) segments. The coated pipe is stored (stacked) at the pipe yard until it is needed offshore.

To meet deepwater demand, pipe-coating companies were expanding capacity or building new plants before the *Deepwater Horizon* explosion, oil spill, and response; afterwards, activity levels dropped temporarily, then rebounded until the oil price drop and economic downturn of late 2014/early 2015, resulting in a decrease in OCS activity levels and less demand for pipe-coating services. Demand for pipe-coating recovered after 2015 but has taken a downturn as commodity prices have dropped in 2020 and the industry has contracted across the Gulf Coast. As activity levels fluctuate in the GOM, the demands for pipe-coating services fluctuate accordingly.

B.5.2.1.2 Support Facilities and Transportation

Service Bases and Ports

A service base is a community of businesses that load, store, and supply equipment, supplies, and personnel needed at offshore work sites. A service base may also be referred to as a supply base or terminal and may be associated with a port. Although a service base may primarily serve the adjacent OCS planning area and EIAs in which it is located, it may also provide substantial services for the other OCS planning areas and EIAs. **Table B.5.2-1** shows service bases organized by EIA, and **Figure B.5.2-3** shows the geographic location of the service bases.

Table B.5.2-1. OCS Oil- and Gas-Related Service Bases.

State	EIA	County/Parish		
Texas	TX-1	Port Isabel (Cameron)	Port Mansfield (Willacy)	
	TX-2	Aransas Pass (Nueces) Bayside (Aransas) Corpus Christi (Nueces)	Harbor Island (Nueces) Ingleside (San Patricio) Port Aransas (Nueces)	Port O'Connor (Calhoun) Rockport (Aransas)
	TX-3	Freeport (Brazoria) Galveston (Galveston)	Pelican Island (Galveston)	Surfside (Harris)
	TX-5	Port Arthur (Jefferson) Sabine Pass (Jefferson)		
Louisiana	LA-1	Cameron (Cameron)	Grand Chenier (Cameron)	Lake Charles (Calcasieu)
	LA-3	Amelia (St. Mary) Bayou Boeuf (St Mary)	Berwick (St. Mary)	Cocodrie (Terrebonne)
	LA-4	Dulac (Terrebonne) Fourchon (Lafourche) Gibson (Terrebonne) Houma (Terrebonne)	Leeville (Lafourche) Louisa (St. Mary) Morgan City (St. Mary) New Iberia (Iberia)	Patterson (St. Mary) Theriot (Terrebonne) Weeks Island (Iberia)
	LA-6	Empire (Plaquemines) Grand Isle (Jefferson)	Harvey (Jefferson) Hopedale (St. Bernard)	Paradis (St. Charles) Venice (Plaquemines)
Mississippi	MS-1	Pascagoula (Jackson)		
Alabama	AL-1	Bayou LaBatre (Mobile)	Mobile (Mobile)	Theodore (Mobile)
Florida	FL-1	Panama City (Bay)		

EIA = Economic Impact Area.

As the OCS oil and gas industry continues to evolve, so do the requirements of the onshore support network. With advancements in technology, the shore-side supply network would continue to be challenged to meet the industry's needs and requirements. The intermodal nature of oil and gas operations gives ports (which traditionally have water, rail, and highway access) a natural advantage as ideal locations for onshore activities and intermodal transfers (**Figure B.5.2-3**). Therefore, ports would continue to be a vital factor in the total process and must incorporate the needs of the offshore oil and gas industry into their planning and development efforts, particularly with regard to determining their future investment needs. In this manner, both technical and economic determinants influence the dynamics of port development.

Expansion of some existing service bases is expected to occur to capture and accommodate the current and future oil and gas business that is generated by development on the OCS. Some channels in and around the service bases would need to be deepened and expanded in support of deeper draft vessels and other port activities, some of which would be OCS-related. Channel depths at most major U.S. ports typically range from 35 to 45 ft (11 to 14 m). The current generation of new large ships that service the offshore industry requires channels from 45 to 53 ft (14 to 16 m).

Helicopter Hubs

There are numerous heliports within the GOM region that support OCS oil- and gas-related activities. Dozens are located in Texas and Louisiana, and a handful are located in Mississippi and Alabama. There are no OCS-related heliport hubs located in Florida.

Tanker Port Areas

The transport of OCS-produced oil from FPSO operations to onshore facilities would be accomplished with shuttle tankers rather than oil pipelines. The following tanker ports were identified as destinations for shuttle tankers transporting crude oil from FPSO operations in the GOM: Houston or the Louisiana Offshore Oil Port are most likely candidates, followed by possibly Corpus Christi, Freeport, and Port Arthur/Beaumont, Texas, although it would be most likely for oil to be transported to Port Arthur/Beaumont via pipeline (Dismukes 2011). Tankers may also offload in the other following areas: Nederland, Texas; Pascagoula, Mississippi; Mobile, Alabama; Garyville, Louisiana; Lake Charles, Louisiana; Saint Rose, Louisiana; Galveston Bar, Texas; Texas City, Texas; Baton Rouge, Louisiana; and Yabucoa, Puerto Rico.

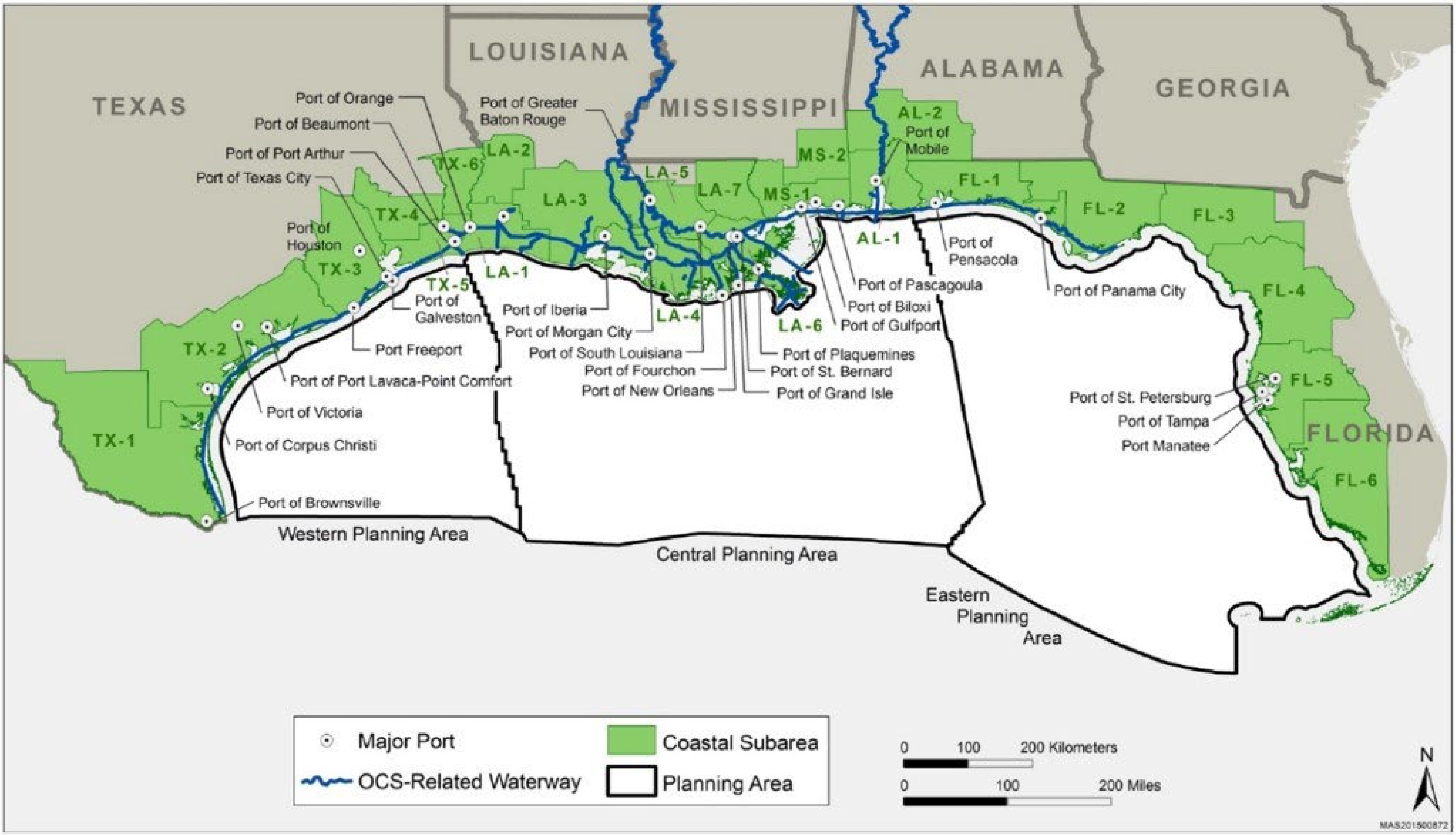

Figure B.5.2-3. Ports and Waterways in the Gulf of Mexico.

Barge Terminals

The OCS oil barged from offshore platforms to onshore barge terminals represents a small portion of the total amount of oil barged in coastal waters. While there is a tremendous amount of barging that occurs in the coastal State waters of the GOM, no estimates exist of the volume of this barging that is directly attributable to the OCS industry. Secondary barging of OCS oil often occurs between terminals or from terminals to refineries. Oil that is piped to shore facilities and terminals is often subsequently transported by barge up rivers, through the Gulf Intracoastal Waterway, or along the coast.

Pipeline Shore Facilities

The term “pipeline shore facility” is a broad term describing the onshore facilities where the first stage of processing occurs for OCS pipelines carrying different combinations of oil, condensate, gas, and produced water. Some processing may occur offshore at the platform; only onshore facilities are addressed in this discussion. Pipelines carrying only dry gas do not require pipeline shore facilities; the dry gas is piped directly to the gas processing plant. Therefore, new pipeline shore facilities are projected to only result from oil pipeline landfalls. A pipeline shore facility may support one or several pipelines; therefore, new pipeline shore facilities are projected to only result from larger pipelines (>12 in; 30 cm). Although older facilities may be located in wetlands, current permitting programs prohibit or discourage companies from constructing any new facilities in wetlands. Also, it is more cost effective for companies to tie into the existing offshore pipeline network.

Waste Disposal Facilities

A variety of different types of wastes are generated by offshore oil and gas exploration and production activities along the GOM. Some wastes are common to any manufacturing or industrial operation (e.g., garbage, sanitary waste [toilets], and domestic waste [sinks and showers]) while others are unique to the oil and gas industry (e.g., drill fluids and produced water). Most waste must be transported to shore-based facilities for storage and disposal. In the analysis area, there are 13 waste disposal facilities in Texas, 29 in Louisiana, 3 each in Mississippi and Alabama, and 1 in Florida.

Natural Gas Storage Facilities

Most of the natural gas storage facilities in the GOM region are salt caverns. The overwhelming majority of all salt cavern storage facilities operating in the U.S. are located along the Gulf Coast. Gulf Coast salt caverns account for only 1 percent of total U.S. working gas capacity. In the GOM, Texas has 16 salt cavern sites with 168 billion cubic feet per day (Bcf/day) of working gas capacity, Louisiana has 11 sites with 156 Bcf/day of working gas capacity, Mississippi has 6 sites with 135 Bcf/day of working gas capacity, and Alabama has 1 site with 22 Bcf/day of working gas capacity (Dismukes 2020). Not all of these facilities are located within the BOEM-defined EIAs. More specifically, there are 22 underground natural gas storage facilities in the BOEM-defined EIAs. These facilities total 165 Bcf/day of working gas capacity.

B.5.2.1.3 Processing Facilities

The sections below discuss various processing facilities, i.e., gas processing facilities, refineries, onshore liquefied natural gas (LNG) facilities, and petrochemical plants. These are included as the final endpoint for OCS oil and gas; however, at the time that OCS product reaches these facilities, it has already been joined with non-OCS product from State waters and onshore activities. The percentage of oil and gas product processed by these facilities that originates from Federal OCS waters has not been determined previously and would not likely be given the numerous factors unrelated to the delivery of OCS product, such as downstream demand. Therefore, in contrast to most other infrastructure types, scenario projections for processing facilities are inherently limited with no direct correlation to OCS oil- and gas-related activities.

Gas Processing Plants

All natural gas is processed in some manner to remove unwanted water vapor, solids, and/or other contaminants that would interfere with pipeline transportation or marketing of the gas. After processing, gas is then moved into a pipeline system for transportation to an area where it is sold. Much of the natural gas processing plant capacity in the U.S. is located along the Gulf Coast and is available for supporting Federal offshore production. While natural gas production on the OCS shelf (shallow water) has been declining, deepwater gas production has been increasing, but not at the same pace. Overall, the combined trends of increasing onshore shale gas development, declining offshore gas production, and increasing efficiency and capacity of existing gas processing facilities have lowered demands for new gas processing facilities along the Gulf Coast. Spare capacity at existing facilities should be sufficient to satisfy new gas production for many years, although there remains a slim chance that a new gas processing facility may be needed by the end of the 50-year life of a proposed lease sale. Expectations for new gas processing facilities being built during the analysis period (2022-2072) are dependent on long-term market trends that are not easily predicable over the next 50 years (Dismukes 2011).

Refineries

The U.S. Department of Energy’s Energy Information Administration updates national energy projections annually, including refinery capacity. Most of the GOM region’s refineries are located in Texas and Louisiana. Texas contains 30 operable refineries, with an operating capacity of over 6.2 million barrels (MMbbl)/day, which is over 30 percent of the total U.S. capacity. Louisiana contains 17 operable refineries, with an operational capacity of over 3.5 MMbbl/day, which is over 17 percent of the total U.S. capacity (Energy Information Administration 2020b). There has been a trend toward constructing simple refineries instead of complex refineries. In the United States, the last complex refinery started operating in 1977 in Garyville, Louisiana. In the GOM analysis area, a new simple refinery was constructed in 2017 in Channelview, Texas (Energy Information Administration 2020a).

Onshore Liquefied Natural Gas Facilities

The wide variety of pipeline systems and delivery markets makes the GOM attractive for LNG developers. Onshore natural gas production has increased to the extent that LNG facilities along the

GOM are seeking and receiving approval to export natural gas to foreign countries. There are 10 existing LNG import/export terminals in the GOM region – 4 in Texas, 5 in Louisiana, and 1 in Mississippi (FERC 2020b; 2020d). There are 16 proposed LNG export terminals in the GOM region – 2 under construction in Texas and 4 under construction in Louisiana (FERC 2020c). There are 19 facilities with export approval that are not yet built – 9 in Texas, 9 in Louisiana, and 1 in Mississippi (FERC 2020a).

Petrochemical Plants

Petrochemical plants are usually located in areas with close proximity to the raw material supply (petroleum-based) and multiple transportation routes, including rail, road, and water. Texas, New Jersey, Louisiana, North Carolina, and Illinois are the top domestic chemical producing states. However, most of the basic chemical production is concentrated along the Gulf Coast where petroleum and natural gas feedstock are available from refineries. Many of the Nation's top production complexes are located in Texas and Louisiana.

Along the Gulf Coast, the petrochemical industry is heavily concentrated in coastal Texas and south Louisiana and in various counties along the Alabama, Mississippi, and Florida coasts. The vast majority of petrochemical plants in the GOM region are located along coastal Texas and south Louisiana. **Figure B.5.2-2** illustrates the geographical distribution of petrochemical facilities across the 133 GOM counties and parishes within the analysis area.

B.5.2.2 Non-OCS Oil- and Gas-Related Activities

B.5.2.2.1 Sea-Level Rise and Subsidence

Although absolute sea-level rise is a contributor to the total amount of sea-level rise along the Gulf Coast, subsidence is the most important contributor to the total.

Some areas of the Gulf Coast have experienced higher local rates of sea-level rise than the global average (U.S. Global Change Research Program 2018). This, coupled with coastal subsidence, will likely increase the risks to and extent of impacts from storm surges (U.S. Global Change Research Program 2018). There are two aspects of sea-level rise: absolute sea-level rise and relative sea-level rise. Absolute sea-level rise refers to a net increase in the volume of water in the world's oceans. Absolute sea-level rise is caused primarily by (1) change in the volume of ocean water based on temperature and (2) change in the amount of ice locked in glaciers, mountain ice caps, and the polar ice sheets. Relative sea-level rise refers to the appearance of or observed sea-level rise when factoring in other circumstances such as subsidence of the land is taking place at the same time that an absolute sea-level change may be occurring. Geologists tend to consider all sea-level rises as relative because the influence of one or the other is difficult to separate over geologic timeframes.

The Intergovernmental Panel on Climate Change (IPCC) reported that, since 1961, global average sea level (mean sea level) has risen at an average rate of 1.8 millimeter/year (mm/yr) (0.07 inch/year [in/yr]) and, since 1993, at 3.1 mm/yr (0.12 in/yr) (Bindoff et al. 2007). With updated satellite data to 2010, Church and White (2011) show that satellite-measured sea levels continue to rise at a rate close to that of the upper range of the IPCC projections (IPCC 2012). It is unclear whether the faster rate for 1993-2010 reflects decadal variability or an increase in the longer-term trend. In the structured context used by the IPCC, there is high confidence that the observed sea-level rise rate increased from the 19th to the 20th century. Over the period 1901 to 2010, global mean sea level rose by 0.19 m (0.62 ft) (with a range of 0.17-0.21 m [0.56-0.69 ft]). The rate of sea-level rise since the mid-19th century has been larger than the mean rate during the previous two millennia (IPCC 2014). In 2018, the U.S. Global Change Research Program (2018) reported that, over the last 50 years, sea level has risen up to 8 in (203 mm) along parts of the Atlantic and Gulf Coasts, which included Louisiana and Texas, and that global sea level is currently rising at an increasing rate. The most recent IPCC report (IPCC 2021) projects sea-level rise under five different warming scenarios: 1.5°C, 2°C, 3°C, 4°C, and 5°C (35°F, 36°F, 38°F, 40°F, and 41°F, respectively). The projected sea-level rises by 2100 are 0.44 m (1.4 ft), 0.51 m (1.7 ft), 0.62 m (2.0 ft), 0.7 m (2.3 ft), and 0.81 m (2.7 ft), respectively.

Results from the National Assessment of Coastal Vulnerability to Sea Level Rise estimate the rate of sea-level rise in the GOM, in particular the areas around Eugene Island, Louisiana, to be the highest (9.65 mm)/yr; 3.17 ft/century) in the United States (NOAA 2020b). This classification is based upon variables such as coastal geomorphology, regional coastal slope, rate of sea-level rise, wave and tide characteristics, and historical shoreline change rates. As much as 88 percent of the northern GOM falls within the high vulnerability category. Areas ranked as the very low vulnerability category still have some sea-level rise. The lowest rate of rise is found in Panama City, Florida, with a rate of 1.6 mm/yr or 0.53 ft/century. Given this range, BOEM anticipates that, over the next 50 years, the northern GOM would likely experience a minimum relative sea-level rise of 80.7 mm (3.18 in) and a maximum relative sea-level rise of 482.6 mm (19.0 in). Sea-level rise and subsidence together have the potential to affect many important areas, including the OCS oil and gas industry, waterborne commerce, commercial fishery landings, and important habitat for biological resources (Coastal Protection and Restoration Authority of Louisiana 2012). Programmatic aspects of climate change relative to the environmental baseline for the GOM are discussed in **Section C.4** of **Appendix C**.

Formation Extraction and Subsidence

Extracting fluids and gas from geologic formations can lead to localized subsidence at the surface. The Texas coast is experiencing high (5-11 mm/yr) (0.19-0.43 in/yr) rates of relative sea-level rise that are the sum of subsidence and eustatic sea-level rise (Sharp and Hill 1995). Even higher rates are associated with areas of groundwater pumping from confined aquifers. Berman (2005) Figure 3) reported that 2 m (6 ft) of subsidence had occurred in the vicinity of the Houston Ship Channel by the mid-1970s as a result of groundwater withdrawal.

Morton et al. (2005) examined localized areas or “hot spots” corresponding to fields in the Louisiana Coastal Area (LCA) where oil, gas, and brine were extracted at known rates. Morton et al. (2005, Figure 26) shows measured subsidence along transects across these fields that range from 18 to 4 mm/yr (0.7 to 0.15 in/yr), with the greatest rates tending to coincide with the surface footprints of oil or gas fields. Mallman and Zoback (2007) interpreted downhole pressure data in several Louisiana oil fields in Terrebonne Parish and found localized subsidence over the fields; however, they could not link these localized rates to the subsidence measured and observed on a regional scale.

Down-to-the-basin faulting, also called listric or growth faulting, is a long recognized fault style along deltaic coastlines, and the Mississippi Delta is no exception (Dokka 2006; Dokka et al. 2006; Gagliano 2005c). There is currently disagreement in the literature regarding the primary cause of modern fault movement in the Mississippi Delta region, and the degree to which it is driven by fluid withdrawal or sediment compaction resulting from the sedimentary pile pressing down on soft, unconsolidated sediments that causes downward and toward the basin movement along surfaces of detachment in the shallow and deep subsurface. Berman (2005) discussed the conclusions of Morton et al. (2005) and believed that they failed to make the case that hydrocarbon extraction caused substantial subsidence over the broader area of coastal Louisiana, a conclusion also reached by Gagliano (2005a; 2005b) and Chan and Zoback (2007).

Oil production on the LCA peaked at 513 MMbbl in 1970 and gas production peaked at 7.8 million cubic feet in 1969 (Ko and Day 2004). Between 2003 and 2012, oil production from Federal GOM waters continued to decline (Energy Information Administration 2014a). From the peak, the level of production activity is slowly decreasing. The magnitude of subsidence caused by formation extraction is a function of how pervasive the activity is across the LCA. The oil and gas field maps in Turner et al. (1988a; 1988b; 1988c) and Ko and Day (2004) seem an adequate basis to estimate the LCA's oil- and gas-field footprint at ~20 percent of the land area. The amount of subsidence from formation extraction is also occurring on a delta platform that is experiencing natural subsidence and sea-level rise. Fluid and gas extraction may lead to high local subsidence on the scale of individual oil and gas fields but not as a pervasive contributor to regional subsidence across the LCA.

B.5.2.2.2 Erosion

Thatcher et al. (2011) estimates that the average canal is widening at a rate of 0.99 m/yr (3.25 ft/yr). Because OCS Oil and Gas Program-related vessel traffic constitutes such a small percentage (<1%) of the contributing factors to erosion in navigation canals and other waterways, most of this land loss can be attributed to non-OCS oil- and gas-related activities.

Net landloss due to navigation canals alone can be calculated by comparing erosion rates with beneficial activities such as land gained through the use of dredged sands. BOEM anticipates that, over the next 40 years, if current trends in the beneficial use of dredged sand and sediment are projected based on past land additions (USACE 2009), approximately 50,000 acres (ac) (20,234 hectares [ha]) may be created or protected in the LCA through dredged materials programs.

B.5.2.2.3 Saltwater Intrusion

Saltwater intrusion is one of many factors that impact coastal environments, contributing to coastal land loss. Such impacts can be natural, as when storm surge brings GOM water inland, or anthropogenic, as when navigation or pipeline canals allow tides to introduce high salinity water to interior marshes. In addition, produced water from oil wells in the coastal zones can be a source of water of extreme high salinity, well over 100 parts per thousand. Produced water, which is regulated, often contains pollutants such as heavy metals and hydrocarbons as well.

Marsh plants are exposed to salinity stress when higher salinity GOM waters reach interior marshes, exposing plants to salinities above their tolerance levels. This can result in decreased plant growth and/or mortality depending on the tolerance of the plant species and the amount, rate, and duration of salinity increase (Mendelssohn and McKee 1987). Plant dieback can be followed by subsequent erosion of the marsh substrate and eventual land loss (Boesch et al. 1994; Ko and Day 2004).

The freshwater-adapted habitats (i.e., fresh or intermediate marsh and forested wetlands) are more sensitive to saltwater intrusion than the other more salt-tolerant habitats, such as brackish and saline marsh. Saltwater intrusion can result in conversion of freshwater to saline habitats or can simply kill fresh or intermediate marshes, thus converting them to open water (Johnston et al. 2009).

The leveeing of the Mississippi River and the construction of numerous water control structures are generally thought to have accelerated coastal land loss by isolating coastal wetlands from the freshwater, sediment, and nutrients of the Mississippi River, which previously served to nourish and sustain these wetlands. Among other impacts, this isolation effect results in the loss or reduction in freshwater flow, and thus a greater marine influence on the coastal wetlands, which in turn results in saltwater intrusion (Johnston et al. 2009).

Saltwater intrusion into coastal environments can also impact estuarine species distribution, shifting patterns of habitat usage. Marine species penetrate farther inland when salinities are within their tolerance, and less salt-tolerant species are restricted to the fresher areas. This can also lead to a shift in the pattern of availability of preferred fish species to fishermen.

B.5.2.2.4 Dredging and Navigation Canals

The Gulf Intracoastal Waterway (GIWW) is a Federal, shallow-draft navigation channel constructed to provide a domestic connection between GOM ports after the discovery of oil in East Texas in the early 1900s, as well as to provide a pathway to support the growing need for interstate transport of steel and other manufacturing materials in the early 20th century. It extends approximately 1,400 mi (2,253 km) along the Gulf Coast from St. Marks in northwestern Florida to Brownsville, Texas, with the Louisiana part reported to be 994 mi (1,600 km) in length (Louisiana Department of Natural Resources 1995). With the exception of the east-west GIWW in Louisiana, Federal channels are approximately north-south in orientation, making them vulnerable to saltwater intrusion during storms.

Along the Texas Coast there are eight federally maintained navigation channels in addition to the GIWW. Most of the dredged materials from the Texas channels have high concentrations of silt and clay. Beneficial uses of dredged material include beach nourishment for the more sandy materials and storm reduction projects or ocean disposal for much of the finer-gained material.

There are 10 Federal navigation channels in the LCA, ranging in depth from 4 to 14 m (12 to 45 ft) and in width from 38 to 300 m (125 to 1,000 ft), that were constructed as public works projects beginning in the 1800s (Louisiana Department of Natural Resources 1995, Table 1). The combined length of the Federal channels was reported as 2,575 mi (1,600 km), with three canals considered deep-draft and seven considered shallow (Louisiana Department of Natural Resources 1995, page 9). The Federal navigation channels in Louisiana identified by (Louisiana Department of Natural Resources 1995, Table 1) are as follows: (1) GIWW East of the Mississippi River; (2) Mississippi River Gulf Outlet; (3) GIWW between the Atchafalaya and Mississippi Rivers; (4) GIWW West of the Atchafalaya River; (5) Barataria Bay Waterway; (6) Bayou Lafourche; (7) Houma Navigation Canal; (8) Mermentau Navigation Channel; (9) Freshwater Bayou; and (10) Calcasieu River Ship Channel. The Mississippi River Gulf Outlet has been decommissioned and sealed with a rock barrier as of July 2009 (Shaffer et al. 2009, page 218).

Impacts include the displacement of wetlands by original channel excavation and disposal of the dredged material. Table 4-5 in Turner et al. (1988b) estimated that immediate land loss impacts from the construction of navigation channels were between 58,000 and 96,000 ac (23,472 and 38,850 ha). Separating the causes of coastal land loss is difficult, but Turner et al. (1988b) estimated that the total of direct and indirect impacts from OCS oil- and gas-related activities from 1955 to 1978 accounted for 8-17 percent of Louisiana's total wetland loss.

Indirect cumulative land losses resulted from hydrologic modifications, saltwater intrusion, or bank erosion from vessel wakes (Wang 1988). Once cut, navigation canals tend to widen as banks erode and subside, depending on the amount of traffic using the channel. Table 1 in Louisiana Department of Natural Resources (1995) estimated indirect impacts on wetland loss from bank erosion at 35,000 ac (14,164 ha).

Federal channels and canals are maintained throughout the relevant onshore area by the USACE, State, county, commercial, and private interests. The USACE is charged with maintaining all larger navigation channels in the area of interest. The USACE dredges millions of cubic meters of material per year in the area of interest, most of which is under the responsibility of the New Orleans District. Proposals for new and maintenance dredging projects are reviewed by Federal, State, and local agencies as well as by private and commercial interests to identify and mitigate adverse impacts upon social, economic, and environmental resources.

The USACE reported that the New Orleans District has the largest channel maintenance dredging program in the U.S., with an annual average of 78 million yd^3 (53.5 million m^3) of material dredged (USACE 2014). Maintenance dredging activity for Federal channels by USACE's Galveston District, New Orleans District, and Mobile District are reported in the USACE's Ocean Disposal Database, which can be found on the USACE website at https://odd.el.erdc.dren.mil/. Between 2009 and 2018, the New Orleans District has averaged about 9.87 million yd^3 (7.55 million m^3) of material dredged per year disposed of at ODMDSs, while the Mobile District has about one-quarter of that quantity, or 3.75 million yd^3 (2.87 million m^3) (USACE 2020c). BOEM anticipates that, over the next

70 years, the amount of dredged material disposed of at ODMDSs will fluctuate generally within the trends established by the USACE's district offices.

Maintenance dredging is performed on an as-needed basis. Typically, the USACE schedules surveys every 2 years on each navigation channel under its responsibility to determine the need for maintenance dredging. Dredging cycles may be from 1 to as many as 11 years from channel to channel and from channel segment to channel segment. Some shallower port-access channels may be deepened over the next 10 years to accommodate deeper draft vessels. Vessels that support deepwater OCS oil- and gas-related activities may include those with drafts to about 7 m (23 ft).

Construction and maintenance dredging of rivers and navigation channels can furnish sediment for a beneficial purpose, a practice the USACE calls "beneficial uses of dredged material." Drilling, production activity, and maintenance at most coastal well sites in Louisiana require service access canals that undergo some degree of periodic maintenance dredging to maintain channel depth, although oil and gas production on State lands peaked in 1969-1970 (Ko and Day 2004). In recent years, dredged materials have been sidecast to form new wetlands using the beneficial uses of dredged material program. Potential areas suited for beneficial uses of dredged material are considered most feasible within a 10-mi (16-km) boundary around authorized navigation channels in the New Orleans District, but the potential for future long-distance pipelines for disposal of dredged material could increase the potential area available for the beneficial use of dredge materials program considerably (USACE 2009, page 27).

As discussed in **Section B.3.2.2.5**, the New Orleans District dredges an average of 78 million cubic yards of material annually during maintenance dredging of Federal navigation channels, with approximately 38 percent of that average used for the beneficial use of the dredge materials program (USACE 2020a). The USACE reported in 2013 that, over a 20-year period, approximately 12,545 ha (31,000 ac) of wetlands were created with dredged materials, most of which are located on the LCA delta plain (USACE 2013).

B.5.2.2.5 Coastal Restoration Programs

BOEM's Marine Minerals Program partners with communities to address serious erosion along the Nation's coastal beaches, dunes, barrier islands, and wetlands. Erosion affects natural resources, energy, defense, public infrastructure, and tourism. To help address this problem, the Marine Minerals Program leases sand, gravel, and/or shell resources from Federal waters on the OCS for shore protection, beach nourishment, and wetlands restoration with vigorous safety and environmental oversight. The OCSLA provides the authority to manage minerals on the OCS and the requirement to provide environmental oversight. Additional information on the Marine Minerals Program's coastal restoration efforts can be found in **Section B.7.2.2.7**.

In the GOM region, one of the major coastal features is the Mississippi River Delta. The Mississippi Delta sits atop a pile of Mesozoic- and Tertiary-aged sediments up to 7.5 mi (12.2 km) thick at the coast, and it may be as much as 60,000 ft (18,288 m) or 11.4 mi (18.3 km) thick offshore

(Gagliano 1999). Five major lobes are generally recognized within about the uppermost 50 m (164 ft) of sediments (Britsch and Dunbar 1993; Frazier 1967), Figure 1). The oldest lobe contains peat deposits dated as 7,240 years old (Frazier 1967). The youngest delta lobe of the Mississippi Delta is the Plaquemines-Balize lobe that has been active since the St. Bernard lobe was abandoned about 1,000 years ago. The lower Mississippi River has shifted its course to the Gulf of Mexico every thousand years or so, seeking the most direct path to the sea while building a new deltaic lobe. Older lobes were abandoned to erosion and subsidence as the sediment supply was shut off. Because of the dynamics of delta building and abandonment, the Louisiana coastal area (USACE 2004a; 2004b) experiences relatively high rates of subsidence relative to more stable coastal areas eastward and westward. Coastal Louisiana wetlands make up the seventh largest delta on Earth and undergo about 90 percent of the total coastal wetland loss in the continental United States. In fact, from 1932 to 2010, coastal Louisiana has undergone a net change in land area of about 1.2 million ac (0.48 million ha). Trend analyses conducted from 1985 to 2010 show that the coastal Louisiana wetland loss rate is 16.57 mi^2 (42.92 km^2) per year. If this loss were to occur at a constant rate, it would equate to Louisiana losing an area the size of one football field per hour (Couvillion et al. 2011).

In recognition of these ongoing impacts, several programs have been established for the conservation, protection, and preservation of coastal areas, including wetlands along the Gulf Coast. In recent years, Louisiana has received over $1 billion in offshore 8(g) revenues, over half a billion dollars in Coastal Impact Assistance Program funds, and stands to receive many more billions in offshore revenue shares in coming years. These programs are described below.

Coastal Wetlands Planning, Protection and Restoration Act

The first systematic program authorized for coastal restoration in the LCA was established by the Federal 1990 Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), otherwise known as the “Breaux Act.” Individual CWPPRA projects are designed to protect and restore between 10 and 10,000 ac (4 and 4,047 ha), require an average of 5 years to transition from approval to construction, and are funded to operate for 20 years (GAO 2007), which is a typical expectation for project effectiveness (Campbell et al. 2005).

The 1990 CWPPRA introduced an ongoing program of relatively small projects to partially restore the coastal ecosystem. As the magnitude of Louisiana’s coastal land losses and ecosystem degradation became more apparent, it was identified that a more systematic approach to integrate smaller projects with larger projects to restore natural geomorphic structures and processes was needed. Projects have ranged from small demonstration projects to projects that cost over $50 million. The Coast 2050 report combined previous restoration planning efforts with new initiatives from private citizens, local governments, State and Federal agency personnel, and the scientific community to converge on a shared vision to sustain the coastal ecosystem. The LCA Ecosystem Restoration Study (USACE 2004a; 2004b) built upon the Coast 2050 Report. The LCA’s restoration strategies generally fell into one of the following categories: (1) freshwater diversion; (2) marsh management; (3) hydrologic restoration; (4) sediment diversion; (5) vegetative planting; (6) beneficial use of dredge material; (7) barrier island restoration; (8) sediment/nutrient trapping; and (9) shoreline protection, as well as other types of projects (USACE 2004a).

As of September 2016, 210 authorized CWPPRA projects were approved, 108 of which have been constructed. Over 100,000 “anticipated total acres” have been projected from completed projects, and 102 projects that were not yet completed as of mid-2016 are reported to result in greater than 54,000 anticipated total acres (USGS 2020). Of the 108 completed projects listed on USGS (2020), more than half were one of three categories types: shoreline protection projects (30 projects); hydrologic restoration projects (24 projects); and marsh creation projects (22 projects).

Following Hurricanes Katrina and Rita in 2005, an earlier emphasis on coastal or ecosystem restoration of the LCA was reordered to add an equal emphasis on hurricane flood protection. The Department of Defense Appropriations Act of 2006 required Louisiana to create a State organization to sponsor the hurricane protection and restoration projects that resulted. The State legislature established the Coastal Protection and Restoration Authority (CPRA) and charged it with coordinating the efforts of local, State, and Federal agencies to achieve long-term, integrated flood control and wetland restoration. The CPRA has since produced comprehensive master plans for a sustainable coast (Coastal Protection and Restoration Authority of Louisiana 2007; 2012; 2017; and drafting 2023) as its vision of an integrated program that identified 109 high-performing projects that could substantially increase flood protection for communities and create a sustainable coast through recreating the natural processes of the system, providing coastal habitat to support commercial and recreational activities, sustaining the unique cultural heritage of coastal Louisiana, and promoting a viable working coast (Louisiana Coastal Protection and Restoration Authority 2013).

Anticipating which projects are undertaken for the USACE’s comprehensive range of flood control, coastal restoration, and hurricane protection measures for the LCA would feed into the CPRA’s Annual Plan for authorization, and which ones would ultimately be completed, is challenging. Past completed projects have the potential of protecting up to 100,000 ac (40,469 ha) of Louisiana’s wetlands (Coastal Protection and Restoration Authority of Louisiana 2017). Because CWPPRA projects compete for annual Federal appropriations, there is no simple way to establish projections for land added or preserved over the lifecycle of OCS oil- and gas-related activities resulting from an OCS oil and gas lease sale and the potential protection those projects would provide. Nor is there a way to anticipate which projects under the protection of the State’s CPRA are admitted to its Annual Plan and completed.

Louisiana Coastal Master Plan

From 2007 to 2017, the CPRA completed or funded for construction a total of 135 projects, resulting in over 36,000 ac (14,569 ha) of land benefited, 282 mi (454 km) of levee improvements, and over 60 mi (96 km) of barrier islands and berms constructed or under construction (Coastal Protection and Restoration Authority of Louisiana 2017). The projects included in the Louisiana Coastal Master Plan have the potential to build between 580 and 800 mi^2 (1,502 and 2,072 km^2) of land over the next 50 years, depending on future conditions.

The 2017 Coastal Master Plan builds on the commitment and knowledge gained from the 2007 and 2012 master plans, recommending diverse projects to build land and reduce flood risk in order to balance short-term needs with long-term goals. It identifies and prioritizes high-performance projects for implementation over the next 10 years, while planning out another 50 years. The plan recommends 124 projects that build or maintain more than 800 mi^2 (2,072 km^2) of land and reduce expected damage by \$8.3 billion annually by year 50, which equates to more than \$150 billion over the next 50 years (Coastal Protection and Restoration Authority of Louisiana 2017). The goal is to not only provide coastal restoration and reduce flood risks but also boost economic development opportunities in Louisiana and its communities.

The CPRA publishes an Annual Plan that inventories projects and presents schedules for these projects. In addition, it identifies funding schedules and budgets. In order to keep track of progress, the Annual Plan also provides updates on the State's efforts to protect and restore its coast and identify results that citizens can expect to see as progress is made towards a sustainable coast.

Coastal Impact Assistance Program

The Coastal Impact Assistance Program (CIAP) provides Federal grant funds derived from Federal offshore lease revenues to oil-producing states for conservation, protection, or restoration of coastal areas. The funds can be directed to a number of different projects, including restoration of wetlands; mitigation of damage to fish, wildlife, or natural resources; planning assistance and payment of the administrative costs of complying with these objectives; implementation of a federally approved marine, coastal, or comprehensive conservation management plan; and mitigation of the impacts of OCS oil- and gas-related activities through the funding of onshore infrastructure projects and public service needs.

The Energy Policy Act of 2005 was signed into law by President George W. Bush on August 8, 2005. Section 384 of Energy Policy Act amended Section 31 of the OCSLA (43 U.S.C. § 1356(a)) to establish the CIAP. The authority and responsibility for the management of CIAP is vested in the Secretary of the Interior; the Secretary delegated this authority and responsibility to BOEM until September 30, 2011. On October 1, 2011, the U.S. Fish and Wildlife Service (FWS) took over administration of CIAP as directed by the Secretary because the program aligned with FWS' conservation mission and similar grant programs run by FWS. The eligibility requirements for States, coastal political subdivisions, and fundable projects remained largely the same after the transfer (**Table B.5.2-2**). Under Section 384, Congress directed the Secretary to disburse \$250 million for each of the fiscal years 2007 through 2010 to eligible OCS oil- and gas-producing States and coastal political subdivisions. At this time, CIAP is closed to new applications and is not currently funded (Texas General Land Office 2020).

Table B.5.2-2. Eligible CIAP States and Coastal Political Subdivisions.

Eligible CIAP States	Eligible CIAP Coastal Political Subdivisions
Alabama	Baldwin and Mobile Counties
Alaska	Municipality of Anchorage and Bristol Bay, Kenai Peninsula, Kodiak Island, Lake and Peninsula, Matanuska-Susitna, North Slope, and Northwest Arctic Boroughs
California	Alameda, Contra Costa, Los Angeles, Marin, Monterey, Napa, Orange, San Diego, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, and Ventura Counties
Louisiana	Assumption, Calcasieu, Cameron, Iberia, Jefferson, Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Martin, St. Mary, St. Tammany, Tangipahoa, Terrebonne, and Vermilion Parishes
Mississippi	Hancock, Harrison, and Jackson Counties
Texas	Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Harris, Jackson, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, Orange, Refugio, San Patricio, Victoria, and Willacy Counties

CIAP = Coastal Impact Assistance Program.

Natural Resource Damage Assessment

The Oil Pollution Act of 1990, as provided in 33 U.S.C. § 2706, allowed the designation of the Natural Resource Damage Assessment Trustee Council (Trustee Council), which included certain Federal agencies, States, and federally recognized Indian Tribes. Executive Order 13554, which was signed on October 5, 2010, recognized the role of the Trustee Council under the Oil Pollution Act and "designated trustees as provided in 33 U.S.C. § 2706, with trusteeship over those natural resources injured, lost, or destroyed as a result of the *Deepwater Horizon* oil spill." Specifically, Executive Order 13554 recognized the importance of carefully coordinating the work of the Gulf Coast Ecosystem Task Force with the Trustee Council, "whose members have statutory responsibility to assess natural resource damages from the *Deepwater Horizon* oil spill, restore trust resources, and seek compensation for lost use of those trust resources" (*Federal Register* 2012). The Task Force, on the other hand, was charged with creating a plan to improve the overall health of the Gulf of Mexico area and has focused on a number of stressors to the Gulf Coast ecosystem beyond those caused by the *Deepwater Horizon* explosion, oil spill, and response. While the work of the Task Force has been independent from the work of the Trustees, the valuable information gathered by the Task Force is useful to the Trustees in their restoration planning efforts (NOAA 2015a).

The Natural Resource Damage Assessment activities for the *Deepwater Horizon* oil spill have been divided into the categories below and focus on specific species, habitats, or uses (Deepwater Horizon Natural Resource Damage Assessment Trustees 2020):

- marine mammals and sea turtles;
- fish and shellfish;
- birds;

- deepwater habitat (e.g., deepwater coral);
- intertidal and nearshore habitats (including seagrasses, mud flats, and coral reefs);
- shoreline habitats (including salt marsh, beaches, and mangroves); and
- public uses of natural resources (including recreational fishing, boating, beach closures).

Since the 2010 oil spill, approximately 200 projects have been approved to restore injured GOM resources. The combined estimated cost of these projects is $1.4 billion.

Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act

In July 2012, in response to the *Deepwater Horizon* explosion, oil spill, and response and other environmental challenges in the Gulf Coast region, Congress passed the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act or the RESTORE Act. In September 2012, an Executive Order was released affirming the Federal Government's Gulf Coast ecosystem restoration efforts in light of the recent passage of the RESTORE Act, which created a Gulf Coast Restoration Trust Fund (Trust Fund), outlined a structure for allocating the Trust Fund, and established the Gulf Coast Ecosystem Restoration Council (Council) (*Federal Register* 2012). The Council is comprised of governors from the five affected Gulf Coast States and the Secretaries of the U.S. Departments of the Interior, Commerce, Agriculture, and Homeland Security, as well as the Secretary of the Army and the Administrator of the U.S. Environmental Protection Agency.

As an independent entity, the Council has responsibilities with respect to 60 percent of the funds made available from a Gulf Coast Restoration Trust Fund and was charged with developing a comprehensive plan for ecosystem restoration on the Gulf Coast (Comprehensive Plan), as well as any future revisions to the Comprehensive Plan (Gulf Coast Ecosystem Restoration Council 2020). Among its other duties, the Council is tasked with establishing additional advisory committees as may be necessary to assist the Council, including a scientific advisory committee and a committee to advise the Council on public policy issues; gathering information relevant to Gulf Coast restoration, including thorough research, modeling, and monitoring; and providing an annual report to Congress on implementation progress *(Federal Register 2012)*.

Under the Council-Selected Restoration Component of the RESTORE Act, 30 percent of available funding will be administered for Gulfwide ecosystem restoration and protection according to a 2016 Comprehensive Plan developed by the Council. Another 30 percent is allocated to the States under the Spill Impact Component according to a formula established by the Council through a regulation and is spent according to individual State Expenditure Plans to contribute to the overall economic and ecological recovery of the GOM (Gulf Coast Ecosystem Restoration Council 2020).

The Council has adopted five strategic goals in the 2013 Comprehensive Plan, recommitting to them (with the addition of *Water Quantity* to Goal 2) in the 2016 Comprehensive Plan Update: (1) restore and conserve habitat; (2) restore water quality; (3) replenish and protect living coastal and marine resources; (4) enhance community resilience; and (5) restore and revitalize the GOM economy (Gulf Coast Ecosystem Restoration Council 2020).

National Fish and Wildlife Foundation: Gulf Environmental Benefit Fund

In early 2013, a U.S. District Court approved two plea agreements resolving certain criminal cases against BP and Transocean, cases which arose from the 2010 *Deepwater Horizon* explosion, oil spill, and response. The agreements direct a total of $2.544 billion to the National Fish and Wildlife Foundation's Gulf Environmental Benefit Fund to fund projects benefiting the natural resources of the Gulf Coast that were impacted by the spill. Funding priorities include projects that

- restore and maintain the ecological functions of landscape-scale coastal habitats, including barrier islands, beaches, and coastal marshes, and ensure their viability and resilience against existing and future threats, such as sea-level rise;
- restore and maintain the ecological integrity of priority coastal bays and estuaries; and
- replenish and protect living resources including oysters, red snapper and other reef fish, Gulf Coast bird populations, sea turtles, and marine mammals.

To date, the Gulf Environmental Benefit Fund has supported 169 projects worth more than $1.4 billion. These projects leverage or compliment other conservation investments worth more than $675 million, creating a total impact of nearly $2.1 billion (National Fish and Wildlife Foundation 2020).

B.5.2.2.6 Tourism Infrastructure

Tourism infrastructure enables humans to spend time away from home in pursuit of recreation, leisure, and other endeavors. Counties and parishes along the Gulf of Mexico are home to various resources and infrastructure that support recreation and tourism. Publicly owned and administered areas (such as national seashores, parks, beaches, and wildlife lands), as well as specially designated preservation areas (such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, and scenic rivers), attract residents and visitors throughout the year. Each of these sites has varying amounts and types of accompanying infrastructure that range from service roads and boat ramps to visitor centers and maintained trails or walking paths. Commercial and private recreational facilities and establishments (such as resorts, casinos, marinas, golf courses, amusement parks, hotels, restaurants, and ornamental gardens) also serve as primary interest areas and support services for people who seek enjoyment from the recreational resources near the Gulf of Mexico. There are many Gulf Coast tourism infrastructure projects resulting from the 2010 *Deepwater Horizon* oil spill. According to the (Deepwater Horizon Project Tracker 2020), as of April 20, 2022, there are 105 recreational use projects with over $428 million in funding, which include infrastructure projects ranging from trail and boat ramp improvements to new boardwalk construction. The recreation and tourism industries are sizable in many areas along the Gulf Coast and make up a significant portion of local coastal economies.

Coastal land use/modification stemming from tourism infrastructure include coastal environment destruction, fragmentation, and degradation. For instance, habitat alteration or loss can occur from the construction of coastal infrastructure and resulting land use changes (Michel 2013). In addition, an increase in associated nonpoint-source pollution, such as runoff, can impair habitat and water quality (Michel 2013). Coastal developments can also change coastal hydrology and sediment transport (Michel 2013). For example, associated runoff can cause an increase in nutrient fluxes (Michel 2013). Further, the natural path of sediment transport can be obstructed (Michel 2013). For more information on potential offshore habitat modification/space-use associated with recreation including tourism, refer to **Section B.7.2**.

B.6 Lighting and Visual Impacts

This IPF broadly addresses the extent to which activities (both wind energy leasing, site characterization, and site assessment-related and other factors) produce infrastructure presence and light emissions that (1) create annoyance or interfere with activities; (2) contrast with, or detract from, the visual resources and/or the visual character of the existing environment; or (3) provide safety and security by illuminating dark areas. Visual effects can be difficult to define and assess because they involve subjectivity. The aesthetic qualities of visible industrialized infrastructure are subjective but are generally regarded as negative, particularly in landscape/seascape settings such as national parks or national marine sanctuaries, where the purpose of designation is often associated with an area's defining natural features. Lighting of areas such as fishing piers or parks for safety or enjoyment during the nighttime hours, however, can provide positive experiences to some user groups.

B.6.1 OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

The placement or removal of infrastructure, both offshore and onshore, could alter the existing landscapes and seascapes. Depending on the location of offshore blocks leased and whether or not those blocks are successfully surveyed and developed, nearby coastal areas could experience the introduction of new infrastructure and increased activity both offshore and onshore that could alter the visual aesthetics of the existing coastal landscapes and seascapes. Many of these potential impacts arise from new activities visible during the day, but there are also potential impacts that could arise from the lighting used on meteorological buoys, service vessels, and coastal infrastructure, including night sky disturbances for visitors at parks. It is important to note, however, that the GOM has an extensive history of oil and gas development. Since the first offshore drilling began in 1942, over 6,000 oil and gas structures have been installed in the Gulf of Mexico, making lighting and visible infrastructure presence from past and ongoing OCS oil- and gas-related activities a well-known aspect of coastal viewsheds along the WPA and CPA for decades.

Using general guidelines for estimating distance to horizon based on the natural curvature of the Earth, a 60-ft (18-m) tall structure greater than 12 mi (19 km) from shore would likely not be visible to a person at sea level on the shoreline (NOAA 2020a). Federal OCS waters are 9 nmi (10.35 mi; 16.66 km) from the Texas and Florida shores and 3 nmi (3.45 mi; 5.6 km) from the Louisiana, Mississippi, and Alabama shores. Survey vessels and meteorological buoys characterized by a lower height (30-40 ft [9-12 m] for a buoy) would drop below the horizon at a closer distance than other offshore infrastructure.

In addition to offshore lighting, coastal support infrastructure is also illuminated. Coastal infrastructure lighting may be specifically designed to emit horizontal or vertical light. Horizontal and near-horizontal light emittance increases the visibility of light sources from a distance and significantly increases the illuminated area, but it can also cause the encroachment of light into adjacent unlit areas. Light emitted horizontally or near horizontally produces more sky glow than that emitted upward and much more than light emitted downward (Gaston et al. 2012). A number of factors can affect light transmission, both in air and water. In air, the transmission of light can be affected by atmospheric moisture levels, cloud cover, and the type and orientation of lights. In water, turbidity levels and waves, as well as the type of light, can affect transmission distance and intensity.

B.6.2 Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

There are many stakeholders that use the ocean environment in addition to those conducting OCS wind energy leasing, site characterization, and site assessment activities, including the OCS Oil and Gas Program, tourism and recreation, commercial and recreational fishing, marine transportation, subsea cables, military activities, deepwater ports, OCS sand borrowing, and ocean dumping (**Section B.7.2**). Each of these uses has the potential to alter or disrupt the existing visual and aesthetic environment. For example, the Gulf Coast region contains some of the world's busiest ports, with shipping fairways that funnel thousands of cargo vessels, cruise ships, and other non-OCS wind energy leasing, site characterization, and site assessment-related vessels annually (**Section B.7.2.2.3**). Spills, marine debris (e.g., derelict fishing gear), structure presence, and light emissions from these activities could have similar visual impacts as those from wind energy leasing, site characterization, and site assessment-related sources. Some lighting may provide user groups safety and security in the dark. For example, lighting in parks and on fishing piers provides user groups a safe environment for recreation at night.

The OCS oil- and gas-related structures in the GOM are illuminated from incandescent lights and from the glow of burning or flaring natural gas that cannot be stored or transported to shore. The USCG regulates workplace health and safety and maritime safety items, including lights illuminating working environments and navigational warning lights, on OCS platforms according to 33 CFR § 143.15. To assist in nighttime operations and aid navigation, manned platforms are generally well illuminated by exterior floodlights. All vessels operating between dusk and dawn are required to have navigation lights turned on as well. Platforms generally have two varieties of floodlights: high-pressure sodium or mercury vapor. High-pressure sodium lights emit yellow-orange light, whereas mercury vapor lights emit a perceptually blue-white light. Some initiative has been taken to move toward downward facing lighting and green light. Although there are differences between platforms, floodlights located between 20 and 40 m (66 and 132 ft) above the water surface illuminate the structure and the surrounding water to a depth of at least 100-200 m (328-656 ft) and can often be observed several miles away from the platform (Keenan et al. 2007). Unmanned structures usually have minimal aid-to-navigation lights.

B.7 OFFSHORE HABITAT MODIFICATION/SPACE USE

Habitats and other specific areas of the OCS offer environmental, recreational, economic, historical, cultural, and/or social values in the same geographic area. Modification and/or use of these areas can be divided based on which space or habitat is being used, i.e., the space above the water or the airspace, water column, and seafloor.

B.7.1 OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

Wind energy leasing on the OCS results in operations that occupy OCS space for dedicated uses both temporary and long term. Likewise, the placement or removal of infrastructure can create long-term alterations to the existing land- and seascapes (i.e., the physical habitat) including seabed, water column, and/or sea surface habitats.

Renewable energy development uses coastal regions, airspace, sea surface, water column, and seafloor space. The majority of interest in U.S. offshore renewable energy development has occurred on the Atlantic OCS, and BOEM is preparing for potential renewable energy operations in the Gulf of Mexico. In preparation, BOEM's Gulf of Mexico Regional Office funded two renewable energy studies to analyze which types of renewable energy technologies are feasible in the GOM and what types of economic impacts could be expected (Musial et al. 2020a; Musial et al. 2020b). In *Offshore Renewable Energy Technologies in the Gulf of Mexico*, BOEM analyzed different offshore renewable energy technologies to determine which are best suited for development in the GOM (Musial et al. 2020b). The renewable energy resources evaluated included wind, wave, tidal, current, solar, deepwater source cooling, and hydrogen. Offshore wind showed the greatest resource potential when applied to the GOM and is the most mature technology of those analyzed for the region. Once offshore wind was identified as the leading technology for GOM application, BOEM and the National Renewable Energy Laboratory further analyzed the economic feasibility of offshore wind for selected sites in the Gulf of Mexico. In the *Offshore Wind in the U.S. Gulf of Mexico: Regional Economic Modeling & Site-Specific Analyses* (Musial et al. 2020a), site-specific economic analysis indicated that a single offshore wind project could support approximately 4,470 jobs and $445 million in gross domestic product during construction and an ongoing 150 jobs and $14 million annually from operation and maintenance labor, materials, and services. Results are based on a 600-megawatt project at a reference site with a commercial operation date of 2030. The results of these studies will inform Federal, State, and local strategic renewable energy planning over the next decade.

As renewable energy planning moves forward in the GOM, the identification of future leasing areas could cause certain areas of the OCS to be unavailable for other uses and must be taken into account when planning for multiple uses of the Gulf of Mexico.

As described in **Section A.2** (Overview of the Renewable Energy Development Process) of **Appendix A**, determining the actual area needed for renewable energy production offshore is difficult to predict in the early planning stages. Each renewable energy project is custom engineered for the specific purpose of the project. Therefore, the area required, and subsequently unavailable for other uses, would vary depending on the needs of the project and energy goals of the involved state(s). Once renewable energy development interest is established, BOEM would engage with Federal-State Intergovernmental Task Forces to address stakeholder issues and public input to determine appropriate sizes for renewable energy areas. Space use between renewable and other uses (e.g., conventional energy development, shipping and navigation, and military) will be an important issue moving forward.

B.7.1.1 Sea Surface and Airspace

The sea surface and airspace consideration includes any activity that would occur skywards of the sea surface. Routine wind energy leasing, site characterization, and site assessment-related activities that could contribute to airspace conflicts or modification include the physical presence of a meteorological buoy(s) that extends above the water surface. A summary of meteorological buoys can be found in **Section A.3.2.2** of **Appendix A**. Service-vessel and helicopter traffic in support of OCS wind energy leasing, site characterization, and site assessment-related activities would also occupy space above the water surface. For more information on helicopters and service-vessel traffic, refer to **Section B.9.2**.

B.7.1.2 Water Column

The water column consideration includes any activity that would occur between the sea surface and the seafloor for a prolonged period of time. Routine wind energy leasing, site characterization, and site assessment-related activities that can contribute to water column space use or modification include tethers used to anchor a meteorological buoy(s) to the seafloor.

B.7.2 Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

There are many stakeholders that use the ocean environment. Some of these stakeholders' needs for space to carry out their activities overlap. In addition to the OCS oil- and gas-related activities, other activities on the Gulf of Mexico OCS include tourism and recreation, commercial and recreational fishing, marine transportation, subsea cables, the military, deepwater ports, OCS sand borrowing, coastal restoration, aquaculture, and ocean dumping. Each of these uses for the Gulf of Mexico OCS requires some amount of space to operate and must be taken into account when planning to hold oil and gas lease sales that would potentially make areas of the Gulf of Mexico OCS unavailable for other uses (**Table B.7.2-1**). This section describes the space-use needs for those other uses for the Gulf of Mexico OCS.

Table B.7.2-1. Areas of Marine Space Use by Industries Other Than Wind Energy.

Industry	Coastal	Sea Surface/ Airspace	Water Column	Seafloor
OCS Oil and Gas	X	X	X	X
Recreation	X	X	X	X
Commercial and Recreational Fishing	X	X	X	X
Ports, Navigation Lanes, and Shipping	X	X	X	
Undersea Cables		X		X
Military	X	X	X	X
Deepwater Ports		X	X	X
OCS Sand Borrowing		X		X
Coastal Restoration	X			X
Ocean Dumping				X
Aquaculture		X	X	X

The Multipurpose Marine Cadastre, a web-based tool developed by BOEM, NOAA's Coastal Services Center, and other partners, was used for identifying uses of the Gulf of Mexico. The Multipurpose Marine Cadastre is an integrated marine information system that provides legal, physical, ecological, and cultural information in a common geographic information system (GIS) framework. This tool is used by Federal regulatory agencies and others who are screening renewable energy sites and other offshore activities, as well as people working on regional and State marine planning efforts. At its core, this data viewer contains the official U.S. marine cadastre, and it is the only place where users can see all of the official U.S. boundaries on one map. Similar to the Nation's land-based parcel system, a marine cadastre describes the spatial extent, rights, restrictions, and responsibilities of U.S. waters. All data come from the appropriate authoritative source; these organizations are responsible for data upkeep. In addition, data from BOEM's Marine Minerals Information System (a separate online, GIS-based data portal for offshore mineral resources), BOEM, and the Naval Facilities Engineering Command were used for the discussions of other uses within the Area of Interest.

B.7.2.1 OCS Oil- and Gas-Related Activities

The OCS oil- and gas-related activities that can potentially create, remove, modify, or occupy space or habitat(s) include G&G surveys, bottom surveys, and the installation of surface or subsurface bottom-founded production structures with anchor cables and safety zones. These activities can create potential space-use conflicts with other OCS uses, but these activities can also have positive or negative effects to biological communities that rely on the presence or absence of these habitats (e.g., fish and invertebrates, birds, marine mammals, and sea turtles).

Routine OCS oil- and gas-related activities that can contribute to both airspace and water-column space use or modification include the physical presence of a platform or other production structure that extends above and below the water surface, tethers used to anchor platforms and other structures to the seafloor, and pipes and risers. Routine OCS oil- and gas-related activities that can contribute to seafloor habitat modification and/or space-use conflicts include emplacement or removal of pipelines, infrastructure footprints including anchors and tethers, and subsea systems. Geologic coring and G&G surveys that deploy bottom nodes can also alter the seafloor or create space-use conflicts. In addition, wells could conflict with any other mining operation interested in other resources below the seafloor (i.e., sand, sulfur, etc).

The G&G surveys can occur in both shallow and deepwater areas. Usually, fishermen are precluded from a very small area for several days during active G&G surveying. Exploratory drilling rigs spend approximately 40-150 days onsite and are a short-term interference to commercial fishing. A major bottom-founded production platform in water depths less than 450 m (1,476 ft), with a surrounding 100-m (328-ft) navigational safety zone, requires approximately 6 ha (15 ac) of space. A bunkhouse structure needs about 4 ha (9 ac), and a satellite structure needs about 1.5 ha (3.7 ac) of space.

In water depths greater than 450 m (1,476 ft), production platforms would be compliant towers, floating production structures (such as tension-leg platforms and spars), and FPSOs. Even though production structures in deeper water are larger and individually would take up more space, there would be fewer of them compared with the great numbers of bottom-founded platforms in shallower water depths. Factoring in various configurations of navigational safety zones, deepwater facilities may require up to a 500-m (1,640-ft) radius safety zone or 78 ha (193 ac) of space per 33 CFR § 147.15. Production structures in all water depths have a life expectancy of 20-30 years.

B.7.2.2 Non-OCS Oil- and Gas-Related Activities

B.7.2.2.1 Recreation

Recreational activities occur in coastal areas, at the sea surface, throughout the water column, and at the seafloor. People are attracted to the Gulf Coast by a diverse range of marine and coastal habitats, including sandy beaches and barrier islands, estuarine bays and sounds, inland waterbodies, maritime forests, and marshlands. Some of these recreational activities occur in large areas (i.e., beach going), but many occur in small, localized areas (i.e., offshore diving). **Table B.7.2-2** shows the types of recreational activities by habitat type. **Table B.7.2-2** does not present every type of recreational activity but lists the main types of activities that occur in a given locale.

Table B.7.2-2. Types of Recreational Activities by Location in the Gulf of Mexico Program Area.

Location	Recreational Activities	Space Use
Offshore Waters (depths >30 m [98 ft])	Fishing Diving (very limited; e.g., Flower Garden Banks National Marine Sanctuary) Wildlife viewing (e.g., whale watching and pelagic birdwatching)	Sea surface Water column Seafloor
Nearshore Waters (depths <30 m [98 ft])	Fishing Boating Diving (artificial reefs and wrecks) Wildlife Viewing (e.g., whale watching and pelagic birdwatching)	Sea surface Water column Seafloor
Beaches	Swimming, snorkeling, surfing Sunbathing Fishing Boating Wildlife viewing Camping (e.g., State parks and national seashores)	Coastal Sea surface Water column Seafloor
Lagoons and Embayments	Swimming Fishing Boating Wildlife viewing Camping	Coastal Sea surface Water column Seafloor
Other Coastal Areas	Sightseeing Golf Bicycling Hiking Hunting	Coastal

The amount of space-use impact on the OCS by ocean-based tourism varies by activity and location. Some types of recreational activities, such as boating, fishing, and wildlife viewing, may occur over large areas of the OCS depending on the targeted species or vessel characteristics. Diving mostly occurs in small, localized locations on the OCS associated with some type of natural or modified habitat such as artificial bottom structure or wreckage. These known seafloor obstructions, including shipwrecks, are identified in NOAA's Automated Wreck and Obstruction Information System database. Shipwrecks are discussed in detail in **Section B.2.2.2.1**. Artificial reefs are a form of habitat modification resulting from various fabricated materials, natural rock, decommissioned oil and gas platforms, or vessels that can attract or aid the proliferation of live bottom communities.

Offshore Texas there are 91 artificial reefs covering greater than 4,000 ac (1,619 ha) (Texas Parks and Wildlife Department 2020a; 2020b). In Louisiana, there are 83 artificial reef sites in coastal and offshore waters covering more than 19,000 ac (7,689 ha) for reef habitat (Louisiana Department of Wildlife and Fisheries 2020). Mississippi has 90 artificial reef sites spread over the coastal and offshore zones encompassing more than 16,000 ac (6,475 ha) (Mississippi Department of Marine Resources 2019). The State of Alabama has one of the largest artificial reef programs in terms of area permitted in the United States with 14 permit areas covering 678,400 ac (274,579 ha) (Alabama Department of Conservation and Natural Resources 2020). Florida has over 2,500 individual reef sites in the Gulf of Mexico that are occur in waters along the entire Gulf Coast of Florida in waters ranging from 4 to 458 ft (1.2 to 139.6 m) in depth (Florida Fish and Wildlife Conservation Commission 2020). In addition, NOAA's Office of National Marine Sanctuaries serves as the trustee for a network of underwater parks on the United States OCS. At present on the Gulf Coast, there is one national marine sanctuary (Flower Garden Banks National Marine Sanctuary) that interacts with offshore oil and gas operations (**Figure B.7.2-1**). The Flower Garden Banks National Marine Sanctuary serves as a popular site for recreational diving in the Gulf of Mexico. This sanctuary is made up of three separate areas: Stetson Bank; West Flower Garden Bank; and East Flower Garden Bank. Together, these areas represent about 56 mi^2 (145 km^2) of protected marine habitat . At present, there is an effort to expand the sanctuary to include 15 additional banks, expanding the sanctuary to approximately 160 mi^2 (414 km^2) (NOAA 2018a; 2020c). Despite the numerous opportunities for recreational use of artificial reefs or the national marine sanctuary, the tourism activities occurring at seafloor obstructions represent only a small and temporary use of the OCS and most commonly occur in nearshore waters, beaches, lagoons, and embayments.

Shore-based tourism activities also represent a significant use of coastal space. The Gulf of Mexico coastal region contains numerous national wildlife refuges, national parks, and national seashores, as well as many State parks and recreational areas where the public engages in various recreational activities (i.e., sunbathing, swimming, and camping; **Figure B.7.2-1**). For example, on the Gulf Coast, there are 13 coastal national wildlife refuges over 20,000 ac (8,094 ha) and 26 under 20,000 ac (8,094 ha) (FWS 2020), 5 national parks covering about 2,568 shoreline miles and 549,159 marine acres, and 2 national seashores covering approximately 645 shoreline miles and 184,360 marine acres (NPS 2018). These public recreational areas represent thousands of acres or shoreline miles that would be unavailable to any future Gulf of Mexico OCS infrastructure needs.

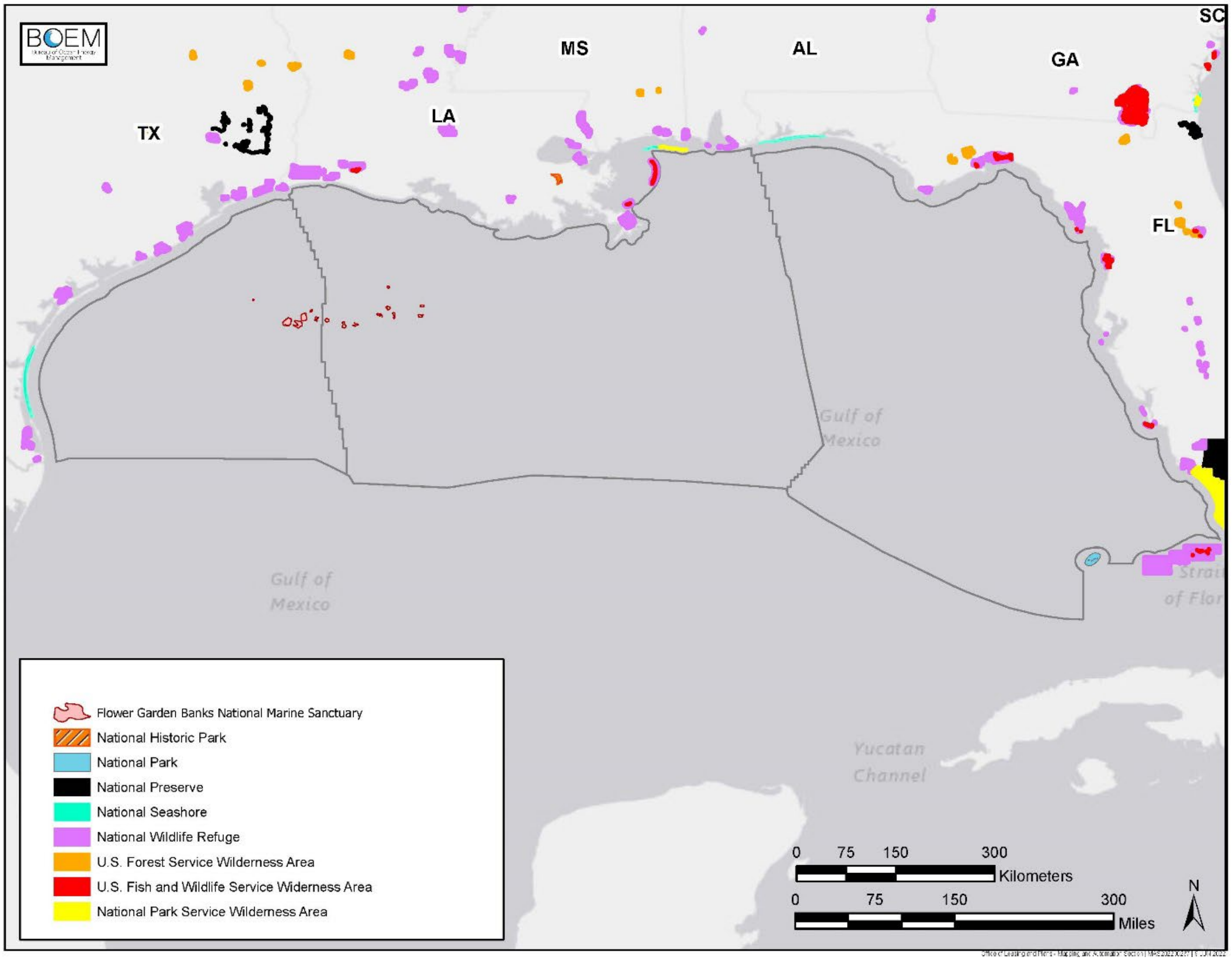

Figure B.7.2-1. Marine Sanctuaries, Coastal Wildlife Refuges, and National Seashores and Parks of the Gulf of Mexico.

B.7.2.2.2 Commercial and Recreational Fishing

Commercial and recreational fishing takes place in coastal and offshore areas, at the sea surface, throughout the water column, and at the seafloor. The U.S. Gulf Coast supports regionally and nationally important commercial fisheries as well as a socially and economically important recreational fishing industry. In 2018, the GOM commercial fishing industry represented approximately 26 percent of landings and 19 percent of value for the Nation, and the GOM has 3 of the top 10 ports for fishery landings in the Nation (NMFS 2020b). Recreational fisheries in the GOM had the highest percentage of trips in the Nation at 28 percent and 37 percent of catch in 2018 (NMFS 2020c). Both of these valuable industries represent significant uses of the OCS and must be considered in future OCS planning.

In areas of dense fishing effort, or where gear is spread over a large area, commercial fishing has the potential to cause semi-permanent, standoff-distance conflicts on the OCS. Marine standoff-distance conflicts are already an issue between many competing fisheries in some portions of the OCS (e.g., pelagic longline fisheries and deepwater crab fisheries). On a space-use basis, commercial fishing can occur anywhere in favored areas where it is not temporarily or permanently excluded (i.e., in areas where it is not prohibited and where there are no surface or bottom obstructions).

Most recreational fishing in the GOM planning areas takes place within State waters. Approximately 95 percent of the total GOM recreational catch came on saltwater trips that fished primarily in the State territorial seas and about 51 percent came on trips that fished primarily in inland waters (NMFS 2020c). However, for those few trips that do take place on the Federal OCS, they represent a short-term and localized use of the OCS.

B.7.2.2.3 Ports, Navigation Lanes, and Shipping

Ports, navigation lanes, and shipping use space on the coast, the sea surface, and to some degree the water column. Maritime shipping is one of the most important industries on the Gulf Coast. As such, there is a large existing infrastructure presence in the GOM to support the industry, including ports and navigation lanes. The USACE annually designates the top 150 ports in the country in terms of tonnage as principal ports. In 2017, the GOM coastal region was home to 25 principal ports (**Figure B.7.2-2**). At that time, these principal ports handled 1,256,697,800 tons of cargo for the Nation (USACE 2017). In order to service these ports, several navigation lanes, fairways, and zones have been designated in the Gulf of Mexico. The USCG determines the fairways to keep ships and the ocean's inhabitants out of harm's way. Different types of lanes and zones exist for straight traveling, turning, and avoiding collisions. Staying within these routing measures often means steering clear of endangered species, wrecks, coral reefs, and other areas (NOAA 2015c; 2019). Because these areas are designated for safety, they are areas off limits for installing fixed structures. Many of these areas extend out onto the OCS, some beyond 100 nmi (115 mi; 185 km) offshore (**Figure B.7.2-2**). The maritime shipping industry represents a major use of GOM coastal space both for onshore infrastructure needs such as port facilities and for offshore needs such as safe navigation.

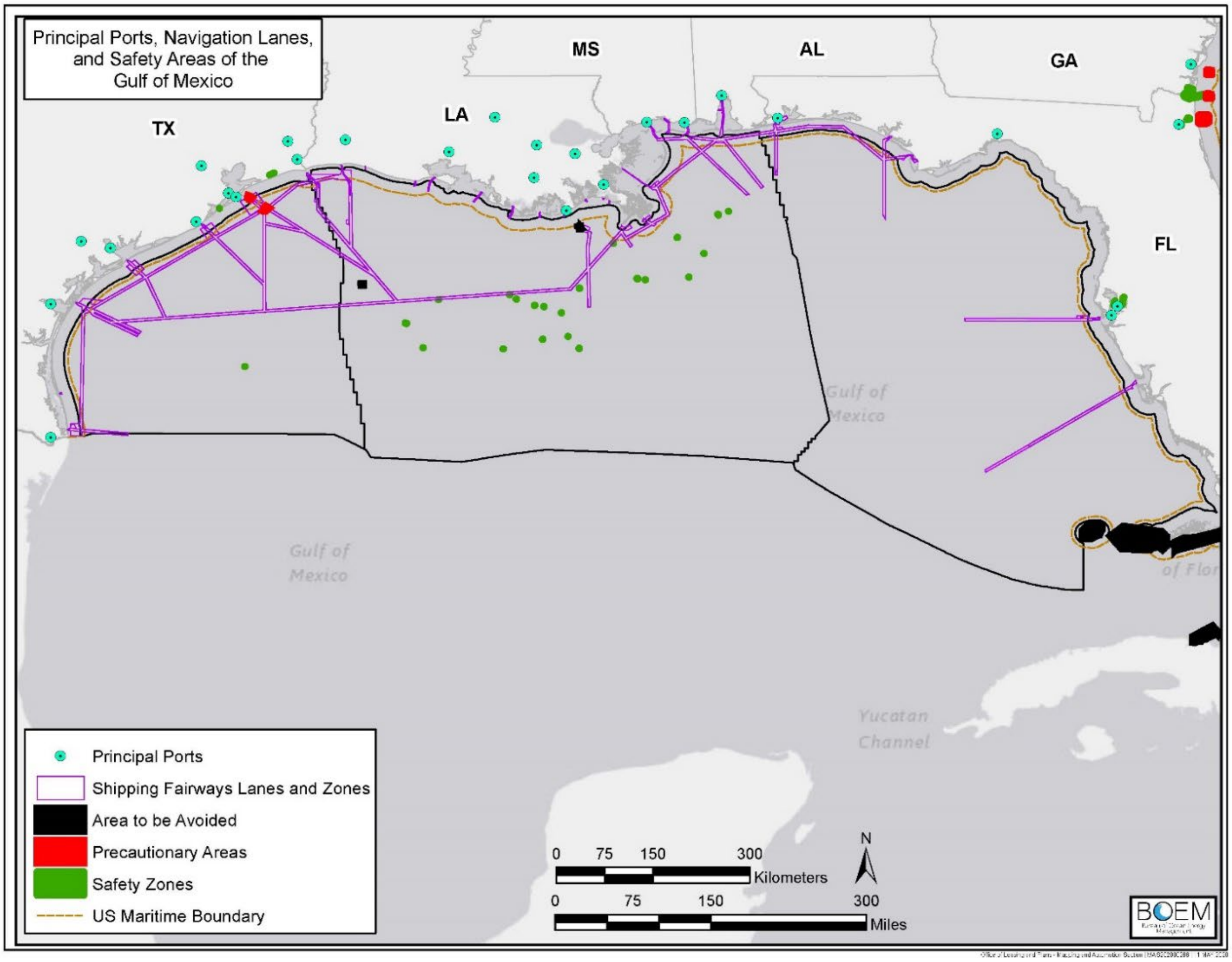

Figure B.7.2-2. Principal Ports, Navigation Lanes, and Safety Areas of the Gulf of Mexico.

B.7.2.2.4 Undersea Cables

Undersea cables use space at the sea surface during laying and the seafloor while in use. The GOM contains undersea cable infrastructure mostly related to the offshore oil and gas industry. The NOAA has identified two large cable networks that utilize the Federal OCS in the Gulf of Mexico (NOAA 2018b). The larger, Gulf of Mexico Fiber Optic Network, is primarily used by the oil and gas industry, and it is reasonably foreseeable that other users like telecommunication companies or the military might utilize these networks as well (BP America 2020). There is also a single telecommunications submarine cable the crosses part of the EPA. The AURORA cable system connects the U.S. (Sarasota, Florida) with Central (Mexico, Guatemala, and Panama) and South America (Colombia and Ecuador) (Fiber Prime Telecommunications 2020). While there is currently no activity in the GOM, the renewable energy industry relies on submarine cables to transmit generated electricity back to shore. These cables are critical infrastructure for telecommunications or power transmission and represent an important use of the OCS.

The space-use requirements for undersea cables are dependent on the requirements for the specific project and are typically determined on a case-by-case basis. However, several guidelines exist that inform separation distances between cables and burial depths. The International Cable Protection Committee recommends that undersea cables in shallow waters be spaced 500 m (1,640 ft) from each other; in deeper waters, the cables should be spaced at the lesser of three times the depth of the water column or 9 km (6 mi) (International Cable Protection Committee, 2015). BOEM's requirements for renewable energy export cables are that the cable be placed in a 200-ft (61-m) wide corridor from the center of the cable per 30 CFR § 585.301. In addition to seafloor areal extent needs, undersea cables have sea surface needs for cable laying and maintenance operations. The vessels required are large and need space in which to maneuver during the often complex processes of cable laying and burial, or repair work. These issues are further compounded during times of inclement weather (Counsel for the North American Submarine Cable Association 2012). Because the space-use requirements may be large and depend on project specifics, coordination with other OCS users and operators is essential.

B.7.2.2.5 Military Space Use of the Gulf of Mexico OCS

The U.S. military uses coastal regional space, airspace, the sea surface, the water column, and the seafloor. The DOD conducts training, testing, and operations in offshore operating areas (OPAREAs), MWAs, at warfare training ranges, and in special use or restricted airspace on the OCS. Some of the most extensive offshore areas used by DOD include U.S. Navy at-sea training areas. Training and testing occurs throughout U.S. Gulf of Mexico OCS waters but is concentrated in OPAREAs and testing ranges (**Figure B.7.2-3**). The Gulf of Mexico Range Complex contains four separate OPAREAs: Panama City and Pensacola, Florida; New Orleans, Louisiana; and Corpus Christi, Texas. The OPAREAs within the Gulf of Mexico Range Complex are not contiguous but are scattered throughout the GOM. The Gulf of Mexico Range Complex includes special-use airspace with associated warning areas and restricted airspace, and surface and subsurface sea space of the four OPAREAs. The air space over the GOM is used by the DOD for conducting various military operations such as air combat training using Air Combat Maneuvering Instrumentation Systems. The Gulf of Mexico air combat maneuvering range is a virtual combat zone, tracking dozens of aircraft in realistic, high-intensity training exercises. The latest systems include the capability to monitor and score air-to-air and air-to-ground weapons deliveries, as well as include ground-based threat systems and simulators (Panarisi 2001). Military operations within MWAs and water test areas (e.g., EWTAs) vary in types of missions performed and their frequency of use. Twelve MWAs and six EWTAs are located within the GOM. Missions may include carrier maneuvers, missile testing, rocket firing, pilot training, air-to-air gunnery, air-to-surface gunnery, minesweeping operations, submarine operations, air combat maneuvers, aerobatic training, and instrument training. These activities are critical to military readiness and national security.

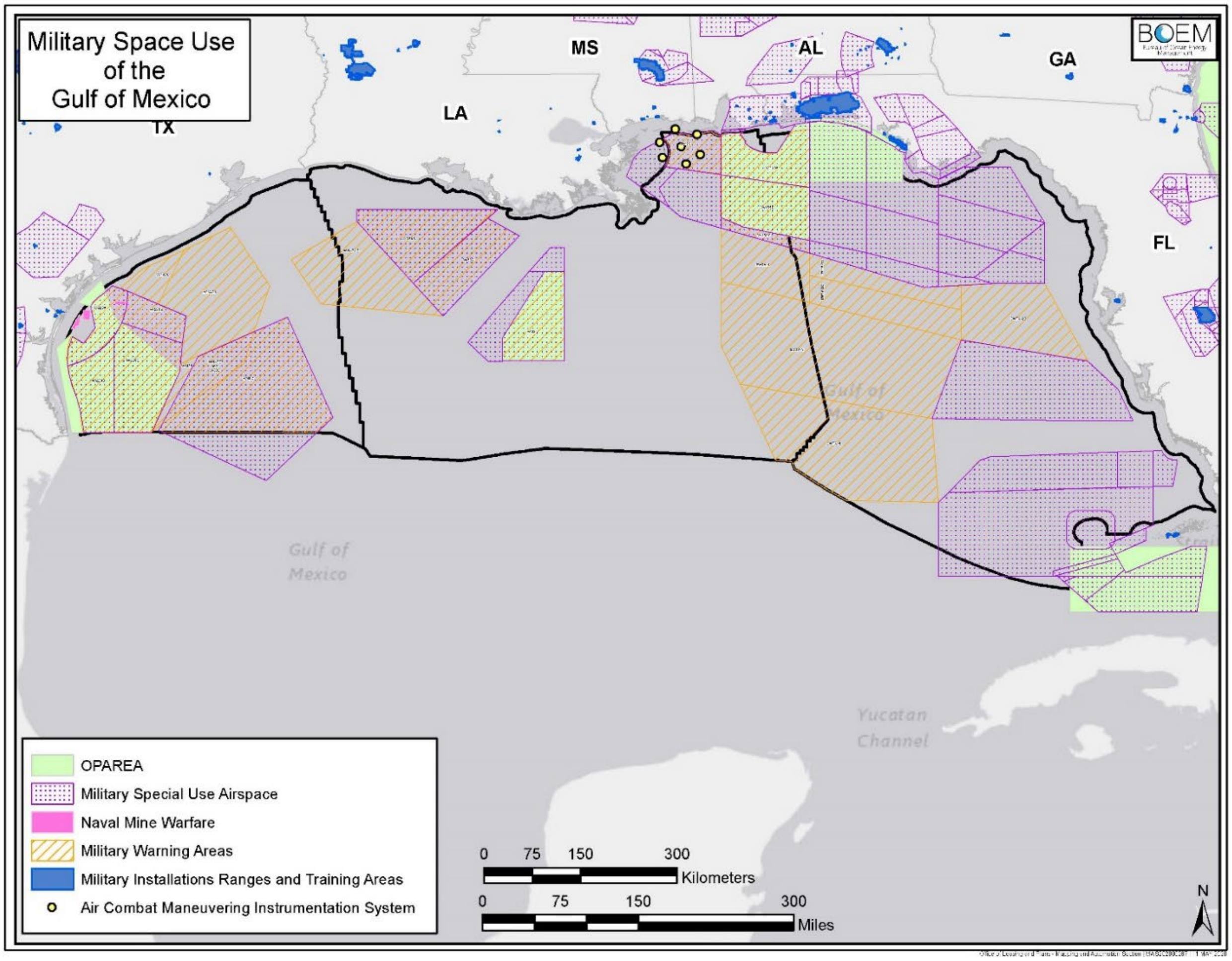

Figure B.7.2-3. Military Space Use of the Gulf of Mexico.

The OPAREAs, MWAs, and EWTAs are multiple-use areas where military operations and oil and gas development have coexisted without conflict for many years. Several military stipulations may be applied for OCS leases issued within identified military areas. To eliminate potential impacts from multiple-use conflicts on the aforementioned area and on blocks that the Navy has identified as needed for testing equipment and for training mine warfare personnel, a Military Areas Stipulation has routinely been applied to all GOM leases. In addition, BOEM's Gulf of Mexico Regional Office issued BOEM NTL No. 2014-G04, which provides links to the addresses and telephone numbers of the individual command headquarters for the military warning and water test areas in the GOM. The Bureau of Ocean Energy Management's NTLs can be found on BOEM's website at https://www.boem.gov/guidance. The DOD and U.S. Department of the Interior will continue to coordinate extensively under the 1983 Memorandum of Agreement, which states that the two parties shall reach mutually acceptable solutions when the requirements for mineral exploration and development, and defense-related activities conflict.

B.7.2.2.6 Deepwater Ports

Deepwater ports use space at the sea surface, in the water column, and at the seafloor. These ports are installations on the OCS that service the importing and exporting of hydrocarbon products like LNG and crude oil. The LNG is a form of natural gas that is used mainly for transport to markets, where the liquid is regasified and distributed via pipeline networks. Deepwater ports are under the jurisdiction of the USCG and U.S. Department of Transportation's Maritime Administration (MARAD). There is one licensed, operational deepwater port in the Gulf of Mexico (**Figure B.7.2-4**). The Louisiana Offshore Oil Port (LOOP) is located about 18 nmi (21 mi; 33 km) off the coast of Louisiana in about 115 ft (35 m) of water (LADOTD 2020; LOOP LLC 2020). The major fixed components of the LOOP deepwater port are the unloading buoy system, three single-point moorings consisting of wire rope and chain connecting to anchor points on the seabed, a control platform and a pumping platform, approximately 1.5 mi (2.4 km) of 56-in (142-cm) diameter pipeline to bring crude to the pumping platform, and approximately 18 nmi (21 mi; 33 km) of 48-in (122-cm) pipeline to connect to LOOP's onshore infrastructure (LADOTD 2020). While there is currently only the LOOP in the Gulf of Mexico, several additional deepwater ports have been proposed and are in the licensing and permitting process. Four oil export facilities and one gas export facility have pending license applications with MARAD, and one LNG project has been approved and is pending license issuance. These projects are proposed to be built off the coasts of Texas and Louisiana from 10.5 to 40.8 nmi (12.1 to 47.0 mi; 19.4 to 75.6 km) in water depths from 57 to 115 ft (17.4 to 35 m) (*Federal Register* 2016; MARAD 2020a; 2020b).

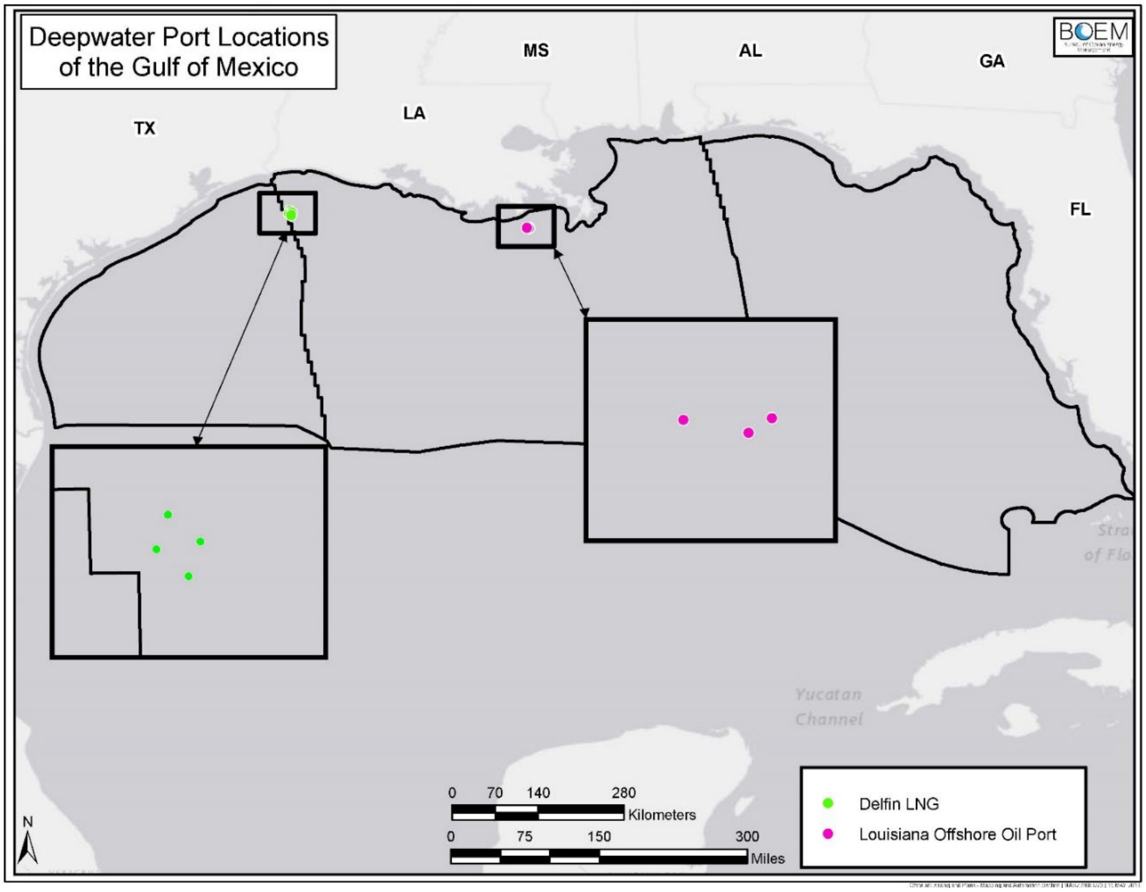

Figure B.7.2-4. Deepwater Port Locations of the Gulf of Mexico.

B.7.2.2.7 OCS Sand Borrowing and Coastal Restoration

Sand borrowing and coastal restoration uses space in coastal regions from the sea surface to the seafloor. Loss of sand from the Nation's beaches, dunes, and barrier islands is a serious problem that affects the coastal environment, storm damage, and the economy. Sand, gravel, and other mineral resources from the OCS are often used in beach nourishment, wetlands restoration, and other coastal restoration projects to address erosion issues. BOEM has conveyed rights to millions of cubic yards of OCS sand for coastal restoration projects along the Gulf Coast through leases (in the form of negotiated noncompetitive agreements for sand and gravel projects). W.F. Baird & Associates Ltd (2018) summarize a forecast of activities that could require OCS sand resources along the Gulf Coast through 2028.

BOEM recently launched the Marine Minerals Information System (MMIS), which is accessible at https://mmis.doi.gov/BOEMMMIS. Through the MMIS, users can find information about marine minerals lease areas, core sample information derived from multiple sources, and identified sand sources. The MMIS also provides citations for BOEM's environmental study reports and environmental assessments through the Environmental Studies Program (https://www.boem.gov/ESPIS/) or through the Marine Minerals Program in your State (https://www.boem.gov/MMP-in-Your-State/) and includes topics such as sea turtle behavior or habitat and fish use of shoal habitat in specific offshore areas. The MMIS is the result of coordination through our partnerships with other Federal agencies and State and local governments, particularly research conducted through our cooperative agreements with the States.

While drilling for oil and gas may not be prescribed in the 3- to 8-nmi (3- to 9-mi; 6- to 15-km) zone currently typical of OCS borrow areas, the pipelines that could bring these resources onshore could impact both known and unidentified sediment resources. Borrow areas are typically located in water depths of 30-60 ft (9-18 m) (not more than 120-ft [37-m] depth), in close proximity to the coast (within 3-12 nmi; 3-14 mi; 6-22 km), and cover less than 32 mi^2 (83 km^2) per lease. These projects have resulted in the restoration of hundreds of miles of the Nation's coastline, protecting billions of dollars of infrastructure, as well as protecting, creating, and enhancing important ecological habitat.

BOEM published a “Final Environmental Assessment and Finding of No Significant Impacts for Sand Survey Activities” in support of BOEM’s Marine Minerals Program (BOEM 2019), concluding that potential effects from sand-related surveys are expected to be negligible to minor, localized, and short lived. The EA identifies mitigation, monitoring, and reporting requirements necessary to avoid, minimize, and/or reduce and track any adverse impacts that could result from sand survey activities. Any future connected actions, such as dredging, conveyance, and placement of OCS sand resources would be considered separately in subsequent environmental reviews.

BOEM/USACE Memorandum of Understanding

BOEM and the USACE often work together on projects involving the use of OCS sand. In order to solidify this collaborative relationship, BOEM and the USACE signed a Memorandum of Understanding on February 24, 2017, to coordinate on the use of sand, gravel, and shell resources from the OCS. The Memorandum of Understanding establishes a framework for early and sustained coordination and cooperation between BOEM and the USACE. Items covered in the Memorandum of Understanding include consistency in environmental compliance, project scheduling, and negotiated agreement requirements for all projects proposing to use OCS sand, gravel, and shell resources, for which there has been a growing demand.

In order to anticipate and coordinate future OCS sand needs, BOEM participates in many marine planning bodies. BOEM facilitates regional Sand Management Working Group meetings in order to provide a forum for the exchange of information between BOEM and other agencies and local stakeholders in the region. These meetings are intended to foster communication and collaboration, understand stakeholder interests, communicate current projects and research efforts, deconflict multi-use areas, and understand local priorities. BOEM’s Marine Minerals Program participates on the Federal Communications Commission Interagency Submarine Cable Coordination meetings to monitor the location of proposed submarine cables as they traverse the sea bottom and have the potential to cross sediment resources. BOEM solicits and directs field work and studies designed to identify and characterize sediment resources on the OCS through cooperative agreements with our partners at State and local governments, universities, or private contractors, such as the

BOEM-funded study by Baird (2018) that forecasted potential future use of OCS sediment through 2028, a 10-year horizon.

B.7.2.2.8 Ocean Dumping

Ocean dumping uses space at the seafloor. Prior to 1972, no complete records exist of the volumes and types of materials disposed in ocean waters in the United States. Some of the types of wastes disposed of in the oceans were chemical and industrial wastes, radioactive wastes, trash, munitions, sewage sludge, and contaminated dredged material. In October 1972, Congress enacted the Marine Protection, Research and Sanctuaries Act (MPRSA), sometimes referred to as the Ocean Dumping Act, declaring that it is the policy of the United States to regulate the dumping of all materials, which would adversely affect human health, welfare or amenities, or the marine environment, ecological systems or economic potentialities. The USEPA is responsible for issuing ocean dumping permits for materials other than dredged material. In the case of dredged material, the USACE is responsible for issuing ocean dumping permits using USEPA's environmental criteria. Permits for ocean dumping of dredged material are subject to USEPA review and written concurrence (USEPA 2020c). Designated ocean disposal sites for dredged materials are selected to minimize the risk of potentially adverse impacts of the disposed material on human health and the marine environment. The USEPA is responsible for designating and managing ocean dumping sites under the Marine Protection, Research and Sanctuaries Act. Ocean disposal of dredged material requires use of a USEPA-designated ODMDS to the greatest extent feasible (USEPA 2019b). As of March 2020, there were 31 active ocean-dredged material disposal sites in the GOM (USACE 2020c) (**Table B.7.2-3 and Figure B.7.2-5**).

Table B.7.2-3. Ocean Dredge-Material Disposal Sites (ODMDS) of the Gulf of Mexico.

ODMDS	USACE Region	Last Used	Cumulative Disposal	Disposal Events
Atchafalaya River, Bayous Chene, Boeuf, Black (East)	LA	2002	213,968,086	30
Atchafalaya River, Bayous Chene, Boeuf, Black (West)	LA	2017	111,195,977	21
Barataria Bay Waterway	LA	1988	3,480,353	5
Brazos Island Harbor	TX	2018	7,294,846	18
Brazos Island Harbor – 42-ft Project	TX	1992	575,100	1
Calcasieu Dredged Material Site 1	LA	2008	61,133,265	13
Calcasieu Dredged Material Site 2	LA	2018	114,872,477	33
Calcasieu Dredged Material Site 3	LA	2018	5,946,564	11
Corpus Christi New Work	TX	-	no disposal	-
Corpus Christi Ship Channel	TX	2017	8,883,176	14
Freeport Harbor – Maintenance 45-ft Project	TX	2018	57,603,306	39
Freeport Harbor – New Work 45-ft Project	TX	2015	6,015,690	4
Galveston	TX	2018	64,435,511	34
Gulfport – Eastern Site	MS	2005	13,717,677	9
Gulfport – Western Site	MS	2018	20,589,246	20
Matagorda Ship Channel	TX	2017	3,619,304	8

ODMDS	USACE Region	Last Used	Cumulative Disposal	Disposal Events
Mississippi River Southwest Pass	LA	2018	200,750,270	57
Mobile	AL	2018	133,286,271	95
Pascagoula	MS	2018	28,855,405	30
Pensacola – Nearshore Site	FL	1987	1,834,997	4
Pensacola – Offshore Site	FL	2014	4,938,817	4
Port Mansfield	TX	2002	590,524	4
Sabine-Neches – Material Site 1	TX	2017	16,222,341	15
Sabine-Neches – Material Site 2	TX	2018	20,454,959	15
Sabine-Neches – Material Site 3	TX	2018	24,044,782	17
Sabine-Neches – Material Site 4	TX	2018	57,373,415	25
Sabine-Neches – Material Site A	TX	-	no disposal	-
Sabine-Neches – Material Site B	TX	-	no disposal	-
Sabine-Neches – Material Site C	TX	-	no disposal	-
Sabine-Neches – Material Site D	TX	-	no disposal	-
Tampa	FL	1997	12,713,519	16

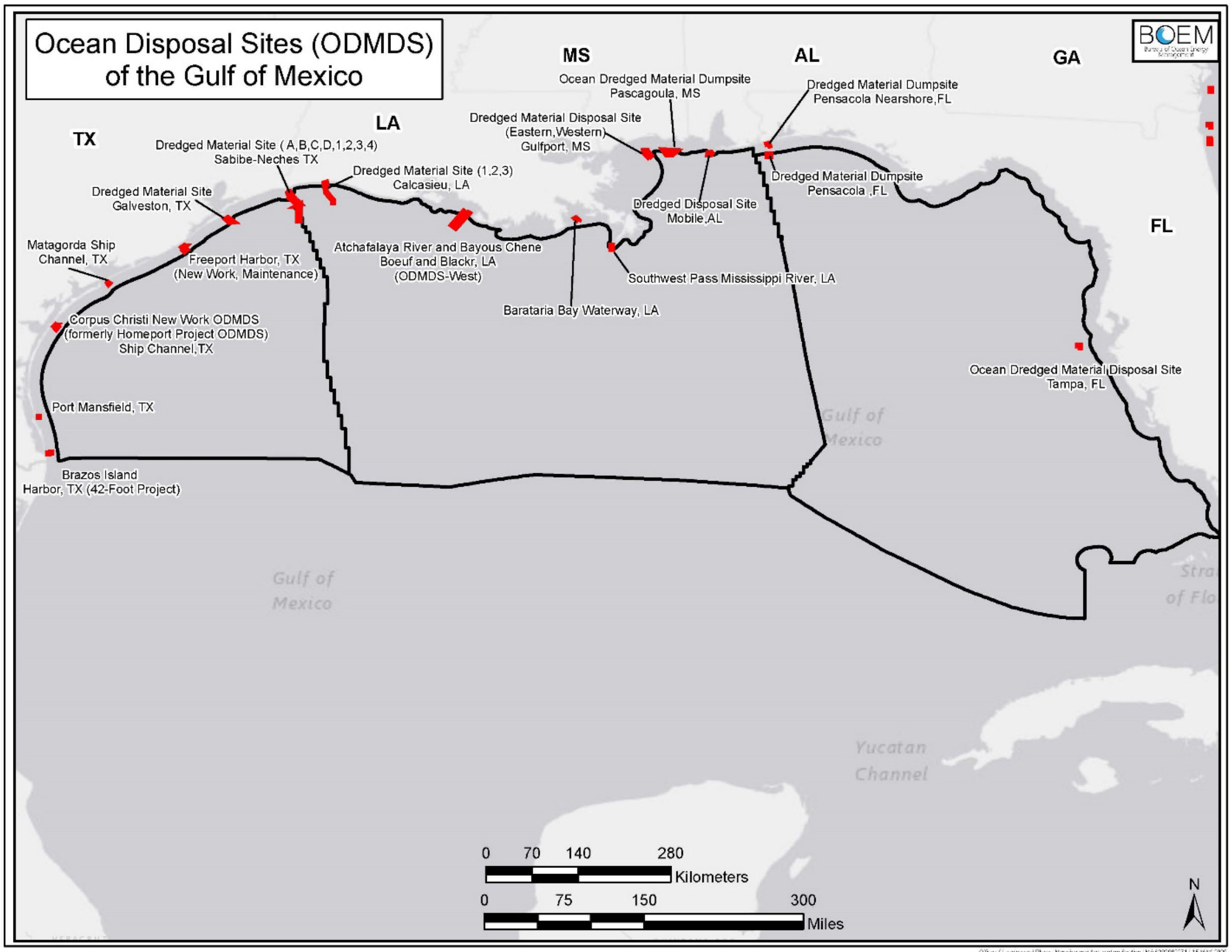

Figure B.7.2-5. Ocean Dredged-Material Disposal Sites (ODMDSs) of the Gulf of Mexico.

The USEPA Region 4 and the USACE Mobile and Jacksonville Districts classify ODMDSs that have not been used within 5 years and are not expected to be used within the next 5 years (e.g., Pensacola-Nearshore site) as “Inactive.” The Pensacola-Nearshore site, however, remains part of the ocean site list at 40 CFR § 228.15 and, therefore, can still technically be made available for disposal of dredged sediment should the “inactive” status be removed by the USEPA/USACE (Wilkens 2020, official communication). The frequency of use of active disposal sites and the amount of dredged material disposed will continue to fluctuate; however, the USACE must obtain USEPA concurrence and use the USEPA’s dumping criteria and sites to the extent practicable to minimize potential effects.

As previously described in **Section B.2.2.2.4**, from World War I through 1970, the U.S. Armed Forces disposed of weapons in ocean waters. Unfortunately, the precise locations of many of these dumping sites are unknown. Some sites have rough coordinates while others are only identified by the body of water or a distance offshore. Through a coordinated effort between the DOD and NOAA, seven dumping sites were identified in the Gulf of Mexico. Identified sites ranged from <1 nmi to 80 nmi (1 mi to 92 mi; 2 km to 148 km) from shore and in water depths of >30 ft to >5,500 ft (9 m to 1,676 m) (**Figure B.7.2-6**).

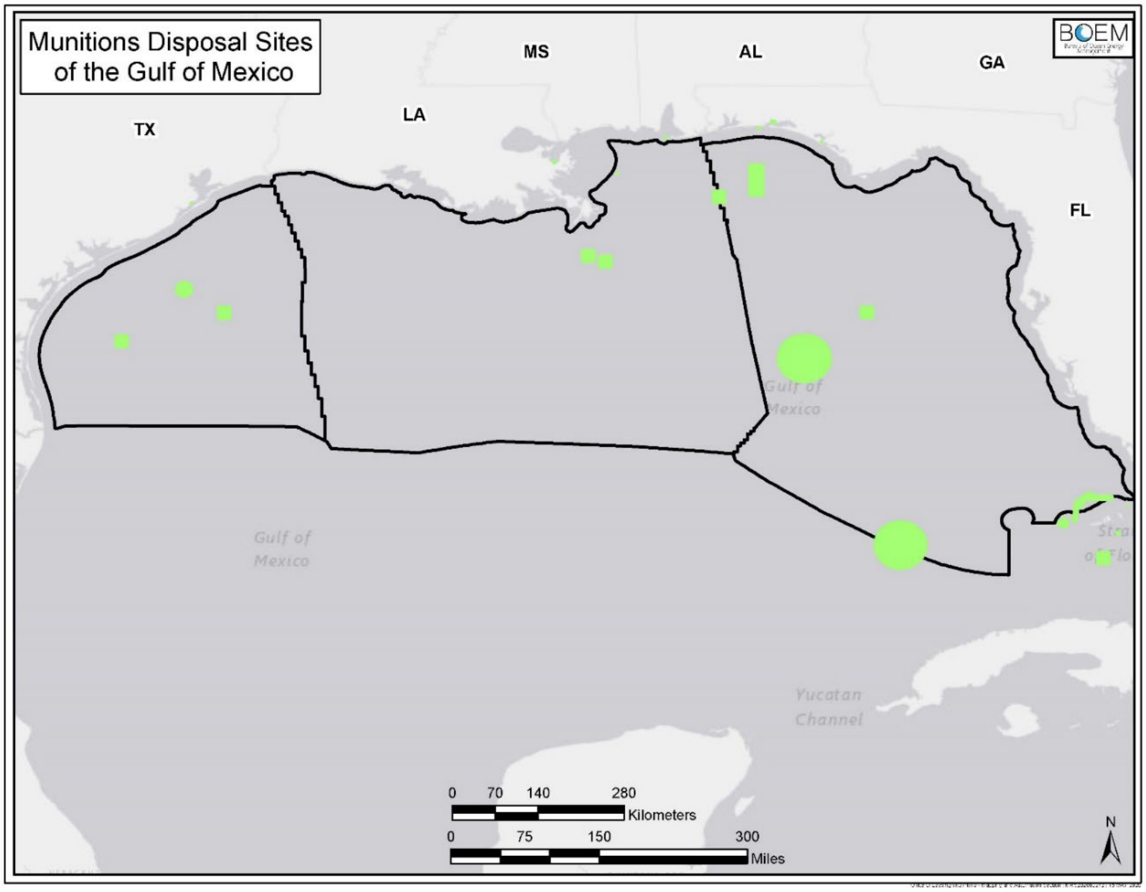

Figure B.7.2-6. Munitions Disposal Sites of the Gulf of Mexico.

B.7.2.2.9 Aquaculture

Offshore aquaculture is the rearing of aquatic animals in controlled environments (e.g., cages or net pens) in Federal waters. In the GOM, marine aquaculture focuses on stock enhancement (i.e., the release of juvenile fishes to supplement wild populations), food production, research, and restoration efforts (NMFS 2020a). Species cultured in the region include oysters, clams, shrimp, red drum, almaco jack, spotted seatrout, summer flounder, snook, pompano, black seabass, and algae. More information on NOAA's role in marine aquaculture can be found on NOAA's website at https://www.fisheries.noaa.gov/topic/aquaculture.

Due to a 2018 court ruling, NOAA is not currently issuing permits for aquaculture in Federal waters of the GOM; however, NOAA continues to support the development of offshore aquaculture through early engagement and participation in other Federal agency permitting processes. The Department of Justice, on behalf of the United States, has appealed the court's decision and the appeal was struck down in August 2020. An interagency group led by NOAA has been established and is working on the permitting process for future proposed aquaculture activities. This group consists of the three permitting agencies, i.e., NOAA, USEPA, and USACE, and other agencies with an interest or expertise on the OCS, including the USCG, FWS, BOEM, and BSEE. *A Guide to the Permitting and Authorization Process for Aquaculture in U.S. Federal Waters of the Gulf of Mexico* provides information on the Federal permitting and authorization requirements to establish an aquaculture operation in U.S. Federal waters of the Gulf of Mexico (NOAA et al. 2019). The operator of an offshore aquaculture facility must obtain all required Federal permits and authorizations prior to beginning operations, e.g., placing any structures or animals in OCS waters. The type of permit(s) required will vary depending on the type of aquaculture operation, e.g., finfish versus macroalgae.

B.8 Socioeconomic Changes and Drivers

This IPF broadly addresses the extent to which activities (both OCS wind energy leasing, site characterization, and site assessment-related factors; and non-OCS wind energy leasing, site characterization, and site assessment-related factors) produce socioeconomic changes. Because humans plan for, instigate, avoid, and react to changes in myriad ways, socioeconomic considerations are also drivers of change in the offshore industry and elsewhere in society, changes which, in turn, beget additional changes with their own impacts. These impacts are often interpreted subjectively and can be perceived as positive, negative, or neutral, often simultaneously, for multiple reasons or by multiple groups of people.

Wind energy is one element in the socioeconomic landscape of the GOM. It exists in and is supported by other elements of the landscape, including communities, governments, industries, and individuals. The GOM's socioeconomic landscape is rich and varied, representing diverse peoples, cultures, ways of life, and industries. There are six economic sectors that depend on the ocean, including living resources (e.g., seafood), marine construction, marine transportation, offshore mineral extraction (mostly comprised of OCS oil- and gas-related activities), ship and boat building, and recreation and tourism. The combination of these sectors is called the ocean economy. Overall, in 2016, the ocean economy accounted for 598,000 employees and $104 billion in gross domestic product in the GOM region and, since 2007, employment in the ocean economy has grown almost 10 percent faster than the U.S. economy (NOAA and Office for Coastal Management 2019). Marine and coastal resources play a significant role in generating income and employment through fishing, recreation, and tourism. These resources may be particularly crucial to the well-being of vulnerable coastal communities but are also significant to the sense of place and culture of communities across the GOM.

B.8.1 OCS Wind Energy Leasing, Site Characterization, and Site Assessment Related IPFs

Activities associated with wind energy leasing, site characterization, and site assessment have the potential to contribute impacts on socioeconomic resources such as demographics, employment, public services, and property values. Actions occurring offshore could result in additional employment related to offshore and onshore construction activity, and increased port utilization as well as vessel traffic and associated support. Impacts of alternative energy facilities on employment and income would depend on the number of people employed during construction and operations, the size of the populations in the areas where facilities were sited, and whether jobs would be able to utilize existing capacity in the local workforce. Since many coastal communities already support port infrastructure and activity, the available capacity in the local workforce and marine crews with the required skillset for potential activities will determine the related demographic and employment impacts. Also, the duration and scale of offshore activities would determine the level of impacts to employment.

Several recent studies discuss the potential for the creation of high-paying and sustained local jobs as a result of offshore wind development (Bristol Community College et al. 2018; BVG Associates Limited 2017). These jobs may be particularly important if they are created in areas that have experienced economic declines such as many industrialized coastal areas. Employment and regional economic impacts of wind energy development projects can be calculated using the Offshore Wind Jobs and Economic Development Impact (JEDI) model developed by National Renewable Energy Laboratory. Given information on a project location, construction start year, nameplate capacity, and turbine size (if available), JEDI can provide information on construction phase and operating phase impacts, including local labor impacts, local revenue, and supply chain and induced impacts.

Impacts to demographics (e.g., population size, population growth, age, and racial distributions) are unlikely from temporary activities such as construction (BOEM 2016) . Numerous activities in the same geographic region could result in larger numbers of jobs, but the numbers would likely still be small relative to the overall economy and population (MMS 2007). Socioeconomic impacts from wind energy development are typically positive impacts related to additional employment.

Impacts to property values can result from the presence of structures and changes to the viewshed. These impacts depend on the density of visible offshore development and its distance from shore; therefore, it may not have much impact during leasing, site characterization, and site assessment.

Environmental justice impacts are environmental or economic impacts to all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies. The IPFs from a variety of activities that affect demographics and employment have the potential to disproportionately affect certain populations. These impacts are likely to be highly site-specific and require review for every specific project (MMS 2007). Considering that major activities for offshore development would occur at a distance away from populations, the temporary onshore construction would likely have the largest potential environmental justice implications (MMS 2007). These impacts could include adverse health impacts from air emissions and noise, which could negatively affect local populations. Construction, operation, and decommissioning of facilities have a variety of impacts ranging from air, water, and noise pollution as well as potentially affecting land use and property values disproportionately (MMS 2007). The potential for environmental justice impacts depends on the regional distribution of minority and low-income population groups (MMS 2007) .

B.8.2 Non-OCS Wind Energy Leasing, Site Characterization, and Site Assessment-Related IPFs

B.8.2.1 OCS Oil- and Gas-Related Activities

Many people, both nationally and internationally, rely on coastal and marine resources such as food, tourism, and industry. The OCS oil- and gas-related activity in the GOM contributes significantly to regional employment and income arising from industry expenditures, government revenues, corporate profits, and other market impacts. The GOM ocean economy is dominated by offshore mineral extraction, which puts this region at the top in terms of gross domestic product (NOAA and Office for Coastal Management 2019). Likewise, the GOM ocean economy has above-average wages, which is largely due to the high wages found in the offshore mineral extraction sector (NOAA Office for Coastal Management 2019). The heavy presence of the oil and gas industry can also contribute to the culture and sense of place in many parts of the GOM region, many of which would be concentrated along the immediately adjacent coasts.

The oil and gas industry is one element in the socioeconomic landscape of the GOM. It exists in and is supported by other elements of the landscape, including communities, governments, industries, and individuals. This landscape is tied into global networks, markets, and forces, making the region both responsive to and an instigator of changes across the world. For example, the offshore oil and gas industry was developed in the GOM in the early 20th century and is now a driver of change across the globe. Conversely, the oil and gas price crash following the spread of the novel coronavirus (COVID-19) in early 2020 instigated widespread slowdowns in the offshore oil and gas industry, including the shut-ins of some GOM facilities. While the full impacts of COVID-19 are not yet known, it illustrates the impact of outside forces on the offshore oil and gas industry in the GOM.

The OCS oil- and gas-related activities may affect onshore areas because of the various industries involved and because of the complex supply chains for these industries. Many of these impacts occur in counties and parishes along the GOM region. BOEM aggregates 133 counties and parishes from the five Gulf Coast States into 23 EIAs based on economic and demographic similarities among counties and parishes. Much of BOEM's socioeconomic analyses focus on these EIAs since many of the positive and negative effects related to OCS oil and gas leasing in the GOM are concentrated in these EIAs. These EIAs also serve as consistent units for which to present economic and demographic data.

B.8.2.1.1 Employment Conditions

From 2010 to 2014, employment growth was slightly greater in the coastal areas of the GOM (2.43%) as compared to the total for coastal states as a whole (2.29%) (Kildow et al. 2016). Offshore oil and gas contributes to this employment growth.

The offshore oil and gas industry generally follows an employment pattern on offshore oil and gas projects. Direct employment levels for a single project typically increase shortly after a lease sale during the data acquisition and analysis phase (typically years 2 to 5 after a lease sale) and increase rapidly during exploration and development. Employment peaks during design, fabrication, and installation, but these levels are short term, only lasting several years. Employment then declines and flattens out during long-term production, which may last 15-35 years, depending on the size of the oil and gas reserves. Employment then initially increases before tapering off during the decommissioning phase. The timing of the different development phases varies by individual project, with the pre-production phases likely to be shorter in mature areas and longer in frontier areas. Increases in employment do not necessarily represent the creation of new jobs but the maintenance of current job levels in mature areas and migration of skilled workers from other regions to frontier areas.

In established basins, such as the WPA and CPA, multiple projects in a lease sale area tend to be staggered, resulting in smoother employment patterns over time.

Theoretically, direct changes in employment, income, and expenditures resulting from the project would initiate subsequent rounds of income generation, spending, and re-spending. Third-party contractors, vendors, and manufacturers receiving payment for goods and services required by the project would, in turn, be able to pay others who support their businesses. In addition, persons directly and indirectly employed because of the project would generate additional jobs and income in the economy as they purchase goods and services. These indirect and induced effects are sometimes referred to as "multiplier effects." Shifts in offshore oil and gas employment would therefore have impacts on local spending and associated industries, such as recreation and tourism. They would also impact the overall local economy.

Offshore oil and gas development requires an extensive network of onshore support facilities and services that generate many of the indirect and induced employment opportunities. Port facilities, fabrication facilities, oil and gas processing facilities, pipelines, and waste management facilities are among those that provide support to offshore oil and gas projects. These facilities are described above in **Sections B.2 and B.5**. Transportation, lodging, food, legal, architectural, and other services also employ many workers that provide project-related support.

The nature of offshore and onshore support activities allows for regional employment impacts to vary considerably. Offshore worker schedules (e.g., 2 weeks on and 2 weeks off) allow for very long-distance commuting. The schedules allow employees to participate in a range of economic, subsistence, and cultural activities that may not be as possible, lucrative, or pleasurable on an alternative schedule. Employees who work in company offices or in support industries often work business hours, shift work, or other alternative schedules. These schedules may be more desirable for many but reduce the reasonable commuting area unless employees can work remotely. Continued leasing in the GOM is likely to help maintain the current levels of offshore-related employment in the adjacent states (as workers cycle from one project to the next) rather than create significant levels of new employment.

In the GOM, offshore oil and gas workers typically earn higher-than-average incomes. Wages of employees in support industries vary greatly, as does the availability of overtime, bonuses, and benefits, which contribute to an employee's total compensation and factor into decisions of where to seek or accept employment. Contractors are also a significant source of labor in the offshore oil and gas and support industries. Employment opportunities associated with offshore oil and gas and support industries, therefore, range from highly paid, skilled full-time, permanent employees who work directly for companies to employees of contract companies to minimum wage employees to part-time and temporary contract workers. Depending on the industry, benefits and job stability vary. The shipbuilding and fabrication industry illustrates this diversity. In some commuting areas, shipbuilding and fabrication, along with oil and gas (including offshore and petrochemical plants) are among the highest paid jobs for skilled labor (McGuire et al. 2014). Despite that, workers for some companies may count on the availability of overtime in their livelihood strategies and suffer when that overtime is not available. Companies who cannot afford to pay the same wages as larger or better-funded shipyards can instead find skilled employees who find other factors significant in their employment decisions, including flexibility in schedule, additional overtime, shorter commute, lack of a union, and availability of training (McGuire et al. 2014). Contractors have become an increasingly important feature in the hiring decisions in the industry, where again wages and benefits vary, from some who are full-time employees of contract companies with generous benefits to others who work temporary positions and accept additional pay in exchange for benefits and job security.

B.8.2.1.2 Industry Spending

In addition to spending on employment, industry has expenditures on various goods and services. For example, offshore oil and gas activity directly affects firms that drill wells, manufacture equipment, construct pipelines, and service OCS oil- and gas-related activities. The OCS oil- and gas-related activities also impact the suppliers to those firms, as well as firms that depend on consumer spending of oil and gas industry workers, as discussed above.

Industry spending is also tied to development of coastal and submerged lands, either directly by offshore oil and gas or by associated industries. Associated IPFs are discussed in **Sections B.3, B.5, and B.7**. Increases in spending and subsequent development can also be linked to increased air emissions, discharges and wastes, noise, and visual impacts, as discussed in **Sections B.1, B.2, B.4, and B.6**

B.8.2.1.3 Government Revenues

The Federal Government collects revenues from the production of oil and natural gas on the OCS through bonus bids, royalties, and rents from lessees. Federal revenues reported for all OCS oil and gas leases totaled over $4 billion in Fiscal Year 2021 (ONRR 2022). A large portion of OCS revenues are retained by the U.S. Department of the Treasury, others are deposited into the Historic Preservation Fund and the Land and Water Conservation Fund, shared with states through the Section 8(g) provision of the OCSLA, as amended, or shared with states and coastal political subdivisions through GOMESA revenue sharing.

Section 8(g) of the OCSLA, as amended, requires that 27 percent of the revenues for Federal lease blocks within 3 nmi (3.5 mi; 5.6 km) of a State’s seaward boundary be shared with the state to compensate for oil and gas reservoirs that might be underlying both OCS and submerged State tidelands. Revenue sharing authorized under GOMESA in 2006 shares specific percentages of OCS revenues with GOM producing states (i.e., Texas, Louisiana, Mississippi, and Alabama) and their coastal political subdivisions, and provides additional revenue to the Land and Water Conservation Fund. The GOMESA revenue sharing program was designed to compensate for potential negative impacts of OCS activities. Beginning in Fiscal Year 2007, and thereafter, the GOM producing states and their coastal political subdivisions received 37.5 percent and the Land and Water Conservation Fund received 12.5 percent of the qualified OCS revenue from new leases, including bonus bids, rentals, and production royalties issued in the 181 Area in the EPA and in the 181 South Area. The second phase of GOMESA revenue sharing started in Fiscal Year 2017, which expanded the areas that qualify for revenue sharing. Phase II also imposes revenue-sharing caps on States and the Land and Water Conservation Fund. Overall, State revenue-sharing caps under Phase II are $375 million for Fiscal Years 2017-2019, $487.5 million for Fiscal Years 2020 and 2021, and $375 million for Fiscal Years 2022-2055. The cap will be lifted beginning in Fiscal Year 2056. Governments also receive revenues from OCS oil- and gas-related activities in the form of property taxes related to onshore support infrastructure and corporate income taxes. The impacts generated by these revenues depend on where and how the revenues are used.

B.8.2.1.4 Profit

In addition to contributing to local and regional spending and government revenues, Gulf of Mexico OCS activity contributes to corporate profits to firms along the OCS supply chain. Corporate profits can be distributed to stockholders as dividends or retained by firms for future spending on goods and services. Higher profits can also increase stock prices, which would increase the wealth of stockholders. Since stocks of most energy firms can be held by people from anywhere in the world, the wealth and dividend impacts would be fairly widespread and, thus, not overly concentrated in the GOM. Similarly, it is difficult to trace specific spending by firms to increases in corporate profits, although these impacts are also likely to be widespread.

B.8.2.1.5 Energy Supply and Prices

Gulf of Mexico OCS oil- and gas-related activity is intended to add to the Nation's energy supply. This contributes to U.S. policy goals of energy independence and security. Increased energy supply resulting from Gulf of Mexico OCS oil- and gas-related activity would put downward pressure on energy prices, although the small scale of a proposed lease sale(s) relative to the overall energy market would make these price effects minimal. Both can have additional impacts on energy markets.

B.8.2.1.6 Fluctuations in the Oil and Gas Industry

The global oil and gas industry is particularly volatile. When prices rise or fall, activity levels follow, though due to the size of expenditures and the length of development needed before a return on investment can be realized with offshore oil and gas, activity is insulated from some of the short-term impacts of this volatility. When activity shifts, this causes swings in spending and employment.

B.8.2.1.7 Population Shifts

As one of the leading industries in the GOM, decisions made by oil and gas companies about development, including facility siting and staffing, contribute to population shifts in the GOM region. As companies are founded, merge, go out of business, or relocate, they alter the landscape of available employment. As companies moved their headquarters or regional offices out of southern Louisiana to New Orleans and then Houston, they altered the availability of employment in both the cities and towns they left and the cities to which they moved. Since, as discussed above, offshore oil and gas employment can be more lucrative than other available options, this may have substantial impacts on the sustainability and character of these areas, particularly smaller areas where other options may be more limited.

B.8.2.1.8 Public Perceptions

Nothing exists in a vacuum and activities and patterns of activity are noticed, remarked upon, and influence future choices. As public perception changes, activities or situations that were perceived as normal or acceptable at one time may no longer be tolerated. For example, offshore oil and gas workers who survived the bust of the 1980s and industry fluctuations of the 1990s and 2000s may encourage their children to seek employment that offers more stability elsewhere (also refer to Austin et al. 2002). Others who left during a downturn refuse to return because they see any increase in wages or benefits as short-term and not worth the risk of future volatility. Support industries experience similar shifts in perception, and employment can rise and fall in popularity, especially as compared to other available options in the community (McGuire et al. 2014).

B.8.2.2 Economic Strength and Outlook

Changes to the local, State, national, and global economy and economic outlook can have far-reaching impacts on human activity. As these economies strengthen or weaken, and as outlooks for the future improve or worsen, government, industry, and consumers respond in myriad ways. Consumers and industries can increase spending to take advantage of low prices or interest rates, or due to confidence in continued economic growth. This spending can serve to increase employment, government revenue, and profits, as discussed above. It can also serve to increase competition, raise prices, and therefore decrease activity. Alternatively, a poor economic outlook or high prices may generally serve to limit spending, decreasing those subsequent impacts. Planners and decisionmakers may take different approaches, so responses to a shift in trends or a shock are likely to vary. Development, itself, may be controversial, i.e., viewed by some stakeholders as positive for the myriad benefits associated with growth, or a negative, particularly when it threatens to change areas or resources considered central to sense of place or local identity.

Commodity prices also vary with the state of the economy, market forces, and other factors, including international trade flows, geopolitical developments, and widespread shifts in human behavior, including that due to a pandemic or other social disruption. This includes oil and gas, as discussed above. Price fluctuations can have positive or negative impacts on industries, sectors, and communities, depending on their relationship with that commodity (e.g., buyer or seller, immediate or long-term need, etc.).

B.8.2.3 Ocean Economy

The six economic sectors that depend on the ocean include living resources (e.g., seafood), marine construction, marine transportation, offshore mineral extraction (mostly comprised of offshore oil and gas activities), ship and boat building, and recreation and tourism. They are all important to the regional economies of the Gulf of Mexico, which contributed the highest percentage of gross domestic product in the entire U.S. ocean economy (NOAA and Office for Coastal Management 2019). As of 2016, ocean economy employment declined by 0.4 percent overall, largely due to decreased employment in the offshore mineral extraction sector (NOAA and Office for Coastal Management 2019). The tourism and recreational sector was the largest employer with 56.6 percent, and it also experienced the highest absolute gains in employment (NOAA and Office for Coastal Management 2019).

B.8.2.4 Laws, Regulations, and Governmental Priorities

Government at all levels is both responsive to and instigates change through its legal and regulatory action and administrative priorities. This includes, but is not limited to, infrastructure, education and workforce development, environmental and land management (including zoning, development planning, conservation, and resource management), taxes and financial management, emergency planning, military, public health, and social services. Collectively, the impacts are widespread and touch on every aspect of human life. Government actions and decisions are based on myriad types of input, including public opinions and election results.

B.8.2.5 Population and Workforce

In 2010, 39 percent of the U.S. population (or 123.3 million people) lived in coastal shoreline counties (Crossett et al. 2013). From 2010 to 2014, employment growth was slightly greater in the coastal areas of the Gulf Coast States (2.43%) as compared to the total for the Gulf Coast States as a whole (2.29%) (Kildow et al. 2016). Population growth has also been slightly greater (1.45%) in the coastal areas as compared to the total Gulf Coast States as a whole (1.30%) (Kildow et al. 2016). It is anticipated that, as areas feel the impacts of climate change and sea-level rise, however, these trends will reverse and coastal areas will see losses of population (Hauer 2017; Robinson et al. 2020), as is already evident in areas of coastal Louisiana.

Areas with larger populations have more diverse economies, offer more services, and provide more varied employment opportunities. The availability of employees in all labor categories, including skilled and unskilled labor and technical expertise and the facilities to train workers, influences industry siting and development plans, just as the availability of employment influences migration decisions. Additional factors that influence the constitution of the labor force include the mix of industries, presence and quality of educational and training facilities, availability and strength of unions, and the content of labor laws and regulations.

B.8.2.6 Culture

Culture is a socialized pattern of behavior and understanding (Center for Advanced Research on Language Acquisition 2014), which can help define a "sense of place." It is also "the set of attitudes, values, beliefs, and behaviors shared by a group of people, but different for each individual, communicated from one generation to the next." While all Gulf Coast States participate in American culture, they, and their regions, cities, and ethnic, religious, and linguistic communities all have their unique cultures. Culture creates shared understandings that allow for social function. For example, how business is conducted varies from one place to another, i.e., does a handshake create a binding contract or is written documentation required? Individuals and communities may also choose to value certain livelihoods or lifestyles because of their cultural importance. Those choices may not be easily understandable to people who do not share their culture. These differences can lead to conflict, particularly around questions of development and resource use, where decisions are, or can be perceived as, mutually exclusive or as impacting the identity or sense of place of a group. Culture changes over time and things that were once normal may no longer be accepted, or the once strange may become commonplace.

B.9 ACCIDENTAL OCS WIND ENERGY LEASING, SITE CHARACTERIZATION, AND SITE ASSESSMENT-RELATED IPFS

Impacts associated with accidental events are considered in terms of accidental events that occur with enough frequency that such events are statistically expected to occur.

Categories of impact-producing factors associated with reasonably foreseeable accidental events include the following:

- releases into the environment, which includes spills, and trash and debris;
- vessel strikes as a result of vessels colliding with a resource or habitat and vessel collisions as a result of vessels colliding with other vessels, aircraft, or structures; and
- recovery of equipment lost during site characterization surveys or site assessment-related activities.

B.9.1 Unintentional Releases into the Environment

B.9.1.1 Spills

As described in **Section A.3.3.3** of **Appendix A**, a spill of petroleum product could occur as a result of hull damage from collisions between vessels, accidents during the maintenance or transfer of offshore equipment and/or crew, or due to natural events (i.e., strong waves or storms). The meteorological buoy may include a diesel generator for powering equipment, and small diesel spills could occur during refueling. Accidental spills of petroleum products or lubricants or releases of solid debris are possible during installation, maintenance, and decommissioning of the buoy(s).

Accidental spills of petroleum product from vessels would likely be small in volume; as described in **Section A.3.3.3** of **Appendix A**. From 2010 to 2020, the average spill size for vessels other than tank ships and tank barges was 114 gallons (432 liters) (USCG 2011). Diesel fuel, which is lighter than water, would float on the water surface as a sheen that is readily dispersed by wave action into the water column. Dispersion down to the seafloor would be extremely unlikely. Because diesel oil does not contain the heavier, more persistent components found in crude oil, it would be expected to dissipate rapidly in the environment(MMS 2007). The likelihood of a diesel spill would be greatest during installation and decommissioning; the potential for impacts would be reduced substantially during operation of the buoy(s) because vessels would be needed only for periodic maintenance. Although spills are unlikely, vapors from fuel spills resulting either from vessel collisions or from servicing or refueling generators on the meteorological buoy(s) may result in impacts on air quality and water quality in a leased area or along a cable survey route.

The discharge and disposal of garbage and other solid debris, including plastics, from vessels into the sea or navigable waters of the United States is prohibited (MARPOL Annex V, Public

Law 100-220 [Statute 1458]). According to 33 CFR §§ 151.51 through 151.77, all trash and debris must be returned to shore for proper disposal with municipal and solid waste unless it can pass through a comminutor and a 25-mm (1-in) mesh screen onboard ship. The combination of crew training on avoiding accidental discharge and on existing regulations will minimize the risk of solid debris entering the water.

B.9.1.2 Trash and Debris

As discussed in greater detail in **Section C.5** of **Appendix C**, marine trash and debris is a growing concern both regionally and globally. In the United States, about 80 percent of marine debris washes into the oceans from land-based sources and 20 percent is from ocean sources (USEPA 2017b). The offshore industry makes up only a small part of those sources. Some trash items, such as glass, pieces of steel, and drums with chemical or chemical residues, can be a health threat to local water supplies and, as a result, also to biological, physical, and socioeconomic resources; beachfront residents; and users of recreational beaches.

The discharge of marine debris by the offshore industries and supporting activities is subject to a number of laws and treaties. These laws and treaties include the Marine Debris Research, Prevention, and Reduction Act; the Marine Plastic Pollution Research and Control Act; and the MARPOL-Annex V treaty. Regulation and enforcement of these laws is conducted by a number of agencies, such as the USEPA, NOAA, and USCG. The USEPA works with the International Maritime Organization to develop and implement legal standards that address vessel-source pollution and ocean dumping. It also partners with the Caribbean Environment Programme to reduce land-based sources of pollution in the GOM and the wider Caribbean region (UNEP 2017). In order to address the issue of oceans pollution, NOAA also engages in strong outreach and education activities dedicated to minimizing the introduction of debris into the marine environment.

B.9.2 Strikes and Collisions

Strikes are defined as a vessel or aircraft unintentionally hitting a resource or habitat, including entanglements. Collisions are defined as a vessel or aircraft unintentionally hitting another vessel, aircraft, or structure. Both strikes and collisions may occur as a result of routine OCS wind energy leasing, site characterization, and site assessment-related activities, accidental events, or other events that are not related to OCS wind energy leasing, site characterization, and site assessment-related activities. Whatever the cause of the strike or collision, the result is an accidental event.

The OCS wind energy site characterization and site assessment-related vessels could strike marine mammals, sea turtles, coral reefs and hard bottom benthic communities, and other marine animals during transit. To limit or prevent such strikes to marine mammals and sea turtles, the National Marine Fisheries Service (NMFS) provides all boat operators with whale-watching guidelines, which are derived from the Marine Mammal Protection Act. These guidelines suggest safe navigational practices based on speed and distance limitations when encountering marine mammals. The frequency of vessel strikes with marine mammals, sea turtles, or other marine animals probably varies as a function of spatial and temporal distribution patterns of the living resources, the pathways of maritime traffic (coastal traffic is more predictable than offshore traffic) and vessel speed, the number of vessel trips, and navigational visibility.

BOEM will include language similar to NTL No. 2016-G01, “Vessel Strike Avoidance and Injured/Dead Protected Species Reporting,” as a Standard Operating Condition (SOC) for renewable energy leases which explains how operators must implement measures to minimize the risk of vessel strikes to protected species and to report observations of injured or dead protected species. The Protected Species Stipulation, when applied, would make compliance with the guidance identified in the SOC mandatory for lessee activities. Adherence to the SOC protocols is expected to reduce but not eliminate the risk of potential vessel strikes with marine mammals and sea turtles. NTL No. 2016-G01 was reissued June 19, 2020 and as of March 13, 2020, BOEM has implemented the terms and conditions and reasonable and prudent measures of the 2020 NMFS Biological Opinion, including Appendix C, “Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols,” which has been applied in place of NTL No. 2016-G01 for lease sale stipulations and conditions of approval for permits, plans, and other authorizations approved by BOEM.

Vessels in transit could strike coral reefs and hard bottom benthic communities in shallow water, particularly if the vessel ventures outside of navigation channels. The vessels could also accidently drop an anchor on a shallow benthic community. Deeper hard bottom benthic communities could also accidentally be struck by anchors, infrastructure, or equipment falling from vessels or structures. Although BOEM has many protections (described below) for sensitive seafloor features, it is possible that an operator may still accidently drop an anchor or equipment, or even possibly place a cable or structure, on a sensitive benthic habitat.

BOEM will include language similar to NTL No. 2009-G39 as an SOC, that all bottom-disturbing activity must be distanced from topographic features, pinnacles, live bottoms, and potentially sensitive biological features in order to prevent injury to these sensitive habitats. Stipulations are attached to leases in topographic feature, pinnacle, and live bottom low-relief OCS lease areas to ensure that operators avoid these areas by the recommended distances in each stipulation. BOEM has No Activity Zones surrounding each protected topographic feature within which no bottom-disturbing activity is permitted. In addition, BOEM’s Topographic Features Stipulation requires bottom-disturbing activity to be distanced 152 m (500 ft) from a No Activity Zone surrounding a topographic feature. The Pinnacle Trend and Live Bottom Low Relief Stipulations do not allow bottom-disturbing activity within 33 m (100 ft) of a pinnacle or live bottom feature. As part of the Topographic Features Stipulation, no bottom-disturbing activity is allowed within 33 m (100 ft) of a potentially sensitive biological feature, which is located outside of a No Activity Zone.

The SOC language similar to BOEM NTL No. 2009-G40 provides guidance to operators indicating that no bottom-disturbing activity is allowed within 610 m (2,000 ft) of a deepwater benthic community (including deepwater coral and chemosynthetic communities). BOEM conducts site-specific seafloor reviews prior to a permit approval to ensure that cables and structures are not placed on sensitive benthic habitat. Conditions of approval are attached to permits that describe the distancing requirements for deepwater benthic communities near the proposed activity to ensure that these sensitive habitats are protected from OCS oil- and gas-related activity.

A meteorological buoy(s) located in a potential lease area could pose a risk to vessel navigation. A collision between a ship and a meteorological buoy(s) could result in the loss of the entire facility and/or the vessel, as well as loss of life and spillage of petroleum product. The vessel damage to the buoy hull could cause it to lose its buoyancy and sink, or it could damage the equipment or its supporting structure.

Vessels associated with site characterization and site assessment-related activities could collide with other vessels, resulting in damages, petroleum product spills, or capsizing. Vessel collisions are unlikely assuming vessel operator adherence to the Coast Guard Navigation Rules and Regulations (i.e., Rules of the Road). More information is available online at www.navcen.uscg.gov/?pageName=navRulesContent. Additional routing measures, such as safety fairways and traffic separation schemes that control traffic, also help minimize risk. Airplane collisions are also considered unlikely. BOEM anticipates that aerial surveys would not be conducted during periods of storm activity because the reduced visibility conditions would not meet visibility requirements for conducting the surveys, and flying at low elevations would pose a safety risk during storms and times of low visibility. Risk of collisions with a meteorological buoy(s) for vessels would be further reduced by USCG-required marking.

Historical data support the conclusion that the number of potential collisions resulting in damage to property and equipment would be small. Collision incident data were reviewed for the years 2007 through 2020 for the Gulf of Mexico and Pacific regions (BSEE 2022b), which contain many fixed structures on the OCS, such as oil and gas platforms. The collision data, which were recorded over a 13-year period and are available at https://www.bsee.gov/stats-facts/offshore-incident-statistics, reported 185 collisions in the Gulf of Mexico and Pacific regions. For those data, the most commonly reported causes of the allisions and collisions include human error, weather-related causes, equipment failure on the vessels, and navigational aids not working on the structures (BSEE 2022a).

Most collision mishaps are the result of service vessels colliding with platforms or vessel collisions with pipeline risers. Fires have resulted from hydrocarbon releases in several collision incidents in the GOM. If a fire was associated with an accidental event, it could produce a broad array of pollutants including VOCs, NAAQS primary pollutants, and greenhouse gases. Diesel fuel is the product most frequently spilled, while oil, natural gas, corrosion inhibitor, hydraulic fluid, and lube oil have also been released as the result of vessel collisions on the GOM. The air pollutants could include NAAQS criteria pollutants, volatile and semi-volatile organic compounds, hydrogen sulfide, and methane. The BSEE data show that, from 2008 to 2019 in the GOM, there were 160 OCS oil- and gas-related vessel collisions (Mathews 2020). Approximately 10 percent of vessel collisions with platforms in the OCS caused diesel spills. To date, the largest diesel spill associated with a collision occurred in 1979 when an anchor-handling boat collided with a drilling platform in the Main Pass leasing area, spilling approximately 1,500 bbl. In 2014, approximately 3,571 bbl of bunker fuel spilled into the Houston Ship Channel after a collision between a barge and a ship. Safety fairways, traffic separation schemes, and anchorages are the most effective means of preventing vessel collisions with OCS structures.

In general, fixed structures are prohibited in fairways. Temporary underwater obstacles, such as anchors and attendant cables or chains, may be placed in a fairway under certain conditions. A limited number of fixed structures may be placed at designated anchorages. The USCG's requirements for indicating the location of fixed structures on nautical charts and for lights, sound-producing devices, and radar reflectors to mark fixed structures and moored objects also help minimize the risk of collisions. In addition, the USCG's 8th District would provide Local Notices to Mariners (monthly editions and weekly supplements) to inform users of the Gulf of Mexico OCS about the addition or removal of structures, locations of aids to navigation, and defense operations involving temporary moorings. Marked structures often become aids to navigation for vessels (particularly fishing boats and vessels supporting offshore operations) that operate in areas with high densities of fixed structures.

Hill et al. (1999) summarized collision avoidance measures between a generic deepwater structure and marine vessels in the GOM, which were examined for possible implementing recommendations by the National Offshore Safety Advisory Committee. Hill et al. (1999) offered 15 recommendations that can be grouped into three overarching categories: (1) voluntary initiatives for offshore operators; (2) joint government/industry cooperation or study; and (3) new or continued USCG action. Many of the recommendations discussed in Hill et al. (1999) have been incorporated into the U.S. version of the International Regulations for Preventing Collisions at Sea 1972, which are enforced by the U.S. Coast Guard (USCG 2020).

Accurately modelling vessel-to-structure collision risk, however, has been a challenge for over 20 years given the numerous social, technical, and environmental variables (Pengfei et al. 2016). Over time, the likelihood of collisions has decreased with advanced technology of ships, particularly dynamic positioning systems. As more vessels have incorporated the use of dynamic positioning systems, the potential risk of collision is now higher for those who do not operate with this system (Verhoeven et al. 2004). To date, a major collision between passing merchant vessels and offshore structures has not been experienced. Though the likelihood of this causal factor is relatively low in all regions of the OCS, the consequences could be severe (Pengfei et al. 2016).

B.9.2.1 Service Vessels

Service vessels are expected to be one of the primary modes of transporting personnel between service bases and offshore structures, and are required at practically every stage of the offshore wind energy site characterization and site assessment. Service vessels are typically required for the following processes: site characterization surveys and installation, operation, maintenance, and decommissioning of site assessment structures. In addition to offshore personnel, service vessels carry cargo offshore. Other vessel operations, including G&G activity, can also require service vessels. Service vessels have the potential to collide with any structure, rig, or vessel they are servicing, as well as other vessels anchored, tied up, or underway.

Service vessels could also strike marine mammals and sea turtles during transport. BOEM's Protected Species Stipulation, explained to operators in the SOC language similar to BOEM NTL No. 2016-G01, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting," helps minimize the risk of vessel strikes to protected species and explains how to report observations of injured or dead protected species. Compliance with the guidance in the SOC is mandatory for lessees when the Protected Species Stipulation is applied to leases. Adherence to the SOC protocols is expected to reduce but not eliminate the risk of potential vessel strikes with marine mammals.

B.9.2.2 G&G Vessel Activity

The majority of G&G activities are expected to be conducted from ships. The exception would be remote-sensing methods from aircraft or satellites. Vessels are on average 200-300 ft (60-90 m) long for HRG surveys, and the ship typically travels at 3.5-4 miles per hour (3-3.5 knots). The vessel tow speed during non-airgun HRG surveys may be up to 4.6-5.8 miles per hour (4-5 knots). In general, any combination of HRG techniques, which are employed for both shallow hazard and archaeological surveys, may be conducted during a single deployment from the same vessel. Marine gravity and magnetic surveys are commonly conducted during seismic surveys, but they can also be done separately using ships.

Geotechnical surveys are typically conducted independently using ships approximately 65-328 ft (20-100 m) in length. Geotechnical vessels are stationary when conducting sampling and testing.

Vessels for G&G surveys are likely to remain offshore for most of the survey duration. The G&G activity may be supported by supply vessels operating from ports in the GOM, but service vessel support is not a requirement. Vessels towing equipment during surveys follow pre-plotted track lines and have limited maneuverability during data acquisition. The limited maneuverability could result in towed equipment becoming entangled with structures, other vessels, and equipment from other vessels. The vessel itself could also collide with other vessels or structures due to limited maneuverability as well as strike marine mammals and sea turtles. Accordingly, seismic vessels typically are accompanied by an escort vessel, which is used to scout the route ahead; identify hazards, such as adverse currents, vessel traffic, or fishing equipment; and ensure that other vessels do not cross over or interfere with the equipment being towed. For safety reasons, survey operators attempt to keep a zone around the source vessel and its towed equipment clear of other vessel traffic. The size of the vessel exclusion zone that would be maintained around a source vessel and its towed equipment varies depending on the array configuration. In addition, BOEM NTL No. 2016-BOEM-G01, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting," explains how to minimize the risk of vessel strikes to protected species and to report observations of injured or dead protected species. Compliance with the Protected Species Stipulation, when applied, is expected to reduce the risk of potential vessel strikes with marine mammals. NTL No. 2016-G01 was reissued June 19, 2020 and as of March 13, 2020, BOEM has implemented the terms and conditions and reasonable and prudent measures of the 2020 NMFS Biological Opinion, including Appendix C, "Gulf of Mexico Vessel Strike Avoidance and Injured/Dead Aquatic Protected Species Reporting Protocols," which has been applied in place of NTL No. 2016-G01 for lease sale stipulations and conditions of approval for permits, plans, and other authorizations approved by BOEM.

B.9.2.3 Helicopters and Other Aircraft

Helicopters may be used during site characterization surveys and to transport personnel between service bases and site assessment structures. In addition, equipment and supplies are sometimes transported. An operation includes one takeoff and landing.

The G&G activities also use helicopters and fixed wing aircraft on occasion. For example, helicopters could be used for personnel transport during vessel- and structure-based seismic surveys that stay onsite for extended periods. Helicopters or fixed wing aircraft may also be used to collect gravity and/or aeromagnetic data, but such surveys are more commonly done from ships because of the logistics required to keep the aircraft in the air for extended periods far from shore.

Helicopters and fixed wing aircraft could collide with structures, vessels, and each other during takeoff, landing, and survey operations. They could also strike birds during operations. On average, 3.4 helicopter accidents per year have occurred in the GOM since 2009. The year 2018 marked the fifth fatality-free year for helicopter accidents; however, there was a non-fatal accident in 2018 in which the landing gear of the helicopter collapsed during taxi. There was a second accident in 2018 that resulted in the ditching of a helicopter. In March 2019, however, a helicopter was lost shortly after takeoff, resulting in two deaths. The 2018 GOM oil industry helicopter accident rate per 100,000 flight hours was 0.55 with a 5-year average of 0.83 incidents per 100,000 flight hours (Duprie 2019). Between 2009 and March 2019, there have been 37 helicopter accidents, of which 8 were fatal. The leading causes, not all inclusive, of the accidents since 1999 were engine related, loss of control or improper procedures, helideck obstacle strikes, controlled flight into terrain, and other technical failures (Aerossurance 2019; Duprie 2019). There were at least two reported fatal accidents in 2019; however, as of October 2020, the 2019 Helicopter Safety Advisory Conference statistics remained unpublished (Aerossurance 2019).

B.9.2.4 Other Activities That Could Potentially Cause Strikes or Collisions

As a sovereign state, the United States has extensive authority to regulate ships entering its ports and to establish port-of-entry conditions. Therefore, the United States has the authority to require foreign flag vessels calling at U.S. ports to adhere to the vessel operational measures to reduce ship strikes.

B.9.2.4.1 Vessel Traffic Patterns

Several types of routing measures are used by the USCG and International Maritime Organization to provide safe access routes to and from ports, including recommended routes, anchorage/no anchorage areas, and traffic separation schemes (TSSs). The purpose of a TSS is to separate opposing streams of traffic by appropriate means and to establish traffic lanes per 33 CFR part 167. The TSSs have been adopted by the International Maritime Organization in certain areas of the world to aid in navigation safety; all vessels must adhere to operating rules within these routes, although vessels may enter a TSS anywhere along its course. There is one TSS in the waters along the Gulf Coast, in the approaches to Galveston Bay, which was designed to aid in the prevention of collisions in the approach to the harbor. The scheme consists of directed traffic lanes for inbound and outbound traffic, a separation zone, and two precautionary areas.

B.9.2.4.2 Types of Vessels

Many vessels operate in the GOM and only a relatively small portion of potential vessel strikes could be related to OCS oil- and gas-related activity. Total port calls, or vessel stops at a port, in the GOM are increasing, as total port calls in the U.S. as a whole are increasing. Freight and cruise ship passenger marine transportation within the analysis area should continue to grow at a modest rate or remain relatively unchanged based on historical freight and cruise traffic statistics. In 2017, 656 cruise ships departed from ports in Galveston, New Orleans, and Tampa, greater than 172 more than were scheduled to depart from these ports in 2011 (American Association of Port Authorities 2017; MARAD 2011). As of 2015, tankers, followed by dry bulk ships, make up the majority of the port calls in the GOM (MARAD 2015). Total vessel calls in U.S. Gulf of Mexico ports made up more than half (51% of all calls) the total vessel calls in the United States (MARAD 2015). Tankers also make more calls (31% of all calls) in U.S. Gulf of Mexico ports than in other areas of the United States.

The NOAA's National Marine Fisheries Service whale ship strike records from 1975 to 2002 suggest that collisions between ships and whales were associated with a wide variety of vessel types and that the average speed of a vessel at the time of impact ranges from 5 to 51 knots (5.7 to 58.7 miles per hour) (Jensen and Silber 2004). The following table (**Table B.9.2-1**) summarizes information from Jensen and Silber (2004) about the type of vessels with the known number of strike incidences to large whales.

Table B.9.2-1. Ship Strikes of Large Whales by Type of Vessel.

Unknown Vessel Strikes	158 cases
Known Vessel Strikes	134 cases
Navy Vessels*	17.1% (23 cases)
Container/Cargo Ships	14.9% (20 cases)
Whale-watching Vessels	14.2% (19 cases)
Cruise Ships	12.7% (17 cases)
Ferries	11.9% (16 cases)
Coast Guard*	6.7% (9 cases)
Tankers	6.0% (8 cases)
Recreational Vessels	5.2% (7 cases)
Steamships	5.2% (7 cases
Fishing Vessels	3.0% (4 cases)
Dredge Boat	0.75% (1 case)

Research Vessel	0.75% (1 case)
Pilot Boat	0.75% (1 case)
Whaling Catcher Boat	0.75% (1 case)

*It should be carefully noted that the relatively high incidence of Navy and Coast Guard collision reports may be largely a factor of standardized military and government reporting practice rather than an actual higher frequency of collisions relative to other ship types.

Non-OCS oil- and gas-related tankering includes ships carrying crude or ships carrying product. Overall, tankering (including U.S. ships and foreign ships) in the U.S. increased by 28 percent between 2003 and 2011 (MARAD 2013). While port calls by U.S.-flagged tankers declined between 2003 and 2011, port calls by foreign-flagged tankers increased, as listed in **Table B.9.2-2**.

Table B.9.2-2. Comparison of Port Calls by U.S.- and Foreign-Flagged Tankers Between 2003 and 2011.

Ship Origin	2003	2011
U.S. Tankers	3,759	2,956
Foreign Tankers	14,744	20,722

Source: (MARAD 2013).

The Oil Pollution Act of 1990 included provisions for the double hulling of all oil tankers. The Act required new oil tankers to be double hulled and established a phase out scheme for existing single-hulled tankers. Older single-hulled tankers were phased out starting in 1995, and the final date for phase out of all single-hulled tankers was 2015.

Non-OCS oil- and gas-related vessels other than those listed above use the Gulf of Mexico OCS and pose potential vessel strike issues. These ships include research vessels, recreational vessels, and commercial vessels. Commercial and recreational fishing in the Gulf of Mexico OCS are regulated by NMFS.

Navy vessels operate differently from commercial vessels in ways important to the prevention of vessel strikes. As described in the Atlantic Fleet Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement,(U.S. Navy 2018) surface ships operated by or for the Navy have personnel assigned to stand watch at all times, day and night, when a ship or surfaced submarine is moving through the water. Per vessel safety requirements, personnel standing watch for threats to the vessel also report any marine mammals sighted in the path of the vessel as a standard collision avoidance procedure. All vessels use extreme caution and proceed at a safe speed so they can to avoid a collision with any object, including marine mammals, and can be stopped at an appropriate distance from the object. Lines, cables, and buoys deployed in the water present entanglement risks to marine wildlife, archaeological resources that stand proud of the bottom, and benthic communities. Specific to G&G activities in the GOM, acoustic buoy releases, tethered acoustic pingers, and nodal tethering lines pose an entanglement risk to marine mammals, sea turtles, and other marine life, and could impact archaeological resources through direct contact or by being dragged through an archaeological site. Although rare, entanglement has occurred in association with ocean-bottom cable and ocean-bottom node surveys where rope or cable connections are used between nodes, and with associated equipment (e.g., anchors and buoys). The deployment of ocean-bottom cables and ocean-bottom nodes is accomplished by an ROV, by dropping nodes on a tether, or by laying cables off the back of a layout boat. The assemblage remains on the seafloor during the seismic survey and is retrieved at the completion of the survey. Not all surveys will have tethered nodes; however, a typical tethered survey can lay out more than 500 km (310 mi) of line for nodal surveys. According to BOEM (2013), risks of entanglement for pelagic organisms can be minimized further by implementing the following measures: (1) shortening acoustic buoy and tethered acoustic pinger lines to the shortest length practical; and (2) replacing tether rope lines <0.25 inches (0.64 centimeters) in diameter with a thicker, more rigid tether line or modifying the line to increase the diameter and rigidity. BOEM also requires that if, upon retrieval, a cable becomes snagged, the operator must verify what is causing the snag, which could possibly minimize further damage to archaeological resources or benthic communities.

B.9.3 Response Activities

B.9.3.1 Spill Response

As described above in **Sections B.9.1.1 and A.3.3.3** of **Appendix A**, spills of petroleum products are possible. The most likely would be spills of diesel fuel from vessel collisions or leakage from generators on site assessment infrastructure. These spills are expected to remain relatively small, and diesel is known to dissipate rapidly. An acceptable response is to allow the spill to degrade naturally, if the dissipation will occur without assistance. If the spill cannot be expected to evaporate on its own quickly, then there are multiple response strategies for diesel spills (NOAA 2017). In the amounts of potential diesel spills related to renewable energy activities, using sorbent booms and pads could also be likely responses for larger spills.

B.9.3.2 Recovery of Lost Equipment

Equipment used during site characterization and site assessment-related activities (e.g., towed HRG survey equipment, cone penetration test components, grab sampler, buoys, lines, and cables) could be accidentally lost during survey operations. Additionally, it is possible (although unlikely) that a meteorological buoy could disconnect from the clump anchor. In the event of lost equipment, recovery operations may be undertaken to retrieve the equipment. Recovery operations may be performed in a variety of ways depending on the equipment lost. A commonly used method for retrieval of lost equipment that is on the seafloor is through dragging grapnel lines (e.g., hooks and trawls). A single vessel deploys a grapnel line to the seafloor and drags it along the bottom until it catches the lost equipment, which is then brought to the surface for recovery. This process can result in significant bottom disturbances as it requires dragging the grapnel line along the bottom until it hooks the lost equipment, which may require multiple passes in a given area. In addition to dragging a grapnel line along the bottom, after the line catches the lost equipment, it will drag all the components along the seafloor until recovery.

Where lost survey equipment is not able to be retrieved because it is either small or buoyant enough to be carried away by currents or is completely or partially embedded in the seafloor (e.g., a broken vibracore rod), a potential hazard for bottom-tending fishing gear may occur, and additional bottom disturbance may occur. A broken vibracore rod that cannot be retrieved may need to be cut and capped 1-2 m (3-6 ft) below the seafloor. For the recovery of lost survey equipment, BOEM would work with the lessee/operator to develop an emergency response plan. Selection of a mitigation strategy would depend on the nature of the lost equipment, and further consultation may be necessary. The IPFs associated with recovery of lost survey equipment may include vessel traffic, noise and lighting, air emissions, and routine vessel discharges from a single vessel. Bottom disturbance and habitat degradation may also occur as a result of recovery operations.

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APPENDIX C

REGIONAL SETTING AND PROGRAMMATIC CONCERNS

<u>What is in This Appendix?</u>

- A regional overview of the geology, oceanography, and meteorology across the Gulf of Mexico (GOM) basin.
- An overview of natural events (e.g., major storms) and other regional-scale processes or environmental factors (e.g., climate change) that contribute to existing baseline conditions or have the potential to influence future baseline conditions on the GOM Outer Continental (OCS).

<u>Key Points</u>

- The factors described in this appendix shape the environmental setting of the Area of Analysis and contribute significantly to existing baseline conditions in the GOM.
- Programmatic issues (e.g., climate change) and their influence on the various impact-producing factor (IPF) categories are described in this appendix and acknowledged throughout **Appendix B**, where applicable.
- These issues were analyzed programmatically as part of the existing and future baseline conditions rather than as unique IPF categories; however, cascading effects on marine ecosystems through additive or synergistic effects with the other stressors described in **Appendix B** were also evaluated.

C REGIONAL SETTING AND PROGRAMMATIC ENVIRONMENTAL FACTORS

This appendix provides a regional overview of the physical, geological, oceanographic, and meteorological characteristics of the GOM and a description of the various regional-scale natural events and processes, as well as other programmatic environmental concerns. The regional effects of these programmatic factors are summarized below and, where applicable, **Chapter 4** discusses the unique impacts that these factors could pose to individual resource categories and whether the addition of wind energy leasing, site characterization, and site assessment-related activities in the GOM could have any synergistic or additive effects.

C.1 PHYSICAL AND GEOLOGIC SETTING

The Gulf of Mexico OCS region is comprised of the OCS within the Gulf of Mexico, a semi-enclosed marginal sea, which is fed by the Atlantic Ocean. Formed during the breakup of Pangaea in the Mesozoic Era, this area contains abundant deposits of salt, limestone, and sandstone. Along the Gulf Coast, the Mississippi River has and continues to deposit an enormous fan of sediment, extending about 600 kilometers (km) (373 miles [mi]) offshore and containing about 400 trillion cubic yards of mud, silt, and sand, which is enough to fill over 70 Grand Canyons. Although the smallest by area, the GOM is currently the most important region for offshore conventional energy production.

Hydrocarbon resources are naturally occurring liquid, gaseous, or solid compounds of predominantly hydrogen and carbon that exist in the subsurface as crude oil and natural gas. Oil is a liquid hydrocarbon resource and may include crude oil and/or condensate. Crude oil exists in a liquid state in the subsurface and at the surface. Condensate (natural gas liquids) may exist in a dissolved gaseous state in the subsurface and liquefy at the surface. The volumetric estimates of oil resources assumed for this appendix represent combined volumes of crude oil and condensate and are reported as standard stock tank barrels.

Natural gas is a gaseous hydrocarbon resource and may include associated and/or nonassociated gas; the terms natural gas and gas are used interchangeably in this appendix. Associated gas exists in spatial association with crude oil; it may exist in the subsurface as free (undissolved) gas within a “gas cap” or as gas that is dissolved in crude oil (“solution gas”). Nonassociated gas (dry gas) does not exist in association with crude oil. Oil-equivalent gas is a volume of gas (associated and/or nonassociated) expressed in terms of its energy equivalence to oil (5,620 cubic feet of gas per barrel of oil) and is reported as barrels. The combined volume of oil and oil-equivalent gas resources is referred to as combined oil-equivalent resources or barrels of oil equivalent and is reported as barrels.

Resource assessments are a critical component of energy policy analysis and provide important information about the relative potential of United States OCS areas as sources of oil and natural gas. More information on the assessment of offshore oil and gas resources can be found in the *2016a National Assessment of Undiscovered Oil and Gas Resources of the U.S. Outer Continental Shelf* (BOEM 2017b).

The present-day GOM is a small ocean basin with a water-surface area of more than 1.5 million square kilometers (km^2) (371 million acres). The greatest water depth is approximately 3,700 meters (m) (roughly 12,000 feet [ft]). It is almost completely surrounded by land, opening to the Atlantic Ocean through the Straits of Florida and to the Caribbean Sea through the Yucatan Channel. The northern GOM may be divided into several physiographic subprovinces. In the OCS area, these include the Texas-Louisiana Shelf, Texas-Louisiana Slope, Rio Grande Slope, Mississippi Fan, Sigsbee Escarpment, Sigsbee Plain, Mississippi-Alabama-Florida Shelf, Mississippi-Alabama-Florida Slope, Florida Terrace, Florida Escarpment, and Florida Plain (**Figure C.1-1**). In the GOM, the continental shelf extends seaward from the shoreline to about the 200-m (656-ft) water depth and is characterized by a gentle slope of a few meters per kilometer (less than 1 degree). The shelf is wide off Florida and Texas, but it is narrower where the Mississippi River delta has extended seawards to near the shelf edge. The continental slope extends from the shelf edge to the Sigsbee and Florida Escarpments in about 2,000- to 3,000-m (6,562- to 9,843-ft) water depth. The topography of the slope is irregular and characterized by canyons, troughs, and salt structures. The gradient on the slope is normally 1-2 degrees, while the gradient of the Florida Escarpment may reach 45 degrees in some places. The Mississippi Fan has a gentle incline, with slopes of 4 m (13 ft) or less per kilometer (21 ft or less per mile), with the lower Mississippi Fan having an even flatter slope at 1 m (3 ft) or less per kilometer (5 ft or less per mile). The Sigsbee and Florida abyssal plains (ocean floor) are basically horizontal physiographic subprovinces and are surrounded by features with higher topography.

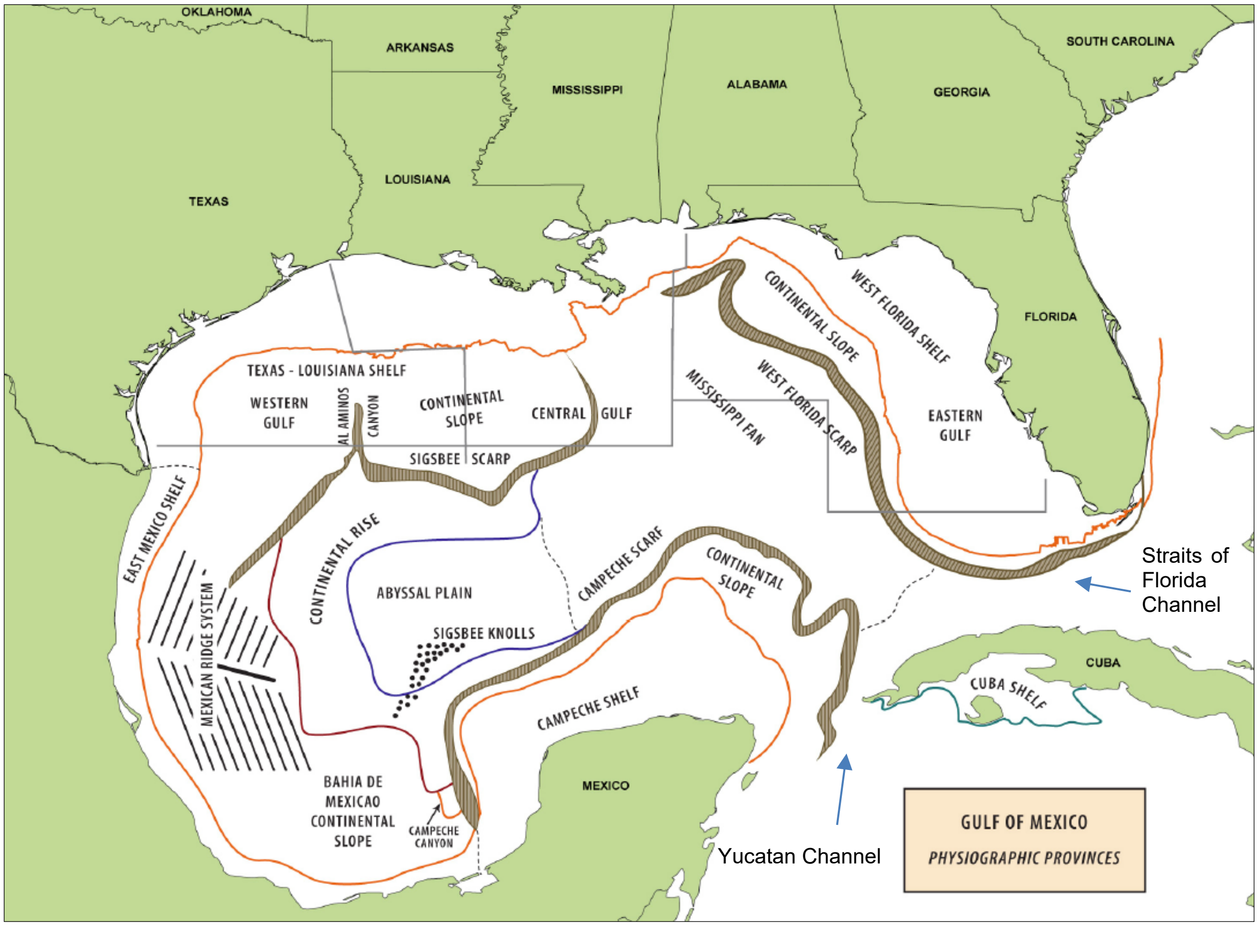


Figure C.1-1. Generalized Physiographic Map of the Gulf of Mexico OCS (Adapted from The Encyclopedia of Earth (2011).

There are two major sedimentary provinces in the Gulf Coast region: Cenozoic (the western and central part of the GOM) and Mesozoic (the eastern GOM). Over 45,000 wells have been drilled in the GOM. As such, the geology of the GOM has been studied in detail for the identification, exploration, and development of natural gas and oil resources. The Bureau of Ocean Energy Management (BOEM) maintains an inventory of over 30,000 discovered oil and gas reservoirs in the GOM that, in aggregate, comprise over 1,300 unique BOEM-designated oil and gas fields. BOEM includes an analysis of 12 assessment units of Cenozoic age (6 on the modern shelf [shallow water] and 6 on the modern slope [deep water]) and 19 geologic plays of Mesozoic age (BOEM 2017c). Assessment units include all reservoirs of a specific geologic age in a specified geographic area, whereas geologic plays are a group of known and/or postulated pools that share common geologic, geographic, and temporal properties, such as the history of hydrocarbon generation, migration, reservoir development, and entrapment. More detail on the assessment units, geologic plays, and geologic setting of the GOM can be found below and in the *Assessment of Technically and Economically Recoverable Hydrocarbon Resources of the Gulf of Mexico Outer Continental Shelf as of January 1, 2014* (BOEM 2017c).

To produce economically viable accumulations of oil and gas, five things must occur in the geologic setting. First, rocks must contain an enriched supply of organic material capable of forming oil and gas by the chemical and physical changes that occur during the burial process (the source). Second, a rock must have pores and openings sufficiently connected to hold and transmit oil or gas after it is generated (the reservoir rocks). Third, the hydrocarbons must migrate to the reservoir rocks from the source. Fourth, the layers of rock must be structurally and/or stratigraphically configured so as to capture a large accumulation of hydrocarbon resource (the trap). And fifth, the trapping structure and the reservoir rock must be overlain or configured so that the trap is sealed to prevent the escape of oil or gas (the seal). Upper Jurassic deposits are considered the major source rocks for gas and oil generation in the GOM. Other source rocks that have been identified in the GOM that may have generated hydrocarbons are as young as Pleistocene (approximately 2 million years ago [Mya]).

C.1.1 Cenozoic Province

The plays of the Cenozoic Province extend from offshore Texas eastward across the north-central GOM to the edge of the Cretaceous Shelf Edge (commonly known as the Florida Escarpment) offshore Mississippi, Alabama, and Florida. It incorporates the entire Western Planning Area, a large portion of the Central Planning Area, and the southwestern portion of the Eastern Planning Area. To date, all of the hydrocarbon production on the OCS in the Cenozoic Province is from sands ranging in age from Paleocene to Pleistocene (approximately 62-0.1 Mya).

C.1.2 Mesozoic Province

To date, the only discovered Mesozoic fields in the OCS are the Jurassic Norphlet (14 fields), Cretaceous James (9), and Cretaceous Andrew (1). BOEM identifies 24 plays in the Mesozoic Province: 3 proven and 21 conceptual (BOEM 2017a). Most of these fields are located in the northeastern portion of the Central Planning Area. The Mesozoic Province in the OCS extends eastward from the Cretaceous Shelf Edge off the coast of Mississippi, Alabama, and Florida towards the coastline of Florida. Most of this area, however, has experienced limited drilling, mainly on the shelf. In the area offshore of the Florida Panhandle (Pensacola and Destin Dome), a total of 34 wells have been drilled, with 18 of the wells penetrating the Norphlet Formation. The depths at which the Norphlet Formation is found in the Gulf Coast region vary from less than 5,000 ft (1,525 m) onshore to more than 24,000 ft (7,320 m) subsea offshore Mississippi and 15,000 ft (4,575 m) subsea in Apalachicola Embayment. This province has several potential Mesozoic hydrocarbon plays that are equivalents of onshore productive fields.

C.1.3 Deep Gas (Continental Shelf)

The sediments of the GOM are deposited mostly in deltaic environments of sands and shales, usually deposited as channel or delta front sands on the shelf. Shifting of the delta complex and ocean currents tend to widely disperse these sands laterally along the shelf. Drilling on the shelf targeted these sands as potential hydrocarbon accumulations. It was a general belief that, on the slope and abyssal fans, the sands gradually became less dense and less continuous farther from the proximity of the channels. The present-day shelf was once the slope environment during the Oligocene and

Miocene age (approximately 34-5.3 Mya). The shelf area holds the potential for deepwater delta systems with channels, distributary bars, levees, overbank deposits, and large fan lobes in the older and deeper section. Subsequent faulting and salt movement created traps and supplied conduits for the migration of hydrocarbons. It is anticipated that these older, deeper reservoirs will be more likely located adjacent to or under the present shelf fields. The shelf off the western and central Louisiana coast is also prospective for the older and deeper Mesozoic age reservoir rocks. These rocks would also be under extreme pressure and high temperatures because of their depth.

C.1.4 Deep Water (Continental Slope and Abyssal Plain)

The continental slope in the GOM extends from the shelf edge to approximately 2,000-m (6,562-ft) water depth (**Figure C.1-1**). The seafloor gradient on the slope varies from 3 to 6 degrees to over 20 degrees in places along the escarpments. At the base of the Cenozoic Province slope is an apron of thick sediment accumulation referred to as the continental rise. It gently inclines seaward into the abyssal plain. Bathymetric maps of the continental slope in the northwestern GOM (Bouma and Bryant 1994; Bryant et al. 1990) reveal the presence of over 105 intraslope basins with relief in excess of 150 m (492 ft), 28 mounds, and 5 major and 3 minor submarine canyons. These intraslope basins occupy much of the area of the continental slope.

The middle and lower portions of the Cenozoic Province continental slope contain a canopy of salt. The near-surface continental slope offshore Texas and Louisiana is the area of greatest concern with regard to submarine slope stability. Many slope sediments have been uplifted, folded, fractured, and faulted by diapiric action. Between diapirs (topographic highs) were fairways for sand-rich channels. Oversteepening on the basin flanks and resulting mass movements have resulted in highly overconsolidated sediments with extremely weak underlying sediments.

The construction of the Mississippi Canyon is in part a function of sidewall slumping and pelagic draping of low-shear-strength sediments. In contrast, slope oversteepening and subsequent mass movement have resulted in high pore pressures in rapidly deposited debris flows on the upper slope and on basin floors, resulting in unexpected decreased shear strengths. Biologically generated gas (from microbial activity) and thermally generated gas (from burial maturation) induce the accumulation of hydrates and underconsolidated gassy sediments, which are common on the upper slope. On the middle and lower slope, gassy sediments are uncommon except in basins that do not have a salt base, such as Beaumont Basin; the salt canopy restricts the upward movement of gas from below.

Seismic interpretation and drilling in the deep waters of the GOM over the last few decades have proven that prolific sands can be deposited in the slope environment and probably on the abyssal plain. Some of the largest fields in the GOM (i.e., Thunder Horse in Mississippi Canyon Block 778, Mad Dog in Green Canyon Block 826, Mars in Mississippi Canyon Block 807, Ursa in Mississippi Canyon Block 810, Auger in Garden Banks Block 426, Ram-Powell in Viosca Knoll Block 956, etc.) have hydrocarbon accumulations in sands deposited in the slope environment. Gas hydrates are a naturally occurring “ice-like” combination of natural gas and water (gas trapped in ice crystals) that have the potential to be a significant new source of energy from the world's oceans and polar regions. The gas hydrates form under low temperature and high pressure when natural gas comes into association with water, such as in the deep waters of the continental margins of the GOM.

CSA Ocean Sciences Inc et al. (2019) provides geospatial and resource summaries of the large submarine canyons in the Gulf of Mexico OCS, including Alaminos, Keathley, Perdido, Mississippi, and De Soto Canyons. The submarine canyons along the Sigsbee Escarpment (i.e., Alaminos, Keathley, Bryant, Cortez, Farnella, and Green Canyons) are the result of the coalescing of salt canopies, migration of the salt over the abyssal plain, and erosion of the escarpment during periods of low-stand sea level (Bouma and Bryant 1994). In addition to these large submarine canyons, numerous small submarine canyons and gullies and large slumps occur along the escarpment. Submarine fans of various sizes extend seaward of the canyons onto the continental rise. "Growth faults," which form with rapid accumulation of massive volumes of sediments, are found mostly on the outer shelf and upper slope where sediment accumulation is thickest (Rowan et al. 1999). Faulting resulting from the formation of salt diapirs is the most common type of faulting on the upper slope. On the middle and lower continental slope, faulting related to salt-stock and salt canopies is the most common type of faulting. Extensive faulting is present along the middle and lower continental slope. These faults are extensional faults caused by the upward movement of salt resulting from pressures created by sediment accumulation within basins. This type of faulting results in the occurrence of a large number of small faults in the area of the seafloor undergoing extension. In some areas of the slope, the upward migration of salt results in the seafloor being extensively fractured (i.e., faulted) and continuously displaced.

Portions of some of the submarine canyons (e.g., Bryant Canyon) are being filled with salt. Turbidity current flows that are active during times of low-stand sea level create the canyons. Subsequently, sediments that accumulate on the margins of the canyon create a differential loading on the salt, causing the salt to migrate into the canyon. The migration of salt into the canyon can occur at a rate of centimeters or inches per year. On the middle and lower continental slope, salt may occur very close to the seafloor. For example, on the salt plug called "Green Knoll," salt is exposed at the seafloor and is being dissolved by seawater, resulting in the collapse of the cap of the knoll. In the intraslope-interlobal Orca Basin, salt is exposed at the bottom of the northern portion of the basin forming a well-documented brine pool.

The most prolific play in the deepwater continental slope is identified to be the deposits of basin-floor fan environment ranging in age from Oligocene to Pleistocene. Recent drilling near the Sigsbee Escarpment indicates a large potential of hydrocarbons associated with the emerging Paleogene (Paleocene-Oligocene) Play. Relative to the thoroughly explored, mature plays on the shelf, plays on the slope and abyssal plain are estimated to have the most undiscovered resources, with Lower Tertiary sediments containing the highest potential for future discoveries (BOEM 2017b).

Also, efforts are made to assess natural gas resource potential from hydrates in the GOM. BOEM has a three-pronged effort regarding methane hydrates, focusing on (1) resource assessment and evaluation; (2) environmental assessment, protection, and monitoring; and (3) exploration and production activities, including offshore safety.

Hydrates have been observed and sampled from the Gulf of Mexico OCS in association with naturally occurring oil and gas seeps in localized deepwater areas of very cold temperature and high pressure at or near the seafloor. On the GOM and the Atlantic OCS, hydrates have been studied for two decades by academia, the oil industry, and BOEM. Naturally occurring seep features, including hydrates, result in higher seismic amplitude (higher reflectivity). Most hydrate occurrences in the GOM are associated with deep-seated faulting, which penetrates the seafloor. These faults provide migration pathways for gas to reach the zone where hydrates are stable. The geothermal gradient increases with depth, allowing ideal temperatures only in the upper couple thousand feet of sediments for hydrates to be stable.

C.1.5 Geologic Hazards

The seafloor geology of the GOM reflects the interplay between episodes of diapirism, mass sediment movement, and sea-level fluctuations. Geologic features on most of the continental shelf (shoreline to about 200-m [656-ft] water depth) are simple and uniform. The main hazards in this area are faulting, shallow-gas pockets, and buried channels. Deepwater regions in the GOM have complex regional salt movement, both horizontal and vertical, which makes it a unique ocean basin. This movement alters the seafloor topography, forming sediment uplifts, mini-basins, and canyons. Salt moves horizontally like a glacier and can be extruded to form salt tongues, pillows, and canopies below an ever-increasing weight of sediment. Vertical salt forms range from symmetric bulb-shaped stocks to walls. While salt creates traps that are essential to petroleum accumulation, salt movement can cause potential hazards such as seafloor fault scarps, slumping from steep unstable slopes, shallow gas pockets, seeps and vents, and rocky or hard bottom areas. Gas hydrates (gas trapped in ice crystals) have been found in the GOM in localized deepwater areas of very cold temperature and high pressure at or near the seafloor. Gas hydrates can rapidly dissociate when heated or otherwise disturbed (e.g., by an anchor) and cause sediment instability. Although the GOM has had no drilling incident associated with hydrates, they are a problem in other parts of the world. The Mississippi River delta presents a unique set of geologic hazards because of high sedimentation rates, which cause very unconsolidated, high-water-content, and low-strength sediments. Under these conditions, the sediments can be unstable, and slope failure or mass transport of sediments can result. These failures can be triggered by cyclic loading associated with hurricanes, overloading or oversteepening of the slope sediments, or uplift associated with movement of salt. These failures can form mudflow gullies, overlapping mudflow lobes, collapse depressions, slumps, and slides. Small, buried river channels can result in differential sediment compaction and pose a hazard to jack-up rigs.

Over-pressure conditions in a sedimentary section can result from loading by rapid deposition, sand collapse, in-leaking gas, or salt tectonics. Drilling through an over-pressured, shallow-gas pocket can cause loss of mud circulation or a blowout (a blowout occurs when improperly balanced well pressure results in sudden uncontrolled release of fluids from a well bore or well head). A shallow water flow can cause similar drilling problems. Over-pressured conditions can develop in deep water when "water sand" is trapped by a shale seal. Over-pressured formation water may escape around or through the wellbore to the seafloor and wash out the well foundation. No shallow-water flow event in the GOM has resulted in an oil spill. Deep drilling may encounter abnormally high geopressures. Deep drilling may also encounter hydrogen sulfide, which can occur near salt domes overlain by caprock and is the product of sulfate-reducing microbes.

C.2 Physical Oceanography and Meteorology

The GOM is a semi-enclosed, subtropical sea with an area of approximately 1.5 million km^2 (371 million acres). The main physiographic regions of the Gulf Basin are the continental shelf (including the Campeche, Mexican, and U.S. shelves), continental slopes and associated canyons, abyssal plains, the Yucatan Channel, and Florida Straits. The continental shelf width along the U.S. coastline is about 10 mi (16 km) off the Mississippi River and 97 mi (156 km) off Galveston, Texas, decreasing to 55 mi (88 km) off Port Isabel near the Mexican border. The depth of the central abyss ranges to approximately 3,700 m (12,139 ft).

The relative humidity over the GOM is high throughout the year. Minimum humidity occurs during the late fall and winter when cold, continental air masses bring dry air into the northern GOM. Maximum humidity occurs during the spring and summer when prevailing southerly winds bring in warm, moist air. The GOM is influenced by a maritime subtropical climate controlled mainly by the clockwise circulation around the semi-permanent area of high barometric pressure commonly known as the Bermuda High. The GOM is located to the southwest of this center of circulation. This proximity to the high-pressure system results in a predominantly southeasterly wind flow in the GOM region. Two important classes of storms occasionally occur with this circulation pattern. During the winter months, cold fronts associated with cold air masses from land influence the northern coast of the GOM. Behind the fronts, strong north winds bring drier air into the region. Secondly, hurricanes may develop in or migrate into the GOM during the warmer months (refer to **Section C.3.1**).

The western extension of the Bermuda High dominates the circulation throughout the year, weakening in the winter and strengthening in the summer. The average monthly pressure shows a west to east gradient along the northern GOM during the summer. In the winter, the monthly pressure is more uniform along the northern GOM. The minimum average monthly pressure occurs during the summer.

The maximum pressure occurs during the winter as a result of the presence and influence of transitional continental cold air. Average air temperatures at coastal locations vary with latitude and exposure. Air temperature ranges from highs in the summer of 24.7-28.0°C (76.5-82.4°F) to lows in the winter of 2.1-21.7°C (35.8-71.1°F). Winter temperatures depend on the frequency and intensity of penetration by polar air masses from the north. Air temperatures over the open GOM exhibit narrower limits of variations on a daily and seasonal basis due to the moderating effect of the large bodies of water. The average temperature over the center of the GOM is about 29°C (84°F) in the summer and between 17 and 23°C (63 and 73°F) in the winter.

C.2.1 Currents

The Loop Current, the dominant circulation feature in the GOM, enters through the Yucatan Channel and exits through the Florida Straits. The sill depth at the Florida Straits is about 700 m (2,300 ft); the effective sill depth at the Yucatan Channel is nearly 2,000 m (6,560 ft) (Badan Jr. et al. 2005). Water masses in the Atlantic Ocean and Caribbean Sea that occur at greater depths cannot enter the GOM. The Loop Current is a part of the western boundary current system of the North Atlantic. This is the principal current and source of energy for the circulation in the Gulf of Mexico. The Loop Current has a mean area of 142,000 km^2 (35 million acres) (Hamilton et al. 2000). It may be confined to the southeastern GOM or it may extend well into the northeastern or north-central GOM, with intrusions of Loop Current water northward and on to the West Florida Shelf (Vukovich 2005). Closed rings of clockwise-rotating (anticyclonic) water, called Loop Current eddies (LCEs), separate from the Loop Current at intervals of 5 to 19 months (Vukovich 2005). These LCEs are also called warm-core eddies since they surround a central core of warm Loop Current water (**Figure C.2.1-1**). The Loop Current usually penetrates about as far north as 27°N. latitude just prior to shedding an LCE (Vukovich 2005).

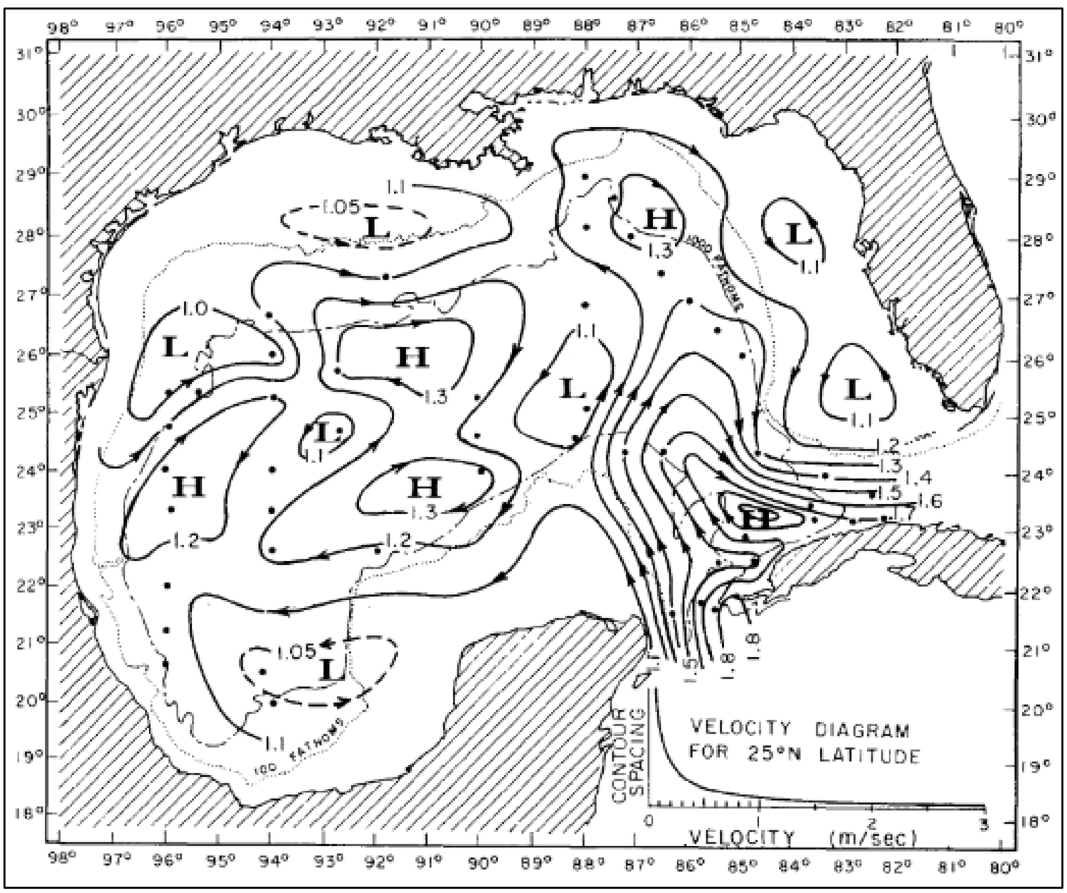


Figure C.2.1-1. Relative Surface Circulation Patterns in the Gulf of Mexico (Adapted from Figure 1-3 in Nowlin Jr. (1972).

Studies on the frequency of Loop Current intrusions into the eastern Gulf and the frequency of LCE separation (Sturges 1994; Vukovich 2005) suggest these are chaotic processes. Currents associated with the Loop Current and its eddies extend to at least depths of 700 m (2,300 ft), the sill depth of the Florida Straits, and geostrophic shear is observed to extend to the sill depth of the Yucatan Channel. These features may have surface speeds of 150-200 centimeters/second (cm/s) (59-79 inches/second [in/s]) or more; speeds of 10 cm/s (4 in/s) are not uncommon at a depth of 500 m (1,640 ft) (Cooper et al. 1990). The average diameter of warm-core eddies is about 200 km (124 mi), and they may be as large as 400 km (249 mi) in diameter. Warm-core eddies can have life spans of 1 year or more (Elliott 1982). Therefore, their effects can persist at one location for long periods—weeks or even months (e.g., PREFIX) (Nowlin Jr. et al. 1998). After separation from the Loop Current, these eddies often translate westward across the GOM at a speed of about 5 km/day (3 mi/day) (range 1-20 km/day [0.6-12.4 mi/day]). Energetic, high-frequency currents have occurred when LCEs flow past structures, but they are not well documented. Such currents would be of concern to offshore operators because they could induce structural fatigue of materials. The LCEs decay and generate secondary cyclones and anticyclones (Science Applications International Corporation 1989) by interactions with boundaries, ring shedding, and ring-ring interactions. Consequently, the GOM is typically populated with numerous eddies, which are interacting with one another and with the margins (Hamilton and Lee 2005; Science Applications International Corporation 1989).

Cold-core cyclonic (counter-clockwise rotating) eddies have been observed in the study region as well (**Figure C.2.1-1**). These cyclones are often cold-core eddies since they surround a central core of seawater that is cooler and fresher than adjacent waters. Cyclonic circulation is associated with upwelling, which brings cooler, deeper water towards the surface. A cyclone will form north of an LCE encountering northern GOM bathymetry because of off-shelf advection (Frolov et al. 2004). Cyclones are also associated with the Loop Current (Schmitz Jr. 2005). Small cyclonic eddies around 50-100 km (31-62 mi) in diameter have been observed over the continental slope off Louisiana (Ross et al. 2012). These eddies can persist for 6 months or longer and are relatively stationary.

Near the bottom of the Loop Current, velocities are low and fairly uniform in the vertical although with bottom intensification, a characteristic of Topographic Rossby Waves (TRWs). This indicates that the Loop Current is a source of the TRWs, which are a major component of deep circulation below 1,000 m (3,281 ft) in this part of the GOM (Hamilton 1990; Science Applications International Corporation 1989; Sturges et al. 1993). Exchange of surface and deep water occurs with descent of surface water beneath the Loop Current in the eastern GOM and with the ascent of deep water in the northwestern GOM where LCEs spin down (Welsh and Inoue 2002). The Sturges et al. (1993) model suggests a surprisingly complex circulation pattern beneath LCEs, with vortex-like and wave-like features that interact with the bottom topography (Welsh and Inoue 2000). These model findings are consistent with Hamilton's (1990) interpretation of observations. Occasionally currents have been directly measured at abyssal depths exceeding 3,000 m (9,843 ft) in the GOM. The major low-frequency fluctuations in velocity of these currents in the bottom 1,000-2,000 m (3,281-6,562 ft) of the water column have the characteristics of TRWs. These long waves have wavelengths of 150-250 km (93-155 mi), periods greater than 10 days, and group velocities estimated at 9 km/day (9 mi/day). They are characterized by columnar motions that are intensified near the seafloor. They move westward at higher group velocities than the translation velocity of 3-6 km/day (2-4 mi/day) that is typical of anticyclonic eddies. The Loop Current and LCEs are thought to be major sources of these westward propagating TRWs (Hamilton 1990; Oey and Zhang 2004).

These TRWs transition from short to longer period in going from east to west over the GOM basin, probably because of bottom slope and regional bathymetric conditions (Donohue et al. 2008).

Deepwater GOM Currents

In general, past observations of currents in the deepwater GOM have revealed decreases in current speed with depth. During late 1999, a limited number of high-speed current events, at times approaching 100 cm/s (39 in/s), were observed at depths exceeding 1,500 m (4,921 m) in the northern GOM (Hamilton and Lugo-Fernandez 2001; Hamilton et al. 2003). Furrows oriented nearly parallel to depth contours have been observed recently in the region of 90°W. longitude just off the Sigsbee Escarpment and near the Bryant Fan, south of Bryant Canyon, from 91° to 92.5° W. longitude. Depths in those regions range from 2,000 to 3,000 m (6,562 to 9,843 ft). It is hypothesized that near-bottom speeds of currents responsible for the furrows that are closest to shore might be 50 cm/s (20 in/s), possibly in excess of 100 cm/s (39 in/s), and that these currents may be oriented along isobaths and increase in strength toward the escarpment. These currents might be sporadic or quasi-permanent. Mean deep (~2,000 m [~6,562 ft]) flow around the edges of the GOM circulates in a cyclonic (counterclockwise) direction (Sturges et al. 2004). A net counterclockwise circulation pattern was also observed at about 900-m (2,953-ft) depth around the borders of the GOM (Weatherly 2004). In deep water, several oil and gas operators have observed very high-speed currents in the upper portions of the water column. These high-speed currents can last as long as a day. Such currents may have vertical extents of less than 100 m (328 ft), and they generally occur within the depth range of 100-300 m (328-984 ft) in total water depths of 700 m (2,297 ft) or less over the upper continental slope. Maximum speeds exceeding 150 cm/s (59 in/s) have been reported. The mechanisms by which these currents are generated may include motions derived from the Loop Current and associated eddies, motions due to eddy-eddy and/or slope-shelf/eddy interaction, internal/inertial wave motions, instabilities along eddy frontal boundaries, and biases in the data record related to instrument limitations (DiMarco et al. 2004).

The major large-scale permanent circulation feature present in the western and central GOM is an anticyclonic (clockwise-rotating) feature oriented about east-northeast to west-southwest with its western extent near 24°N. latitude off Mexico. There has been debate regarding the mechanism for this anticyclonic circulation and the possible associated western boundary current along the coast of Mexico. Elliott (1982) attributed LCEs as the primary source of energy for the feature, but Sturges et al. (1993) argued that wind stress curl over the western GOM is adequate to drive an anticyclonic circulation with a western boundary current. Sturges et al. (1993) found annual variability in the wind stress curl corresponding to the strongest observed boundary current in July and the weakest in October. Based on ship-drift data, Sturges et al. (1993) reported the maximum northward surface speeds in the western boundary current were 25-30 cm/s (10-12 in/s) in July and about 5 cm/s (2 in/s) in October; the northward transport was estimated to vary from 2.5 to 7.5 m^3/s. Sturges et al. (1993) reasoned that the contribution of LCEs to driving this anticyclonic feature must be relatively small.

Others have attributed the presence of a northward flow along the western GOM boundary to ring-slope-ring interactions (Vidal et al. 1999).

C.2.2 Wind

In coastal areas, the sea breeze effect may become the primary circulation feature during the summer months of May through October. The primary wind pattern moves from shore to offshore, transporting air pollutants from land to offshore areas. In general, however, the subtropical maritime climate is the dominant feature in driving all aspects of the weather in this region; as a result, the climate shows very little diurnal or seasonal variation. Tropical conditions normally prevail over the GOM from May to November. Wind events such as cold-air outbreaks can also result in extreme waves and current speeds over the continental shelf. Surface waves and sea state can occasionally limit normal oil and gas operations as well as oil-spill response activities (Fingas and Fieldhouse 2003; French-McCay et al. 2005).

Winds are more variable near the coast than over open waters because coastal winds are more directly influenced by the moving cyclonic storms that are characteristic of the continent and because of the land and sea breeze regime. During the relatively constant summer conditions, the southerly position of the Bermuda High generates predominantly southeasterly winds, which become more southerly in the northern Gulf of Mexico. Winter winds usually blow from easterly directions with fewer southerlies but more northerlies. Precipitation is frequent and abundant throughout the year but does show distinct seasonal variation. Stations along the entire coast record the highest precipitation values during the warmer months of the year. The warmer months usually have convective cloud systems that produce showers and thunderstorms (NOAA 2020d). The month of maximum rainfall for most locations is July. Winter rains are associated with the frequent passage of frontal systems through the area. Rainfalls are generally slow, steady, and relatively continuous, often lasting several days. Snowfalls are rare, and when frozen precipitation does occur, it usually melts on contact with the ground. Incidence of frozen precipitation decreases with distance offshore and rapidly reaches zero.

Warm, moist GOM air blowing slowly over chilled land or water surfaces brings about the formation of fog. Fog occurrence decreases seaward, but visibility has been less than 800 m (2,625 ft) due to offshore fog. Coastal fogs generally last 3-4 hours, although particularly dense sea fogs may persist for several days. The poorest visibility conditions occur during winter and early spring. The period from November through April has the lowest visibility. Industrial pollution and agricultural burning also impact visibilities. The mixing height is very important because it determines the volume available for dispersing pollutants. Because the mixing height is directly related to vertical mixing in the atmosphere, a mixed layer is expected to occur under neutral and unstable atmospheric conditions. The mixing height tends to be lower in winter, and daily changes are smaller than in summer.

> ***Mixing height*** *is the height of vertical mixing of air and suspended particles above the ground, which is largely driven by the vertical temperature profile of the air.*

The GOM is part of the Atlantic tropical cyclone basin. Tropical cyclones generally occur in summer and fall seasons; however, the Gulf of Mexico also experiences winter storms or extratropical storms. These winter storms generally originate in middle and high latitudes and have winds that can attain speeds of 9-50.5 knots (kn) (11.2-58.2 miles per hour [mph]). The GOM is an area of cyclone development during cooler months due to the contrast of the warm air over the GOM and the cold continental air over North America. Cyclogenesis, or the formation of extratropical cyclones, in the GOM is associated with frontal overrunning (Hsu 1991). The most severe extratropical storms in the GOM originate when a cold front encounters the subtropical jet stream over the warm waters of the Gulf of Mexico. Statistics of 100-year data of extratropical cyclones reveal that most activity occurs above 25°N. latitude in the western GOM. The mean number of these storms range from 0.9 near the southern tip of Florida to 4.2 over central Louisiana (Florida A&M University 1988).

The frequency of cold fronts in the GOM exhibits similar patterns during the four-month period of December through March. During this time the area of frontal influence reaches 10°N. latitude. Frontal frequency is about nine fronts per month (1 front every 3 days on the average) in February and about seven fronts per month in March (1 front every 4-5 days on the average). By May, the frequency decreases to about four fronts per month (1 front every 7-8 days) and the region of frontal influence retreats to about 15°N. latitude. During June-August, frontal activity decreases to almost zero and fronts seldom reach below 25°N. latitude (Florida A&M University 1988).

In 2020, BOEM published a study, conducted by the National Renewable Energy Laboratory, which provided a feasibility assessment for offshore renewable energy technologies (Musial et al. 2020). **Figure C.2.2-1** illustrates average annual wind speeds over the gross resource potential area. The GOM's gross offshore wind capacity potential is the amount of power that could be produced in the GOM before technology filters, economic filters, or siting considerations (e.g., areas where protected species migrate and shipping lanes) are applied.

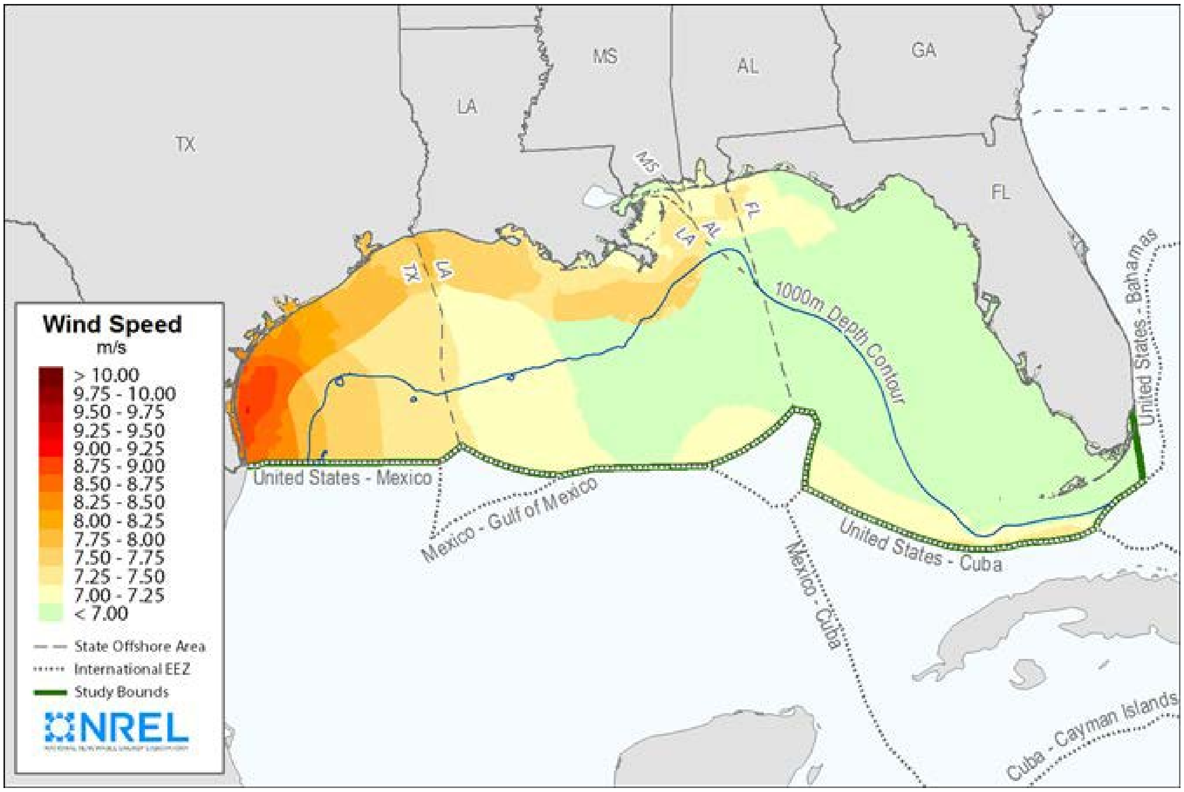


Figure C.2.2-1. Average Annual Wind Speeds at a Hub Height of 100 m (328 ft) in the Gulf of Mexico for the Gross Resource Area.

C.2.3 Water Temperature

Cold fronts, as well as diurnal and seasonal cycles of heat flux at the air/sea interface, affect near-surface water temperatures, although water at depths greater than about 100 m (328 ft) remains unaffected by surface boundary heat flux. Water temperature is greater than air temperature at the air/sea interface during all seasons. Frontal passages over the region can cause changes in temperature and velocity structure in the upper layers, specifically increasing current speeds and variability. These fronts tend to occur with frequencies from 3 to 10 days (weatherband frequency). In the winter, the shelf water is nearly homogeneous due to wind stirring and cooling by fronts and winter storms.

Continental shelf waves may propagate along the continental slopes of the GOM. These are long waves similar to TRWs, but their energy is concentrated along a sloping bottom with shallow water to the right of the direction of propagation and, because of this constraint, they are effectively “trapped” by the sloping bottom topography. Cold water from deeper off-shelf regions moves onto and off of the continental shelf by cross-shelf flow associated with upwelling and downwelling processes.

A class of energetic surface currents previously unreported in the GOM were found over the Texas and Louisiana shelves during the Texas-Louisiana Shelf Circulation and Transport Process (LATEX) program of the early 1990s (Nowlin Jr. et al. 1998). July 1992 observations in 200 m (656 ft) water offshore of Louisiana were of maximum amplitudes of 40-60 cm/s (16-27 in/s) at a depth of 12 m

(39 ft) during conditions of light winds. The period of diminished amplitudes followed an atmospheric frontal passage. These are near-circular, clockwise-rotating oscillations with a period near 24 hours. They seem to be an illustration of thermally induced cycling (DiMarco et al. 2000) in which high-amplitude rotary currents can exist in thin mixed layers typical of summer. By contrast, December 1992 measurements evidence no such behavior. Many examples of such currents, in phase at distinct locations, exist for the Texas-Louisiana shelf and, by implication, farther offshore. Currents at a depth of 1 m (3 ft) have been observed to reach 100 cm/s (40 in/s). In deepwater regions of the GOM, clearly episodic wind events can cause major currents in the deep waters of the Gulf of Mexico. The initial currents give rise to inertial oscillations with decreasing amplitudes, which last for up to about 10 days and are superimposed on longer period signals.

Inner-shelf currents on the Louisiana-Texas continental shelf flow in the downcoast (south or west) direction during non-summer months, reversing to upcoast flow in the summer (Nowlin Jr. et al. 2005). Monthly averaged alongshore currents on the outer shelf are upcoast in the mean but showed no coherent pattern in the annual signal and were not often in the same alongshore direction at different outer-shelf locations (Nowlin Jr. et al. 1998). Mean cross-shelf geostrophic transport observed at the Louisiana-Texas shelf break was offshore during the winter (particularly in the upper 70 m [230 ft] of the water column) and onshore during the summer (Current and Wiseman Jr. 2000).

Circulation on the continental shelf in the northeastern GOM has been observed to follow a cyclonic pattern, with westward alongshore currents prevailing on the inner and middle shelf and opposing alongshore flow over the outer shelf and slope (Brooks et al. 1991). Inner shelf currents are primarily wind driven and are also influenced by river outflow and buoyancy forcing from water discharged by the Mississippi, Apalachicola, Tombigbee, Alabama, and other rivers in the region. Cold water from deeper off-shelf regions moves on and off the continental shelf by cross-shelf flow associated with upwelling and downwelling processes. Upwelling of nutrient rich, cold water onto the shelf in 1998 was correlated with hypoxia, anoxia, and mass mortalities of fishes and invertebrates in the region, although causation has not been established (Collard and Lugo-Fernández 1999).

Mean circulation on the West Florida inner shelf tends to be along the coast towards the southeast during the winter and reverses to be along the coast towards the northwest during the summer. These seasonal means in flow direction are because of the influence of seasonal local winds and heat flux forcing. Midshelf flow (around the 50-m [164-ft] isobath) can be in the opposite direction from inner shelf flow on the broad, gently sloping West Florida shelf because of the partial closure imposed by the Florida Keys to the south. The outer shelf is an area of transition between deepwater currents over the continental slope and the shelf regime. The nearshore regions are influenced by freshwater outflow from rivers and estuaries. Mississippi River water is advected onto the West Florida shelf at times in spring and summer because of strong currents along the shelf break. Fresh water from the Mississippi River is sometimes entrained by the Loop Current as well (Liu and Weisberg 2012).

Water mass property extremes are closely associated with specific density surfaces. Summer heating and stratification affect continental-shelf waters in the GOM. Salinity is generally lower nearshore, although fresh water from the Mississippi and other rivers occasionally moves into outer shelf waters. Freshwater intrusions further lower the salinity after local storms. Subsurface waters derive from outside the Gulf of Mexico and enter from the Caribbean Sea through the Yucatan Channel. Below about 1,800 m (5,906 ft), temperature and salinity across the GOM is relatively uniform (Nowlin Jr. 1972).

C.3 NATURAL EVENTS AND PROCESSES

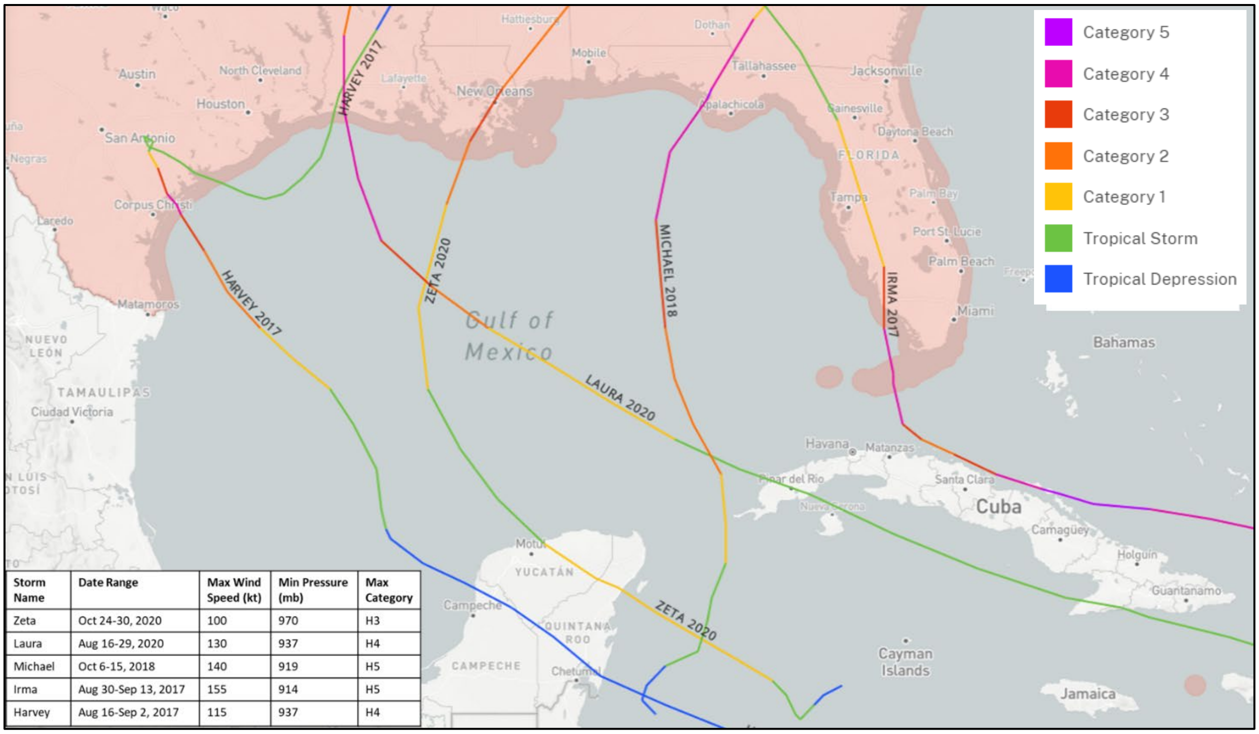
C.3.1 Major Storms

Tropical cyclones (especially hurricanes) affecting the Gulf of Mexico originate over the equatorial portions of the Atlantic Ocean, Caribbean Sea, and GOM. Tropical cyclones occur most frequently between June and November. Based on 50 years of data, there are about 10.2 storms per year with about 5.9 of those becoming hurricanes in the Atlantic Ocean. Data from 1950 to 2000 show that 81 percent of these storms could affect the GOM (Klotzbach et al. 2020). The Yucatan Channel is the main entrance of Atlantic storms into the GOM, and a reduced translation speed over Gulf of Mexico waters leads to longer residence times in this basin.

There is a high probability that tropical storms will cause damage to physical, economic, biological, and social systems in the Gulf of Mexico. Tropical storms also affect OCS operations and activities; platform design needs to consider the storm surge, waves, and currents generated by tropical storms. Most of the damage is caused by storm surge, waves, and high winds. Storm surge depends on local factors, such as bottom topography and coastline configuration, and storm intensity. Water depth and storm intensity control wave height during hurricane conditions. Sustained winds for major hurricanes (Saffir-Simpson Category 3 and above) are higher than 95.2 kn (109.6 mph).

Tropical cyclones (especially hurricanes) and extra tropical cyclones can result in extreme waves and cause currents with speeds of 100-150 cm/s (40-59 in/s) over the continental shelves. Brooks (1983; 1984) measured the effects of such phenomena down to depths of 700 m (2,297 ft) over the continental slope in the northwestern Gulf of Mexico. Hurricanes can trigger a series of internal waves with near inertial period. Waves as high as 91 ft (28 m) were measured under Hurricane Ivan (Wang et al. 2005). Tropical cyclones may develop or migrate into the GOM during the warmer months. These storms may affect any area of the GOM and substantially alter the local wind circulation around them.

There were 22 major hurricanes (Category 3 or higher at landfall) that impacted the Gulf Coast from 2000 through 2020. Hurricanes Katrina (2005) and Rita (2005) are notable historic major hurricanes, while more recent major storms include Hurricanes Harvey (2017), Irma (2017), Michael (2018), Laura (2020), Zeta (2020), and Ida (2021) (**Figure C.3.1-1**). In terms of accumulated cyclone energy, which measures the strength and duration of tropical storms and hurricanes, activity in the North Atlantic, Caribbean Sea, and GOM in 2021 was above average, about 20 percent above the long-term mean (NOAA 2020c).



Storm Name	Date Range	Max Wind Speed (kt)	Min Pressure (mb)	Max Category
Zeta	Oct 24-30, 2020	100	970	H3
Laura	Aug 16-29, 2020	130	937	H4
Michael	Oct 6-15, 2018	140	919	H5
Irma	Aug 30-Sep 13, 2017	155	914	H5
Harvey	Aug 16-Sep 2, 2017	115	937	H4

Figure C.3.1-1. Major Hurricanes Making U.S. Landfall along the Gulf Coast Between 2015 and 2020 (NOAA 2020b). Note: Hurricane Ida data not available.

The following summaries of each are provided from the National Oceanic and Atmospheric Administration (NOAA), National Hurricane Center's tropical cyclone reports. The National Hurricane Center's reports can be searched for all category storms online at http://www.hurricanes.gov/data/tcr/index.php?season=2020&basin=atl.

Hurricane Katrina was one of the costliest and deadliest hurricanes to ever strike the U.S. and caused a wide swath of catastrophic damage and inflicted large loss of life. There was also a significant storm surge west of the path of the eye of Hurricane Katrina. The level of Lake Pontchartrain rose; a 12- to 16-ft (4- to 5-m) storm surge pushed several feet of water into the northeastern shore of St. Tammany Parish. A storm surge of 15-19 ft (5-6 m) occurred in eastern New Orleans, St. Bernard Parish, and Plaquemines Parish, Louisiana. This storm surge severely strained the levee system in the New Orleans area, and several of the levees and floodwalls were overtopped and/or breached. About 80 percent of the city of New Orleans flooded up to 20 ft (6 m). The most significant damage and loss of life was inflicted in Louisiana and Mississippi, and significant effects also extended into the Florida Panhandle, Georgia, and Alabama (Knabb et al. 2005).

Less than a month after Hurricane Katrina, Hurricane Rita impacted the Gulf Coast States and OCS-related infrastructure. The following information on Hurricane Rita is from the *Tropical Cyclone Report: Hurricane Rita, 18-26 September 2005* by the National Hurricane Center. Like Hurricane Katrina, Hurricane Rita was an intense hurricane that reached Category 5 strength over the central GOM and weakened prior to making landfall as a Category 3 hurricane near the Texas/Louisiana border (Knabb et al. 2006).

Hurricane Rita also produced significant storm surge. This storm surge devastated coastal communities in southwestern Louisiana, an area very vulnerable to surge. Storm surge ranged from 12-18 ft (3.7-5.5 m) in Cameron, Louisiana (National Weather Service 2022). Water was also pushed into Calcasieu Lake, flooding portions of communities along its shoreline, such as Grand Lake, with a storm surge of at least 8 ft (2 m). The surge then propagated up the Calcasieu River and flooded portions of the Lake Charles area. Flood waters in downtown Lake Charles were as deep as 6 ft (2 m). Farther east, most or all of Vermillion, Iberia, and St. Mary Parishes were inundated by the storm surge, visually estimated at 8-12 ft (2-4 m) in some of these areas. Hurricane Rita also produced storm surges of 4-7 ft (1-2 m) in coastal areas of southeastern Louisiana, flooding some areas already impacted by Hurricane Katrina. It took until early October to remove all floodwaters from the New Orleans area following these two storms (Knabb et al. 2006).

Hurricane Harvey made landfall on the northern end of San Jose Island, Texas, on August 25, 2017, with estimated sustained winds of 132 mph (115 kn) (**Figure C.3.1-1**). The hurricane then made a second landfall on the Texas mainland 3 hours later, slightly weaker due to land interaction. The combined effect of the surge and tide produced maximum inundation levels of 6-10 ft (2-3 m) above ground level to the north and east of Harvey's center landfalls in Texas in the back bays between Port Aransas and Matagorda, including Copano Bay, Aransas Bay, San Antonio Bay, and Matagorda Bay. Copano Bay, where Hurricane Harvey made its second Texas landfall, also had significant storm surge flooding of 4-7 ft (1-2 m) above ground level. Harvey was the most significant tropical cyclone rainfall event in United States history, both in scope and peak rainfall amounts, since reliable rainfall records began around the 1880s. The highest storm total rainfall report from Harvey was 60.58 in (153.87 cm) near Nederland, Texas, with another report of 60.54 in (153.77 cm) near Groves, Texas. The latest NOAA damage estimate from Harvey is $125 billion, with the 90 percent confidence interval ranging from $90 to $160 billion. Harvey is responsible for at least 68 direct deaths in the United States, all in Texas. Over half of the deaths (36) were in Harris County in the Houston metro area. The mid-point of the estimate would tie Hurricane Katrina (2005) as the costliest United States tropical cyclone, which was also $125 billion (refer to https://www.ncdc.noaa.gov/billions/) (Blake and Zelinsky 2018).

Hurricane Irma made U.S. landfall in September 2017 as a Category 4 in the Florida Keys and struck southwestern Florida at Category 3 intensity (**Figure C.3.1-1**). The hurricane continued northward across central Florida with hurricane conditions decreasing in areal coverage near the Orlando and Tampa areas; however, tropical storm conditions were experienced on both the west and east coasts of the state, as well as in part of Georgia and South Carolina. Irma produced heavy rain across much of the State of Florida, and rainfall totals of 10-15 in (25-38 cm) were common across the peninsula and the Keys. In coastal Georgia, rainfall totals were generally between 5 and 10 in (13-25 cm), with major flooding in St. Simon's Island and along the Satilla River. Southwestern Florida experienced maximum storm surge levels of 6-10 ft (2-3 m) along the unpopulated coast between Cape Sable and Cape Romano, within Everglades National Park and the Ten Thousand Islands National Wildlife Refuge. Maximum inundation levels of 3-5 ft (1-2 m) above ground level occurred along the remainder of the southwestern coast of Florida from Marco Island northward through Naples to Ft. Myers. The east coast of Florida experienced maximum storm surge levels of 4-6 ft (1-2 m) around Miami-Dade County, especially along Biscayne Bay. In the U.S, 10 direct deaths were reported, and an additional 82 indirect deaths occurred, 77 of which were in Florida. Hundreds more were injured before, during, or after the hurricane. About 6 million residents in Florida were evacuated from coastal areas (Cangialosi et al. 2018).

Hurricane Michael made landfall as a Category 5 near Tyndall Air Force Base (AFB) in the Florida Panhandle, quickly weakening to a Category 3 shortly after landfall (**Figure C.3.1-1**). Maximum storm surge inundation heights were estimated at 9-14 ft (3-4 m) above ground level in the surrounding GOM counties near Tyndall AFB, with the highest inundation occurring in Mexico Beach. The storm center continued northeastward, eventually weakening to a tropical storm through North Carolina. Extratropical transition started as Michael moved into North Carolina, however, with the winds intensifying as it continued through North Carolina and eventually into Virginia. Storm surge flooding also occurred along portions of the North Carolina and Virginia coasts while Michael underwent extratropical transition, with localized maximum inundation heights of 2-4 ft (1-2 m) occurring in parts of the North Carolina sounds and Lower Chesapeake Bay. The storm eventually regained hurricane-force winds in October over the open ocean south of Nova Scotia and Newfoundland, followed by a sharp eastward motion and eventually dissipating just west of northern Portugal. Michael's track across the southeastern U.S. resulted in widespread rains of 3-6 in (6-15 cm) and localized rainfall totals in excess of 10 in (25 cm). The maximum storm total rainfall reported was 13.01 in (33.05 cm) near Black Mountain, North Carolina, while Lynn Haven, Florida, reported a storm total of 11.62 in (25.91 cm). The winds, storm surge, and rains of the hurricane directly caused 16 deaths: 7 in Florida, 5 in Virginia, 3 in North Carolina, and 1 in Georgia. Michael's passage across the Florida Panhandle and the remainder of the southeastern U.S. left a swath of destruction, the worst of which occurred in Mexico Beach and at Tyndall AFB. As of May 2019, NOAA's National Centers for Environmental Information had estimated the total damage from Michael in the U.S. alone at approximately $25 billion. Of this total, about $18.4 billion occurred in Florida (with about $3 billion of this on Tyndall AFB), $4.7 billion occurred in Georgia, and $1.1 billion occurred in southeastern Alabama, with smaller amounts of damage in South Carolina, North Carolina, and Virginia (Beven II et al. 2019).

Hurricane Laura formed on August 21, 2020, and became the first major hurricane of 2020 on August 26. Laura made landfall as a Category 4 storm on August 27, 2020, near Cameron, Louisiana, close to the Texas-Louisiana border, bringing catastrophic storm surge, extreme wind, and flash flooding. Laura made landfall with 150-mph (130-kn) winds, stronger than Hurricane Katrina in 2005, and tied with the Last Island hurricane of 1856 as the strongest to strike Louisiana. The remnants of Laura traveled through the mid-Mississippi Valley and brought heavy rain to the Mid-Atlantic States. Laura is responsible for four deaths in Louisiana (Pasch et al. 2021) and widespread property damage, especially in Lake Charles, Louisiana. Insured loss estimates by catastrophe modelers range from $4 billion to $12 billion (Insurance Information Institute Inc. 2020).

Hurricane Zeta formed on October 19, 2020, and became the last major hurricane of 2020 on October 26. Zeta made landfall as a Category 3 storm on October 28, 2020, near Cocodrie, Louisiana. Zeta made landfall with 115-mph (100-kn) winds and 6-10 ft (1.8-3 m) of storm surge. After landfall, the eye of Zeta traveled directly over New Orleans then into southern Mississippi, finally becoming a tropical storm just south of Tuscaloosa, Alabama. Zeta is responsible for five deaths in the U.S. and caused $4.4 billion in damage in the U.S. (Blake et al. 2021).

Hurricane Ida formed on August 14, 2021, off the coast of Africa, and became a hurricane on August 27, 2021. Ida made landfall as a Category 4 storm on August 29, 2021, near Port Fourchon, Louisiana, bringing catastrophic storm surge, extreme wind, and flash flooding. Ida made landfall with 150-mph (130-kn) winds (although unofficial records of instantaneous gusts of 223 mph [194 kn] and 173 mph [150 kn] exist), stronger than Hurricane Katrina in 2005, and tied with the Last Island hurricane of 1856 and Hurricane Laura as the strongest to strike Louisiana. The remnants of Ida traveled through the mid-Mississippi Valley and brought heavy rain to the Mid-Atlantic and Northeastern States. Ida is responsible for six deaths in Louisiana and widespread property damage, especially in southeast Louisiana. Damages due to Ida were $55 billion in Louisiana alone and $75 billion for the U.S. (Insurance Information Institute Inc. 2020).

C.3.2 Eutrophication and Hypoxia

Nutrients are elements that are essential to both plant and animal growth. Common nutrients include nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, and silicon. While nutrients are an essential component to healthy ecosystems, excess amounts of nutrients added to water bodies (sometimes called “eutrophication”) can create unintended side effects. Eutrophication occurs when excess nutrients cause an overproduction in the growth of aquatic plant life, usually resulting in the depletion of dissolved oxygen. Natural external sources include riverborne phytoplankton, organic detritus, and marginal vegetation, supplemented considerably by anthropogenic point sources and nonpoint sources (refer to **Section B.2.2.2.7** of **Appendix B**) that include sewage and some industrial effluents. Natural internal production sources include phytoplankton, macroalgae, and aquatic organism feces. The increase in loads of nutrients (nitrogen and phosphorus) to the marine environment stimulates the production of organic matter, principally in the form of phytoplankton and macroalgae. These blooms of harmful algae species can cause neurotoxic shellfish poisoning and respiratory problems in humans and other mammals (Kirkpatrick et al. 2004). **Figure C.3.2-1** provides a generalized depiction of eutrophication and its influence on aquatic environments.

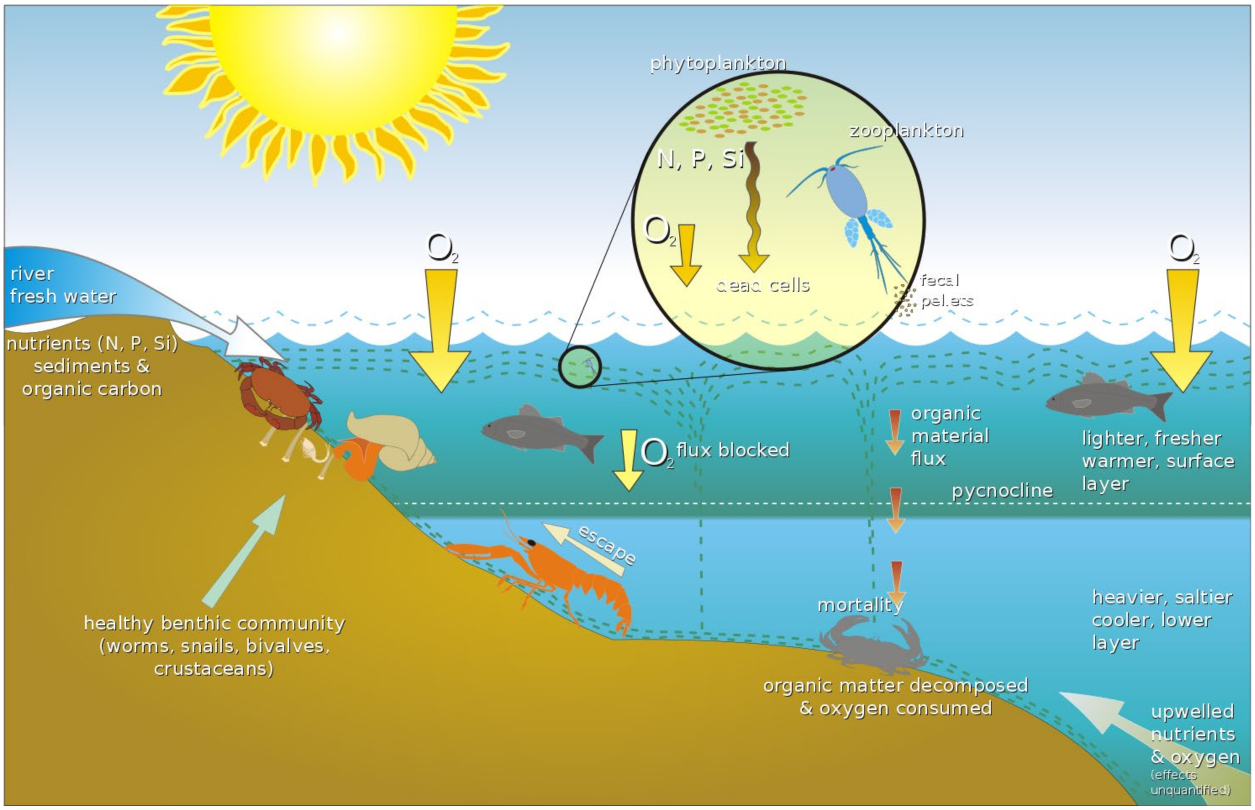


Figure C.3.2-1. Generalized Schematic of Eutrophication Cycle (Hillewaert 2006).

The Mississippi River basin drains 41 percent of the contiguous United States. The basin covers more than 1,245,000 mi^2 (3,224,535 km^2) and includes all or parts of 31 states and 2 Canadian provinces (USACE 2020). Dissolved pollutants, including nutrients, enter surface water within the Mississippi River basin via uncontained runoff and groundwater discharge (nonpoint sources).

The sources of nutrients in surface waters can be broadly divided as natural and anthropogenic. Natural sources are generally ubiquitous; however, their contribution is usually low because, over the course of time, natural systems have established balances between the production and consumption of nutrients. Anthropogenic sources arise from many activities. In the agricultural setting of the Mississippi River drainage basin, farmers increase the productivity and yield of their crops by use of chemical fertilizers. If more fertilizers are applied than are used by the crops, they can move into ground and surface waters and become a major source of nutrients in rivers. Additionally, fertilizer that is bound to soil or “loose” fertilizer may be subject to erosion by wind or water and affect surface waters. Information regarding nutrient management can be found on the U.S. Department of Agriculture’s Natural Resources Conservation Service website at https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/ecoscience/mnm/. Other major sources of nutrients in surface waters are domestic and animal wastes. Although municipal wastewater is treated, only a fraction of the nutrients is removed. In addition to the nutrients derived from human sewage, municipal wastewater also contains nutrients from such things as lawn fertilizers, household cleaners, and detergents. Other anthropogenic sources of nutrients are industrial, either from the manufacture of fertilizers or as by-products of other manufacturing processes (Antweiller et al. 1995).

At the basin scale, agricultural inputs (i.e., manure, fertilizer, and legume crops) were the largest total nitrogen source into the GOM (60% of the total), with farm fertilizers contributing 41 percent of that amount. Atmospheric deposition, which may include volatilized losses from natural, urban, and agricultural sources, contributed 26 percent; urban sources contributed about 14 percent (7% from urban areas and 7% from wastewater treatment plants) (USEPA 2017a).

Agricultural inputs (i.e., manure and fertilizers) were also the largest total phosphorus source into the GOM: 49 percent of the total, with 27 percent from chemical fertilizers and 22 percent from manure. Urban sources contributed 29 percent: 16 percent from urban areas and 13 percent from wastewater treatment plants. Background sources of phosphorus included erosion of channels and banks of large streams where phosphorus was previously deposited from other upstream sources (14%), deeply weathered loess soils (5%), and forests (3%) (USEPA 2017a).

Nutrient enrichment results in eutrophication, causing growth of algae (algal bloom) and other aquatic plants. A second effect of eutrophication is the increased uptake of dissolved oxygen by bacteria in response to higher concentrations of organic matter. If oxygen is taken up by decaying organic matter faster than it is imported from the atmosphere or produced by photosynthesis, it becomes depleted and the aquatic species that require it are adversely affected. Furthermore, oxygen depletion causes basic changes in the chemical environment (i.e., a reduced environment) that allow materials (including many metals) that were formerly associated with the solid phase sediments (e.g., sorbed) to become soluble and, therefore, more mobile in the aqueous phase (National Reseach Council 2003).

On October 21, 2014, the U.S. Department of the Interior and the U.S. Department of Agriculture announced a new partnership to strengthen the effectiveness of State and Federal nutrient-reduction strategies (USGS 2014). As a result of this and other efforts, states are beginning to impose Best Management Practices on growers within the Mississippi River basin to develop nutrient management plans, including fertilizer applicator certification programs, and monitoring to minimize excess nutrients from washing into waterways.

Oxygen enters the ocean at the air-sea boundary via exchange with the atmosphere. The main factors controlling oxygen concentrations in the water column are physical (temperature) and biological (respiration, photosynthesis, and bacterial decomposition). Nutrient overload to the marine environment can drive biological oxygen demand to exceed the oxygen content of the water. Low dissolved oxygen concentration (<2 milligrams/liter [mg/L]) is referred to as hypoxia.

"Hypoxia" occurs when the amount of dissolved oxygen in the water becomes too low to support most aquatic life (typically below 2 mg/L).

The GOM hypoxic zone is a band of oxygen-stratified water that stretches along the Texas-Louisiana shelf each summer where the dissolved oxygen concentrations are less than 2 mg/L (USEPA 2019). Other small hypoxic areas infrequently form at the discharge of smaller rivers along the Gulf Coast; however, in the GOM, the hypoxic zone resulting from the Mississippi and Atchafalaya Rivers is by far the predominant feature. The hypoxic zone is the result of excess nutrients, primarily nitrogen, carried downstream by rivers to discharge to coastal waters. Density stratification results where the less dense, nutrient-rich freshwater spreads on top of the denser seawater and prevents oxygen from replenishing the bottom waters. The excess nutrients cause phytoplankton blooms that eventually die and sink to the bottom, where bacterial decomposition consumes dissolved oxygen. The oxygen-depleted bottom waters occur seasonally and are affected by the timing of the Mississippi and Atchafalaya Rivers' discharges carrying nutrients and freshwater to shelf surface waters. Hypoxic zones are sometimes called "dead zones" because of the absence of commercial quantities of shrimp and fish in the bottom layer.

The hypoxic zone on the Louisiana-Texas shelf is the largest such zone in the United States and the entire western Atlantic Ocean (Rabalais et al. 2010). The Louisiana Universities Marine Consortium generally forecasts the seasonal maximum size of the Louisiana-Texas hypoxic zone based on nitrogen loading in the Mississippi River (as measured in May of each year), and the actual size reported is based on cruise data collected by the Louisiana Universities Marine Consortium in July of each year. The 2021 area of low oxygen was larger than the average measured over the past 5 years. In 2021, the area was measured as 6,334 mi^2 (16,405 km^2), which was larger than the forecasted size of 4,880 mi^2 (12,639 km^2) (**Figure C.3.2-2**) (NOAA 2021).

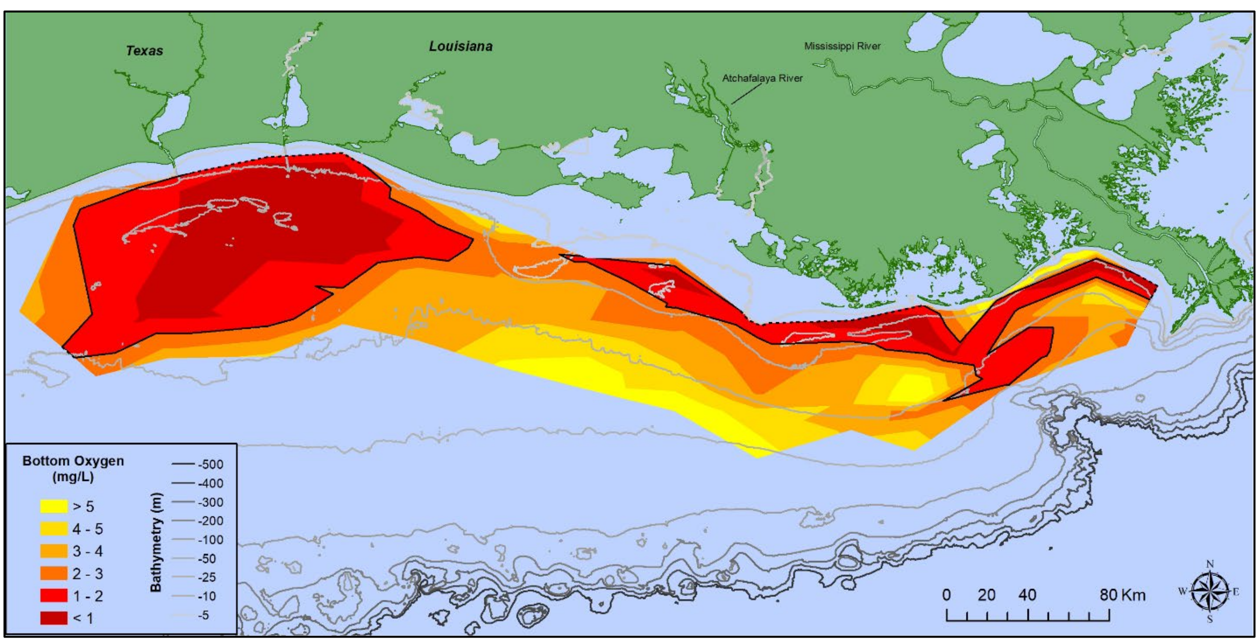


Figure C.3.2-2. 2021 Gulf of Mexico Hypoxic Zone (Louisiana State University 2021).

Rabalais (2005) and Bierman et al. (2008) evaluated the potential contributions of carbon and nitrogen in discharged produced waters on the hypoxic zone. Both studies found that the effects due to produced water from OCS oil- and gas-related activities were minimal compared with those of the Mississippi River. As such, the Louisiana-Texas hypoxic zone is considered unrelated to OCS oil- and gas-related activities but is discussed and considered when assessing cumulative effects from OCS oil- and gas-related activities.

The Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) was passed in 1998 in response to a surge in blooms nationwide, which resulted in fish kills, beach and shellfish bed closures, and manatee deaths. It has since undergone numerous reauthorizations and amendments (U.S. Congress 2004; 2014; 2018), which reaffirmed and expanded the mandate for NOAA to advance the scientific understanding and ability to detect, monitor, assess, and predict harmful algal bloom and hypoxia events. The Act also requires an assessment of the causes and consequences of hypoxia in the GOM and the development of a plan to reduce hypoxia. Six reports commissioned by the White House Committee on Environment and Natural Resources comprise the assessment. The Interagency Working Group on HABHRCA (IWG-HABHRCA) is tasked with coordinating and convening Federal agencies, which includes BOEM, and their stakeholders to discuss harmful algal bloom and hypoxia events in the United States and to develop action plans and assessments of these situations (BOEM 2020).

The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force was established in the fall of 1997 to understand the causes and effects of eutrophication in the Gulf of Mexico; coordinate activities to reduce the size, severity, and duration; and ameliorate the effects of hypoxia. Activities include coordinating and supporting nutrient management activities from all sources, restoring habitats to trap and assimilate nutrients, and supporting other hypoxia-related activities in the Mississippi River and Gulf of Mexico watersheds.

The Task Force includes Federal and State agencies and tribes. Federal agencies include those with responsibilities over activities in the Mississippi River and its basin, and in the Gulf of Mexico. The role of the Task Force is to provide executive level direction and support for coordinating the actions of participating organizations working on nutrient management within the Mississippi River/Gulf of Mexico watershed. The Task Force has designated members of a Coordinating Committee and solicits information from interested stakeholders.

The goal, as stated in the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force's January 2001 Action Plan, was as follows: "By the year 2035, subject to the availability of additional resources, reduce the 5-year running average aerial extent of the Gulf of Mexico hypoxic zone to less than 5,000 square kilometers through implementation of specific, practical, and cost effective voluntary actions by all States, Tribes, and all categories of sources and removals within the Mississippi/Atchafalaya River Basin to reduce the annual discharge of nitrogen into the Gulf" (USEPA 2017a).

C.3.3 Natural Seeps

Natural petroleum seeps, in which crude oil and gas naturally migrate up through the seafloor and into the water column, are very common in the GOM and have likely been active throughout history. Gulf of Mexico seeps are highly variable in composition and volume and include gases, volatiles, liquids, pitch, asphalt, tars, water, brines, and fluidized sediments. Seeps are most abundant and most prolific in the central and western regions of the northern GOM (Garcia-Pineda et al. 2010).

Natural seeps are difficult to quantify due to challenges in detection (e.g., occurs subsea), differences in quantification methods (e.g., satellite observations and sampling by corer), dispersion by ocean currents, gaps in geographic coverage, and variable and uncertain seep volumes and rates (National Research Council 2003). According to the National Research Council (2003), annual seepage for the entire GOM was estimated to be between 80,000 and 200,000 tonnes per year (roughly 24.6 million to 61.6 million gallons [crude oil equivalent]) slowly entering the GOM from thousands of locations across the entire region (National Research Council 2003). More recently, natural seepage of oil has been estimated to exceed 42 million gallons annually: 21 million gallons in the northeastern GOM and 21 million gallons in the northwestern GOM (Kennicutt II 2017; National Research Council 2003). MacDonald et al. (2015) further observed that oil from natural slicks was regionally concentrated as follows: 68 percent in the northwest, 25 percent in the southwest, 7 percent in the northeast, and <1 percent in the southeast Gulf of Mexico.

In contrast to a large accidental oil spill resulting from human-related activities, this volume of oil slowly enters the GOM from thousands of locations over a huge area annually. Oil from these seeps contributes to the region's "background" chemicals, but the magnitude and effects of this oil source are very different from acute effects that would be typical of an accidental oil spill.

C.4 CLIMATE CHANGE

The Earth's climate system is driven by solar radiation, which provides heat to the planet. Increasingly, human-influenced changes to the Earth's atmosphere have slowed the rate at which this incoming solar radiation is re-radiated back into space, resulting in a net increase of energy in the Earth system (IPCC 2014). The climate's subsequent response is complicated by a number of positive and negative feedback processes among atmospheric, terrestrial, and oceanic systems, but the overall result is climatic warming, as is evident by observed increases in air and ocean temperatures, melting snow and ice, and rising sea levels (IPCC 2014). These planet-wide chemical and physical changes are collectively referred to as climate change. **Figure C.4-1** shows factors that have increased and decreased as a result of climate change.

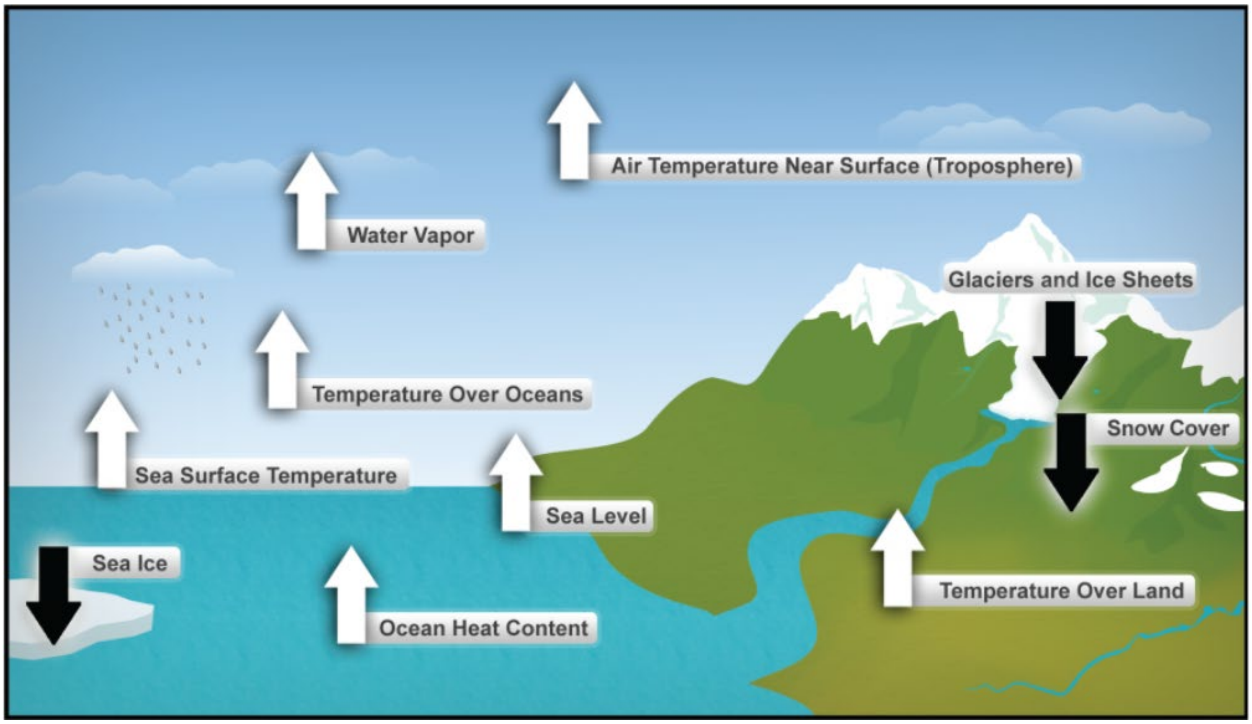


Figure C.4-1. Effects of Climate Change (white arrows indicate increases and black arrows indicate decreases) (Melillo et al. 2014).

Chief among drivers of climate change are increasing atmospheric concentrations of carbon dioxide (CO_2) and other greenhouse gases (GHGs), such as methane (CH_4, also known as natural gas), and nitrous oxide (N_2O). In November 2016, BOEM released *OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon* (Wolvovsky and Anderson 2016). This report is a comprehensive analysis of potential greenhouse gas emissions that may result from offshore oil and gas leasing. This includes emissions released during offshore operations for which BOEM has jurisdiction, along with the onshore processing, distribution, and consumption of oil and gas products.

Anthropogenic GHG emissions have increased since the pre-industrial era, which increase is driven largely by economic and population growth. From 2000 to 2010 emissions were the highest in history, with CO_2 being the major anthropogenic GHG, accounting for 76 percent of total anthropogenic GHG emissions (IPCC 2014). Greenhouse gases are compounds that contribute to the greenhouse effect—a natural phenomenon in which gases trap heat within the lowest portion of the Earth's atmosphere (surface-troposphere system), causing heating (radiative forcing) at the surface of the earth. Other climate forcers, such as black carbon, a specific kind of fine particulate matter ($PM_{2.5}$), also contribute to Earth's rising surface temperature.

C.4.1 Temperature Shifts and Sea-Level Rise

Average temperature in the continental United States has increased approximately 0.3°C (0.5°F) since 1895, and most of this increase has occurred since 1970. The most recent decade was the Nation's and the world's hottest since 1880, and 2016 was the hottest year since 1880 (NOAA

2020a). The rate of warming for the past 50 years is about twice as high as the rate of the past 100 years (IPCC 2014). Across the U.S., temperatures are generally expected to rise another 1.1 to 2.2°C (2 to 4°F) over the next few decades. During the 21st century, average global atmospheric temperature is projected to rise 1.65 to 2.75°C (3 to 5°F), which is under the lowest emissions scenarios (IPCC 2014). Even if significant emissions reductions occur, many of the effects from sea-level rise over this century—and particularly through mid-century—are already locked in due to historical emissions, and many communities are already dealing with the consequences (U.S. Global Change Research Program 2018).

The majority of heat energy associated with climate change is being absorbed by the oceans (Levitus et al. 2012), offsetting what would otherwise be a more rapid rise in atmospheric temperatures. Although there are annual and decadal shifts in ocean heat content (Levitus et al. 2012), temperatures in the upper 2,000 m (6,562 ft) of the water column have increased dramatically since the 1950s (IPCC 2014). The IPCC (2014) indicates a high likelihood of Atlantic meridional overturning circulation slowdown in the next 100 years; however, overall understanding is limited by both a lack of direct observations and high uncertainty among the various model results.

The entire Gulf Coast has seen an increase in long-term, sea-level rise (**Figure C.4.1-1**). Sea-level rise poses a large and continuing threat to regional activities, economy, and environments. The Gulf Coast is a major producer of seafood and home to many significant ports that could be vulnerable. Yin et al. (2020) suggested that, in the Gulf of Mexico, increased rates of sea-level rise will increase the risk of hurricane-induced flooding substantially. This is also applicable to the mid- and south Atlantic region, especially as barrier island complexes shift (Stutz and Pilkey 2011). Some low-lying metropolitan areas of the GOM region are already experiencing more frequent tidal flooding, even in the absence of storms or rainfall events. The GOM region's subsiding land and higher-than-average relative sea-level rise both contribute to this increase in flooding. Dahl et al. (2017) describe how climate change will promote changes in flushing regime, freshwater inputs, water chemistry, and inundation from sea-level rise.

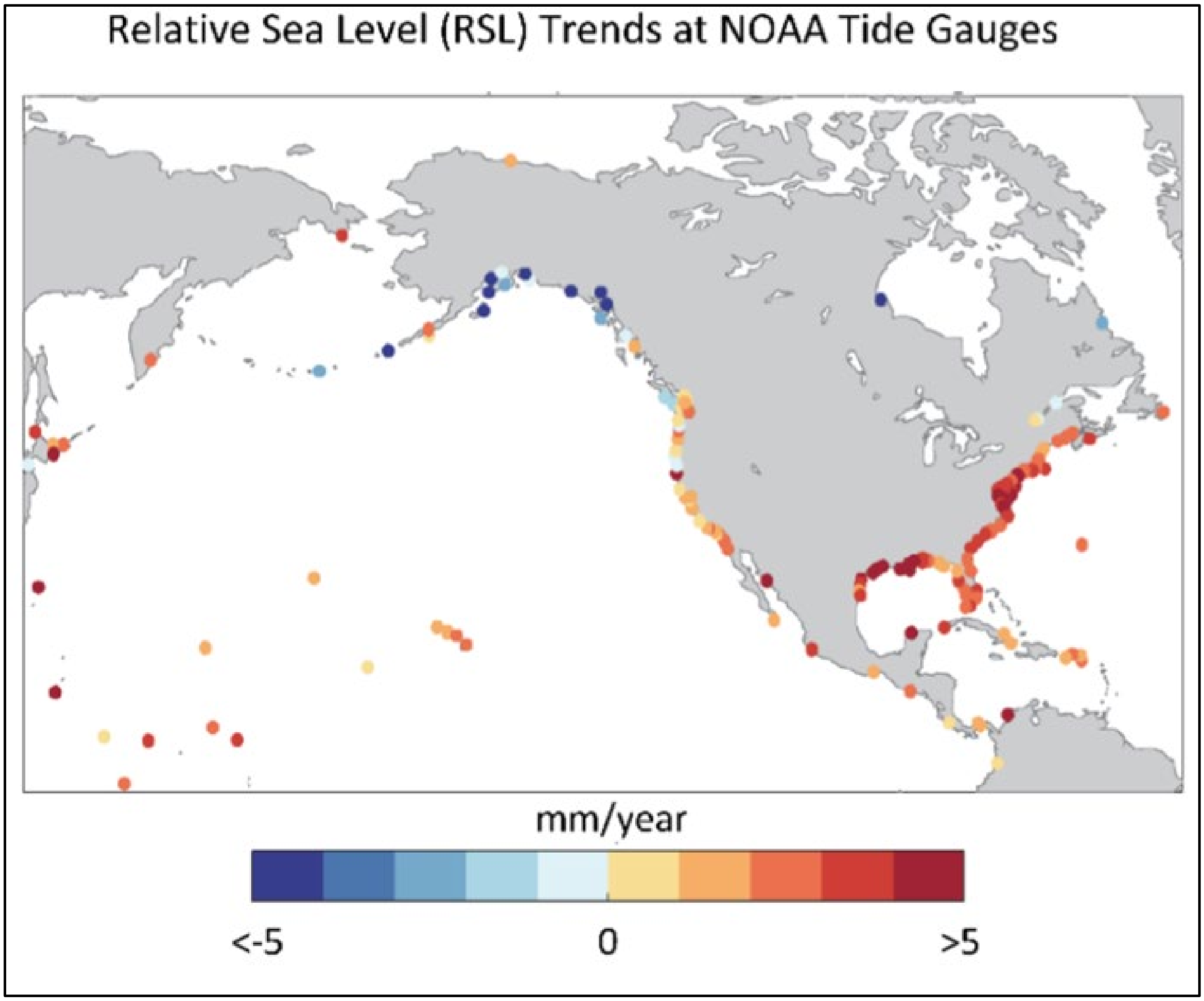


Figure C.4.1-1. Long-term, Sea-level Rise Recorded at Tide Gauges Over the Past 30 Years (note that the entire Gulf Coast has seen an increase in sea level) (NOAA and South Florida Water Management District 2018).

C.4.2 Changes in Weather Patterns and Ecosystem Shifts

With the advent of human-induced climate change, spatial and temporal variations in weather patterns and extreme weather events (e.g., hurricanes and flood events) have become more pronounced. Very heavy precipitation events have increased across the southeastern half of the U.S. For example, the number of days with 3 or more inches of precipitation has been historically high over the past 25 years, with the 1990s, 2000s, and 2010s ranking as the decades with the 1st, 3rd, and 2nd highest number of events, respectively (U.S. Global Change Research Program 2018). High-intensity storms, coupled with higher sea levels, could increase coastal flooding and erosion, damage coastal infrastructure, and degrade coastal habitats. High-intensity storms can also have significant impacts on the resuspension and distribution of bottom sediment (Wren and Leonard 2005). However, no consensus appears to exist on whether climate change will generate more tropical storms or whether those storms will be more intense (NOAA 2012). If storm frequency and intensity increase, the additional disturbance of sediment may impact water quality in nearshore and coastal areas.

Fragile marine ecosystems like coral reefs can also be directly damaged by such storms, while other sensitive areas like seagrass beds may experience indirect impacts from increased water turbidity and nutrient runoff. Storm impacts on coastal communities will be exacerbated if shoreline vegetation is lost. Strong storms can also move or damage marine archaeological sites; Hurricane Irma (Fall 2017) moved a 107-ft (32.6-m) wreck about 200 ft (61 m) off the coast of Florida (Emmons 2018).

These changes to weather patterns have long-term consequences for regional climates and the flora and fauna of the regions. Warming ocean and coastal temperatures can push species to the edge of their optimal temperature ranges, with poleward shifts predicted for some species (Sigler et al. 2011; Simpson et al. 2011). Certain ecosystems in the region are located near thresholds where small changes in winter air temperature regimes can trigger comparatively large and abrupt landscape-scale ecological changes (in other words, ecological regime shifts) (U.S. Global Change Research Program 2018). These changes may affect marine ecosystems by increasing the vertical stratification of the water column, shifting prey distribution, impacting competition, and generally impacting species' ranges (Learmonth et al. 2006; Richardson and Schoeman 2004). Some species, however, cannot readily shift their range (e.g., corals) and could experience significant impacts from temperature and salinity changes due to climate change. For example, warmer ocean temperatures have caused severe bleaching in reef-building corals, and this is expected to continue in future years (IPCC 2014). Zooplankton may serve as "beacons of climate change" because they are short-lived and particularly sensitive to changes in water temperature, making them tightly coupled to environmental changes (Richardson 2008). Warming waters can affect the timing of annual events like plankton blooms, migration, and reproduction in some species, which can in turn affect the animals and people who eat them, potentially disrupting predator-prey relationships with cascading effects throughout the food web (Ullah et al. 2018).

Climate change models show a higher likelihood of extinction of local species by 2050, with species invasion and replacements also occurring but less prominent (Cheung et al. 2009). Some predict that climate change will cause large-scale redistribution of global fishing catch and alter coastal economies (Cheung et al. 2010). As species extend their spatial ranges, there can be negative consequences related to expansion and colonization by non-native and invasive species (Stotz et al. 2016), but on the whole it remains unclear how species, particularly those directly harvested, would fare in response to climate change (Cheung et al. 2015).

C.4.3 Sector Interactions, Sustainability, and National Interest

Ecosystem level changes could also negatively affect national security by changing food and water availability, and increasing the frequency of climate-driven emergencies. For example, based on the currently projected climate change by the mid-21st century, global marine species redistribution and marine biodiversity reduction in sensitive regions could challenge fisheries productivity and other ecosystem services (IPCC 2014). Climate change, including changes in some extreme weather and climate events, can adversely affect global and U.S. food security by, for example, threatening food safety, disrupting food availability, decreasing access to food, and increasing food prices (U.S. Global Change Research Program 2018). Globally, rural and disadvantaged areas are most likely to experience the major impacts on water availability, food security, infrastructure, and agricultural incomes, including shifts in the production areas of food and non-food crops around the world (IPCC 2014). Projected changes in carbon dioxide concentrations and climate change could diminish expected gains in global nutrition; however, any impact on human health will depend on the many other drivers of global food security and factors such as food chain management, human behavior, and food safety governance.

The sectors and systems subject to climate-related risks do not exist in isolation; they interact with one another and with other sectors and systems. In addition, while climate-related risks such as heat waves, floods, and droughts have an important influence on these interdependent systems, these systems are also subject to a range of other factors, such as population growth, economic forces, technological change, and deteriorating infrastructure (**Figure C.4.3-1**). The number and complexity of possible interactions among systems affected by climate expand the scope of climate change risk assessment. Recent assessments discuss interactions among climate changes and the sectors that people and economies depend on. Other recent climate change impact assessments have highlighted risks emerging from interactions among different energy, water, and land systems; economic sectors; and stressors (IPCC 2018; Rosenzweig et al. 2017). An important research challenge is therefore advancing scientific methods and tools that can be applied in climate research, risk assessment, and risk management for complex, interdependent systems under deep uncertainty.

There are specific U.S. interests that can be affected by climate-related impacts outside of U.S. borders, such as climate variability (e.g., El Niño/La Niña events), climate extremes (e.g., floods resulting from extreme precipitation), and long-term changes (e.g., sea-level rise). These interests include economics and trade, international development and humanitarian assistance, national security, and transboundary resources (U.S. Global Change Research Program 2018). For example, climate-related disasters in developing countries not only have significant local and regional socioeconomic impacts but can also set back U.S. development investments, increase the need for U.S. humanitarian assistance, and affect U.S. trade and national security. United States citizens have long been concerned about the welfare of those living beyond U.S. borders and their vulnerability to the global impacts of climate.

The national security implications of climate change within U.S. borders include risks to energy and other critical infrastructure. Critical infrastructure, major military installations, and hurricane evacuation routes are increasingly vulnerable to impacts, such as higher sea levels, storm surges, and flooding exacerbated by climate change. Reports by the The White House (2015) and Navy through the National Reseach Council (2011) provide expansive descriptions of the cascading effects of climate change on national security.

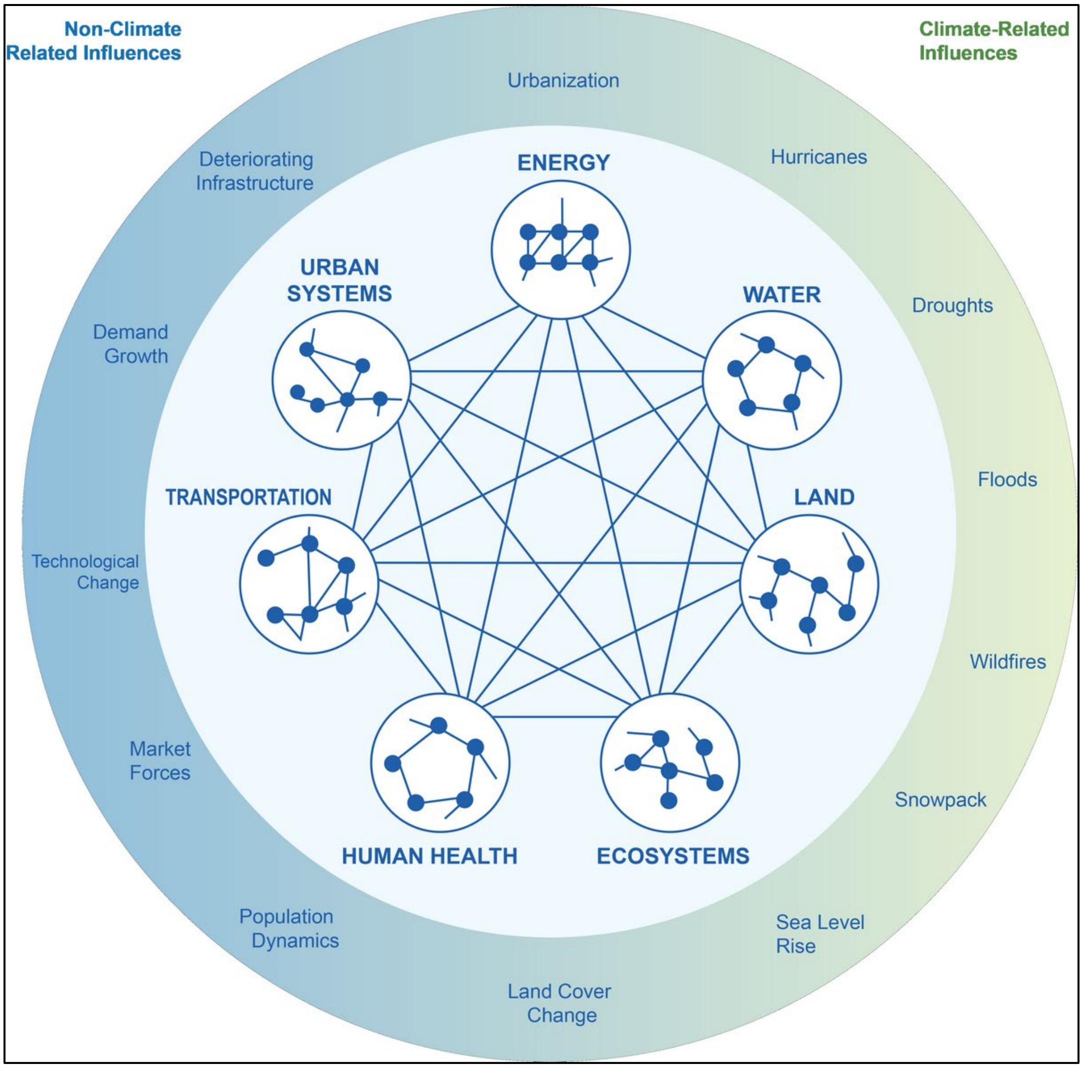


Figure C.4.3-1. Illustration of Common Sectors and the Interactions Among the Climate-related and Non-climate-related Influences (Adapted from the U.S. Global Change Research Program (2018).

C.4.4 Changes in Ocean Chemistry

Additional CO_2 in the Earth's atmosphere also changes ocean chemistry, affecting marine life. As seawater absorbs CO_2, it becomes more acidic, a phenomenon known as "ocean acidification." Anthropogenic ocean acidification refers to the component of pH (potential hydrogen) reduction that is caused by human activity (IPCC 2014). Ocean acidification can also be caused by other chemical additions or subtractions from the oceans that are natural (e.g., increased volcanic activity, methane hydrate releases, and long-term changes in net respiration). Since the beginning of the industrial era, oceanic uptake of CO_2 has resulted in ocean acidification corresponding to a 26 percent increase in acidity measured by hydrogen ion concentration with reductions in the availability of carbonate ions (IPCC 2014).

The skeletons and shells of some organisms, including crustaceans, foraminiferans, and some types of phytoplankton, are made from calcium carbonate, which dissolves in acid. Increased seawater acidity and the resulting lower concentrations of carbonate ion makes it more difficult for these organisms to build and maintain their shells and exoskeletons, potentially impacting individuals and populations (Fabry et al. 2008; Perry et al. 2015). Refer to **Figure C.4.4-1** for an example of a shell that is being dissolved as a result of exposure to acidified ocean waters. Raised acidity is also a challenge for both shallow and deepwater coral species by decreasing calcification rates or even dissolving exoskeletons (Doney et al. 2009; Thresher et al. 2015). Ocean acidification can also affect the growth and physiology of fishes at different life-history stages. Larval stages may be the most vulnerable (Llopiz et al. 2014), but it is not well understood whether fish can adapt to new environmental conditions (Ishimatsu et al. 2008). Finally, not only will ocean acidification affect the success of some species, it will also impact oceanic carbon sequestration, as some calcifying plankton play a crucial role in the global carbon cycle (Hofmann and Schellnhuber 2009). Changes to the global carbon cycle could lead to additional impacts on habitats and food webs, potentially triggering larger scale ecosystem responses (refer to **Section C.4.2**).

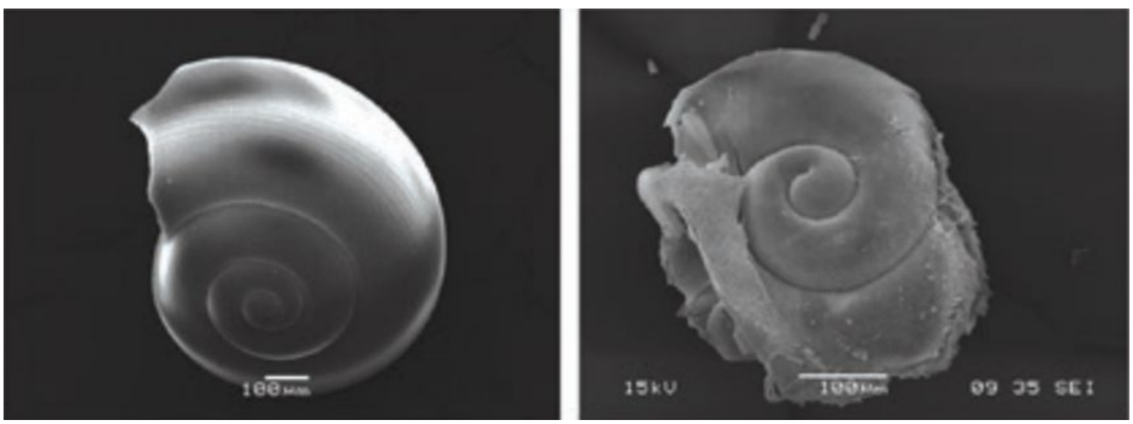


Figure C.4.4-1. Example of a Calcified Shell Dissolving from Exposure to Ocean Acidification (Melillo et al. 2014).

Scarcity of dissolved oxygen may become a more widespread problem, even in offshore waters, as temperatures increase with climate change because warmer water holds less oxygen. Climate-induced oxygen loss associated with ocean warming and reduced vertical mixing of deep and shallow waters has become evident locally, regionally, and globally (Jewett and Romanou 2017). This oxygen loss could be further exacerbated by increasing nutrient input to coastal waters through excess runoff, which leads to earlier onset and longer periods of seasonal hypoxia in many eutrophic sites, most of which occur in areas that are also warming (Altieri and Gedan 2015). At the same time, however, other factors could partially offset that trend. For example, climate change is expected to increase the frequency of severe storms and windiness, which serve to “mix” air into seawater and increase dissolved oxygen.

Perry et al. (2015) emphasized the importance of integrating measurements of biogeochemistry in concert with studies assessing the effects on keystone species in order to better understand how organisms and ecosystem functions are impacted by ocean acidification. A national strategy and recommended plans have been put forward supporting the development of a more integrated observing network to better understand the extent and effects of ocean acidification (Mathis and Feely 2013). As part of this effort, for example, BOEM has partnered with NOAA and other stakeholders to establish a “sentinel site” in the Flower Garden Banks. This site is actively collecting field data to assess ocean acidification variability in the Flower Garden Banks National Marine Sanctuary, which will eventually help BOEM and other stakeholders better understand the implication of regional ocean acidification changes (Perry et al. 2015). More information on this ongoing study and partnership can be found at https://marinecadastre.gov/espis/#/search/study/27205.

C.4.5 Marine and Vector-Borne Diseases

Marine diseases illustrate how host-pathogen relationships are very sensitive to environmental conditions and how climate change can affect disease risk (Burge et al. 2014). However, the prevalence of these diseases is extremely difficult to ascribe to any one particular governing factor, such as a change in temperature, precipitation, or runoff. Most host-parasite systems are predicted to experience more frequent or severe disease impacts with warming (Harvell et al. 2002). For example, *Perkinsus marinus* (an oyster parasite) thrives in warmer temperatures, and as winters have become warmer, this pathogen has spread northward along the U.S. East Coast (Burge et al. 2014). Changes in El Niño-Southern Oscillation events have also had a detectable influence on oyster pathogens as well as coral diseases (Harvell et al. 2002). Although there is evidence for climate-related links in some marine diseases, lack of reliable baselines and incomplete disease time series complicate the partitioning of climate effects and other anthropogenic disturbances (Harvell et al. 2002).

Climate change is expected to alter the geographic range, seasonal distribution, and abundance of disease vectors, exposing more people in North America to ticks that carry Lyme disease or other bacterial and viral agents, and to mosquitoes that transmit West Nile, chikungunya, dengue, and Zika viruses (Linthicum et al. 2016). Changing weather patterns interact with other factors, including how pathogens adapt and change, changing ecosystems and land use, demographics, human behavior, and the status of public health infrastructure and management. Increased temperatures and more frequent and intense extreme precipitation events can create conditions that favor the movement of vector-borne diseases into new geographic regions (Belova et al. 2017; Monaghan et al. 2018).

C.4.6 Resource-Specific Effects

Climate change is likely to continue contributing to existing stressors on the OCS and resources in the Area of Interest; however, determining how it influences existing stressors and the potential consequences of OCS energy development remains a challenge. All the climate change-related impacts described above can have cascading effects on marine ecosystems because they may act additively or synergistically with the other stressors described in **Appendix B**, including those introduced by OCS oil- and gas-related activities (Doney et al. 2012).

Where applicable, each resource category in **Chapter 4** will discuss the unique impacts that climate change could pose and whether the addition of oil and gas activities along the Gulf of Mexico OCS could have any synergistic effects (**Figure C.4.6-1**).

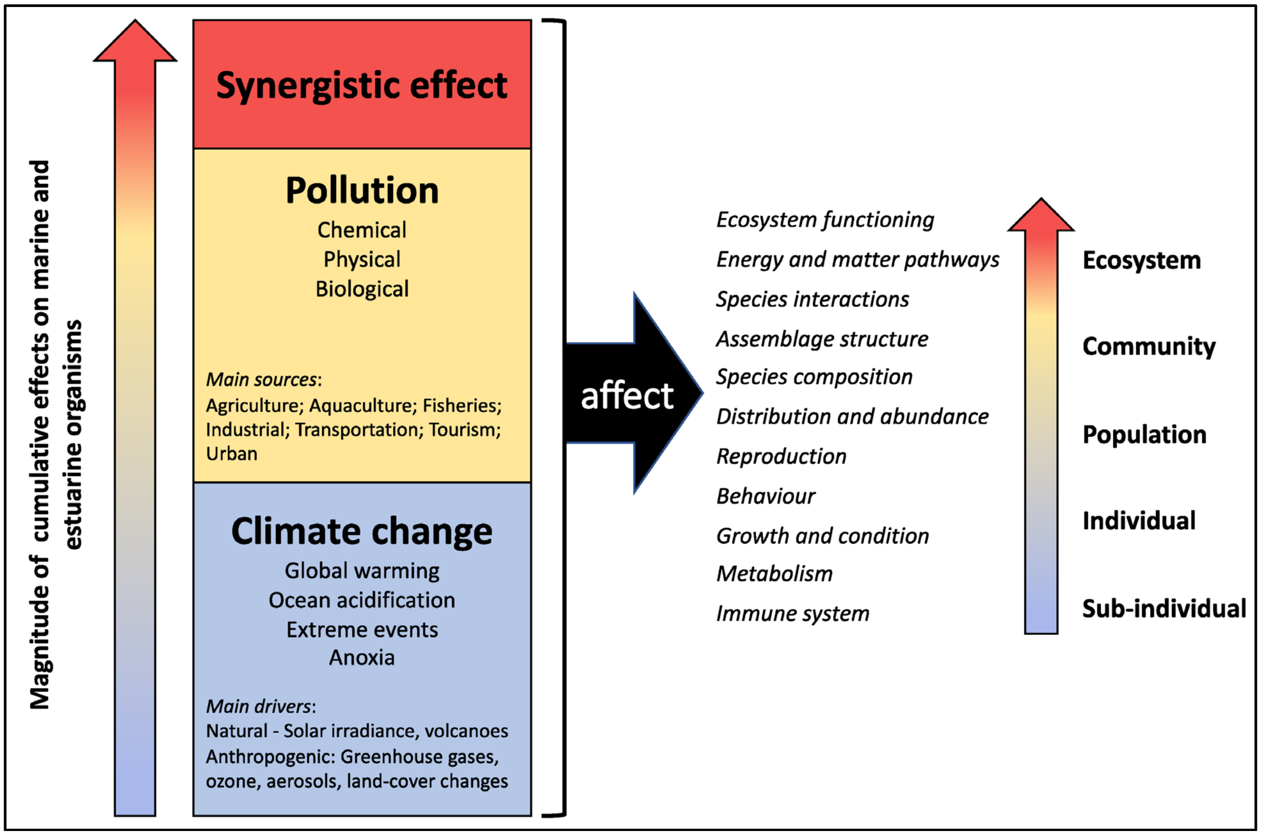


Figure C.4.6-1. Conceptual Diagram of the Cumulative and Synergistic Effects of Climate Change and Pollution on Marine and Coastal Systems (Adapted from Cabral et al. (2019).

C.5 Marine Trash and Debris

In the United States, about 80 percent of marine debris washes into the oceans from land-based sources and 20 percent is from ocean sources (USEPA 2017b). Plastic debris and microplastics are by far the main components of marine litter, forming sometimes up to 95 percent of the waste that accumulates on shorelines, the sea surface, and the seafloor (Galgani et al. 2015). Some of the sources of land-based marine debris are beachgoers, storm-water runoff, landfills, solid waste, rivers, floating structures, and ill-maintained garbage bins. Marine debris also comes from combined sewer overflows and typically includes medical waste, street litter, and sewage. To compound this problem, there is population influx along the coastal shorelines. These factors, combined with the growing demand for manufactured and packaged goods, have led to increases in nonbiodegradable solid wastes in waterways. The quantity of plastic observed in coastal waters off densely populated regions, however, represents only a fraction of the total amount in the marine environment.

Ocean-based sources of marine debris include galley waste and other trash from ships, recreational boaters, fishermen, military operations, renewable and marine mineral operations, and offshore oil and gas exploration and production facilities. The oil and gas industry makes up only a small part of those sources. Oil and gas operations on the OCS sometimes lose hard hats, plastic bags and packaging, rope, wood, and other items. Commercial and recreational fishers produce trash and debris by discarding plastics (e.g., ropes, buoys, fishing line and nets, strapping bands, and sheeting), wood, and metal traps. Some trash items, such as glass, pieces of steel, and drums with chemicals or chemical residues, can be a health threat to local water supplies and as a result to biological, physical, and socioeconomic resources; beachfront residents; and users of recreational beaches.

Likewise, 90 percent of the litter collected from seafloor trawls is made up of plastic (Galgani et al. 2015). Many types of plastic waste are denser than water and will sink to the seafloor. Surface accumulations in mid-ocean subtropical gyres make up only a small fraction of marine trash and debris. While uncertainties remain, it is estimated that open-ocean floating plastic accounts for less than 1 percent of the total that has reached the oceans since plastic began to be produced (UNEP and GRID-Arendal 2016).

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APPENDIX D

RESOURCE DESCRIPTIONS AND AFFECTED ENVIRONMENT FOR AIR QUALITY AND CULTURAL, HISTORIC, AND ARCHAEOLOGICAL RESOURCES

What is in This Appendix?

- This chapter provides a summarized description of air quality and cultural, historic, and archaeological resources in or near the Gulf of Mexico (GOM) Outer Continental Shelf (OCS) and the affected environment.
- Resources described here are those in which the affected environment description is not incorporated by reference from another document but which the Bureau of Ocean Energy Management (BOEM) has identified as having potential impacts from wind energy site characterizarion and site assessment activities and are as follows:
  - Air Quality
  - Cultural, Historical, and Archaeological Resources

Key Points

- The affected environment descriptions for biological resources determined to experience impacts from site characterization and site assessment activities are incorporated by reference from the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a).
- The descriptions provide summarized information useful to understanding the broader context of potential impacts of wind energy leasing, site characterization, and site assessment activity in the GOM.
- Programmatic issues such as climate change and ocean acidification, and their influence on the baseline conditions for each resource, are discussed as part of **Appendix C**.

D RESOURCE DESCRIPTIONS AND AFFECTED ENVIRONMENT FOR AIR QUALITY AND CULTURAL, HISTORIC, AND ARCHAEOLOGICAL RESOURCES

D.0 INTRODUCTION

This appendix provides a summarized description of the affected environment for air quality and cultural, historic, and archaeological resources identified in the environmental assessment to potentially be impacted by wind energy leasing, site characterization, and site assessment activities in the GOM. The affected environment descriptions for biological resources determined to experience impacts from site characterization and site assessment activities are incorporated by reference from the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021a). The descriptions of air quality and cultural, historic, and archaeological resources provide expanded information on the physical processes, geographical settings, and distinct characteristics that may be useful in understanding the broader context of any impacts from wind energy leasing, site characterization, and site assessment activities in the GOM.

D.1 AIR QUALITY

D.1.1 Resource Description

Air quality is the degree to which the ambient air is free of pollution. Ambient air pollution occurs when emissions (i.e., gases and particles) are emitted into the atmosphere. Air pollution can transport and/or chemically transform in the atmosphere and can deposit on the surfaces of soils and waters. The transport of air pollution can also be influenced heavily by the meteorology of the region (Biazar et al. 2010); therefore, evaluating both emissions and meteorology (e.g., temperature, sunlight, precipitation, and wind) is important when assessing air quality. Circulation patterns, geography, time of day, season, and other variables can also influence the transport and/or chemical transformation of pollutants and overall air quality of a region. For example, the Bermuda High influences the direction of air flows (refer to **Section C.2.2** of **Appendix C**). During the summer, it has been demonstrated that the Bermuda High causes southerly air flows transporting air pollution from the northeast to the GOM (Biazar et al. 2010). Reidmiller et al. (2009) demonstrated that intercontinental transport of emissions can lead to exceedances in the ozone (O_3) National Ambient Air Quality Standards (NAAQS).

> *Ambient air means that portion of the atmosphere, external to buildings, to which the general public has access (40 CFR § 50.1(e)).*

For this analysis, the affected environment comprises parts of the Western Planning Area and Central Planning Area (WPA and CPA), including the States of Texas, Louisiana, Mississippi, and Alabama, and the respective State waters, as depicted in **Figure D.1.1-1**. The Clean Air Act (CAA) Amendments of 1990 require the U.S. Environmental Protection Agency (USEPA) to set the NAAQS for six common air pollutants of concern called criteria air pollutants. Refer to **Section B.1** of **Appendix B** and the *Gulf of Mexico OCS Regulatory Framework* technical report (BOEM 2020) for more information. Therefore, criteria air pollutants were analyzed in this report. In addition to the NAAQS, the CAA Amendments give special air quality and visibility protection to national parks and wilderness areas because air pollution can impact scenic resources. Each of these parks and wilderness areas are identified as Class 1 (highest air quality protection), Class 2 (moderate air quality protection), or Class 3 (least air quality protection) areas. These areas are protected by the maximum allowable concentration increases (also referred to as the Prevention of Significant Deterioration [PSD] increments). However, the PSD increments are used for proposed single facility impacts and therefore are typically analyzed during site-specific National Environmental Protection Act (NEPA) reviews. Moreover, under the CAA Amendments, the Federal Land Manager is responsible for the management of PSD Class 1 parks and wilderness areas to protect the air quality-related values (AQRVs) (including visibility) of such lands and to consider adverse impacts on such values. The AQRVs include a visibility assessment, potential deposition (sulfur [S] and nitrogen [N]) effects, and potential ozone (O_3) effects on vegetation (USFS et al. 2010). Since Class I areas are of concern, these areas located in or near the GOM region were considered in this analysis and are shown in **Figure D.1.1-1**. The protected Class I areas in the GOM region include the following: the Breton Wilderness Area in Louisiana; and the Bradwell Bay Wilderness Area, Chassahowitzka National Wilderness Area, Everglades National Park, and St. Marks Wilderness Area in Florida (**Figure D.1.1-1**). However, the Breton Wilderness

Area was the only Class I area considered in the AQRV analysis for this report as it would likely have higher impacts from air pollution due to its proximity to the majority of OCS oil- and gas-related activities.

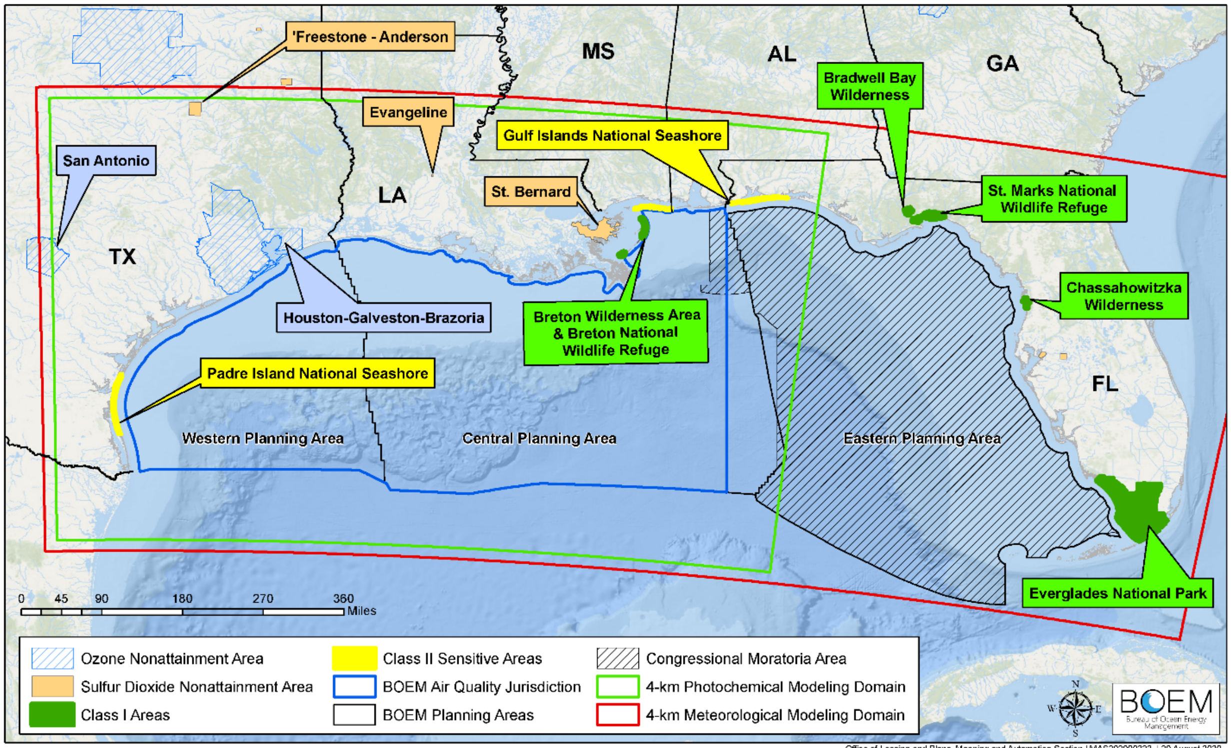

Figure D.1.1-1. Gulf of Mexico Region with the Planning Areas, Nonattainment Areas, BOEM's Air Quality Jurisdiction, and Class I and Class II Sensitive Areas.

The current conditions of the air quality onshore along the Gulf Coast are known through ambient air quality monitoring. Most criteria air pollutants along the Gulf Coast are below the NAAQS; however, O_3 and sulfur dioxide (SO_2) remain a concern in nonattainment areas (USEPA 2020c). In accordance with the CAA Amendments, only areas within State boundaries are designated as either unclassifiable/attainment or nonattainment status. The OCS, which includes GOM waters, are not designated areas for the NAAQS since there are no regulatory provisions under the CAA or Outer Continental Shelf Lands Act. Refer to the *Gulf of Mexico OCS Regulatory Framework* technical report for more information (BOEM 2020). A discussion of the most recent emissions inventories for onshore and offshore sources in the GOM region, as well as BOEM's recently completed *Air Quality Modeling in the Gulf of Mexico Region* study (Wilson et al. 2019b), is presented below. Further information on the emissions inventories is provided in **Section B.1** of **Appendix B**.

D.1.1.1 Air Emissions Inventory Data

The *Year 2017 National Emissions Inventory Report* (USEPA 2020b) and *Year 2017 Emission Inventory Study* (Wilson et al. 2019a) are the most recent inventory reports and the basis for the following overview of air emissions in the GOM. The primary pollutants covered in the inventories and analyzed in this chapter are as follows:

- criteria air pollutants[1] (CAPs)—CO, Pb, NO_x (includes NO_2), SO_2, PM_{10}, and $PM_{2.5}$;
- criteria precursor air pollutants (CPAPs)—NH_3, VOCs, and NO_x;
- select hazardous air pollutants (HAPs) and sources; and
- greenhouse gases (GHGs)—CO_2, CH_4, and N_2O.

Between the two emission inventory reports, it was indicated that most of the CAP and CPAP emissions come from onshore sources, which contributed to the total CAP and CPAP emissions in the GOM – about 99 percent for SO_2, PM_{10}, $PM_{2.5}$, Pb, VOCs, NH_3, and CO, and about 91 percent for NO_x. The CAP and CPAP emissions from onshore sources are summarized in **Section B.1.2.2** of **Appendix B**. Offshore sources, including OCS oil- and gas-related activities, contributed to the total CAP and CPAP emissions in the GOM – about 1 percent for SO_2, $PM_{2.5}$, Pb, VOCs, NH_3, and CO, and about 9 percent for NO_x. The CAP and CPAP emissions from offshore sources are summarized in **Section B.1.2.1** of **Appendix B**.

For the HAP emission inventories, onshore sources contribute to the total HAP emissions in the GOM, about 95-99 percent for each of the 28 HAPs. The HAP emissions from onshore sources are summarized in **Section B.1.2.2** of **Appendix B**. Offshore sources, including OCS wind energy leasing, site characterization, and site assessment-related and non-OCS wind energy leasing, site characterization, and site assessment-related activities, contribute to the total HAP emissions in the GOM, about 1-5 percent for each of the 28 HAPs. The HAP emissions from offshore sources are summarized in **Sections B.1.1 and B.1.2.1** of **Appendix B**. Any HAP emissions could be of concern; however, HAPs generally are not common air pollutants and are usually emitted by a limited number of specific and discrete sources. As stated above, the emission inventories indicate that the vast majority of the 28 HAP emissions come from onshore sources.

For GHG emission inventories, onshore sources contribute to the total GHG emissions in the GOM, about 99 percent for carbon dioxide (CO_2), 88 percent for methane (CH_4), and 96 percent for nitrous oxide (N_2O). The GHG emissions from onshore sources are summarized in **Section B.1.2.2** of **Appendix B**. Offshore sources contribute to the total GHG emissions in the GOM, about 1 percent for CO_2, 12 percent for CH_4, and 4 percent N_2O. The GHG emissions from offshore sources are summarized in **Sections B.1.1 and B.1.2.1** of **Appendix B**. The emission inventories show that most GHG emissions come from onshore sources. However, studies on CH_4 emissions from offshore sources (Gorchov Negron et al. 2020; Yacovitch et al. 2020) potentially indicate that emission inventory estimates for CH_4 are underestimated.

[1] Though not directly emitted, O_3 is also a criteria air pollutant formed from photochemical reactions.

In addition to the CAP and CPAP emission inventories, air quality modeling studies have been conducted to better understand the criteria air pollutant concentrations in the GOM. More recently, (Wilson et al. 2019b), in the *Air Quality Modeling in the Gulf of Mexico Region* study (2019b), has conducted air quality modeling with a 4-km (2.5-mi) domain, as shown in **Figure D.1.1-1**. Wilson et al. (2019b) used year 2011 emission inventory data from the *Year 2011 Gulfwide Emission Inventory Study* (Wilson et al. 2014) for offshore OCS emissions and the *Year 2011 National Emissions Inventory* report (USEPA 2020a) for onshore emissions. Using the emission inventory data, emission estimates (referred to as "base case year" in Wilson et al. (2019b) to define current baseline air quality conditions) were modeled, using a photochemical model, in order to evaluate the predicted criteria air pollutant (i.e., O_3, CO, NO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$) concentrations against concurrent measured ambient concentrations from available monitors. Refer to Chapter 3.3 of Wilson et al. (2019b) for more information on the base case modeling scenario emission estimates. **Table D.1.1-1** shows the modeled minimum and maximum air pollutant levels of the 4-km (2.5-mi) domain in the GOM for all existing sources based on the NAAQS. **Table D.1.1-1** shows the modeled minimum and maximum air pollutant levels of the 4-km (2.5-mi) domain in the GOM for all existing sources based on the NAAQS. The maximum modeled criteria air pollutant concentrations (i.e., potential worst-case modeled baseline conditions) of the 4-km (2.5-mi) domain for the 1-hour (hr) SO_2, 8-hr O_3, 24-hr PM_{10}, 24-hr $PM_{2.5}$, and annual $PM_{2.5}$ NAAQS were exceeded. The Pb level was undetermined. All other criteria air pollutants were below the NAAQS.

Table D.1.1-1. Modeled Criteria Air Pollutant Concentrations in the Gulf of Mexico for All Existing Sources.

Criteria Air Pollutant	Minimum Concentration of the 4-km (2.5-mi) Domain – Base Case Year Results	Maximum Concentration of the 4-km (2.5-mi) Domain – Base Case Year Results
1-hr CO	0.2 ppm	8.9 ppm
8-hr CO	0.2 ppm	6.9 ppm
Pb	Unknown	Unknown
1-hr NO_2	0.8 ppb	99.9 ppb
Annual NO_2	0.1 ppb	42 ppb
24-hr PM_{10}	14.1 μg/m^3	414.7 μg/m^3
24-hr $PM_{2.5}$	7.9 μg/m^3	98.5 μg/m^3
Annual $PM_{2.5}$	2.6 μg/m^3	26.5 μg/m^3
1-hr SO_2	0.5 ppb	148.4 ppb
3-hr SO_2	0.5 ppb	154.9 ppb
8-hr O_3	38.6 ppb	86.5 ppb

μg/m^3 = microgram per cubic meter of air; CO = carbon monoxide; hr = hour; km = kilometer; mi = mile; NO_2 = nitrogen dioxide; O_3 = ozone Pb = lead; PM_{10} = particulate matter with diameter less than or equal to 10 microns; $PM_{2.5}$ = particulate matter with diameter less than or equal to 2.5; ppb = parts per billion; SO_2 = sulfur dioxide.

However, there are uncertainties in the modeled data. The influence of environmental variables, modeling uncertainties, as well as a lack of ambient air monitors offshore, present many challenges and limit information for assessing air quality in the GOM at a regional level. Nevertheless, BOEM can use these regional-scale studies as a basis in environmental impact assessments to broadly estimate the potential incremental air quality effects associated with leasing, as well as to broadly evaluate cumulative air quality effects.

The *Air Quality Modeling in the Gulf of Mexico Region* study was peer reviewed by the National Academies of Sciences, Engineering, and Medicine (NASEM), who published a consensus study report (National Academies of Sciences 2019). The committee that reviewed the *Air Quality Modeling in the Gulf of Mexico Region* study concluded that there were “potential underestimates of the impacts of GOMR emissions on air quality” (National Academies of Sciences 2019). Their reasons included the lack of performance evaluations of the highest air quality impacts from offshore to onshore and not using warmer years for modeling O_3, PM_{10}, and $PM_{2.5}$ formation (National Academies of Sciences 2019). The *Air Quality Modeling in the Gulf of Mexico Region* study also had similar conclusions regarding uncertainties, stating “one of the key uncertainties associated with analyzing the air quality impacts from offshore sources in the Gulf of Mexico is the magnitude of the modeled O_3 and particulate matter concentrations over the Gulf waters” (Wilson et al. 2019b). These uncertainties are likely due to the lack of available offshore air quality monitoring data.

Air Pollution at National Parks and Wilderness Areas

The closest onshore wilderness area to be impacted by OCS air emissions sources in the GOM west of 87.5 degrees longitude is the Breton Wilderness Area. The Breton Wilderness Area is a PSD Class 1 area, which is further protected by the AQRVs. The AQRVs include a visibility assessment, potential deposition (sulfur [S] and nitrogen [N]) effects, and potential O_3 effects on vegetation (USFS et al. 2010). In visibility assessments, deciview is used as a measure of visibility derived from calculated light extinction measurements. It corresponds to the incremental changes in visual perception between clear and highly impaired, so a lower value would correspond to better visibility. In year 2017, the haze index for the clearest days (based on the 20% best or clearest visibility days monitored) were reported to be a maximum of 12 deciview (USEPA 2020e). In year 2002, the haze index for the clearest days were reported to be a maximum of 17.4 deciview. In year 2017, the haze index for the most impaired days (based on the 20% worst visibility days monitored) were reported to be a maximum of 22.8 deciview. In year 2002, the haze index for the most impaired days were reported to be a maximum of 29.9 deciview. The visibility trend assessment for the Breton Wilderness Area up to year 2017 has shown improvements.

Sulfur and nitrogen deposition (wet and dry) may cause acidification or nutrient imbalances to ecosystems. The National Atmospheric Deposition Program’s (NADP) most recent available deposition report was published in year 2019 (National Atmospheric Deposition Program 2019). The two NADP monitoring sites for sulfur and nitrogen deposition are (1) the Southeast Research Station (LA30) located in Washington Parish, Louisiana; and (2) the Grand Bay National Estuarine Research Reserve (MS12) located in Jackson, Mississippi, which monitors for potential deposition impacts to the Breton Wilderness Area. **Table D.1.1-2** shows NADP values for the wet deposition of nitrogen from nitrate and ammonium, and sulfur from sulfate (National Atmospheric Deposition Program 2018; 2019). The wet deposition of nitrogen in 2018 decreased in comparison with 2017. The wet deposition of sulfur at LA30 did not change from 2017 to 2018, while a decrease was observed at MS12. The *Air*

Quality Modeling in the Gulf of Mexico Region study's base case year modeled a maximum nitrogen deposition (dry and wet) impact of 8.0 kilograms/hectare/year and maximum sulfur deposition (dry and wet) impact of 4.1 kilograms/hectare/year (Wilson et al. 2019b); however, there are uncertainties in the modeled data (National Academies of Sciences 2019; Wilson et al. 2019b).

Table D.1.1-2 National Atmospheric Deposition Program's (NADP) Deposition Concentration Reported in Years 2017 and 2018.

Year	Monitoring Site	Wet Deposition	Concentration (kilograms/hectare)
2017	LA30	Sulfur	9
		Nitrogen	4.2
2017	MS12	Sulfur	8
		Nitrogen	5.1
2018	LA30	Sulfur	9
		Nitrogen	4
2018	MS12	Sulfur	7
		Nitrogen	4.2

Ozone is not only an issue for humans but for vegetation as well. Plant leaves adsorb ozone through pores (stomata), where it can kill plant tissues. This causes visible damage like bleaching, dark stippling, or reduced photosynthesis, growth, and reproduction abilities (Ashmore et al. 2004). The closest ozone monitoring site near the Breton Wilderness Area is in Meraux, Louisiana (air quality site ID 22-087-0004). As of 2019, the maximum value of O_3 was reported to be 0.064 parts per million for the 8-hr standard, which is below the primary and secondary NAAQS (USEPA 2020d). Discussion of the modeled O_3 concentrations is addressed in **Section D.1.1.1**.

D.2 CULTURAL, HISTORICAL, AND ARCHAEOLOGICAL RESOURCES

D.2.1 Resource Description

Archaeological resources are any material remains of human life or activities that are at least 50 years of age and that are capable of providing a scientific or humanistic understanding of past human behavior, cultural adaptation, and related topics through the application of scientific or scholarly techniques, such as controlled observation, contextual measurement, controlled collection, analysis, interpretation, and explanation. These resources include any physical evidence of human habitation, occupation, use, or activity, and further include the site, location, or context in which such evidence is situated (30 CFR § 585.112). The National Historic Preservation Act of 1966 (NHPA), as amended (54 U.S.C. § 300101), includes archaeological resources among potential "historic properties," defined as any pre-contact or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register of Historic Places (NRHP), including artifacts, records, and material remains relating to the district, site, building, structure, or object (54 U.S.C. § 300308). Traditional cultural properties and sacred sites also may be designated as historic properties. To be eligible for inclusion on the NRHP, a historic property typically must be at least 50 years old; retain the integrity of location, design, setting, materials, workmanship, feeling, and association; and meet at least one of four significance criteria (36 CFR § 60.4):

(1) be associated with events that have made a significant contribution to the broad patterns of our history; or

(2) be associated with the lives of persons significant in our past; or

(3) embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or that possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or

(4) have yielded, or may be likely to yield, information important in prehistory or history.

BOEM's authorities and responsibilities towards the management of cultural, historical, and archaeological resources are specified in various legislative Acts including the NHPA, NEPA, and Outer Continental Shelf Lands Act. In particular, Section 106 of the NHPA requires all agencies having direct or indirect jurisdiction over a federally funded or permitted undertaking to take into account the effects of that undertaking on historic properties. Additionally, Section 110 of the NHPA directs agencies to establish historic preservation programs for the identification, evaluation, and protection of historic properties, whether these properties are under the jurisdiction or control of the agency, or merely potentially affected by agency actions. These provisions of NHPA collectively establish the foundation for BOEM's regulations (30 CFR part 585 subpart F), policies, procedures, and guidance documents (BOEM 2020b) regarding the identification, protection, and preservation of cultural and archaeological resources during agency activities.

Since the 1970s BOEM has identified numerous archaeological resources that either have been discovered or have the potential to be discovered on the Gulf of Mexico OCS using a combination of archival research, industry and other Federal agencies' remote-sensing surveys, BOEM-funded environmental studies, consultations, and frequent review of current scientific literature. Much of this information has been synopsized in regional and site-specific archaeological studies published through BOEM's Environmental Studies Program, which are publicly available on BOEM's website at https://www.boem.gov/environment/environmental-studies/esp-data-and-information-systems. Examples include Coastal Environments, Inc. (Coastal Environments Inc. (1977a; 1977b), Pearson et al. (1986), MMS (1989), Garrison et al. (1989a; 1989b; 1989c), Pearson et al. (2003a; 2003b; 2003c), Enright et al. (2006), Church et al. (2007), Krivor et al. (2011), and Evans et al. (2013), among others.

Archaeological resources on the OCS are categorized under one of two general designations: pre-contact or historic. There are some similarities between these site types in geographic location and in the survey methodologies used to identify them, but there are also significant differences in their age, artifact composition, diagnostic evidence in remote-sensing data, and methods of data collection and interpretation during Phase II (NRHP evaluation) and Phase III (data recovery) archaeological investigations. The two site categories also reflect a general deviation of expertise within the archaeological profession at-large between pre-contact and historic archaeologists, with submerged pre-contact archaeology rapidly emerging as a robust sub-discipline of underwater archaeology specialization requiring its own theories, methods, and technologies (Dixon and Davis 2020).

Pre-Contact

__Pre-contact__ generally refers to archaeological sites associated with the first peoples to occupy the Americas, before the advent of written history.

The term “pre-contact” is used to distinguish Native American archaeological sites or artifacts that date prior to the arrival of Europeans in North America beginning in the late 15th century A.D. It includes sites associated with the first humans to occupy areas of the Gulf Coast that are now submerged on the OCS. Available evidence suggests that sea level in the northern GOM was at least 90 meters (m) (295 feet [ft]), and possibly as much as 130 m (427 ft) lower than present sea level during the period 20,000-17,000 years before the present (B.P.) (Nelson and Bray 1970). Sea level in the northern GOM reached its present stand around 3,500 years B.P. (Pearson et al. 1986). During periods that the continental shelf was exposed above sea level, the area was open to habitation by Indigenous populations.

Until the late 20th century, it was generally accepted by archaeologists that the earliest humans in North America were the so-called Clovis peoples, named for a lanceolate-shaped, fluted projectile point first found near Clovis, New Mexico. The Clovis culture was thought to have entered the continent around 13,500 years B.P. by way of Beringia, a landmass connecting Asia to North America exposed during the Last Glacial Maximum and along an ice-free corridor opened between the Cordilleran and Laurentide ice sheets. Today, however, a growing body of evidence has dispelled the “Clovis First” model with the discovery of several sites with accurate pre-Clovis dates in the eastern United States (Goodyear 2005), Chile (Dillehay 1989; Meltzer et al. 1997), and central Texas (Waters et al. 2011). The Buttermilk Creek Complex identified by Waters et al. (2011) at the Debra L. Friedkin Site (41BL1239) is the nearest to the GOM region and is dated from ~13,200 to 15,000 years B.P.

Establishing a reliable date for the entrance of Native Americans into the coastal regions of the GOM is complicated by the fact that archaeological deposits pre-dating 5,500 B.P lie buried under as much as 40 m (131 ft) of Holocene sediments or are underwater on the OCS (Rees 2011). Conclusive evidence for pre-contact sites on the OCS is sparse. The McFaddin Beach Site (41JF50) in Jefferson County, Texas, has produced hundreds of artifacts 8,000 years old or older that have been redeposited from a site or sites eroding from the now-submerged Pleistocene shoreline. Forty-three percent of the total sample includes artifacts diagnostic of the Middle and Late Paleoindian periods and include Clovis, Dalton, Scottsbluff, and San Patrice projectile points (Stright et al. 1999).

Recent archaeological research in Florida has confirmed that Pre-Clovis peoples inhabited the southeastern region of North America more than 14,500 years ago (Halligan et al. 2016). The sea-level curve for the northern GOM proposed by CEI suggests that sea level at 12,000 years B.P. would have been approximately 45-60 m (148-197 ft) below the present-day sea level (Coastal Environments Inc. 1977a; 1977b; Gagliano et al. 1982). On this basis, the continental shelf shoreward of the 45- to 60-m (148- to 197-ft) bathymetric contours has potential for pre-contact sites dating after 12,000 years B.P. Because of inherent uncertainties in both the depth of sea level and the entry date of the earliest humans into North America, BOEM adopted the 60-m (197-ft) water depth as the seaward extent for pre-contact archaeological site potential in the GOM region.

Distinct pre-contact archaeological sites on the OCS are difficult to identify in wide-area, remote-sensing surveys due to their small footprint and material composition (e.g., stone, shell, wood, ceramics, etc.). Instead, archaeologists and geophysicists attempt to identify intact landforms that survived the erosional processes associated with sea-level rise and therefore may also contain intact archaeological materials. Based on their 1977 baseline study, (Coastal Environments Inc. 1977a; 1977b) proposed that paleo-landforms analogous to the types of environments frequented by Paleoindians can be identified on the now-submerged shelf. Geomorphic features that have a high potential for associated pre-contact sites include barrier islands and back-barrier embayments, river channels and associated floodplains and terraces, and salt-dome features. Investigations in Louisiana and Florida indicate that the mound-building activity by Indigenous inhabitants may have occurred as early as 6,200 years B.P. (Gibson 1994; Gibson and Shenkel 1984; Russo 1992; 1994; Saunders and Allen 1994; Saunders et al. 2005). Therefore, humanmade features, such as mounds, may also exist in the shallow inundated portions of the OCS.

Regional geological mapping studies by BOEM allow interpretations of specific geomorphic features and assessments of archaeological potential in terms of age, type of system the geomorphic features belong to, and geologic processes that formed and modified them. In general, sites protected by sediment overburden have a high potential for preservation from the destructive effects of marine transgression. The same holds for sites submerged in areas subjected to low wave energy and for sites on relatively steep shelves, which were inundated during periods of rapid rise in sea level. Although many specific areas in the GOM believed to have the potential for pre-contact site preservation are identified through archaeological and geohazard surveys, the oil and gas industry generally has chosen to avoid these areas rather than conduct further investigations. Thus, the validity of the hypothesis that the landforms identified in industry surveys are archaeological sites remains speculative until further testing can be done.

Along the coast, archaeologists have documented pre-contact sites representing the period between the Paleoindian culture and European contact. The McFaddin Beach Site (41JF50), east of Galveston in the McFaddin National Wildlife Refuge, has produced late Pleistocene megafauna remains and lithics from all archaeological periods, including a large percentage of Paleoindian artifacts (Stright et al. 1999). A study funded by the Minerals Management Service (MMS) (BOEM's predecessor) to locate pre-contact archaeological sites in association with the buried Sabine-Calcasieu River Valley was completed in 1986 (Pearson et al. 1986). Five types of relict landforms were identified and evaluated for archaeological potential. Coring of selected features was performed, and sedimentary analyses suggested the presence of at least two archaeological sites. A subsequent BOEM study in the Galveston and High Island Areas of the northwestern GOM conducted remote-sensing and coring surveys of four additional areas that had been identified in industry surveys and indicated a potential presence of archaeological sites (Evans 2016). The collected cores confirmed that the paleo-landforms are preserved and had been available for exploitation by Paleoindian or Early Archaic peoples, and evidence of a shell midden or localized burning was present at two of the study sites. However, the evidence was ultimately inconclusive as to whether these features were naturally occurring or the result of human-induced modifications to the landscape.

High-resolution geophysical surveys have produced evidence of floodplains, terracing, and point-bar deposits in association with relict late Pleistocene fluvial systems. Pre-contact sites associated with these features would have a high potential for preservation. Salt diapirs with bathymetric expression have also been recorded during lease-block surveys in the Gulf of Mexico. Solution features at the crest of these domes would have a high potential for preservation of associated pre-contact sites. The Salt Mine Valley site (16IB23) on Avery Island is a Paleoindian site associated with a salt-dome solution feature (Coastal Environments Inc. 1977a; 1977b). The shallow subsurface depth of many of these relict landforms relative to the seafloor facilitates access for further investigation and data recovery.

Historic

> ***Historic** generally refers to archaeological resources occurring since the beginning of European exploration in the New World.*

Historic archaeological resources on the Gulf of Mexico OCS consist of historic shipwrecks, aircraft, and a single historic lighthouse, the Ship Shoal Light. A historic shipwreck is defined as a submerged or buried vessel or its associated components, at least 50 years old, that has foundered, stranded, or wrecked, and that is currently lying on or embedded in the seafloor. Europeans are known to have traversed the waters of the western GOM as early as Captain Alonso Alvarez de Piñeda's expedition in 1519. Alvar Nuñez Cabeza de Vaca is likely to have the dubious distinction of being the first European to be shipwrecked along the Texas coast as early as 1528 (Francaviglia 1998). The earliest shipwrecks in the GOM region to be identified and excavated by archaeologists are from a 1554 Spanish fleet that wrecked off Padre Island, Texas (Arnold III and Weddle 1978), and the 1559 expedition of Tristan de Luna that wrecked in Pensacola Bay, Florida (Smith 2018).

Spanish navigation in the GOM continued throughout the 16th and 17th centuries as the early exploratory missions expanded to include conquest and colonization. French and, to a lesser degree, English excursions into the GOM began in the late 17th century. As the European colonial empires continued to expand their North American territories into the early 19th century, the maritime character of the GOM developed into a complex international network of trade, transportation, privateering, and warfare. Beginning in the mid-19th century, technological advancements ushered in a transition of vessel types from exclusively wooden-hulled sailing ships to steam-powered vessels and, by the end of the century, iron and steel-hulled merchant and military craft. By the end of World War I, wooden-hulled merchant vessels had become all but extinct and were replaced by steel-hulled ships of gradually increasing size and cargo capacity. During World War II, many of these vessels ended up at the bottom of the GOM as a result of German U-boat attacks, primarily near the approaches to the Mississippi River. Shipwrecks from the entire span of European and American Gulf of Mexico maritime history are represented in the archaeological record, and shipwrecks in the GOM remain frequent despite centuries of technological and navigational advancements. In addition to ever-present merchant vessel losses, modern examples include commercial fishing boats, scientific research vessels, pleasure craft, drilling rigs, and other support vessels associated with the oil and gas industry.

BOEM and its predecessor agencies have commissioned multiple studies aimed at modeling and predicting areas in the GOM where historic shipwrecks are most likely to exist (Coastal Environments Inc. 1977a; 1977b; Garrison et al. 1989a; 1989b; 1989c; Pearson et al. 2003a; 2003b; 2003c). The Coastal Environments Inc. (1977a; 1977b) relied primarily on secondary-source literature to determine general shipwreck site distribution and identify “theoretical boundaries between zones of relatively high and relatively low occurrence of historic-period shipwreck[s].” That study concluded that two-thirds of the total number of shipwrecks in the northern GOM are likely to lie within 1 mile (mi) (1.6 kilometers [km]) of the shore, and most of the remainder lie between 1 and 6 mi (1.6 and 10 km) of shore. However, CEI acknowledged that these conclusions were untested and that several limitations were inherent in their source material. Published (and frequently non-scholarly) shipwreck volumes often repeat unreliable information from earlier sources, sometimes use poor translations of primary documents, and are purposefully selective in the shipwrecks they include (such as those laden with treasure) and those they omit, like small vernacular fishing and coasting vessels that are likely to be identified only in primary sources. Depending on their age, the primary sources themselves are often insufficient for identifying accurate shipwreck locations, or even the occurrence of shipwrecks. The early explorers were sailing in uncharted waters and often wrecked out of sight of land or near landmarks or place names that no longer are recognizable today. Many wrecks had no survivors to document even rudimentary information and were simply reported, if they were reported at all, as “lost at sea” after leaving a port and never arriving at their destination, which may have been hundreds of miles away.

Historic shipwreck reports in the archival record are also hampered by the fact that for centuries ship navigators had a limited ability to record their geographic location with any real accuracy. Sailors have long been able to accurately determine their latitude with instruments such as the astrolabe and sextant. But they could not determine their longitude with the same accuracy until the marine chronometer was invented in England in 1762, and it took several more decades before that technology became commonly used on large merchant and naval vessels. Even the development of electronic navigation aids in the early 20th century did not significantly improve the accuracy of shipwreck reporting. World War II-era shipwrecks in the Gulf of Mexico, which had the benefit of radar positioning and eye-witness testimony, have been discovered tens of miles from their reported sinking locations, including one (the German U-boat, U-*166*) found over 100 mi (161 km) from where it was reported in official records (Church et al. 2007). Not until the advent of satellite-based technology in the second half of the 20^{th} century, such as the global positioning system (GPS), could shipwreck locations be accurately reported.

Garrison et al. (1989a; 1989b; 1989c) built on CEI's (1977a; 1977b) study by examining not just the spatial distribution of GOM shipwrecks but also what factors influenced that distribution, such as port development, shipping lanes, and hurricanes. Garrison et al. concurred with CEI's main conclusion that the majority of shipwrecks occurred in nearshore waters within areas of heavy marine traffic, such as the approaches and entrances to seaports and the mouths of navigable rivers and straits. However, Garrison et al. countered that CEI had underestimated the number of wrecks in open seas due to changes in the late 19^{th}- and early 20^{th}-century sailing routes, particularly in the eastern GOM, and that there was a higher potential for unreported shipwrecks in high-traffic maritime lanes than had been identified by CEI. Garrison et al. further recommended an expansion of the areas in the GOM that should be considered as having the highest potential for shipwreck discoveries. Finally, Garrison et al. (1989a; 1989b; 1989c) acknowledged that CEI (1977a; 1977b) and similar studies aimed at modeling shipwreck locations "have conceptual merit but little predictive or hindcast power in the delineation of the archaeology of the OCS," and that "the [Garrison et al.] study cannot redress this lack of primary, direct archaeological observations which are necessary to construct a realistic picture of historic cultural resources on the northern Gulf OCS."

Pearson et al. (2003a; 2003b; 2003c) again revisited the concept of a probability model for shipwreck occurrence on the Gulf of Mexico OCS. Pearson et al. (2003a; 2003b; 2003c) produced a GIS-based database of over 2,000 reported GOM shipwrecks, adding over 600 new wrecks to the list compiled by Garrison et al. (1989a; 1989b; 1989c). Pearson et al. (2003a; 2003b; 2003c) also had the benefit of over a decade of confirmed shipwreck discoveries (or absence thereof) from oil and gas industry surveys with which to test the efficacy of Garrison et al.'s (1989a; 1989b; 1989c) model. In brief, they concluded that "there is no statistically significant difference between discovering a shipwreck in an identified high probability lease block or in finding one in a lease block not assigned a high probability of containing historic wrecks." This conclusion was based, in part, on the unreliability of reported wreck locations as well as a significant underreporting of vessel losses, particularly prior to the mid-19^{th} century.

Instead of simply dividing the GOM into areas of high or low probability for shipwreck occurrence, Pearson et al. (2003a; 2003b; 2003c) improved the previous models by assigning a numerical value to each reported shipwreck location, indicating its relative location reliability. The location reliability values are as follows:

- wreck location is confirmed through physical verification (e.g., diver or remote-sensing investigations);
- a specific location is provided but has not been confirmed by direct physical investigation;

- a general location is provided in the literature (e.g., coordinates to degrees latitude and longitude, or location relative to a known landmark); and
- unreliable or vague location, such as “off the coast of Louisiana.”

BOEM continues to add to the wreck database created by Pearson et al. (2003a; 2003b; 2003c), which as of March 2022 now contains approximately 2,240 reported and confirmed shipwrecks. Approximately 420 shipwrecks are confirmed locations with a reliability value of 1, and BOEM has determined that 39 of these are potentially eligible for listing on the NRHP based on remotely operated vehicle or diver investigations. Eligible or potentially eligible OCS wrecks that have been discovered include a sailing vessel from the late 17th or early 18th century based on visual dating of an assemblage of bottles on the site; numerous wooden-hulled mechant sailing vessels spanning the early 19th to early 20th centuries (Atauz et al. 2006; Brooks et al. 2016; Church and Warren 2008; Horrell and Borgens 2017); the mid-19th century sidewheel steamboats USS *Hatteras* (Enright et al. 2006; Evans et al. 2013) and SS *New York* (Gearhart II et al. 2011); and 15 of the 56 Allied merchant vessel casualties, plus U-*166,* sunk during World War II (Brooks et al. 2016; Church et al. 2007; Enright et al. 2006; Evans et al. 2013). In 2018, BOEM successfully nominated to the NRHP nine of the World War II wrecks (U-*166*, *Alcoa Puritan*, *Gulfoil*, *Gulfpenn*, *Halo, R.M. Parker, Jr.*, *Robert E. Lee*, *Sheherazade*, and *Virginia*), as well as the 20th-century steam yacht *Anona.* These vessels join the USS *Hatteras* as the only Gulf of Mexico OCS shipwrecks currently listed on the NRHP.

BOEM’s database of known and reported shipwrecks is by no means exhaustive or complete. This is due to the underreporting and unreliability of shipwreck information in the historic record as discussed in CEI (1977a; 1977b), Garrison et al. (1989a; 1989b; 1989c), and Pearson et al. (2003a; 2003b; 2003c), as well as the inability of those authors to investigate every possible archival source. And despite BOEM’s repeated efforts to identify areas of high probability for shipwreck occurrence on the OCS, Pearson et al.’s (2003a; 2003b; 2003c) conclusion that there is no statistically significant correlation between high-probability areas and actual shipwreck discoveries continues to be borne out. Oil and gas industry surveys to locate seafloor hazards have consistently identified historic shipwrecks in lease blocks considered “low probability” in BOEM’s models, particularly in deepwater areas of the western and central Gulf of Mexico. Several of these deepwater wrecks have been subject to additional archaeological investigation by BOEM in collaboration with Federal, academic, and private partners. Examples and additional site-specific information can be found at BOEM’s Virtual Archaeology Museum, which can be found on BOEM’s website at https://www.boem.gov/environment/virtual-archaeology-museum.

In 2021, BOEM used sources compiled from vessel sailing logs and sailing route maps to produce a cartographic analysis of historic sea lanes and shipwrecks in the GOM (BOEM 2021b). Forty-six historic maps spanning the 17th-20th centuries and containing 411 vessel sailing routes were digitally georectified using the known locations of GOM ports or natural shoreline features (https://www.boem.gov/oil-gas-energy/mapping-and-data/map-gallery/historic-sailing-routes-gulf-mexico-application). Each of the routes was assigned a buffer distance of 10, 20, or 30 nautical miles (12, 23, or 35 mi; 19, 37, or 56 km), depending on the age of the map. These buffer distances reflect the estimated variation of possible ship routes during each century of GOM maritime history, given the differences in technology, navigational accuracy, shipping volume, and available ports during any given time period. This analysis showed that by the mid-19th century there was essentially no area of the northern GOM that had not been traversed by ocean-going vessels and, therefore, no area of the northern GOM where historic shipwrecks would be unlikely to occur.

Natural Processes and Their Influence on Archaeological Sites

Submerged shipwrecks off the coasts of Texas, Louisiana, Mississippi, and Alabama are likely to be moderately well-preserved because of the high sediment load in the water column from upland drainage and wind and water erosion. Wrecks occurring within or close to the mouths of bays likely would have been quickly buried by transported sediment and therefore somewhat protected from the destructive effects of wood-eating shipworms (*Teredo navalis*) or storms, as has been observed at the site of *La Belle* in Matagorda Bay, Texas (Bruseth and Turner 2005). Wrecks occurring in deeper water also have a moderate to high preservation potential. Seafloor temperature in deep water is extremely cold (~4 ºC; 39 ºF), which slows the oxidation of ferrous metals and eliminates warm water wood-eating shipworms such as *Teredo navalis*. However, it is clear from recent studies that other marine organisms, including chemosynthetic species, consume wooden shipwrecks and that microbial organisms are at work breaking down steel and iron hulls (Atauz et al. 2006; Church et al. 2007; Church and Warren 2008; Ford et al. 2008). Due to the high levels of preservation and fewer impacts from anthropogenic (e.g., diving, looting, and fishing trawling) and meteorological (e.g., tropical storms and hurricanes) events, there is a higher likelihood of discovering undisturbed sites in deeper waters.

Hurricane activity in the GOM (discussed further in **Section C.3** of **Appendix C**) has directly influenced the distribution and characteristics of numerous archaeological sites. Wrecks occurring as a result of a major storm, for example, are more likely to be scattered over a broad area. The wreckage of the 19th-century steamer *New York*, which was destroyed in a hurricane, lies in 65 ft (20 m) of water and has been documented by MMS/BOEM (Gearhart II et al. 2011; Irion and Anuskiewicz 1999) as scattered over the ocean floor in a swath over 1,500 ft (457 m) long.

In the GOM, it is almost certain that many existing shipwrecks on the OCS can be, or have been, affected by significant storm events and hurricanes, primarily due to storm surge and seabed shifting. Studies have shown hurricane activity in the GOM to directly impact archaeological resources, even in water depths greater than 200 ft (61 m) (Gearhart II et al. 2011; Lukens and Selberg 2004). Observed impacts to shipwrecks include hull displacement, structural damage, scouring of the surrounding seabed, and site burial due to increased sediment deposition. Shipwrecks occurring in shallow water nearer to shore, such as the Spanish wrecks of the 1554 fleet (Arnold III and Weddle 1978) and *El Nuevo Constante* (Pearson and Hoffman 1995), have been reworked and scattered by subsequent storms more often than those wrecks occurring at greater depths on the OCS. Similar patterns would be expected for future major storm events as well. The National Park Service studied sites along the Gulf Coast that were impacted by Hurricane Katrina and identified three types of damage that can occur to archaeological sites: tree throws; storm surge, scouring, and erosion; and seabed shifting (NPS 2005). Furthermore, in 2007, MMS (BOEM's predecessor) investigated the potential impacts of Hurricanes Katrina and Rita (2005) on historic shipwrecks in the GOM with similar findings. Analysis of the remote-sensing surveys and diver investigations indicated that at least 3 of the 10 shipwrecks examined were affected by recent storm activity. Also, the older wrecks that had been exposed to more hurricanes and had achieved a more advanced level of equilibrium with their environment were less affected than more recent wrecks (Gearhart II et al. 2011).

In addition to the direct effects of major storms discussed above, major storm events (e.g., hurricanes) can also indirectly trigger other events such as seafloor mudslides (discussed further in **Section B.3.2.3** of **Appendix B**), potentially leading to secondary effects to archaeological resources by induced bottom disturbance.

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APPENDIX E

SCENARIO AND TABLES

E SCENARIO AND TABLES

This appendix provides the Proposed Action scenario used in the analysis in this environmental assessment (EA). **Section E.1** provides the scenario and tables for the vessel trips for the issuance of a single Outer Continental Shelf (OCS) wind energy lease and for the high-end OCS wind energy lease issuance scenario (18 leases). **Section E.2** provides the scenario and tables for the air emissions calculations for the issuance of a single OCS wind energy lease and for the high-end OCS wind energy lease issuance scenario (18 leases) used to support the analysis of air quality and greenhouse gas emissions presented in **Chapter 4.4.1**.

E.1 VESSEL TRIPS

Tables E.1-1-E.1-8 provide the estimated quantification of site characterization and site assessment survey effort and activities, including survey lengths in kilometers, estimated durations and vessel trips, as well as timing of some surveys for a single OCS wind energy lease and for the high-end OCS wind energy lease issuance scenario (18 leases).

E.2 AIR EMISSIONS CALCULATIONS

Tables E-2.1-E-2.4 provide emission summaries and **Tables E-2.5-E-2.14** provide emissions calculations for the analyzed site characterization and site assessment activities for a single lease and for the high-end scenario (18 leases) used to support the analysis of air quality and greenhouse gas emissions presented in **Chapter 4.4.1**.

Table E.1-1. Summary of High-Resolution Geophysical Survey Calculations for the Issuance of a Single OCS Wind Energy Lease.

Location	Vessel Type	Kilometers (miles)	Hours	Days	Months	Distance (km) Transited To/From Shore Monthly (24-hr vessel)	Vessel Trips
Grand Total Vessel Routes	24-hr vessel 70%	13,251.36 (8,234.01)	1,590.04	66.25	2.21	509.83	3
	12-hr vessel 30%	24,424.99 (15,176.99)	2,930.76	244.23	8.14	N/A	245
Grand Total Transmission Backbone	24-hr vessel 30%	11,582.91 (7,197.29)	1,389.84	57.91	1.93	445.64	2
	12-hr vessel 70%	27,026.79 (16,739.67)	3,242.96	270.25	9.01	N/A	271
Lease Grand Total	24-hr vessel 100%	58,128.60 (36,119.44)	6,974.87	290.62	9.69	2,236.42	10
Grand Combined Totals		**134,414.65 (83,521.39)**	**16,128.47**	**929.26**	**30.98**	**3,191.88**	**531**

hr = hour; N/A = not applicable.

Assumptions:
Transit Speed = 18.52 kilometers per hour (km/hr) (11.51 miles per hour [mph]).
Survey Speed = 8.334 km/hr (5.179 mph).
Survey corridor for export cables are 1,000 meters (m) (3,280 feet [ft]) wide.
30-m (98-ft) line spacing for the export cable corridor for archaeological surveys.
150-m (492-ft) line spacing for leases and export cable corridor for hazard surveys. Perpendicular tie-lines occur every 500 m (1,640 ft).
Includes an 800-m (2,625-ft) buffer to account for line turns, anchoring, or other activities that may occur beyond the boundary.

Table E.1-2. Summary of High-Resolution Geophysical Survey Calculations for the High-End OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Location	Vessel Type	Kilometers (miles)	Hours	Days	Months	Distance (km) Transited To/From Shore Monthly (24-hr vessel)	Vessel Trips
Grand Total Vessel Routes	24-hr vessel 70%	238,524.55 (148,212.28)	28,620.66	1,192.53	39.75	165,184.12	40
	12-hr vessel 30%	102,224.81 (63,519.55)	12,266.00	1,022.17	34.07	N/A	1,023
Grand Total Transmission Backbone	24-hr vessel 30%	11,582.91 (7,197.29)	1,389.84	57.91	1.93	8,021.45	2
	12-hr vessel 70%	27,026.79 (16,793.67)	3,242.96	270.25	9.01	N/A	271
Grand Total Call Area	24-hr vessel 100%	1,046,314.74 (650,149.84)	125,547.73	5,231.16	174.37	724,598.70	175
Grand Combined Totals		**1,425,673.80 (885,872.63)**	**171,067.17**	**7,774.01**	**259.13**	**897,804.27**	**1,511**

hr = hour; N/A = not applicable.

Assumptions:
Transit Speed = 18.52 km/hr (11.51 mph).
Survey Speed = 8.334 km/hr (5.179 mph).
Survey corridor for export cables are 1,000-m (3,280-ft) wide.
30-m (98-ft) line spacing for export cable corridor for archaeological surveys.
150-m (492-ft) line spacing for leases and export cable corridor for hazard surveys.
Perpendicular tie-lines occur every 500 m (1,640 ft).
Includes an 800-m (2,625-ft) buffer to account for line turns, anchoring, or other activities that may occur beyond the boundary.
High-end scenario assumes the issuance of 18 OCS wind energy leases.

Table E.1-3. Vessel Trip Calculations Associated with Issuance of a Single OCS Wind Energy Lease for Benthic and Geotechnical Sampling.

Survey Type	Samples per 24-hour Day	Days	Trips
Geotechnical	10	147	5
Benthic	20	74	2

Assumptions:

Scenario assumes 1-3 samples will be taken at each survey station to analyze potential export cable corridor route, turbine, and transmission station sites.

Disturbance Areas (estimated maximum)	
Standard Van Veen Benthic	0.1 m^2/sample
Other Benthic	1 m^2/sample
Sediment Profile Imaging	4 m^2/sample
Cone Penetration Test (CPT)	4 m^2/sample
Vibracore	3 m^2/sample
If Anchoring	10 m^2/sample

Number of Survey Stations	
One geotechnical sample (vibracore, CPT, and/or deep boring) at every potential wind turbine location and transmission station location	69
One benthic sample at every potential wind turbine location and transmission station location	69
One geotechnical sample (vibracore, CPT, and/or deep boring) every kilometer of export cable corridor	1,403
One benthic sample every kilometer of export cable corridor	1,403
One benthic sample at each buoy site	2
TOTAL	**2,947**

Table E.1-4. Vessel Trip Calculations Associated with the High-End OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases) for Benthic and Geotechnical Sampling.

Survey Type	Samples per 24-hour Day	Days	Trips
Geotechnical	10	1,049	35
Benthic	20	526	18

Assumptions:
Scenario assumes 1-3 samples will be taken at each survey station to analyze potential export cable corridor route, turbine, and transmission station sites.

Disturbance Areas (estimated maximum)	
Standard van veen Benthic	0.1 m^2/sample
Other Benthic	1 m^2/sample
Sediment Profile Imaging	4 m^2/sample
Cone Penetration Test (CPT)	4 m^2/sample
Vibracore	3 m^2/sample
If anchoring	10 m^2/sample

Number of Survey Stations	
One geotechnical sample (vibracore, CPT, and/or deep boring) at every potential wind turbine location and transmission station location	1,240
One benthic sample at every potential wind turbine location and transmission station location	1,240
One geotechnical sample (vibracore, CPT, and/or deep boring) every kilometer of export cable corridor	9,253
One benthic sample every kilometer of export cable corridor	9,253
One benthic sample at each buoy site	36
TOTAL	**21,020**

Table E.1-5. Vessel Trip Calculations Associated with Site Assessment Buoys.

Installation					
Number of Leases	Number of Buoys	Round Trips for Construction per Buoy – Low	Total Round Trips – Low	Round Trips for Construction per Buoy – High	Total Round Trips – High
1	2	1	2	2	4
18	36	1	36	2	72

Maintenance – Quarterly/Monthly				
Number of Leases	Number of Buoys	Number of Visits per Buoy	Years	Total Trips
1	2	4	5	20
18	36	4	5	360
1	2	12	5	60
18	36	12	5	1,080

Decommissioning					
Number of Leases	Number of Buoys	Round Trips for Construction per Buoy – Low	Total Round Trips – Low	Round Trips for Construction per Buoy – High	Total Round Trips – High
1	2	1	2	2	4
18	36	1	36	2	72

Total		
Lease Issuance Scenario	Low Range	High Range
Single (1)	58	68
High-End (18)	432	1,224

Table E.1-6. Vessel Trip Calculations Associated with Fish and Invertebrate Suveys.

Survey[1]	Vessel Days	*
	Single Lease	High End
Trawl[2]	40	720
Gill net[3]	48	864
Ventless trap[4]	16	288
Molluscan shellfish[5]	1,474	10,529
TOTAL	**1,578**	**12,401**

Assumptions:

[1] Based on June 2019: *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf.*

[2] Trawl Survey Protocols. Demersal Fish and Inertebrates (BOEM 2019).
Trawl speed of 2.9-3.3 knots (3.3-3.8 miles per hour)
2 years x 4 quarters = 8 surveys
30 trawls per survey = 240 samples (trawls)
Vessel trips = 2 days travel (round trip) + 3 days on site = 5 days per survey
5 days/survey x 8 surveys = 40 vessel days

[3] Gill Net Protocols. Microscale Distribution of Fish.
2 years x 2 quarters (spring and fall) x 3 events/quarter = 12 surveys
6 samples per survey = 72 samples
Vessel trips = 2 days RT + 2 day (1-2 days) on site = 4 days per survey
4 days/survey x 12 surveys = 48 vessel days
Other fish surveys that may be completed concurrently or in lieu of gill net surveys with a similar projected activity including pelagic longlines, bottom longline, or bandit gear

[4] Ventless Trap Survey
2 years x 4 quarters = 8 surveys
3 locations/survey = 24 samples (each sample consists of a 5-trap trawl)
Vessel Trips = 2 days RT (day 1, travel and set; 3 days later, day 2 travel and haul)
2 days/survey × 8 surveys = 16 vessel days

[5] Molluscan Shellfish Survey
Assume concurrent with benthic survey

[6] High-end scenario is defined as the the issuance of 18 OCS wind energy leases.

Table E.1-7. Vessel Trip Calculations for the Issuance of a Single OCS Wind Energy Lease Associated with Marine Mammal, Sea Turtle, and Avian Surveys.

Vessel-based Surveys	Vessel speed, 10 kn (12 mph)
	Round-trip distance, 240 km (149 mi)
	Marine mammal surveys 3 years x monthly = 36 surveys
	Avian surveys may be conducted in a minimum of 2 years
Aerial-based Surveys	Aircraft speed, 100 kn (115 mph)
	Round-trip distance, 240 km (149 mi)
	Marine mammal surveys 3 years x monthly = 36 surveys
	Avian surveys may be conducted in a minimum of 2 years
PAM Surveys	Assume concurrent with vessel based surveys

Assumptions:
Based on June 2020: *Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf*
Based on May 27, 2020: *Guidelines for Providing Avian Survey Information for Renewable Energy Development on the Outer Continental Shelf*

Table E.1-8. Vessel Trip Calculations for the High-End OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases) Associated with Marine Mammal, Sea Turtle, and Avian Surveys.

Vessel-based Surveys	• Vessel speed, 10 kn (12 mph) • Round-trip distance, 240 km (149 mi) • Marine mammal surveys 3 years x monthly x 18 leases = 648 surveys • Avian surveys may be conducted in a minimum of 2 years
Aerial-based Surveys	• Aircraft speed, 100 kn (115 mph) • Round-trip distance, 240 km (149 mi) • Marine mammal surveys 3 years x monthly x 18 leases = 648 surveys • Avian surveys may be conducted in a minimum of 2 years
PAM Surveys	• Assume concurrent with vessel-based surveys

Assumptions:
Multi-lease: maximum range of leases considered for this EA is 18 leases.
Based on June 2020: *Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf*
Based on May 27, 2020: *Guidelines for Providing Avian Survey Information for Renewable Energy Development on the Outer Continental Shelf*

Table E.2-9. Summary of Annual Emissions by Activity Associated with the Issuance of a Single OCS Wind Energy Lease.

			Emissions (tons/year)								Emissions (metric tons/year)			
Scenario	**Year**	**Activity/Year**	**CO**	**NO_x**	**VOC**	**$PM_{2.5}$**	**PM_{10}**	**SO_2**	**NH_3**	**Pb**	**CO_2**	**N_2O**	**CH_4**	**CO_{2e}**
No Action	N/A	N/A	No action and, therefore, no emissions											
Single Lease	Year 1	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys	19.02	22.04	0.63	0.54	0.55	0.01	0.01	0.00	1,321.18	0.04	0.17	1,337.14
	Year 2	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys **SA**: Meteorological Buoy Installations, Meteorological Buoy Operations	19.13	22.77	0.65	0.56	0.57	0.01	0.01	0.00	1,365.42	0.04	0.18	1,381.92
	Year 3	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys **SA**: Meteorological Buoy Operations	19.08	22.46	0.65	0.55	0.57	0.01	0.01	0.00	1,346.46	0.04	0.18	1,362.73
	Year 4	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys **SA**: Meteorological Buoy Operations	19.08	22.46	0.65	0.55	0.57	0.01	0.01	0.00	1,346.46	0.04	0.18	1,362.73
	Year 5	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys **SA**: Meteorological Buoy Operations	19.08	22.46	0.65	0.55	0.57	0.01	0.01	0.00	1,346.46	0.04	0.18	1,362.73
	Year 6	**SA**: Meteorological Buoy Operations	0.07	0.42	0.01	0.01	0.01	0.00	0.00	0.00	25.28	0.00	0.00	25.44
	Year 7	**SA**: Meteorological Buoy Decommissioning	0.05	0.32	0.01	0.01	0.01	0.00	0.00	0.00	18.96	0.00	0.00	19.19

CO = carbon monoxide; CO_2 = carbon dioxide; CO_{2e} = carbon dioxide equivalents; CH_4 = methane; HRG = high-resolution geophysical; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SA = Site Assessment; SC = Site Characterization; SO_2 = sulfur dioxide; VOC = volatile organic compounds

This appendix and its calculations are adapted from Appendix D of *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York: Revised Environmental Assessment*. (BOEM 2016).

Assumptions, data, table footnotes, references, Call Area, port locations, vessel trip volumes, and distances are taken from the information in this EA.

Assumes site characterization activities would take place equally over Years 1-5, and the meteorological buoys would be installed in Year 2, operated in Years 2-6, and decommissioned in Year 7.

NH_3 and Pb hazardous air pollutant emission factors use fraction values given in **Table E.2-5**.

Table E.2-10. Summary of Annual Emissions by Activity for the High-End OCS Wind Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

			Emissions (tons/year)								Emissions (metric tons/year)			
Action Alternative	**Year**	**Activity/Year**	**CO**	**NO_x**	**VOC**	**$PM_{2.5}$**	**PM_{10}**	**SO_2**	**NH_3**	**Pb**	**CO_2**	**N_2O**	**CH_4**	**CO_{2e}**
No Action	N/A	N/A	No action and, therefore, no emissions											
High-End	Year 1	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys	34.26	218.46	6.28	5.34	5.50	0.13	0.10	0.00	13,097.00	0.48	2.15	16,395.51
	Year 2	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys **SA**: Meteorological Buoy Installations, Meteorological Buoy Operations	35.32	225.22	6.48	5.50	5.67	0.14	0.13	0.00	13,295.99	0.48	2.17	16,596.90
	Year 3	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys **SA**: Meteorological Buoy Operations	34.87	222.32	6.39	5.43	5.60	0.14	0.10	0.00	13,122.28	0.48	2.15	16,421.09
	Year 4	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys **SA**: Meteorological Buoy Operations	34.87	222.32	6.39	5.43	5.60	0.14	0.10	0.00	13,122.28	0.48	2.15	16,421.09
	Year 5	**SC**: HRG Surveys, Geotech and Benthic Surveys, Biologic Surveys **SA**: Meteorological Buoy Operations	34.87	222.32	6.39	5.43	5.60	0.14	0.10	0.00	13,122.28	0.48	2.15	16,421.09
	Year 6	**SA**: Meteorological Buoy Operations	0.61	3.86	0.11	0.09	0.10	0.00	0.00	0.00	25.28	0.00	0.00	25.59
	Year 7	**SA**: Meteorological Buoy Decommissioning	0.45	2.90	0.08	0.07	0.07	0.00	0.03	0.00	173.71	0.01	0.02	175.81

CO = carbon monoxide; CO_2 = carbon dioxide; CO_{2e} = carbon dioxide equivalents; CH_4 = methane; HRG = high-resolution geophysical; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM10 = particulate matter with aerodynamic diameters of 10 microns or less; SA = Site Assessment; SC = Site Characterization; SO_2 = sulfur dioxide; VOC = volatile organic compounds

This appendix and its calculations are adapted from Appendix D of *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York: Revised Environmental Assessment*. (BOEM 2016).

Assumptions, data, table footnotes, references, Call Area, port locations, vessel trip volumes, and distances are taken from the information in this EA.

Assumes site characterization activities would take place equally over Years 1-5, and the meteorological buoys would be installed in Year 2, operated in Years 2-6, and decommissioned in Year 7.

NH_3 and Pb hazardous air pollutant emission factors use fraction values given in **Table E.2-6**.

Table E.2-11. Detailed Emission Estimation of Annual Emissions by Activities for an Average Year for the Issuance of a Single OCS Wind Energy Lease.

Phase/Source Description	Emissions (tons/year)								Emissions (metric tons/year)			
	CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	NH_3 [2]	PB [2]	CO_2	N_2O	CH_4	CO_{2e}
Surveys												
Site Characterization – Offshore Surveys												
Vessel Travel – HRG	17.68	13.49	0.39	0.33	0.34	0.01	0.01	0.00	809.04	0.02	0.11	818.82
Vessel Travel – Geotech and Benthic	0.88	5.58	0.16	0.14	0.14	0.00	0.00	0.00	334.63	0.01	0.04	338.68
Vessel Travel – Biologic	0.46	2.96	0.09	0.07	0.07	0.00	0.00	0.00	177.50	0.01	0.02	179.65
Site Characterization – Per Year from Years 1-5	**19.02**	**22.04**	**0.63**	**0.54**	**0.55**	**0.01**	**0.01**	**0.00**	**1,321.18**	**0.04**	**0.17**	**1,337.14**
Meteorological Buoys												
Site Assessment – Installation												
Vessel Travel	0.05	0.32	0.01	0.01	0.01	0.00	0.00	0.00	18.96	0.00	0.00	19.19
Site Assessment – Installation Year 2	**0.05**	**0.32**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**18.96**	**0.00**	**0.00**	**19.19**
Site Assessment – Offshore O&M												
Vessel Travel	0.07	0.42	0.01	0.01	0.01	0.00	0.00	0.00	25.28	0.00	0.00	25.59
Site Assessment – O&M Per Year from Years 2-6	**0.07**	**0.42**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**25.28**	**0.00**	**0.00**	**25.59**
Site Assessment – Offshore Decommission [1]												
Vessel Travel	0.05	0.32	0.01	0.01	0.01	0.00	0.00	0.00	18.96	0.00	0.00	19.19
SUBTOTAL Decommissioning – Year 7	**0.05**	**0.32**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**18.96**	**0.00**	**0.00**	**19.19**

CO = carbon monoxide; CO_2 = carbon dioxide; CO_{2e} = carbon dioxide equivalents; CH_4 = methane; HRG = high-resolution geophysical; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; O&M = operations and maintenance; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Assumes potential emissions for meteorological buoy decommissioning are the same as for installation.
[2] Emission factors using fraction values in **Table E.2-5**.

Table E.2-12. Detailed Emission Estimation of Annual Emissions by Activities for an Average Year for the High-End OCS Wind Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Emissions Summary for Average Year – High Range of Leases[1]

Phase/Source Description	Emissions (tons/year)								Emissions (metric tons/year)			
	CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	NH_3	Pb	CO_2	N_2O	CH_4	CO_{2e}
Surveys												
Site Characterization – Offshore Surveys												
Vessel Travel – HRG	22.45	143.13	4.12	3.50	3.60	0.09	0.07	0.00	8,581.16	0.25	1.14	8,684.85
Vessel Travel - Geotech and Benthic	3.46	22.03	0.63	0.54	0.55	0.01	0.01	0.00	1,320.81	0.04	0.17	1,336.77
Vessel Travel – Biologic	8.36	53.29	1.53	1.30	1.34	0.03	0.03	0.00	3,195.02	0.19	0.83	6,373.89
Site Characterization – Per Year from Years 1-5	**34.26**	**218.46**	**6.28**	**5.34**	**5.50**	**0.13**	**0.10**	**0.00**	**13,097.00**	**0.48**	**2.15**	**16,395.51**
Meteorological Buoys												
Site Assessment – Installation												
Vessel Travel	0.45	2.90	0.08	0.07	0.07	0.00	0.03	0.00	173.71	0.01	0.02	175.81
Site Assessment – Installation Year 2	**0.45**	**2.90**	**0.08**	**0.07**	**0.07**	**0.00**	**0.03**	**0.00**	**173.71**	**0.01**	**0.02**	**175.81**
Site Assessment – Offshore O&M												
Vessel Travel	0.61	3.86	0.11	0.09	0.10	0.00	0.00	0.00	25.28	0.00	0.00	25.59
Site Assessment – O&M Per Year from Years 2-6	**0.61**	**3.86**	**0.11**	**0.09**	**0.10**	**0.00**	**0.00**	**0.00**	**25.28**	**0.00**	**0.00**	**25.59**
Site Assessment – Offshore Decommission[2]												
Vessel Travel	0.45	2.90	0.08	0.07	0.07	0.00	0.03	0.00	173.71	0.01	0.02	175.81
SUBTOTAL Decommissioning – Year 7	**0.45**	**2.90**	**0.08**	**0.07**	**0.07**	**0.00**	**0.03**	**0.00**	**173.71**	**0.01**	**0.02**	**175.81**

CO = carbon monoxide; CO_2 = carbon dioxide; CO_{2e} = carbon dioxide equivalents; CH_4 = methane; HRG = high-resolution geophysical; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; O&M = operations and maintenance; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Maxium number of leases assessed in this EA is 18 leases.
[2] Assumes potential emissions for meteorological buoy decommissioning are the same as for installation.
[3] Emission factors calculated using fraction values in **Table E.2-6**.

Table E.2-13. Detailed HAP Emission Estimation of Annual Emissions by Activities for an Average Year for a Single OCS Wind Energy Lease.

Pollutant	Pollutant Code	Basis	Fraction	Survey			Buoy		Total
				HRG	Geotech & Benthic	Biological	Installation	O&M	
2,2,4-Trimethylpentane	540841	VOC	0.00712	2.76E-03	1.14E-03	6.06E-04	6.47E-05	8.63E-05	**4.66E-03**
Acenaphthene	83329	VOC	5.09E-05	1.97E-05	8.17E-06	4.33E-06	4.63E-07	6.17E-07	**3.33E-05**
Acenaphthylene	208968	VOC	0.000118	4.58E-05	1.89E-05	1.00E-05	1.07E-06	1.43E-06	**7.73E-05**
Acetaldehyde	75070	VOC	0.009783	3.80E-03	1.57E-03	8.33E-04	8.90E-05	1.19E-04	**6.41E-03**
Ammonia	NH_3	$PM_{2.5}$	0.019247	6.34E-03	2.62E-03	1.39E-03	1.49E-04	1.98E-04	**1.07E-02**
Anthracene	120127	VOC	0.000344	1.33E-04	5.52E-05	2.93E-05	3.13E-06	4.17E-06	**2.25E-04**
Arsenic	7440382	$PM_{2.5}$	2.59E-05	8.54E-06	3.53E-06	1.87E-06	2.00E-07	2.67E-07	**1.44E-05**
Benz[a]Anthracene	56553	$PM_{2.5}$	8.82E-06	2.91E-06	1.20E-06	6.38E-07	6.81E-08	9.08E-08	**4.91E-06**
Benzene	71432	VOC	0.004739	1.84E-03	7.61E-04	4.03E-04	4.31E-05	5.75E-05	**3.10E-03**
Benzo[a]Pyrene	50328	$PM_{2.5}$	4.18E-06	1.38E-06	5.70E-07	3.02E-07	3.23E-08	4.31E-08	**2.33E-06**
Benzo[b]Fluoranthene	205992	$PM_{2.5}$	8.35E-06	2.75E-06	1.14E-06	6.04E-07	6.45E-08	8.60E-08	**4.65E-06**
Benzo[k]Fluoranthene	207089	$PM_{2.5}$	4.18E-06	1.38E-06	5.70E-07	3.02E-07	3.23E-08	4.31E-08	**2.33E-06**
Benzo(g,h,i)Perylene	203123	$PM_{2.5}$	0.000132	4.35E-05	1.80E-05	9.55E-06	1.02E-06	1.36E-06	**7.34E-05**
Cadmium	7440439	$PM_{2.5}$	0.000236	7.78E-05	3.22E-05	1.71E-05	1.82E-06	2.43E-06	**1.31E-04**
Chrysene	218019	$PM_{2.5}$	1.63E-05	5.37E-06	2.22E-06	1.18E-06	1.26E-07	1.68E-07	**9.07E-06**
Chromium (VI)	18540299	$PM_{2.5}$	7.24E-09	2.39E-09	9.87E-10	5.24E-10	5.59E-11	7.46E-11	**4.03E-09**
Ethyl Benzene	100414	VOC	0.000439	1.70E-04	7.05E-05	3.74E-05	3.99E-06	5.32E-06	**2.87E-04**
Fluoranthene	206440	$PM_{2.5}$	8.97E-05	2.96E-05	1.22E-05	6.49E-06	6.93E-07	9.24E-07	**4.99E-05**
Fluorene	86737	VOC	0.000164	6.36E-05	2.63E-05	1.40E-05	1.49E-06	1.99E-06	**1.07E-04**
Formaldehyde	50000	VOC	0.042696	1.66E-02	6.85E-03	3.63E-03	3.88E-04	5.18E-04	**2.80E-02**
Indeno[1,2,3-c,d]Pyrene	193395	$PM_{2.5}$	8.35E-06	2.75E-06	1.14E-06	6.04E-07	6.45E-08	8.60E-08	**4.65E-06**
Lead	7439921	$PM_{2.5}$	0.000125	4.12E-05	1.70E-05	9.04E-06	9.66E-07	1.29E-06	**6.95E-05**
Mercury	7439976	$PM_{2.5}$	4.18E-08	1.38E-08	5.70E-09	3.02E-09	3.23E-10	4.31E-10	**2.33E-08**
Naphthalene	91203	VOC	0.00273	1.06E-03	4.38E-04	2.32E-04	2.48E-05	3.31E-05	**1.79E-03**
Hexane	110543	VOC	0.00279	1.08E-03	4.48E-04	2.38E-04	2.54E-05	3.38E-05	**1.83E-03**
Phenanthrene	85018	VOC	0.001356	5.26E-04	2.18E-04	1.15E-04	1.23E-05	1.64E-05	**8.88E-04**
Pyrene	129000	$PM_{2.5}$	3.37E-05	1.31E-05	5.41E-06	2.87E-06	3.06E-07	4.09E-07	**2.21E-05**
Toluene	108883	VOC	0.002035	7.90E-04	3.27E-04	1.73E-04	1.85E-05	2.47E-05	**1.33E-03**
Xylenes (Mixed Isomers)	1330207	VOC	0.001422	5.52E-04	2.28E-04	1.21E-04	1.29E-05	1.72E-05	**9.31E-04**

Emission factors were calculated using the fractions provided in the Category 1 and 2 Commercial Marine Vessel 2017 Emissions Inventory document, Table 8. Relevant HAP emissions from offshore sources reported in the Year 2017 Emissions Inventory Study were assessed (Wilson et al. 2019) and analyzed.

Table E.2-14. Detailed HAP Emission Estimation of Annual Emissions by Activities for an Average Year for 18 OCS Wind Energy Leases.

Pollutant	Pollutant Code	Basis	Fraction	Survey			Buoy		Totals
				HRG	Geotech & Benthic	Biological	Installation	O&M	
2,2,4-Trimethylpentane[b]	540841	VOC	0.00712	2.93E-02	4.51E-03	1.09E-02	5.93E-04	7.91E-04	**4.61E-02**
Acenaphthene[a]	83329	VOC	5.09E-05	2.09E-04	3.22E-05	7.80E-05	4.24E-06	5.65E-06	**3.30E-04**
Acenaphthylene[a]	208968	VOC	0.000118	4.86E-04	7.47E-05	1.81E-04	9.83E-06	1.31E-05	**7.64E-04**
Acetaldehyde[a]	75070	VOC	0.009783	4.03E-02	6.20E-03	1.50E-02	8.15E-04	1.09E-03	**6.33E-02**
Ammonia[c]	NH_3	$PM_{2.5}$	0.019247	6.73E-02	1.04E-02	2.51E-02	1.36E-03	1.82E-03	**1.06E-01**
Anthracene[a]	120127	VOC	0.000344	1.42E-03	2.18E-04	5.27E-04	2.87E-05	3.82E-05	**2.23E-03**
Arsenic[c]	7440382	$PM_{2.5}$	2.59E-05	9.05E-05	1.39E-05	3.37E-05	1.83E-06	2.44E-06	**1.42E-04**
Benz[a]Anthracene[a]	56553	$PM_{2.5}$	8.82E-06	3.08E-05	4.75E-06	1.15E-05	6.24E-07	8.32E-07	**4.85E-05**
Benzene[a]	71432	VOC	0.004739	1.95E-02	3.00E-03	7.26E-03	3.95E-04	5.26E-04	**3.07E-02**
Benzo[a]Pyrene[c]	50328	$PM_{2.5}$	4.18E-06	1.46E-05	2.25E-06	5.44E-06	2.96E-07	3.94E-07	**2.30E-05**
Benzo[b]Fluoranthene[c]	205992	$PM_{2.5}$	8.35E-06	2.92E-05	4.49E-06	1.09E-05	5.91E-07	7.88E-07	**4.59E-05**
Benzo[k]Fluoranthene[c]	207089	$PM_{2.5}$	4.18E-06	1.46E-05	2.25E-06	5.44E-06	2.96E-07	3.94E-07	**2.30E-05**
Benzo(g,h,i)Perylene[a]	203123	$PM_{2.5}$	0.000132	4.61E-04	7.10E-05	1.72E-04	9.34E-06	1.25E-05	**7.26E-04**
Cadmium[a]	7440439	$PM_{2.5}$	0.000236	8.25E-04	1.27E-04	3.07E-04	1.67E-05	2.23E-05	**1.30E-03**
Chrysene[a]	218019	$PM_{2.5}$	1.63E-05	5.70E-05	8.77E-06	2.12E-05	1.15E-06	1.54E-06	**8.97E-05**
Chromium (VI)[b]	18540299	$PM_{2.5}$	7.24E-09	2.53E-08	3.90E-09	9.42E-09	5.12E-10	6.83E-10	**3.98E-08**
Ethyl Benzene[a]	100414	VOC	0.000439	1.81E-03	2.78E-04	6.73E-04	3.66E-05	4.88E-05	**2.84E-03**
Fluoranthene[a]	206440	$PM_{2.5}$	8.97E-05	3.14E-04	4.83E-05	1.17E-04	6.35E-06	8.46E-06	**4.93E-04**
Fluorene[a]	86737	VOC	0.000164	6.75E-04	1.04E-04	2.51E-04	1.37E-05	1.82E-05	**1.06E-03**
Formaldehyde[a]	50000	VOC	0.042696	1.76E-01	2.70E-02	6.54E-02	3.56E-03	4.74E-03	**2.76E-01**
Indeno[1,2,3-c,d]Pyrene[c]	193395	$PM_{2.5}$	8.35E-06	2.92E-05	4.49E-06	1.09E-05	5.91E-07	7.88E-07	**4.59E-05**
Lead[c]	7439921	$PM_{2.5}$	0.000125	4.37E-04	6.73E-05	1.63E-04	8.85E-06	1.18E-05	**6.88E-04**
Mercury[c]	7439976	$PM_{2.5}$	4.18E-08	1.46E-07	2.25E-08	5.44E-08	2.96E-09	3.94E-09	**2.30E-07**
Naphthalene[a]	91203	VOC	0.00273	1.12E-02	1.73E-03	4.18E-03	2.27E-04	3.03E-04	**1.77E-02**
Hexane[b]	110543	VOC	0.00279	1.15E-02	1.77E-03	4.28E-03	2.32E-04	3.10E-04	**1.81E-02**
Phenanthrene[a]	85018	VOC	0.001356	5.58E-03	8.59E-04	2.08E-03	1.13E-04	1.51E-04	**8.78E-03**
Pyrene[a]	129000	$PM_{2.5}$	3.37E-05	1.39E-04	2.13E-05	5.16E-05	2.81E-06	3.74E-06	**2.18E-04**
Toluene[a]	108883	VOC	0.002035	8.37E-03	1.29E-03	3.12E-03	1.70E-04	2.26E-04	**1.32E-02**
Xylenes (Mixed Isomers)[a]	1330207	VOC	0.001422	5.85E-03	9.01E-04	2.18E-03	1.18E-04	1.58E-04	**9.21E-03**

Emission factors were calculated using the fractions provided in the Category 1 and 2 Commercial Marine Vessel 2017 Emissions Inventory document, Table 8. Relevant HAP emissions from offshore sources reported in the Year 2017 Emissions Inventory Study were assessed (Wilson et al. 2019) and analyzed.

Table E.2-15. Site Characterization Survey Activities Associated with the Issuance of a Single OCS Wind Energy Lease.

Survey Type	Vessel Type	Single Lease Scenario					
		Total No. of Vessel Round Trips	Duration of Survey Task (years)	No. of Vessel Round Trips (per year)[3]	Avg. Miles Per Round Trip (nautical miles)[4]	Total (nautical miles/year)[5]	Activity (hours/year)[6]
HRG Survey – Export Cable Routes	Crew Boat	248	5	50	82	4,069	904
HRG Survey – Total Backbone	Crew Boat	273	5	55	76	4,170	927
HRG Surveys – Lease Areas	Crew Boat	10	5	2	1,034	2,067	1,395
Geotechnical Sampling[1]	Small Tug Boat	7	5	2	4,261	8,522	710
Avian[2],Marine Mammal, and Sea Turtle Surveys[7]	Crew Boat	36	5	8	130	1,037	104
Fish Surveys[7]	Crew Boat	3	5	1	1,905	1,905	614

HRG = high-resolution geophysical; kn =knots; mph = miles per hour.

[1] Assumes all sampling round trips over the 5-year period were performed using a Small Tug Boat in conjunction with a small cargo barge, which does not have an engine. Geotechnical and benthic sampling are presumed to occur concurrently for the export cable. Turbine and transmission station survey site factor is based on 12-megawatt turbines, resulting in 69 total turbines for a single OCS wind energy lease.

[2] Assumes all avian surveys are completed by boat to obtain the worst-case scenario.

[3] Round trips per year are estimated by dividing the total round trips per task by the number of years over which the surveys will be conducted.

[4] Average miles per round trip was calculated by averaging the round trip to the centroid of each lease area from the nearest of the potential staging ports identified within this environmental assessment.

[5] Distances for the high-resolution geophysical (HRG) surveys and HRG survey cable routes are based on vessel-hours and speed. Distances for other surveys are based on calculated round trips multiplied by the average round-trip nautical miles.

[6] Assumes the following average speeds to estimated activity hours based on total nautical miles traveled:

- HRG Survey – 4.5 kn (5.2 mph)
- Tugs Boats/Barges – 12 kn (14 mph)
- Avian Survey – 10 kn (11 mph)
- Fish Survey – 3.1 kn (3.6 mph) (average trawl speed)

No time for the vessels spent at idle was captured in this calculation.

[7] Avian, marine mammal, and sea turtle surveys are 3 years/lease area. Fish surveys are 2 years/lease area. Assumes avian, marine mammal, sea turtle, and fish surveys occur over 5 years over all lease areas.

Table E.2-16. Site Characterization Survey Activities Associated with the High-End OCS Wind Energy Lease Issuance Scenario (issuance of 18 OCS wind energy leases).

Survey Task	Vessel Type	High-End Lease Scenario					
		Total No. of Vessel Round Trips	Duration of Survey Task (years)	No. of Vessel Round Trips (per year)[3]	Avg. Miles Per Round Trip (nautical miles)[4]	Total (nautical miles/year)[5]	Activity (hours/year)[6]
HRG Survey – Export Cable Routes	Crew Boat	1,063	5	213	173	36,798	8,177
HRG Survey – Total Backbone	Crew Boat	273	5	55	76	4,170	927
HRG Surveys – Lease Areas	Crew Boat	175	5	35	3,228	112,994	25,110
Geotechnical Sampling[1]	Small Tug Boat	50	5	10	3,364	33,635	2,803
Avian[2], Marine Mammal, and Sea Turtle Surveys,[7]	Crew Boat	648	5	130	130	16,847	1,685
Fish Surveys[7]	Crew Boat	62	5	13	2637	34,284	11,059

HRG = high-resolution geophysical; kn = knots; mph = miles per hour.

[1] Assumes all sampling round trips over the 5-year period were performed using a Small Tug Boat in conjunction with a small cargo barge, which does not have an engine. Geotechnical and benthic sampling are presumed to occur concurrently for the export cable. Turbine and transmission station survey site factor are based on 12-megawatt turbines, resulting in 1,240 total turbines for 18 leases.

[2] Assumes all avian surveys are completed by boat to obtain the worst-case scenario.

[3] Round trips per year are estimated by dividing total round trips per task by the number of years over which the surveys will be conducted.

[4] Average miles per round trip was calculated by averaging the round trip to the centroid of each lease area from the nearest of the potential staging ports identified within this environmental assessment.

[5] Distances for the high-resolution geophysical (HRG) survey and HRG survey cable routes are based on vessel hours and speed. Distances for other surveys are based on calculated round trips multiplied by average round-trip nautical miles.

[6] Assumes the following average speeds to estimated activity hours based on total nautical miles traveled:

- HRG Survey – 4.5 kn (5.2 mph)
- Tugs Boats/Barges – 12 kn (14 mph)
- Avian Survey – 10 kn (11 mph)
- Fish Survey– 3.1 kn (3.6 mph) (average trawl speed)

No time for the vessels spent at idle was captured in this calculation.

[7] Avian, marine mammal, and sea turtle surveys are 3 years/lease area. Fish surveys are 2 years/lease area. Assumes avian, marine mammal, sea turtle, and fish surveys occur over 5 years over all lease areas.

Table E.2-17. Estimated Annual Emissions for Vessels from HRG Site Characterization Survey Activities for the Issuance of OCS Wind Energy Leases.

Emission Factors for Vessels

Vessel Type	Engine Size (hp)	Engine Power (kW)[1]	Load Factor (%)[2]	Emission Factors (g/kW-hr)[3] CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	CO_2	N_2O[4]	CH_4
Crew Boat	1,000	746	45%	1.6	10.3	0.3	0.25	0.26	0.006	679	0.02	0.09

CO = carbon monoxide; CO_2 = carbon dioxide; CH_4 = methane; g/kW-hr = grams per kilowatt-hour; hp = horsepower; kW = kilowatt; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Engine power (kW) estimated by dividing horsepower by a factor of 1.341.

[2] Load factor based upon Table 3.4 of *Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories* , U.S. EPA, April 2009 Table 3-1 describes both crew boats and tug boats as Harbor Vessels; therefore, load factors are for Harbor Vessels.

[3] Emission factors were provided in the Category 1 and 2 Commercial Marine Vessel 2017 Emissions Inventory document, Table 5. Tier 0 factors were used for both types of boats since the crew boat is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.

[4] Emission factors were provided in the Current Methodologies document, Table 3-8. Tier 0, Category 2 (typically between 1,000 and 3,000 kW) factors were used for both types of boats since the crew boat is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.

Emissions from Vessels – Average Year Over 5 Years

Alternative	**Vessel Type**	**Emissions (tons/year, metric tons/year for GHG pollutants)[1,2]** CO	**NO_x**	**VOC**	**$PM_{2.5}$**	**PM_{10}**	**SO_2**	**CO_2**	**N_2O**	**CH_4**	**CO_{2e}[3]**
Single Lease	Crew Boat – Export Cable Routes	0.59	3.78	0.11	0.09	0.10	0.00	226.77	0.01	0.03	229.51
	Crew Boat – Backbone	0.61	3.88	0.11	0.09	0.10	0.00	232.39	0.01	0.03	235.20
	Crew Boat – Lease Area	16.48	5.84	0.17	0.14	0.15	0.00	349.88	0.01	0.05	354.10
	TOTAL	**17.68**	**13.49**	**0.39**	**0.33**	**0.34**	**0.01**	**809.04**	**0.02**	**0.11**	**818.82**
18 Leases	Crew Boat – Export Cable Routes	5.37	34.21	0.98	0.84	0.86	0.02	2,050.98	0.06	0.27	2,075.76
	Crew Boat – Backbone	0.61	3.88	0.11	0.09	0.10	0.00	232.39	0.01	0.03	235.20
	Crew Boat – Lease Area	16.48	105.05	3.02	2.57	2.65	0.06	6,297.79	0.19	0.83	6,373.89
	TOTAL	**22.45**	**143.13**	**4.12**	**3.50**	**3.60**	**0.09**	**8,581.16**	**0.25**	**1.14**	**8,684.85**

CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalents; CH_4 = methane; GHG = greenhouse gas; N_2O = nitrogen dioxide; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_x = sulfur oxides; VOC = volatile organic compounds

[1] Emissions quantified using the following equation: Emissions (tons) = Engine Power Rating (kW) x Load Factor (%) x Activity (hrs) x Emission Factor (g/kW-hr) x Power Adjustment ÷ 453.59 (lb/g) ÷ 2,000(lb/t) (or 2,204.62(lb/mt) for GHG pollutants CO_2, N_2O, and CH_4).

[2] Power adjustment of 1.1 was assumed for a crew boat to account for auxiliary engines based upon Table 3.10 of the *Current Methodologies* document.

[3] Global Warming Potential CO_2 1 | N_2O 298 | CH_4 25 USEPA, 40 CFR part 98, Table A-1 (5/19).

Table E.2-18. Estimated Annual Emissions for Vessels from Geotechnical and Benthic Site Characterization Survey Activities for the Issuance of OCS Wind Energy Leases.

Emission Factors for Vessels

			Emission Factors (g/kW-hr)[3]									
Vessel Type	**Engine Size (hp)**	**Engine Power (kW)[1]**	**LoadFactor (%)[2]**	**CO**	**NO_x**	**VOC**	**$PM_{2.5}$**	**PM_{10}**	**SO_2**	**CO_2**	**N_2O[4]**	**CH_4[4]**
Small Tug Boat	2,000	1,491	31%	1.6	10.3	0.3	0.25	0.26	0.006	679	0.02	0.09

CO = carbon monoxide; CO2 = carbon dioxide; CH4 = methane; g/kW-hr = grams per kilowatt-hour; hp = horsepower; kW = kilowatt; N2O = nitrogen dioxide; NOx = nitrogen oxides; PM2.5 = particulate matter with aerodynamic diameters of 2.5 microns or less; PM10 = particulate matter with aerodynamic diameters of 10 microns or less; SO2 = sulfur dioxide; VOC = volatile organic compounds

[1] Engine power (kW) estimated by dividing horsepower by a factor of 1.341.
[2] Load factor based upon Table 3.4 of *Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories*, USEPA, April 2009. Table 3-1 describes both crew boats and tug boats as Harbor Vessels; therefore, load factors are for Harbor Vessels.
[3] Emission factors were provided in the Category 1 and 2 Commercial Marine Vessel 2017 Emissions Inventory document, Table 5. Tier 0 factors were used for both types of boats since the crew boat is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.
[4] Emission factors were provided in the *Current Methodologies* document, Table 3-8. Tier 0, Category 2 (typically between 1,000 and 3,000 kW) factors were used for the tug boat factors were used for both types of boats since the crew boat is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.

Emissions from Vessels – Average Year Over 5 Years

Alternative	**Vessel Type**	**Number of Leases**	**Emissions (tons/year, metric tons/year for GHG pollutants)[1,2]**									
			CO	**NO_x**	**VOC**	**$PM_{2.5}$**	**PM_{10}**	**SO_2**	**CO_2**	**N_2O**	**CH_4**	**CO_{2e}[3]**
18 Leases	Small Tug Boat	1	0.88	5.58	0.16	0.14	0.14	0.00	334.63	0.01	0.04	338.68
		18	3.46	22.03	0.63	0.54	0.55	0.01	1,320.81	0.04	0.17	1,336.77

CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalents; CH_4 = methane; GHG = greenhouse gas; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Emissions quantified using the following equation: Emissions (tons) = Engine Power Rating (kW) x Load Factor (%) x Activity (hrs) x Emission Factor (g/kW-hr) x Power Adjustment ÷ 453.59 (lb/g) ÷ 2,000(lb/t) (or 2,204.62(lb/mt) for GHG pollutants CO_2, N_2O, and CH_4).
[2] Power adjustment of 1.5 was assumed for a harbor tug to account for auxiliary engines based upon Table 3.10 of the Current Methodologies document.
[3] Global Warming Potential CO_2 1 N_2O 298 CH_4 25 USEPA, 40 CFR part 98, Table A-1 (5/19).

Table E.2-19. Estimated Annual Emissions for Vessels from Biological Site Characterization Survey Activities for the Issuance of OCS Wind Energy Leases.

Emission Factors for Vessels

Vessel Type	Engine Size (hp)	Engine Power (kW)[1]	Emission Factors (g/kW-hr)[3] Load Factor (%)[2]	CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	CO_2	N_2O [4]	CH_4 [4]
Crew Boat	1,000	746	45%	1.6	10.3	0.3	0.25	0.26	0.006	679	0.02	0.09

CO = carbon monoxide; CO_2 = carbon dioxide; CH_4 = methane; g/kW-hr = grams per kilowatt-hr; hp = horsepower; kW = kilowatt; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Engine power (kW) estimated by dividing horsepower by a factor of 1.341.

[2] Load factor based upon Table 3.4 of *Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories,* USEPA, April 2009. Table 3-1 describes both crew boats and tug boats as Harbor Vessels; therefore, load factors are for Harbor Vessels.

[3] Emission factors were provided in the *Category 1 and 2 Commercial Marine Vessel 2017 Emissions Inventory* document, Table 5. Tier 0 factors were used for both types of boats since the crew boat is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.

[4] Emission factors were provided in the *Current Methodologies* document, Table 3-8. Tier 0, Category 2 (typically between 1,000 and 3,000 kW) factors were used for both types of boats since the crew boat is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.

Emissions from Vessels – Average Year Over 5 Years

Alternative	Vessel Type	Emissions (tons/year, metric tons/year for GHG pollutants)[1,2] CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	CO_2	N_2O	CH_4	CO_{2e}[4]
Single Lease	Crew Boat – Avian Surveys	0.06	0.39	0.01	0.01	0.01	0.00	23.40	0.00	0.00	23.68
	Crew Boat – Fish Surveys	0.40	2.57	0.07	0.06	0.06	0.00	154.10	0.00	0.02	155.96
	Crew Boat – Marine Mammals Survey[3]	-	-	-	-	-	-	-	-	-	-
	TOTAL	0.46	2.96	0.09	0.07	0.07	0.00	177.50	0.01	0.02	179.65
High-end Scenario	Crew Boat – Avian Surveys	1.10	7.03	0.20	0.17	0.18	0.00	421.24	0.01	0.06	426.33
	Crew Boat – Fish Surveys	7.26	46.27	1.33	1.13	1.17	0.03	2,773.79	0.08	0.37	2,807.30
	Crew Boat – Marine Mammals Survey[3]	-	-	-	-	-	-	-	-	-	-
	TOTAL	8.36	53.29	1.53	1.30	1.34	0.03	3,195.02	0.09	0.42	3,233.63

CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalents; CH_4 = methane; GHG = greenhouse gas; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Emissions quantified using the following equation: Emissions (tons) = Engine Power Rating (kW) x Load Factor (%) x Activity (hrs) x Emission Factor (g/kW-hr) x Power Adjustment ÷ 453.59 (lb/g) ÷ 2,000(lb/t) (or 2,204.62(lb/mt) for GHG pollutants CO_2, N_2O, and CH_4)

[2] Power adjustment of 1.1 was assumed for a crew boat to account for auxiliary engines based upon Table 3.10 of the Current Methodologies document.

[3] Assumes marine mammal surveys conducted concurrent with vessel-based surveys.

[4] Global Warming Potential: CO_2 1 | N_2O 298 | CH_4 25 USEPA 40 CFR part 98, Table A-1 (5/19).

Table E.2-20. Offshore Site Assessment Activities Associated with the Issuance of OCS Wind Energy Leases.

Vessel Details for Installation of Buoys

Vessel Type	Number of Leases	Total No. of Vessel Round Trips/Year[1]	Avg. Miles Per Round Trip (nautical miles)	Total (nautical miles/year)	Activity (hours/year)[2]
Crew Boat	1	2	454	907	76
	18	36	231	8,311	693

[1] Assumes 1 trip/buoy 2 buoys/lease area.
[2] Assumes an average speed of 12 knots (14 miles per hour) for the crew boat.

Activity hours are based upon total nautical miles traveled.
No time for the vessels spent at idle at the buoys was captured in this calculation.

Vessel Details for Operation and Maintenance of Buoys

Vessel Type	Number of Leases	Total No. of Vessel Round Trips/Year[1]	Avg. Miles Per Round Trip (nautical miles)	Total (nautical miles/year)	Activity (hours/year)[2]
Crew Boat	1	4	454	1814	101
	18	72	231	16,622	923

[1] Assumes 1 trip/buoy pair 4 times per year.
[2] Assumes an average speed of 18 knots (21 miles per hour) for the crew boat.

Activity hours are based upon total nautical miles traveled.
No time for the vessels spent at idle at the buoys was captured in this calculation.
Assumes buoys are operational for 5 years.

Table E.2-21. Estimated Annual Emissions for Vessels from Meteorological Buoy Installation as a Part of Site Assessment Activities Associated with the Issuance of OCS Wind Energy Leases.

Emission Factors for Vessels

Vessel Type[1]	Engine Size (hp)	Engine Power (kW)[2]	Load Factor (%)[3]	Emission Factors (g/kW-hr)[4]								
				CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	CO_2	N_2O [5]	CH_4 [5]
Crew Boat	1,000	746	45%	1.6	10.3	0.3	0.25	0.26	0.006	679	0.02	0.09

CO = carbon monoxide; CO_2 = carbon dioxide; CH_4 = methane; g/kW-hr = grams per kilowatt-hour; hp = horsepower; kW = kilowatt; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Supply vessels are typically used to deploy meteorological buoys, assume similar emission factors to crew boat as listed in same category in Current Methodologies.
[2] Engine power (kW) estimated by dividing horsepower by a factor of 1.341.
[3] Load factor based upon Table 3.4 of Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories, USEPA, April 2009. Table 3-1 describes crew boats as Harbor Vessels; therefore, the load factor is for Harbor Vessels.
[4] Emission factors were provided in the Category 1 and 2 Commercial Marine Vessel 2017 Emissions Inventory document, Table 5. Tier 0 factors were used for both types of boats since the crew boat is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.
[5] Emission factors were provided in the Current Methodologies document, Table 3-8. Tier 0, Category 2 (typically between 1,000 and 3,000 kW) factors were used for the crew boat since it is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.

Emissions from Vessels – One Year

Vessel Type	Lease	Emissions (tons/year, metric tons/year for GHG pollutants)[1,2]									
		CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	CO_2	N_2O	CH_4	CO_2e[3]
Crew Boat	1	0.05	0.32	0.01	0.01	0.01	0.00	18.96	0.00	0.00	19.19
	18	0.45	2.90	0.08	0.07	0.07	0.00	173.71	0.01	0.02	175.81

CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalents; CH_4 = methane; GHG = greenhouse gas; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_x = sulfur oxides; VOC = volatile organic compounds

[1] Emissions quantified using the following equation: Emissions (tons) = Engine Power Rating (kW) x Load Factor (%) x Activity (hrs) x Emission Factor (g/kW-hr) x Power Adjustment ÷ 453.59 (lb/g) ÷ 2,000(lb/t) (or 2,204.62(lb/mt) for GHG pollutants CO_2, N_2O, and CH_4).
[2] Power adjustment of 1.1 was assumed for a crew boat to account for auxiliary engines based upon Table 3.10 of the *Current Methodologies* document.
[3] Global Warming Potential CO_2 1 | N_2O 298 | CH_4 25 USEPA, 40 CFR part 98, Table A-1 (5/19).

Table E.2-22. Offshore Site Assessment Routine Maintenance and Evaluation Activities Associated with the Issuance of OCS Wind Energy Leases.

Maintenance Vessel Details

Task	Vessel Type	Number of Leases	Total No. of Vessel Round Trips	Duration ofTask (years)	No. of Vessel Round Trips (per year)	Avg. Miles Per Round Trip (nautical miles)	Total (nautical miles/year)	Activity (hours/year)
Routine Maintenance	Crew Boat	1	20	5	4	454	1,814	101
		18	360	5	72	231	16,622	923

Emission Factors for Vessels

Vessel Type	Engine Size (hp)	Engine Power (kW)[1]	Load Factor (%)[2]	Emission Factors (g/kW-hr)[3]								
				CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	CO_2	N_2O	CH_4
Crew Boat	1,000	746	45%	1.6	10.3	0.3	0.25	0.26	0.006	679	0.02	0.09

CO = carbon monoxide; CO_2 = carbon dioxide; CH_4 = methane; g/kW-hr = grams per kilowatt-hour; hp = horsepower; kW = kilowatt; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_2 = sulfur dioxide; VOC = volatile organic compounds

[1] Engine power (kW) estimated by dividing horsepower by a factor of 1.341.

[2] Load factor based upon Table 3.4 of *Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories*, USEPA, April 2009. Table 3-1 describes crew boats as Harbor Vessels; therefore, the load factor is for Harbor Vessels.

[3] Emission factors were provided in the Category 1 and 2 Commercial Marine Vessel 2017 Emissions Inventory document, Table 5. Tier 0 factors were used for both types of boats since the crew boat is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.

[4] Emission factors were provided in the *Current Methodologies* document, Table 3-8. Tier 0, Category 2 (typically between 1,000 and 3,000 kW) factors were used for the crew boat since it is almost within that category, and it provides a conservative assumption for pollutants for which the areas are in non-attainment.

Emissions from Vessels – Average Year Over 5 Years

Vessel Type	Leases	Emissions (tons/year, metric tons/year for GHG pollutants)[1,2]									
		CO	NO_x	VOC	$PM_{2.5}$	PM_{10}	SO_2	CO_2	N_2O	CH_4	CO_{2e}[3]
Crew Boat	1	0.07	0.4	0.01	0.01	0.01	0.00	25.28	0.00	0.00	25.59
	18	0.61	3.9	0.11	0.09	0.10	0.00	231.61	0.01	0.03	234.41

CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalents; CH_4 = methane; GHG = greenhouse gas; N_2O = nitrogen dioxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with aerodynamic diameters of 2.5 microns or less; PM_{10} = particulate matter with aerodynamic diameters of 10 microns or less; SO_x = sulfur oxides; VOC = volatile organic compounds

[1] Emissions quantified using the following equation: Emissions (tons) = Engine Power Rating (kW) x Load Factor (%) x Activity (hrs) x Emission Factor (g/kW-hr) x Power Adjustment ÷ 453.59 (lb/g) ÷ 2,000(lb/t) (or 2,204.62(lb/mt) for GHG pollutants CO2, N2O, and CH4)

[2] Power adjustment of 1.1 was assumed for a crew boat to account for auxiliary engines based upon Table 3.10 of the Current Methodologies document.

[3] Global Warming Potential CO_2 1 N_2O 298 CH_4 25 USEPA, 40 CFR part 98, Table A-1 (5/19).

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APPENDIX F

ASSESSMENT OF RESOURCES WITH NO OR NEGLIGIBLE IMPACTS

F ASSESSMENT OF RESOURCES WITH NO OR NEGLIGIBLE IMPACTS

The potential impact-producing factors (IPFs) from routine site characterization and site assessment activities expected to take place after issuance of a single Outer Continental Shelf (OCS) wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (i.e., the issuance of 18 leases) were considered for all resources in this environmental assessment (EA). Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to the resources detailed in this appendix for both a single OCS wind lease and under the high-end of the OCS wind lease issuance scenario were scoped out from further analysis. This appendix provides an assessment of resources with no or negligible impacts from implementation of the Proposed Action. **Chapter 4.2** of this EA provides the assessment methodology used to determine impact levels.

F.1 WATER QUALITY

Clean water is essential to human and environmental health. It is especially important to marine ecosystems and humans who live near the coast and rely on the sea for their livelihood. Water quality relates to the condition or environmental health of a waterbody, reflecting its chemical, physical, and biological integrity, as well as its interrelationship with human health and ecosystem functions. In addition to sustaining life, water also links land, ocean, and atmosphere as an integrated system.

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to water quality for both a single lease and under the high-end of the scenario are listed in **Table F.1-1**. Because all of the IPFs from site characterization and site assessment activities were determined to have no or negligible effects on water quality for both a single lease and under the high-end of the scenario, water quality was scoped out from further analysis. Refer to **Table F.1-1** for the reason each IPF, and therefore water quality, was not analyzed in detail in this EA.

Table F.1-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Water Quality.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	Mixing and deposition of pollutants sourced from air emissions from site characterization and site assessment activities would be lower than levels produced during baseline routine activity in the Gulf of Mexico. Therefore, impacts to water quality would be **negligible**.
Discharges and Wastes	Routine discharges would have short durations and be minimal. In addition, they would be in adherence with regulations related to discharges. Therefore, any potential impacts to water quality would be **negligible**.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Bottom Disturbance	Sediment disturbance and turbidity changes from vibracore sampling and anchoring would be short in duration and highly localized. Therefore, any potential impacts would be **negligible**.
Noise	Does not impact water quality.
Coastal Land Use/ Modification	Port expansion is not expected to occur. Port utilization related to site characterization and site assessment activities would have a **negligible** effect on water quality in comparison to the baseline.
Lighting and Visual Impacts	Does not impact water quality.
Offshore Habitat Modification/Space Use	Few interactions are expected to occur with water as a result of the placement of buoys on the OCS and interactions would be limited in duration. Therefore, any potential impacts to water quality would be **negligible**.
Socioeconomic Changes and Drivers	Does not directly interact with water.
Unintended Releases into the Environment	Unintended fuel spills would be generally small in volume, temporary, and would not require remedial or mitigating action. Therefore, any potential impacts to water quality would be **negligible**.
Response Activities	Spill responses are expected to be rare. In the already unlikely event of a spill, the volume would generally be low enough to not require action. The recovery of lost equipment can produce bottom disturbance, but this impact on water quality would be **negligible**.
Strikes and Collisions	Vessel collisions could result in a fuel spill but are considered an unlikely occurrence. Operators must adhere to U.S. Coast Guard navigation rules and traffic control measures, further minimizing risk of vessel collisions. Therefore, any potential impacts to water quality would be **negligible**.

F.2 PELAGIC COMMUNITIES AND HABITATS

The pelagic zone (i.e., habitat) encompasses the entire water column from the surface of the water column down to the greatest depths (excluding the seafloor); pelagic communities include all swimming and floating organisms that reside in this water column. Although the pelagic zone is overwhelmingly large in extent and volume, the animals found within the various pelagic habitats are not randomly distributed (Hobday et al. 2011). The relationships of pelagic communities to pelagic habitat are complex and frequently tied to physical and chemical attributes that can vary seasonally and annually. Some pelagic habitats are more static and less susceptible to large-scale variations such as the deep-sea meso-, bathy-, and abyssopelagic zones. The pelagic zone is divided into two provinces: neritic and oceanic. The neritic province extends from the intertidal zone (waters between high and low tide) to the continental shelf break (water depths of 328-656 feet; 0-200 meters) while the oceanic province includes all waters beyond the continental shelf (water depths >656 feet; >200 meters). For the purposes of this document, the pelagic zone begins seaward of the State/Federal water boundary line of the Gulf of Mexico (GOM) and does not include all of the neritic province. Inland waters of the State/Federal water boundary line are considered coastal and estuarine waters in this analysis. Coastal communities and habitats are analyzed in **Chapter 4.4.2** of this EA. For more detail on pelagic communities and habitats, refer to Chapter 3.3 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021).

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to pelagic communities and habitats for both a single lease and under the high-end of the scenario are listed in **Table F.2-1**. Because all of these IPFs from site characterization and site assessment activities were determined to have no or negligible effects on pelagic communities and habitats for both a single lease and under the high-end of the scenario, pelagic communities and habitats were scoped out from further analysis. Refer to **Table F.2-1** for the reason each IPF, and therefore pelagic communities and habitats, was not analyzed in detail in this EA. Note that any effects to fish and invertebrates, marine mammals, and sea turtles are discussed in **Chapters 4.4.4, 4.4.5, and 4.4.6** and are not considered in **Table F.2-1**.

Table F.2-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Pelagic Communities and Habitats.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	The scale of the proposed action is not anticipated to result in large enough air emissions and pollution to affect pelagic habitat and does not warrant further investigation at this time. Air emissions and pollution would result in **negligible** impacts to pelagic habitat.
Discharges and Wastes	Routine vessel discharges of graywater, bilge, cooling water, ballast, and waste could cause localized changes in water quality by creating a plume within the water column. Rules and regulations are in place to avoid and minimize impacts to water quality and pelagic habitat with vessels required to be compliant with National Pollutant Discharge Elimination System (NPDES) Vessel General Permits (VGPs) if greater than 79 feet and also adhere to the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78). Further, vessels are required to have ballast water treatment systems in compliance with the USCG Ballast Water Management Program (33 CFR part 151) and meet the standards for organisms established in regulation D-2 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments. Because of their limited swimming ability, any discharge plumes that are generated may result in entrainment of plankton, including ichthyoplankton, which could cause a reduction in fitness or death. Whether effects are lethal or sublethal would depend on the amount of temperature, salinity, or dissolved oxygen change within the plume as well as toxicity, exposure time, and sensitivity of the life stages exposed. Based on the localized nature of any temporary plume compared to the relative volume of surrounding offshore waters, the high natural mortality of plankton, rapid dilution from wind and current driven mixing, and the rules and regulations in place for discharges and wastes, any impacts to

Impact-Producing Factor Category	Reason Not Analyzed in Detail
	pelagic species and habitat would be short-term and **negligible** with no population-level effects.
Bottom Disturbance	Activities that disturb the seafloor (e.g., anchoring and sediment sampling) can generate a near-bottom turbidity plume. However, due to the limited amount of seafloor disturbance expected as a result of the proposed action, any effects to pelagic species and habitat would be intermittent, short-term, and **negligible**.
Noise	Study results have been mixed concerning the potential effects of underwater noise on plankton and larvae as a result of high-intensity sounds, especially when in close range (Carroll et al. 2017; Fields et al. 2019; McCauley et al. 2017; Richardson et al. 2017). The use of deep-penetration surveys that produce the highest levels of underwater sound is not expected. Further, high-intensity, sound-producing activities (e.g., pile drivers and explosives) would also not be required as part of construction, operation, or decommissioning of the monitoring buoys. Bubble guns may be used for the seismic surveys conducted under the proposed action; however, their acoustic characteristics are in line with those of medium penetration survey equipment such as boomers and sparkers (refer to **Table B.4.1-1** of **Appendix B**) and would not be used for deep-penetration surveys typical of oil and gas exploration. Any effects from underwater noise as a result of the proposed action would be **negligible** (indetectable) relative to the plankton population/biomass present and the existing baseline level of offshore survey, vessel, and helicopter activity, and associated underwater noise in the northern GOM.
Coastal Land Use/ Modification	Does not overlap or directly interact with pelagic habitat. The scale of the proposed action in coastal waters would have **negligible** impacts to pelagic habitat and does not warrant further investigation at this time.
Lighting and Visual Impacts	Although light from vessels and survey equipment might be detectable underwater, it would be minimal and non-stationary. The light field would be localized to the time and place of the vessel and equipment and short-term. Thus, it is anticipated that any changes in species behavior and/or predator/prey interactions in response to the light field would be **negligible**. Monitoring buoys would meet USCG lighting and marking requirements (33 CFR part 66). Although the underwater light field that a buoy creates could be detectable, there would only be up to 2 buoys per lease (i.e., 2 buoys for every approximate 80,000 acres). Therefore, the contribution of the buoys to the existing baseline underwater light conditions of the northern GOM and any effects of the light field on pelagic species distribution and/or behavior would be **negligible**. Visual resources do not interact with pelagic habitat.
Offshore Habitat Modification/Space Use	There would only be up to 2 buoys per lease (i.e., 2 buoys for every approximate 80,000 acres). Relative to the other, numerous structures in the northern GOM, any contribution of the buoys to effects on pelagic species (e.g., attraction and avoidance) would be **negligible**.
Socioeconomic Changes and Drivers	Does not directly interact with pelagic habitat. The scale of the proposed action would have **negligible** impacts to pelagic species and habitat and do not warrant further investigation at this time.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Unintended Releases into the Environment	The probability of a spill is low. The volume of any spill is also anticipated to be low. Compared to the relative volume of surrounding offshore waters and the plankton and *Sargassum* population/biomass present in the northern GOM, any effects from an unintended release are anticipated to be **negligible**. Offshore discharge of trash and debris is prohibited by BOEM (30 CFR § 585.105(a)) and USCG (International Convention for the Prevention of Pollution from Ships [MARPOL], Annex V, Public Law 100-220 [101 Stat. 1458]) regulations. With adherence to these regulations, the effects of any incidental loss would be **negligible** relative to the volume of surrounding offshore waters and overall plankton and *Sargassum* population/biomass present in the northern GOM.
Response Activities	The activities required for spill cleanup or retrieval of lost equipment are expected to be minimal and localized. Compared to the relative volume of surrounding offshore waters and the plankton and *Sargassum* population/biomass present in the northern GOM, any effects of the response activities would be **negligible**.
Strikes and Collisions	Although potentially causing fragmentation, vessel strikes would not eliminate *Sargassum* habitat, which is prolific in the GOM and reproduces by fragmentation. Any effects of a vessel strike would be intermittent, localized, and **negligible**. Because of their limited swimming ability, vessel strikes could cause injury/mortality of plankton, including ichthyoplankton. Any effects of the proposed action would be intermittent, localized, and **negligible** relative to the plankton population/biomass present in the northern GOM; their naturally high mortality rate; and the extensive presence of similar vessels in the northern GOM.

BOEM = Bureau of Ocean Energy Management; GOM = Gulf of Mexico; USCG = U.S. Coast Guard.
Note: Effects to marine mammals, sea turtles, and fish and invertebrates are discussed elsewhere and are not considered here as part of pelagic communities and habitats.

F.3 BIRDS

Several bird groups utilize the U.S. Gulf of Mexico environment, as the area serves multiple habitat and life staging purposes. Birds from six distinct taxonomic and ecological groups are represented within the GOM region, including passerines (i.e., Passeriformes), raptors (i.e., Falconiformes, Accipitriformes), seabirds (i.e., Charadriiformes, Pelecaniformes, Procellariiformes, Gaviiformes, Podicipediformes), waterfowl (i.e., Anseriformes, Gaviiformes), shorebirds (i.e., Charadriiformes), and wading or marsh birds (i.e., Ciconiiformes, Gruiformes). Seven Endangered Species Act-listed species of birds (i.e., the Cape Sable seaside sparrow, Mississippi sandhill crane, piping plover, rufa red knot, roseate tern, whooping crane, and wood stork) are distributed across the GOM region, either year-round or migratory, with a strong seasonal component. These species are considered and analyzed in consultations with the U.S. Fish and Wildlife Service. For more detail on birds, refer to Chapter 3.8 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021). Birds should not experience impacts from site characterization surveys and site assessment activities (e.g., biological surveys or the installation of meteorological buoys) because these activities occur at or below sea level, within unpreferred bird habitat, including diving birds' foraging habitat. Since site characterization and site assessment activities would be small in scale and similar to the activities that occur in the baseline environment (refer to Chapter 3.8 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021)), BOEM concludes that no or negligible impacts to birds would occur as a result of site characterization and site assessment activities.

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (i.e., the issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to birds for both a single lease and under the high-end of the scenario are listed in **Table F.3-1**. Birds were scoped out from further analysis as all of the IPFs from site characterization and site assessment activities were determined to have no or negligible effects for both a single lease and under the high-end of the scenario. Refer to **Table F.3-1** for the reason each IPF, and therefore birds, was not analyzed in detail in this EA.

Table F.3-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Birds.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	Birds are not expected to be impacted because transport and dispersion dissipate pollutants; most birds in the GOM would be far from pollutant source; offshore air pollutants are temporary and localized; and air emissions are permitted and regulated (e.g., the Clean Air Act and Outer Continental Shelf Lands Act). Furthermore, the anticipated scale of activity from site characterization and site assessment activities is not anticipated to result in large enough impact-producing factors to birds to warrant further investigation at this time.
Discharges and Wastes	The USEPA and USCG regulate certain discharges, so pollutants are expected to be safely disposed of or diluted to below harmful levels to birds. The USEPA or USEPA-authorized State program regulates point-source discharges as part of the NPDES program. Other wastes at onshore facilities (i.e., ports, service bases, shipyards, barge terminals) would be handled by local municipal and solid-waste facilities, which are also regulated by the USEPA or a USEPA-authorized State program. Additionally, all vessels in U.S. waters are required to adhere to International Maritime Organization regulations under the International Convention for the Prevention of Pollution from Ships (MARPOL), limiting discharges and prohibiting the disposal of solid wastes. While ballast water from vessels can introduce biological materials including plants, animals, and microorganisms to coastal and estuarine habitats, which could impact bird habitat, the USCG has established regulations for the discharge of ballast water in U.S. waters to aid in controlling the introduction and spread of nonindigenous species.
Bottom Disturbance	There would be a limited disturbance footprint from site characterization and site assessment activities compared to vast feeding grounds of birds, resulting in **negligible** impacts to birds from these activities.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Noise	Most of the produced sounds related to site characterization and site assessment activities in the OCS are short-term and below diving birds' hearing ranges, as well as limited disturbance potential given the site characterization and site assessment activity's small footprint compared to the vast bird habitat. Therefore, noise from these activities would have **negligible** impacts on birds.
Coastal Land Use/ Modification	Though birds can be affected by coastal land use, the anticipated small scale of site characterization and site assessment activity compared to the baseline activity in the GOM is anticipated to result in **negligible** impacts to birds that would not rise above baseline impacts and not warrant further investigation at this time. Furthermore, ports that would be used for site characterization and site assessment activities already exist and are utilized, and the scale of the proposed activity is not anticipated to increase any ongoing impact.
Lighting and Visual Impacts	Though birds can be affected by lighting, the anticipated small scale of activity in comparison to the baseline activity in the GOM is anticipated to result in **negligible** impacts to birds that would not rise above baseline impacts and not warrant further investigation at this time. Furthermore, lighting from onshore and offshore structures already exists, and the scale of the proposed activity is not anticipated to increase the intensity of any ongoing baseline impacts from lighting.
Offshore Habitat Modification/Space Use	The limited disturbance footprint from site characterization and site assessment activities compared to vast available offshore habitat and the small scale of the proposed activity is not anticipated to increase any impact from ongoing baseline vessel traffic; therefore, offshore habitat modification/space use is anticipated to result in **negligible** impacts on birds.
Socioeconomic Changes and Drivers	Does not directly interact with birds.
Unintended Releases into the Environment	The limited disturbance footprint from a fuel spill or trash release compared to vast available habitat and the small scale of a reasonably foreseeable accidental fuel spill, or accidental trash and debris release is anticipated to result in **negligible** impacts on birds.
Response Activities	The limited disturbance footprint from response activities compared to vast available habitat and the small scale of any spill response from the proposed activity is anticipated to result in **negligible** impacts on birds.
Strikes and Collisions	The limited disturbance footprint of vessel traffic from the proposed activity compared to vast available habitat is anticipated to result in **negligible** impacts from vessel strikes on birds. Furthermore, the implementation of mitigating measures related to lighting (e.g., down-shielding lights, using the minimum necessary amount of lighting, and using LED or low energy lights) could minimize the potential for vessel strikes with birds. Consultation with Federal agencies regarding bird species covered by the Endangered Species Act or the Migratory Bird Treaty Act could further mitigate these effects.

GOM = Gulf of Mexico; NPDES = National Pollutant Discharge Elimination System; OCS = Outer Continental Shelf; USCG = U.S. Coast Guard; USEPA = U.S. Environmental Protection Agency

F.4 Bats

There are four tree bat species that potentially migrate across the GOM. These species include the hoary bat (*Lasiurus cinereus*), northern yellow bat (*Lasiurus intermedius*), red bat (*Lasiurus borealis*), and Seminole bat (*Lasiurus seminolus*). Additionally, other uncommon species may be found in lease areas or in coastal areas where transmission lines could occur. Bats would not experience impacts from site characterization surveys and site assessment activities (e.g., biological surveys or the installation of meteorological buoys) because these activities occur at or below sea level, within unpreferred bat habitat. Since site characterization and site assessment activities are small in scale and similar to the activities that occur in the baseline environment (refer to Chapter 3.8 of the *Biological Environmental Background Report for the Gulf of Mexico OCS Region* (BOEM 2021)), BOEM concludes that no or negligible impacts to bats would occur as a result of site characterization and site assessment activities.

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (i.e., the issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to bats for both a single lease and under the high-end of the scenario are listed in **Table F.4-1**. Bats were scoped out from further analysis as all of the IPFs from site assessment and site characterization activities were determined to have no or negligible effects for both a single lease and under the high-end of the scenario. Refer to **Table F.4-1** for the reason each IPF, and therefore bats, was not analyzed in detail in this EA.

Table F.4-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Bats.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	Bats are not expected to be impacted because transport and dispersion dissipate pollutants; most bats in the GOM would be far from pollutant sources; offshore air pollutants are temporary and localized; and air emissions are permitted and regulated (e.g., the Clean Air Act and Outer Continental Shelf Lands Act). Furthermore, the anticipated scale of activity from site characterization and site assessment activities is not anticipated to result in large enough impact-producing factors to bats to warrant further investigation at this time.
Discharges and Wastes	The USEPA and USCG regulate certain discharges, so pollutants are expected to be safely disposed of or diluted to below harmful levels to bats. The USEPA or a USEPA-authorized State program regulates point-source discharges as part of the NPDES program. Other wastes at onshore facilities (i.e., ports, service bases, shipyards, and barge terminals) would be handled by local municipal and solid-waste facilities, which are also regulated by the USEPA or a USEPA-authorized State program. Additionally, all vessels in U.S. waters are required to adhere to International Maritime Organization regulations under the International Convention for the Prevention of Pollution from Ships (MARPOL), limiting discharges and prohibiting the disposal of solid wastes.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
	While ballast water from vessels can introduce biological materials including plants, animals, and microorganisms to coastal and estuarine habitats, which could impact bat habitat, the USCG has established regulations for the discharge of ballast water in U.S. waters to aid in controlling the introduction and spread of nonindigenous species.
Bottom Disturbance	Bats do not swim or dive below the sea surface, so bottom disturbance does not directly interact with or impact bats.
Noise	Though bats can be affected by noise, site characterization and site assessment activities are expected to result in **negligible** impacts to bats because the anticipated scale of activity is so small in comparison to baseline activities in the GOM that it would not warrant further investigation at this time. Bats are not expected to experience auditory impacts as recent research shows that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Any impacts that were to occur would be limited to behavioral avoidance of the activity, and no temporary or permanent hearing loss would be expected (Simmons et al. 2016). In addition, noise from HRG surveys and pile driving is mostly underwater, where bats do not occur, and therefore would not impact bats because underwater noise does not directly interact with bats.
Coastal Land Use/ Modification	Though bats can be affected by coastal land use, the anticipated small scale of activity compared to the baseline activity in the GOM is anticipated to result in **negligible** impacts to bats and not warrant further investigation at this time. Furthermore, ports that would be used for site characterization and site assessment activities already exist and are utilized, and the scale of the proposed activity is not anticipated to increase any ongoing impact.
Lighting and Visual Impacts	Though bats can be affected by lighting, the anticipated small scale of activity in comparison to the baseline activity in the GOM is expected to result in **negligible** impacts to bats that would not rise above baseline impacts to warrant further investigation at this time. Furthermore, lighting from onshore and offshore structures already exists, and the scale of lighting associated with the proposed activity is not anticipated to increase in intensity above any ongoing baseline impacts. Buoys are also located offshore and not within preferred bat habitat. Lighting may serve as an attractant to bats as they navigate and may indirectly attract bats via insect prey drawn to lights. Bats are adept at avoiding collision with lighted objects as they use sonar to locate obstacles at night. Echolocating bats can orient themselves in complete darkness. With their biological sonar, bats can successfully avoid obstacles by rapidly processing spatial information carried by echoes of their sonar broadcasts (Moss et al. 2006). In acoustically complex environments, where many objects are present, the bat must organize echo information received from multiple sonar targets arriving from different directions and at different times (Moss et al. 2006). Lighting from underwater survey activity occurs underwater, which is not bat habitat.
Offshore Habitat Modification/Space Use	The limited disturbance footprint from site characterization and site assessment activities compared to vast available offshore habitat and the small scale of the proposed activity is not anticipated to increase any impact from ongoing baseline vessel traffic, thus does not warrant further

Impact-Producing Factor Category	Reason Not Analyzed in Detail
	investigation at this time. Furthermore, offshore areas, at or below sea level, are not preferred bat habitat.
Socioeconomic Changes and Drivers	Does not directly interact with bats.
Unintended Releases into the Environment	The probability of a spill is low and the volume of any spill is also anticipated to be low. In addition, offshore discharge of trash and debris is prohibited by BOEM (30 CFR §585.105(a)) and USCG (International Convention for the Prevention of Pollution from Ships [MARPOL], Annex V, Public Law 100-220 [101 Stat. 1458]) regulations. With adherence to these regulations, and with the low probability of a fuel spill, the likelihood of a miniscule accidental fuel spill or accidental release of trash and/or debris reaching onshore bat habitat from the OCS is unlikely and, therefore, impacts from unintended releases to the environment on bats is **negligible**.
Response Activities	For the reasons described above, the likelihood of an accidental fuel spill reaching onshore bat habitat and requiring spill response as well as the recovery of lost equipment to occur in onshore bat habitat is unlikely and therefore impacts from response activities on bats is **negligible**.
Strikes and Collisions	Bats' ability to echolocate make the likelihood of a vessel strike low. The low probability of bats and boats colliding make this potential impact **negligible**. In addition, bats are not expected to experience entanglement because survey activity occurs underwater, which is not bat habitat.

GOM = Gulf of Mexico; HRG = high-resolution geophysical; NPDES = National Pollutant Discharge Elimination System; USCG = U.S. Coast Guard; USEPA = U.S. Environmental Protection Agency

F.5 LAND USE AND COASTAL INFRASTRUCTURE

Land use encompasses six general categories: transportation, recreation, agriculture, and residential and commercial or industrial uses. Coastal infrastructure may provide support for BOEM-regulated activities on the OCS. As opposed to land use, coastal infrastructure may serve as both an impact-producing factor *for* other resources and also as a resource that is impacted *by* BOEM-regulated activities on the OCS. These coastal infrastructure types may support other interests that are unrelated to BOEM-regulated activities, such as State oil and gas activities, commercial entities, and recreational uses. Social effects to human populations are experienced locally, within varying contexts and within complex systems (economic, cultural, regulatory, health, etc.). Potential effects to land use and coastal infrastructure that are related to site characterization and site assessment activities on the OCS are necessarily analyzed within this framework of varied contexts and complex systems.

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to land use and coastal infrastructure for both a single lease and under the high-end of the scenario are listed in **Table F.5-1**. Because all of these IPFs from site characterization and site assessment activities were determined to have no or negligible effects on land use and coastal infrastructure for both a single lease and under the high-end of the scenario, land use and coastal infrastructure was scoped out from further analysis. Refer to **Table F.5-1** for the reason each IPF, and therefore land use and coastal infrastructure, was not analyzed in detail in this EA.

Table F.5-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Land Use and Coastal Infrastructure.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	Air emissions from vehicles and equipment onshore, vessels, aircraft, construction and decommissioning equipment, and diesel engines used to power buoys related to site characterization surveys and site assessment activities are not anticipated to directly affect land use and coastal infrastructure due to the small scale of activity expected and in comparison to the existing baseline air emissions. Therefore, any potential impacts to land use and infrastructure would be **negligible**.
Discharges and Wastes	Onshore point and non-point sources and vessels related to site characterization surveys and site assessment activities are not anticipated to directly affect land use and coastal infrastructure due to the small scale of activity expected and in comparison to the existing baseline discharges and wastes. Therefore, any potential impacts would be **negligible**.
Bottom Disturbance	Disturbance at the bottom of the ocean on the OCS is far removed from land use and coastal infrastructure. Therefore, the resource would not be affected.
Noise	Noise from vehicles and equipment onshore related to site characterization surveys and site assessment activities are not anticipated to directly affect land use and coastal infrastructure due to the small scale of activity expected and in comparison to the existing baseline noise. Therefore, any potential impacts would be **negligible**. Noise in and above the ocean would not affect land use and coastal infrastructure because this resource is located onshore and thus not affected by noise in and above the ocean.
Coastal Land Use/ Modification	A slight increase in port utilization related to site characterization surveys and site assessment activities may be expected in addition to the existing baseline activities in the GOM; however, this would be a short-term, localized effect due to the small scale of activity anticipated. Also, no port expansions are projected. Therefore, any potential impacts would be **negligible**.
Lighting and Visual Impacts	Lighting and visual impacts related to the proposed action are not likely to affect land use and coastal infrastructure beyond the impacts from the existing baseline conditions due to the small scale of activity expected. Therefore, any potential impacts would be **negligible**.
Offshore Habitat Modification/Space Use	Proposed activities in Federal OCS waters associated with the sea surface, airspace, water column, and seafloor occur many miles offshore, far removed from onshore land use and coastal infrastructure and, therefore, the resource would not be affected.
Socioeconomic Changes and Drivers	Socioeconomic changes and drivers related to the proposed action are not likely to affect land use and coastal infrastructure due to the small scale of activity expected. Therefore, any potential impacts would be **negligible**.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Unintended Releases into the Environment	Unintended releases into the environment related to the proposed action are not likely to affect land use and coastal infrastructure beyond the impacts from the existing baseline conditions due to the small scale of activity expected. Therefore, any potential impacts would be **negligible**.
Response Activities	Response activities related to the proposed action are not likely to affect land use and coastal infrastructure beyond the impacts from the existing baseline conditions due to the small scale of activity expected. Therefore, any potential impacts would be **negligible**.
Strikes and Collisions	Collisions related to the proposed action are not likely to affect land use and coastal infrastructure beyond the impacts from the existing baseline conditions due to the small scale of activity expected. Therefore, any potential impacts would be **negligible**. Vessel strikes and entanglement do not apply to land use and coastal infrastructure; therefore, these factors would not affect the resource.

F.6 COMMERCIAL FISHERIES

The Gulf of Mexico is home to a large and complex commercial fishing industry. Some of the most economically important commercial fisheries in the Gulf of Mexico are white shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepenaeus aztecus*), eastern oysters (*Crassostrea virginica*), Gulf menhaden (*Brevoortia patronus*), blue crab (*Callinectes sapidus*), red grouper (*Epinephelus morio*), red snapper (*Lutjanus campechanus*), and tunas (*Thunnus* spp.). Commercial fishers caught 1.4 million pounds of fish and earned $890 million in the Gulf of Mexico, constituting 15.4 percent of total fish revenues in the U.S. (NMFS 2021). A proposed renewable energy lease sale could affect commercial fisheries by affecting fish populations or by affecting the socioeconomic aspects of commercial fishing. Social effects to human populations are experienced locally within varying contexts and within complex systems (economic, cultural, regulatory, health, etc.). Potential effects to commercial fisheries that are related to site characterization and site assessment activities on the OCS are necessarily analyzed within this framework of varied contexts and complex systems.

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to commercial fisheries for both a single lease and under the high-end of the scenario are listed in **Table F.6-1**. Because all of these IPFs from site characterization and site assessment activities were determined to have no or negligible effects on commercial fisheries for both a single lease and under the high-end of the scenario, commercial fisheries was scoped out from further analysis. Refer to **Table F.6-1** for the reason each IPF, and therefore commercial fisheries, was not analyzed in detail in this EA.

Table F.6-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Commercial Fisheries.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	Air emissions from diesel engines used to power buoys and vessels used in site characterization and site assessment activities are not anticipated to adversely affect overall air quality in the Gulf of Mexico (refer to **Chapter 4.4.1**, Air Quality, and **Appendix D**) due to relatively low emissions associated with the proposed action and subsequent activities and steady vertical and horizontal air motion throughout the Gulf of Mexico region that rapidly disperses pollutants. This reduces any chance of potential effects on fish and invertebrate resources, which are causally connected to commercial fisheries. Air emissions and pollution from site characterization and site assessment activities were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. Therefore, there would be no substantial air emissions and pollution interaction with commercial fisheries and no impact or **negligible** impacts are expected.
Discharges and Wastes	Discharges and wastes from onshore point and non-point sources and vessels related to site characterization surveys and site assessment activities are not anticipated to substantially affect water quality in the Gulf of Mexico (refer to **Appendix F.1**, Water Quality). While discharges from onshore point sources are regulated, discharges from non-point sources may degrade habitat quality for commercially valuable fish species over time. Discharges and wastes from site characterization and site assessment activities, however, were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. Due to the likely siting conditions (e.g., already industrialized areas) and small scale of activities projected, population level impacts to fish and invertebrates are not expected, therefore, no impact or **negligible** impacts would be expected for commercial fisheries.
Bottom Disturbance	Geotechnical/sub-bottom sampling activity, biological surveys, vessel and meteorological buoy anchoring, and decommissioning of buoys could temporarily displace commercially valuable species, but the effects would be temporary and localized (refer to **Chapter 4.4.4**, Fish and Invertebrates). Any potential impact to commercial fisheries would be **negligible**.
Noise	Noise from vehicles and equipment onshore would not interact with commercially valuable fish species. The high-resolution geophysical survey equipment, survey vessels, survey aircraft, and anchoring of buoys related to site characterization surveys and site assessment activities are not anticipated to directly affect commercial fisheries because the effects to fish and invertebrates would be localized and temporary (refer to **Chapter 4.4.4**, Fish and Invertebrates). Therefore, any potential impacts to commercial fisheries would be **negligible**.
Coastal Land Use/ Modification	A slight increase in port utilization related to site characterization surveys and site assessment activities may be expected; however, this would be localized and temporary. Any potential impacts to commercially valuable fish species would also be localized and temporary. Coastal land use/modification from site characterization and site assessment activities was determined to have negligible impacts to fish and invertebrates and was not analyzed in detail in **Chapter 4.4.4**. Also, no port expansions are projected due to the small scale of activity anticipated. Therefore, any potential impacts to commercial fisheries would be **negligible**.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Lighting and Visual Impacts	Lighting and visual impacts related to the proposed action would be localized and not likely to cause any population-level effects to commercially valuable fish species. Lighting and visual impacts from site characterization and site assessment activities were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. Therefore, no impact or **negligible** impacts would be expected for commercial fisheries.
Offshore Habitat Modification/Space Use	Offshore habitat modification related to the proposed action may cause some localized effects to commercially valuable fish species; however, no population-level effects are expected. Offshore habitat modification/space use from site characterization and site assessment activities was determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. While vessel traffic may contribute to some space-use conflicts for commercial fisheries, these are expected to be temporary and localized near the sited activities or transportation routes to and from ports, which likely have minimal overlap with commercial fisheries activities. Therefore, any potential impacts to commercial fisheries from offshore habitat modification or space-use conflicts would be **negligible**.
Socioeconomic Changes and Drivers	Socioeconomic changes and drivers related to site characterization and site assessment activities are not likely to affect commercial fisheries due to the small scale of activity expected. Therefore, any potential impacts to commercial fisheries would be **negligible**.
Unintended Releases into the Environment	Unintended releases into the environment caused by spills or other accidental events may indirectly affect commercial fisheries to the extent that they affect fish and their habits. A spill may affect fish larvae and eggs, contaminate adult fish, and cause fish to move out of the affected area for the duration of the event, which may affect commercially valuable fish species. However, unintended releases into the environment from site characterization and site assessment activities were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. In addition, the spill potential for the proposed action would be small, localized and temporary. Therefore, any potential impacts to commercial fisheries would be **negligible**. Trash and debris may indirectly affect commercial fisheries through their effects on fish and their habitats, but the chances of these effects occurring are lessened by existing regulations regarding trash and debris, which require that all trash and debris be transported to shore for proper disposal. Due to these regulatory restrictions and the small amount of activity required for the proposed action, any potential impacts to commercial fisheries would be **negligible**.
Response Activities	Response activities related to the proposed action may affect commercial fisheries to the extent that commercially valuable fish species are affected. For example, spill-response activities may affect fish and invertebrates, particularly oysters, because they are not mobile, cannot engage in avoidance behaviors, and can suffer mortality caused by dispersant use or improper anchoring. However, response activities from site characterization and site assessment activities were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. In addition, at the small scale of activity

Impact-Producing Factor Category	Reason Not Analyzed in Detail
	expected, spill-response effects would be temporary and localized. Therefore, any potential impacts to commercial fisheries would be **negligible**.
Strikes and Collisions	Strikes and collisions from site characterization and site assessment activities were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. Any potential effects from strikes and collisions related to the proposed action would be localized, temporary, and are not likely to affect commercial fisheries. Therefore, any potential impacts to commercial fisheries would be **negligible**.

F.7 RECREATIONAL FISHING

Marine recreational fishing in the Gulf of Mexico is very popular with both residents and tourists, and it is economically important to the coastal states of Florida, Alabama, Mississippi, Louisiana, and Texas. The recreational fishing resource category includes land-based, coastal, and offshore fishing. Recreational fishing is primarily confined to smaller, closer inshore areas of the Gulf of Mexico than commercial fishing. This resource includes private land and vessel-based fishing, rental boat fishing, and charter boat fishing. Recreational fishing activities on the OCS take several forms (e.g., bottom fishing, trolling, and spearfishing). The Proposed Action could affect recreational fishing by affecting fish populations or by affecting the socioeconomic aspects of recreational fishing. Social effects to human populations are experienced locally, within varying contexts and within complex systems (economic, cultural, regulatory, health, etc.). Potential effects to recreational fishing that are related to site characterization and site assessment activities on the OCS are necessarily analyzed within this framework of varied contexts and complex systems.

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to recreational fishing for both a single lease and under the high-end of the scenario are listed in **Table F.7-1**. Because all of these IPFs from site characterization and site assessment activities were determined to have no or negligible effects on recreational fishing for both a single lease and under the high-end of the scenario, recreational fishing was scoped out from further analysis. Refer to **Table F.7-1** for the reason each IPF, and therefore recreational fishing, was not analyzed in detail in this EA.

Table F.7-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Recreational Fishing.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	Air emissions and pollution from the site characterization and site assessment activities are regulated and monitored under the National Ambient Air Quality Standards, and any air emissions are expected to disperse through the Gulf of Mexico's airflow patterns (refer to Air Quality, **Section D.2** of **Appendix D**), therefore air emissions are not considered likely to cause substantial effects to fish and invertebrate resources at the population level. Air emissions and pollution from site characterization and site assessment activities were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. Recreational fishing, which is indirectly affected by the same IPFs as fish and invertebrate resources, is therefore not considered likely to be affected by air emissions.
Discharges and Wastes	While discharges from onshore point sources are regulated, discharges from non-point sources could degrade habitat quality for recreation fish species over time. Discharges and wastes from site characterization and site assessment activities, however, were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. However, because of the scale and likely siting conditions (e.g., occurring in already industrialized areas) of the site characterization and site assessment activities, onshore point and non-point sources would unlikely have a population-level impact to fisheries and would thus not impact recreational fishing. Discharges and wastes from vessel activity associated with the site characterization and site assessment activities are not anticipated to exceed regulated levels (refer to **Section F.1**, Water Quality) and therefore are not considered likely to cause effects to fish and invertebrate resources at the population level. Therefore, recreational fishing, which is indirectly affected by the same IPFs as fish and invertebrate resources, would not be considered likely to be affected by vessel discharge and waste.
Bottom Disturbance	Geotechnical/sub-bottom activity, biological survey activity, vessel and meteorological buoy anchoring, decommissioning of buoys, and suspended sediments could temporarily displace recreational fishing target species, but the effects would be temporary and localized (refer to **Chapter 4.4.4**, Fish and Invertebrates). Therefore, at the scale of the site characterization and site assessment activities, any potential impact to recreational fishing would be **negligible**.
Noise	Although sound from proposed activities is not expected to have population-level effects to fish and invertebrates, anthropogenic sound may negatively affect recreational fishing indirectly through displacement, physical harm, or fatalities within localized fish populations. The severity of these effects would be based on the vulnerability of fish and invertebrate populations. Disturbances to those populations can have proportionate negative effects on recreational fishing and the economic sectors it supports. Noise from high-resolution geophysical survey equipment, vessel engines, survey aircraft, anchoring of buoys, and operation, maintenance, and decommissioning could temporarily displace recreational fishing target species, but the effects would be temporary and localized (refer to **Chapter 4.4.4**, Fish

Impact-Producing Factor Category	Reason Not Analyzed in Detail
	and Invertebrates). Therefore, at the scale of the site characterization and site assessment activities, any potential impact to recreational fishing would be **negligible**.
Coastal Land Use/ Modification	Although coastal land use from the site characterization and site assessment activities is not expected to have population-level effects to fish and invertebrates, localized effects to fish and fishers may occur. Increased traffic could temporarily displace recreational fishers and the fish they target, but the effects would be temporary and localized. However, coastal land use/modification from site characterization and site assessment activities was determined to have negligible impacts to fish and invertebrates and was not analyzed in detail in **Chapter 4.4.4**. When compared to the baseline of vessel traffic existing in the Gulf of Mexico and at the scale of the site characterization and site assessment activities, any potential impact to recreational fishing would be comparatively small. Therefore, any potential impacts would be **negligible** (refer to **Section F.5**, Land Use and Coastal Infrastructure). Fish and invertebrate species important to recreational fisheries can be negatively affected through the modification of coastal vegetation and submerged aquatic vegetation habitats such as salt marsh grasses crucial to various life stages of fish species. Coastal land disturbance can result in a reduction of recreationally important fish, which may negatively affect recreational fishing through reduced landings, which could lead to reduced charter trips. However, no port expansions are projected due to the small scale of activities. Therefore, recreational fishing would not be impacted by this activity (refer to **Section F.5**, Land Use and Coastal Infrastructure).
Lighting and Visual Impacts	Although lighting from the proposed activities onshore and on buoys is not expected to have population-level effects to fish and invertebrates, localized effects to fish may occur. Artificial lighting can negatively affect localized fish and invertebrate resources by altering predator-prey interactions and larval settlement site selection. If these effects cause a decrease in species populations, then recreational fishing also may be negatively affected by decreases in potential catches and by extension, aesthetic enjoyment. Conversely, artificial lighting can also cause positive effects because many recreational fishers enjoy night fishing near structures where the lights attract fish to be caught. However, lighting and visual impacts from site characterization and site assessment activities were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. When compared to the baseline of onshore infrastructure lighting existing in the Gulf of Mexico, at the scale of the site assessment and site characterization activities site characterization and site assessment activities, any potential impact to recreational fishing would be comparatively small, and therefore any potential impacts would be **negligible**. In addition, at the scale of the site characterization and site assessment activities, the effect of lighting from vessels and underwater survey equipment should be temporary and localized and any potential impacts to recreational fishing would be **negligible** compared to the baseline.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
	The visual impacts from buoys for the site characterization and site assessment activities would be minimal in comparison to existing offshore infrastructure that effects on recreational fishers would be **negligible**.
Offshore Habitat Modification/Space Use	The vessel traffic from the site characterization and site assessment activities can contribute to space-use conflicts with recreational fishers. However, there is limited spatial overlap between recreational fishing and energy industry ports. In addition, most recreational fishing activities in the Gulf of Mexico region occur inland or in State waters. Recreational vessels can often easily avoid temporary OCS vessel traffic. The extent of potential effects would depend on the locations of activities, the species affected, the intensity of recreational fishing activity in the affected area, and the substitutability of any lost fishing access. At the scale of the site characterization and site assessment activities, the effect of vessel traffic would be temporary and localized, and any potential impact to recreational fishing would be **negligible** compared to the baseline. Although offshore habitat modification from the site characterization and site assessment activities is not expected to have population-level effects to fish and invertebrates, localized effects to fish may occur. Offshore habitat modification could cause potential effects to fish and invertebrate resources, which range from positive (e.g., structure emplacement adding new habitat) to negative (e.g., structure removal reducing habitat). However, offshore habitat modification/space use from site characterization and site assessment activities was determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. When compared to the baseline of structures existing in the Gulf of Mexico, at the scale of the site characterization and site assessment activities (e.g., tethered buoys), any potential impact to recreational fishing would be **negligible**.
Socioeconomic Changes and Drivers	It is possible that the increased temporary employment could lead to the employed spending more money on recreational fishing or that some charter workers could temporarily take work in the site characterization and site assessment activities at the expense of continuing to engage in recreational fishing, but at the small scale of the site characterization and site assessment activities expected with the Proposed Action, any effects would be inconsequently small and temporary as compared to the baseline recreation fishing activities within the Call Area. The amount of employment resulting from the site characterization and site assessment activities in the context of ongoing employment in other OCS activities would be small, and therefore any potential impacts would be **negligible** (refer to **Section F.10**, Demographics and Employment).
Unintended Releases into the Environment	Fuel spills and other accidental events could indirectly affect recreational fishing activity through their effects on fish and their habitats in the affected areas. A spill could either contaminate fish in the immediate area or cause fish to move during the duration of the spill. A spill would likely cause more direct harm to larvae and eggs than adults, which could possibly affect recreational species in the longer term. Should fish populations that support recreational fishing decline, recreational fishing activity could decline, as well negatively affecting the economic supply chain related to recreational fishing. However, unintended releases into the environment from site characterization and site assessment activities

Impact-Producing Factor Category	Reason Not Analyzed in Detail
	were determined to have negligible impacts to fish and invertebrates and were not analyzed in detail in **Chapter 4.4.4**. The spill potential for the site characterization and site assessment activities would be small, localized, and temporary, and therefore any potential impacts to recreational fishing would be **negligible** (refer to **Section F.1**, Water Quality). Trash and debris could indirectly affect recreational fishing activity through their effects on fish and their habitats in the affected areas. Over time trash and debris could degrade the habitats of fish targeted by recreational fishermen. When compared to the baseline of trash and debris existing in the Gulf of Mexico, regulations surrounding trash and debris, and at the scale of the site characterization and site assessment activities, any potential impact to recreational fishing would be comparatively small, and therefore any potential impacts would be **negligible**.
Response Activities	Spill-response activities can cause negative but localized space-use conflicts for recreational fishing at ports and offshore where fishers would need to avoid certain fishing areas while spill response is ongoing. Spill-response activities may affect fish and invertebrate resources, particularly oysters, because such resources are not mobile, cannot engage in avoidance behaviors, and can suffer mortality caused by dispersant use or improper anchoring. As a result, recreational fishing can be affected by these negative effects to target species' populations, causing reduced landings and adversely affecting charter boat revenues and by extension, the coastal economies associated with those fisheries. However, at the small scale of the site characterization and site assessment activities, effects from spill response would be temporary and localized within a relatively small area; therefore, any potential impact to recreational fishing would be **negligible**. Recovery of lost equipment could have a negative effect on recreational fishing in that recovery efforts could temporarily displace recreational target species or recreational fishing vessels or abandoned equipment could pose a future hazard. At the small scale of the site characterization and site assessment activities, any potential impact to recreational fishing would be **negligible**.
Strikes and Collisions	Recreational fishing may be negatively affected by vessel collisions; however, these would be localized in effect and not likely to interfere with recreational fishing activities unless they occur on inland waterways and disrupt the flow of vessels, possibly interfering with fishing vessels coming from and going to port. Even then, the disruption would be expected to be short term with minimal localized effects. At the small scale of the site characterization and site assessment activities, any potential impact to recreational fishing would be **negligible**. Vessel strikes and entanglement do not apply to recreational fishing.

F.8 Recreation

Recreation includes activities that are primarily for human enjoyment. Recreation includes tourism, which encompasses a variety of services and infrastructure that enables humans to spend time away from home in pursuit of recreation, leisure, business, and other endeavors. The Gulf Coast is home to various resources that support tourism and recreational activities. These include ocean-based resources as well as resources in the counties and parishes along the Gulf of Mexico. The coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes are used for recreational activity by residents of the Gulf Coast States and tourists from throughout the Nation, as well as from foreign countries. Publicly owned and administered areas (such as national seashores, parks, beaches, and wildlife lands), as well as specially designated preservation areas (such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, and scenic rivers), attract residents and visitors throughout the year. Commercial and private recreational facilities and establishments (such as resorts, casinos, marinas, amusement parks, and ornamental gardens) also serve as primary interest areas and support services for people who seek enjoyment from recreation near the Gulf of Mexico. Social effects to human populations are experienced locally, within varying contexts and within complex systems (economic, cultural, regulatory, health, etc.). Potential effects to recreation that are related to site characterization and site assessment activities on the OCS are necessarily analyzed within this framework of varied contexts and complex systems.

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to recreation for both a single lease and under the high-end of the scenario are listed in **Table F.8-1**. Because all of these IPFs from site characterization and site assessment activities were determined to have no or negligible effects on recreation for both a single lease and under the high-end of the scenario, recreation was scoped out from further analysis. Refer to **Table F.8-1** for the reason each IPF, and therefore recreation, was not analyzed in detail in this EA.

Table F.8-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Recreation.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	Air emissions and pollution are not likely to produce impacts to recreation due to the small scale of activity expected from site characterization surveys and site assessment activities. Therefore, any potential impacts would be **negligible**.
Discharges and Wastes	Discharges and wastes related to the proposed action are regulated. Due to the regulation of discharges and wastes because of the small scale of activities that could produce discharges and wastes and because recreation and tourism activities typically do not take place near waste disposal sites, recreators and tourists are not likely to come into contact with waste at disposal sites nor with discharges from renewable energy-related activities. Therefore, any potential impacts to recreation would be **negligible**.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Bottom Disturbance	Bottom disturbances related to the proposed action are not likely to affect recreation due to the small scale of activity expected above baseline conditions. Therefore, any potential impacts to recreation would be **negligible**.
Noise	Noise related to the proposed action is not likely to affect recreation due to the small scale of activity expected above baseline conditions. Therefore, any potential impacts to recreation would be **negligible**.
Coastal Land Use/ Modification	A slight increase in port utilization related to site characterization surveys and site assessment activities above baseline conditions may be expected; however, this would be a short-term effect due to the small scale of activity anticipated. In addition, no port expansions are projected. Therefore, any potential impacts to recreation would be **negligible**.
Lighting and Visual Impacts	Lighting and visual impacts related to the proposed action are not likely to affect recreation due to the small scale of activity expected above baseline conditions. Therefore, any potential impacts to recreation would be **negligible**.
Offshore Habitat Modification/Space Use	Offshore habitat modification and space use impacts related to the proposed action are not likely to affect recreation due to the small scale of activity expected above baseline conditions. Therefore, any potential impacts to recreation would be **negligible**.
Socioeconomic Changes and Drivers	Socioeconomic changes and drivers related to the proposed action are not likely to affect recreation due to the small scale of activity expected. Therefore, any potential impacts would be **negligible**.
Unintended Releases into the Environment	Unintended releases into the environment related to the proposed action are not likely to affect recreation due to the small scale of activity expected above baseline conditions. Therefore, any potential impacts to recreation would be **negligible**.
Response Activities	Response activities related to the proposed action are not likely to affect recreation due to the small scale of activity expected above baseline conditions. Therefore, any potential impacts to recreation would be **negligible**.
Strikes and Collisions	Collisions related to the proposed action are not likely to affect recreation due to the small scale of activity expected above baseline conditions. Therefore, any potential impacts to recreation would be **negligible**. Vessel strikes and entanglement do not apply.

F.9 Environmental Justice

The coastal region of the five Gulf Coast States, i.e., Texas, Louisiana, Mississippi, Alabama, and Florida, is diverse in population, economic mix, and available natural resources. The presence of environmental justice populations, or minority or low-income populations, warrants added attention to identify if these populations experience disproportionate environmental impacts from OCS activities, including human health and social and economic consequences. In that OCS activities related to renewable energy are expected to utilize and expand from existing OCS conventional energy infrastructure, it is worth noting that the OCS conventional energy industry is widespread through the region, but its density and composition vary geographically and there is a strong relationship between the OCS conventional energy industry and the people and communities of the region. Social effects to human populations are experienced locally within varying contexts and within complex systems (economic, cultural, regulatory, health, etc.). Potential effects to environmental justice populations that are related to site characterization and site assessment activities on the OCS are necessarily analyzed within this framework of varied contexts and complex systems.

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to environmental justice for both a single lease and under the high-end of the scenario are listed in **Table F.9-1**. Because all of these IPFs from site characterization and site assessment activities were determined to have no or negligible effects on environmental justice for both a single lease and under the high-end of the scenario, environmental justice was scoped out from further analysis. Refer to **Table F.9-1** for the reason each IPF, and therefore environmental justice, was not analyzed in detail in this EA.

Table F.9-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Environmental Justice.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	Air emissions and pollution from the proposed activities are regulated, permitted, and monitored under the Clean Air Act and Outer Continental Shelf Lands Act. However, air emissions can have negative effects on environmental justice, especially as effects relate to health. The emissions from the Proposed Action, however, would be **negligible** compared to ongoing baseline effects in the Gulf of Mexico (refer to **Chapter 4.4.1**, Air Quality, and **Section D.2** of **Appendix D**), not having a discernable effect on environmental justice considerations.
Discharges and Wastes	Discharges and wastes, although regulated, can have a negative effect on environmental justice. However, potential impacts from discharges and wastes related to the Proposed Action would be **negligible** due to the small scale of activities (refer to **Section F.1**, Water Quality). Therefore, impacts to environmental justice would be **negligible**.
Bottom Disturbance	Bottom disturbance can have negative effects on environmental justice, especially as it can disrupt habitat for fish and invertebrates, including oysters and other shellfish, making them unavailable for consumption or commerce. Conversely, offshore structures could have positive effects by enhancing reef fish habitat and thus improving some fishing and diving opportunities by congregating fish populations near the structures and making them easily available for consumption, commerce, and recreational experiences. However, impacts from bottom disturbance related to the proposed activities would be **negligible** for those environmental justice communities reliant on the fish and invertebrates because the impacts would be so localized and temporary (refer to **Section F-6**, Commercial Fishing, and **Section F.7**, Recreational Fishing). Therefore, impacts to environmental justice would be **negligible**.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Noise	Anthropogenic noise can negatively affect animal behavior. Anthropogenic sound may negatively affect commercial, recreational, and subsistence fishing through decreased landings for environmental justice populations engaged in these activities. However, noise from the proposed activities would be **negligible** because they would be localized and temporary, and small in comparison to the noise in the baseline environment (refer to **Section F.6**, Commercial Fishing, and **Section F.7**, Recreational Fishing). Therefore, impacts to environmental justice would be **negligible**.
Coastal Land Use/ Modification	Port utilization can have environmental justice implications in that the utilization of a specific port contributes to other impact factors, such as air emissions, space use, and socioeconomic factors, amongst others, which could disproportionately affect specific environmental justice communities. Given the current information, including the scale of the Call Area and the fact that the proposed activities are unlikely to substantially alter existing port utilization, the effects of port utilization on environmental justice communities would be **negligible** (refer to **Section F.5**, Land Use and Coastal Infrastructure). Port expansion can have positive or negative effects on environmental justice. As the Proposed Action is not expected to contribute to port expansion, this would not have an impact on environmental justice considerations (refer to **Section F.5**, Land Use and Coastal Infrastructure).
Lighting and Visual Impacts	Lighting and visual impacts can have positive or negative effects on environmental justice. Lighting is installed for working and navigational safety, creating positive effects; however, it can also contribute to light pollution, creating negative effects for certain species or communities in the area. Lighting and visual impacts may disrupt the sense of place of a community or its recreational, cultural, historic, and archaeological resources and economically or culturally significant species. Environmental justice communities may be particularly sensitive to these disruptions if they have culturally significant relationships with those resources or are dependent on income associated with them. However, the potential lighting and visual impacts from the site characterization and site assessment activities, and therefore the potential impacts on environmental justice communities, would be **negligible** because they would be so small in comparison to ongoing baseline activities in the Gulf of Mexico. Lighting from underwater survey equipment could only potentially affect environmental justice populations in that lighting from underwater survey equipment might disrupt predicable fish behavior, possibly impacting environmental justice populations engaged in fishing activities in an extremely temporally and spatially localized manner. Because of this, the impacts on environmental justice populations from underwater lighting related to the Proposed Action would be **negligible** (refer to **Section F.6**, Commercial Fishing, and **Section F.7**, Recreational Fishing).
Offshore Habitat Modification/Space Use	Vessel traffic can have negative effects on environmental justice in that it may affect environmental populations engaging in a conflicting use, such as commercial, recreational, or subsistence fishing. Projected

Impact-Producing Factor Category	Reason Not Analyzed in Detail
	vessel traffic for the Proposed Action, however, is small when compared to the large amount of ongoing vessel traffic utilizing the Gulf of Mexico. Impacts on environmental justice populations would be **negligible** due to the small scale of the site characterization and site assessment activities. The presence of structures, equipment, and meteorological buoys in OCS waters can have negative and positive effects on environmental justice. While placement of structures and buoys prevents competing uses of those areas, such as fish trawls, it provides additional locations for recreational fishing. Structure or buoy removal, however, eliminates or alters potential recreational fishing locations but increases areas where commercial trawlers may operate. However, the Proposed Action is limited to the placement of tethered buoys on the OCS, and impacts would be **negligible** to environmental justice populations because they would be so small in comparison to the other equipment and structures in the GOM under current baseline conditions.
Socioeconomic Changes and Drivers	Temporary increases in employment could benefit environmental justice populations, but only if members of these populations are employed. The amount of employment for the site characterization and site assessment activities would be comparatively small within the larger context of ongoing employment related to other OCS activities. Therefore, potential impacts to environmental justice populations would be **negligible** (refer to **Section F.10**, Demographics and Employment).
Unintended Releases into the Environment	Fuel spills and releases of trash and debris into the environment could have negative effects on environmental justice, particularly on coastal communities and communities with close ties to coastal resources. The small amount of fuel or trash and debris potentially spilled during the site characterization and site assessment activities would be small enough that its effects would be **negligible** to environmental justice communities (refer to **Section F.1**, Water Quality).
Response Activities	Spill response can have both negative and positive effects on environmental justice. It can disrupt normal social and economic functioning, creating disruption and loss. For those workers involved in spill response, however, there can be positive economic gains, as well as economic gains for surrounding hotels and restaurants that gain business from the response, though others may see losses. The effects of a spill on a particular community can depend on a number of factors, such as social and political dynamics, proximity to the spill, economic structure, organizational structure for dealing with disasters, and ability to adapt to the oil cleanup and damage claims processes. The small amount of fuel potentially spilled during the site characterization and site assessment activities would be small enough that its effects would be small, localized, and dissipate quickly. Any response is expected to have **negligible** potential impacts to environmental justice communities. Recovery of lost equipment could have a negative effect on environmental justice populations in that recovery efforts could temporarily displace recreation, commercial, and/or subsistence fishing, or abandoned equipment could pose a future hazard to these industries. However, impacts related to the recovery of lost equipment for the site characterization and site assessment activities on

Impact-Producing Factor Category	Reason Not Analyzed in Detail
	environmental justice populations would be **negligible** (refer to **Section F.6**, Commercial Fishing, and **Section F.7**, Recreational Fishing).
Strikes and Collisions	Vessel collisions could have negative effects on environmental justice. Collisions may affect local populations as they can result in oil or diesel spills, as discussed above, and may interrupt fishing, transportation, and cultural activities along waterways or adjacent roadways. Their impacts would be compounded if they impeded time-limited processes such as fishing seasons or cultural events, such as fleet blessings. However, when compared to the larger overall vessel activity ongoing in the Gulf of Mexico, the potential impact from the site characterization and site assessment activities on environmental justice populations would be **negligible** (refer to **Section F.6**, Commercial Fishing, and **Section F.7**, Recreational Fishing). Vessel strikes and entanglement do not apply to environmental justice.

F.10 DEMOGRAPHICS AND EMPLOYMENT

Demographics and employment are factors that explain and quantify the human behaviors which determine the positive and negative effects that may arise from both OCS wind-related activities and non-OCS wind-related activities. Offshore activities affect various onshore areas because of the various industries involved and because of the complex supply chains for these industries. Many of these impacts occur in counties and parishes along the Gulf of Mexico region. Social effects to human populations are experienced locally, within varying contexts and within complex systems (economic, cultural, regulatory, health, etc.). Potential effects to demographics and employment that are related to site characterization and site assessment activities on the OCS are necessarily analyzed within this framework of varied contexts and complex systems.

The potential impact-producing factors from routine site characterization and site assessment activities expected to take place after issuance of a single OCS wind energy lease and for the high-end of the OCS wind energy lease issuance scenario (issuance of 18 leases) were considered in this analysis. Site characterization and site assessment activities determined not likely to cause effects or to cause only negligible effects to demographics and employment for both a single lease and under the high-end of the scenario are listed in **Table F.10-1**. Because all of these IPFs from site characterization and site assessment activities were determined to have no or negligible effects on demographics and employment for both a single lease and under the high-end of the scenario, demographics and employment was scoped out from further analysis. Refer to **Table F.10-1** for the reason each IPF, and therefore demographics and employment, was not analyzed in detail in this EA.

Table F.10-1. Impact-Producing Factors Determined to Have No or Negligible Impacts on Demographics and Employment.

Impact-Producing Factor Category	Reason Not Analyzed in Detail
Air Emissions and Pollution	Not likely to have a close causal connection to demographics and employment, and therefore, not likely to have reasonably foreseeable effects to any measurable degree to demographics and employment. Therefore, impacts would be **negligible**.
Discharges and Wastes	
Bottom Disturbance	
Noise	
Coastal Land Use/ Modification	
Lighting and Visual Impacts	
Offshore Habitat Modification/Space Use	
Socioeconomic Changes and Drivers	Due to the small scale of activity expected, no measurable impacts to demographics and employment are anticipated. Therefore, impacts would be **negligible**.
Unintended Releases into the Environment	Due to the small scale of activity expected, fuel spills are unlikely to occur and any impacts from spills and trash and debris would be highly localized and temporary with no measurable impacts to demographics and employment. Therefore, impacts would be **negligible**.
Response Activities	Due to the small scale of activity expected, response activities related to spills and recovery of lost equipment are unlikely to occur and any impacts from these activities would be highly localized and temporary with no measurable impacts to demographics and employment. Therefore, impacts would be **negligible**.
Strikes and Collisions	Due to the small scale of activity expected, vessel collisions are unlikely to occur and any impacts from collisions would be highly localized and temporary with no measurable impacts to demographics and employment. Therefore, impacts would be **negligible**.

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APPENDIX G

RELEVENT DOCUMENTS INCORPORATED BY REFERENCE

G RELEVENT DOCUMENTS INCORPORATED BY REFERENCE

This appendix provides a list of relevant regulatory documents and literature considered in this EA and incorporated by reference where appropriate (**Table G-1**).

Table G-1. Relevant Regulatory Documents and Literature Considered in This EA and Incorporated by Reference Where Appropriate.

Reference	Link
BOEM. 2016. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York, Revised Environmental Assessment. 449 p. Report No.: OCS EIS/EA BOEM 2016-070.	https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/NY/NY_Revised_EA_FONSI.pdf
BOEM. 2017. 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.	Vol. I: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Assessment/NEPA/BOEM-2017-051-v1.pdf Vol. II: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Assessment/NEPA/BOEM-EIS-2017-051_v2.pdf Vol. III: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Assessment/NEPA/BOEM-2017-051-v3.pdf Vol. IV: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Assessment/NEPA/BOEM-2017-051-v4.pdf
BOEM. 2019. National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf. 213 p. OCS Study BOEM 2019-036.	https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf
BOEM. 2021. Biological Environmental Background Report for the Gulf of Mexico OCS Region. 298 p. OCS Report BOEM 2021-15.	https://www.boem.gov/sites/default/files/documents/environment/Biological%20Environmental%20Background%20Report%20for%20the%20GOM.pdf
BOEM. 2021. Commercial and Research Wind Lease and Grant Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf of the New York Bight. Final Environmental Assessment. 219 p. OCS EIS/EA BOEM 2021-073.	https://www.boem.gov/sites/default/files/documents//NYBightFinalEA_BOEM_2021-073.pdf
Farrell P, Bowman S, Harris J, Trimm D, Daughdrill W. 2014. Development of Mitigation Measures to Address Potential Use Conflicts between Commercial Wind Energy Lessees/Grantees and Commercial Fishermen on the Atlantic Outer Continental Shelf Final Report on Best Management Practices and Mitigation Measures. 98 p. Report No.: OCS Study BOEM 2014-654.	https://www.boem.gov/sites/default/files/renewable-energy-program/Fishing-BMP-Final-Report-July-2014.pdf

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MMS. 2007. Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf, Final Environmental Impact Statement. 4 vols. Report No.: OCS EIS/EA MMS 2007-046.	https://www.boem.gov/renewable-energy/guide-ocs-alternative-energy-final-programmatic-environmental-impact-statement-eis
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Parsons G, Firestone J. 2018. Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 52 p. Report No.: OCS Study BOEM 2018-013.	https://espis.boem.gov/final%20reports/5662.pdf

APPENDIX H

STANDARD OPERATING CONDITIONS

H STANDARD OPERATING CONDITIONS

The Bureau of Ocean Energy Management (BOEM) would require each lessee to avoid or minimize potential impacts on the environment by complying with various requirements, called Standard Operating Conditions (SOCs), should the decisionmaker choose to implement these requirements in the Final Sale Notice. These SOCs would be detailed in the Final Sale Notice and implemented through lease stipulations to reduce or eliminate potential risks to or conflicts with specific environmental resources. If leases or grants are issued, BOEM would require the lessee to comply with the SOCs through lease stipulations and/or as conditions of Site Assessment Plan (SAP) approval, should the decisionmaker choose to implement these requirements in the Final Sale Notice. If implemented, the lessee's SAP must contain a description of environmental protection features or measures that the lessee will use. **Table H-1** includes the typical SOCs BOEM expects to incorporate into leases as stipulations, or apply as conditions of approval to a SAP, should they be chosen by the decisionmaker. If chosen, these SOCs will be detailed in the Final Sale Notice. **Table H-1** includes SOCs for both resources that are analyzed in detail in this EA and resources that have been scoped out of this EA because each SOC may be included in the Final Sale Notice to inform lessees of BOEM's protective measures for Gulf of Mexico resources.

For offshore cultural, historical, and archaeological resources and biologically sensitive habitats, BOEM's primary mitigation strategy has been, and would continue to be, avoidance. For example, the exact location of meteorological buoys would be adjusted to avoid adverse effects to offshore cultural, historical, and archaeological resources or biologically sensitive habitats, if present. For more detail on potential SOCs for offshore cultural, historical, and archaeological resources and biologically sensitive habitats that may be implemented through lease stipulations, should they be chosen and included in the Final Sale Notice, refer to **Table H-1**.

For marine mammals, sea turtles, fish, bats, and birds, including Endangered Species Act (ESA)-listed species, BOEM is utilizing the best available science and in consultation with other Federal agencies (e.g., the National Marine Fisheries Service [NMFS] and U.S. Fish and Wildlife Service [FWS]) in order to formulate a protective suite of balanced SOCs to minimize the effects of site characterization and site assessment activities associated with offshore wind leasing. These conditions may be implemented through lease stipulations for Alternatives B and C, should the decisionmaker choose to include them in the Final Sale Notice (**Table H-1**).

Stipulations and SOCs are in development by BOEM and through ongoing consultations with appropriate resource agencies. BSEE is assisting in the consultations to inform enforceablability of any stipulations or SOCs. Because a proposed lease sale does not in and of itself make any irreversible or irretrievable commitment of resources that would foreclose the development or implementation of any reasonable and prudent measures determined through consultation to comply with legislation (e.g., the ESA), BOEM may proceed with publication of the Proposed Sale Notice and finalize a decision among alternatives even if consultation is not complete. A link to the product of any consultation will be provided once completed. Additional conditions and/or revisions to these conditions may be developed as new information becomes available or as may be required through consultations.

Table H-1. Description of Potential Standard Operating Conditions That Could be Implemented to Minimize Impacts to Resources (These Standard Operating Conditions would be detailed in the Final Sale Notice and implemented through lease stipulations.)

Category	Related Impact-Producing Factor	Standard Operating Condition (SOC)
General	N/A	Prior to the start of operations, the lessee must hold a briefing to establish responsibilities of each involved party, define the chains of command, discuss communication procedures, provide an overview of monitoring procedures, and review operational procedures. This briefing must include all relevant personnel, crew members and Protected Species Observers (PSOs). New personnel must be briefed as they join the work in progress.
	N/A	The lessee must ensure that all vessel operators and crew members, including PSOs, are familiar with, and understand, the requirements specified in any stipulations and/or SOCs.
	N/A	The lessee must ensure that a copy of the stipulations and SOCs and any Project Design Criteria and/or Best Management Practices resulting from the planned ESA consultation with the National Marine Fisheries Service (NMFS), is made available on every project-related vessel.
	• Bottom Disturbance • Offshore Habitat Modification/Space Use • Noise • Unintentional Releases into the Environment • Strikes and Collisions	The lessee must consult with BOEM, NMFS, and the U.S. Fish and Wildlife Service (FWS) prior to designing and conducting biological surveys intended to support offshore renewable energy plans that could interact with ESA-listed species.
	• Offshore Habitat Modification/Space Use • Strikes and Collisions	BOEM is currently in consultation with NMFS regarding ESA-listed species and anticipates development of requirements for vessel strike avoidance measures.
	• Unintentional Releases into the Environment	BOEM anticipates development of Marine Trash and Debris Protocols.
Surveys	• Air Emissions • Discharges and Wastes • Bottom Disturbance • Noise • Coastal Land Use/Modification • Lighting and Visual Impacts • Offshore Habitat Modification/Space Use	Because details on physical, biological, or cultural resources surveys, including timing and location, are essential for understanding the potential impacts, BOEM will not accept survey plans that do not provide sufficient detail for review. BOEM must review any proposed survey plan and notify the lessee that all necessary ESA Section 7 consultations addressing the proposed survey have concluded before the survey may be conducted.

Category	Related Impact-Producing Factor	Standard Operating Condition (SOC)
	• Unintentional Releases into the Environment • Strikes and Collisions • Response Activities	*Regulatory requirement under 30 CFR §§ 585.610 and 585.626.*
Protected Species	• Offshore Habitat Modification/Space Use • Noise • Strikes and Collisions	BOEM is currently in consultation with NMFS regarding ESA listed species and anticipates development of requirements for PSOs and PSO protocols.
Benthic Habitat	• Bottom disturbance	BOEM is currently in consultation with NMFS regarding Essential Fish Habitat (EFH) and ESA, and anticipates development of avoidance and reporting requirements for activities that could affect hardbottom and live bottom habitats.
Archaeological Surveys	• Bottom Disturbance	In no case may the lessee knowingly impact a potential archaeological resource without BOEM's prior approval.
		The lessee must provide the results of an archaeological survey with its plans. *Regulatory requirement under 30 CFR §§ 585.610 and 585.626.*
		The lessee must ensure that the analysis of archaeological survey data collected in support of plan (i.e., SAP and/or COP) submittal and the preparation of archaeological reports in support of plan submittal are conducted by a qualified marine archaeologist.
		The lessee must coordinate a Tribal pre-survey meeting with regional Tribes. The purpose of this meeting will be for the lessee and the lessee's qualified marine archaeologist to discuss the lessee's survey plan and consider requests to monitor portions of the archaeological survey and the geotechnical exploration activities, including the visual logging and analysis of geotechnical samples (e.g., cores, etc.). The lessee must provide the lessor with documentation of compliance with this stipulation prior to commencement of surveys.
		The lessee may only conduct geotechnical exploration activities performed in support of plan (i.e., SAP and/or COP) submittal in locations where an analysis of the results of geophysical surveys has been completed. This analysis must include a determination by a qualified marine archaeologist as to whether any potential archaeological resources are present in the area. A qualified marine archaeologist must certify, in the lessee's archaeological reports, that geotechnical exploration activities did not impact potential historic properties identified as a result

Category	Related Impact-Producing Factor	Standard Operating Condition (SOC)
		of the high-resolution geophysical surveys performed in support of plan submittal.
		The lessee must inform the qualified marine archaeologist that he or she may elect to be present during high-resolution geophysical surveys and bottom-disturbing activities performed in support of plan (i.e., SAP and/or COP) submittal to ensure avoidance of potential archaeological resources, as determined by the qualified marine archaeologist (including bathymetric, seismic, and magnetic anomalies; side scan sonar contacts; and other seafloor or sub-surface features that exhibit potential to represent or contain potential archaeological sites or other historic properties).
		If the lessee, while conducting geotechnical exploration or any other bottom-disturbing site characterization activities in support of plan (i.e., SAP and COP) submittal and after review of the location by a qualified marine archaeologist discovers an unanticipated potential archaeological resource, such as 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 historic objects; piles of ballast rock) or evidence of a pre-contact archaeological site (e.g., stone tools, pottery or other pre-contact artifacts) within the project area, the Lessee must: (1) immediately halt seafloor/bottom-disturbing activities within the area of discovery; (2) notify the Lessor within 24 hours of discovery; (3) notify the Lessor in writing via report to the Lessor within 72 hours of its discovery; (4) keep the location of the discovery confidential and take no action that may adversely impact the archaeological resource until the Lessor has made an evaluation and instructs the applicant on how to proceed; and (5) if (a) the site has been impacted by the lessee's project activities; or (b) impacts to the site or to the area of potential effect cannot be avoided, conduct additional investigations, as directed by the Lessor, to determine if the resource is eligible for listing in the National Register of Historic Places (30 CFR § 585.802(b)). If investigations indicate that the resource is potentially eligible for listing in the National Register of Historic Places, the Lessor will inform the lessee how to protect the resource or how to mitigate adverse effects to the site. If the Lessor incurs costs in protecting the

Category	Related Impact-Producing Factor	Standard Operating Condition (SOC)
		resource, then, under Section 110(g) of the National Historic Preservation Act, the Lessor may charge the lessee reasonable costs for carrying out preservation responsibilities under the OCS Lands Act (30 CFR § 585.802(c-d)).
Avian and Bat Surveys	• Lighting and Visual Impacts • Offshore Habitat Modification/Space Use	*BOEM is currently in consultation with FWS to finalize SOCs for birds and bats with input from Texas Parks and Wildlife.*
		Recommended mitigations for lighting impacts to birds may be implemented as part of the lease or later as a condition of plan approval.
		Motus Wildlife Tracking System may be required as part of the lease or later as a condition of plan approval to help address information gaps on offshore movements of birds and bats.
		A requirement to install bird deterrent devices (e.g., anti-perching), where appropriate, to minimize the attraction of birds, may be implemented as part of the lease or later as a condition of plan approval.
		Avian annual reporting to BOEM, and FWS may be required to document any dead or injured birds or bats found during activities conducted in support of plan submittal as part of the lease or later as a condition of plan approval.
		The lessee must provide the results of avian surveys and data to BOEM, and FWS with its plans. *Regulatory requirement under 30 CFR §§ 585.610 and 585.626.*
Fisheries Mitigation	• Bottom Disturbance • Noise	Recommended mitigations may be implemented as part of the lease or later as a condition of plan approval. *BOEM Office of Renewable Energy Programs is currently preparing fisheries mitigation guidlance.*

APPENDIX I

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I REFERENCES CITED

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The Department of the Interior Mission

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The Bureau of Ocean Energy Management Mission

The Bureau of Ocean Energy Management (BOEM) is responsible for managing development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.