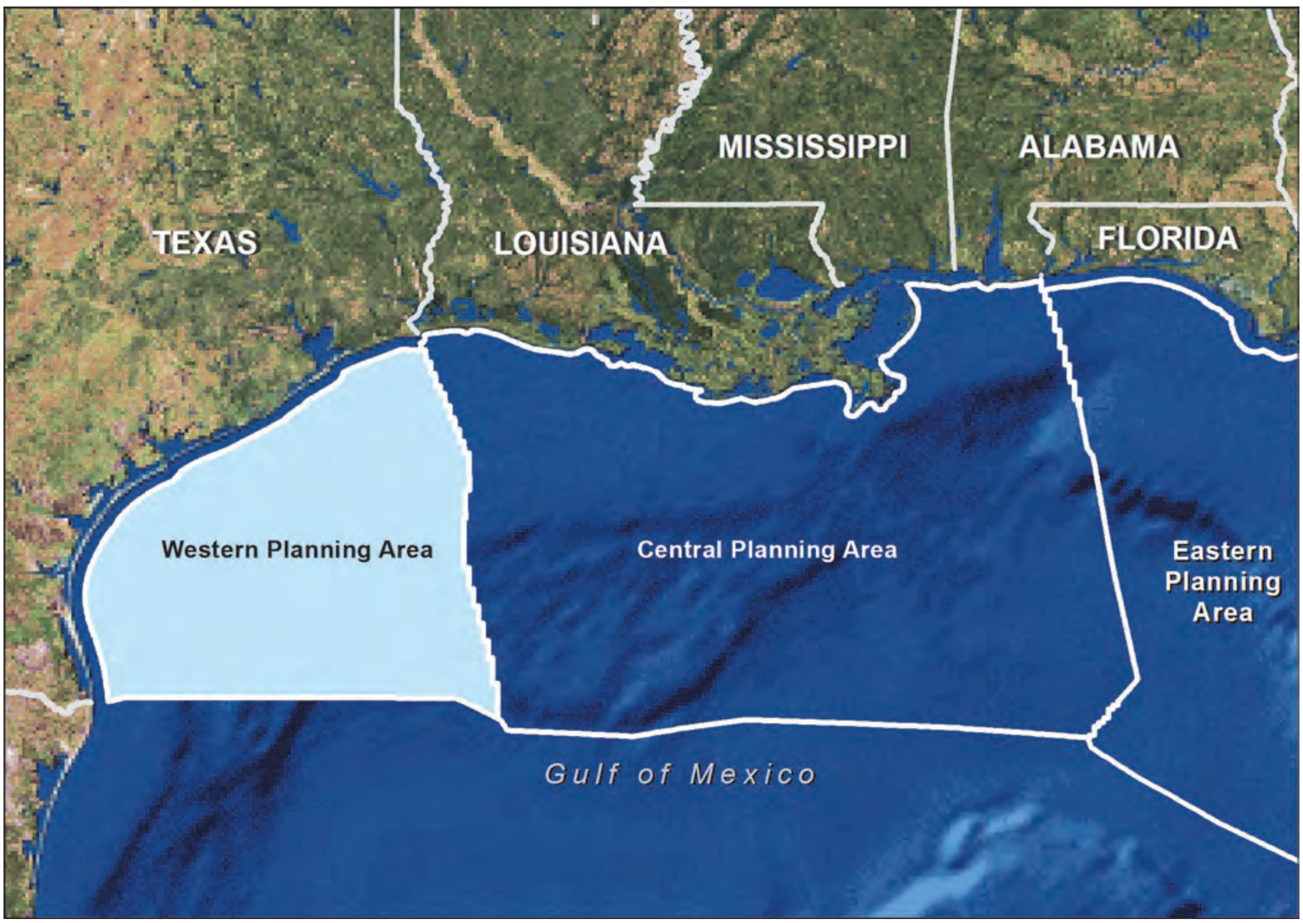
OCS EIS/EA
BOEM 2015-008

Gulf of Mexico OCS
Oil and Gas Lease Sales: 2015 and 2016

Western Planning Area Lease Sales 246 and 248

Final Supplemental Environmental Impact Statement



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

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REGIONAL DIRECTOR'S NOTE

This Supplemental Environmental Impact Statement (EIS) addresses two proposed Federal actions: proposed Outer Continental Shelf (OCS) oil and gas Lease Sales 246 and 248 in the Western Planning Area (WPA) of the Gulf of Mexico, as scheduled in the *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program: 2012-2017* (Five-Year Program) (USDOI, BOEM, 2012a). This Supplemental EIS incorporates by reference all of the relevant material in the EISs from which it tiers: *Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247, Final Environmental Impact Statement* (2012-2017 WPA/CPA Multisale EIS) (USDOI, BOEM, 2012b); *Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231, Final Supplemental Environmental Impact Statement* (WPA 233/CPA 231 Supplemental EIS) (USDOI, BOEM, 2013a); and *Gulf of Mexico OCS Oil and Gas Lease Sales: 2014-2016; Western Planning Area Lease Sales 238, 246, and 248, Final Supplemental Environmental Impact Statement* (WPA 238/246/248 Supplemental EIS) (USDOI, BOEM, 2014).

The 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS analyzed the potential impacts of a WPA proposed action on the marine, coastal, and human environments. It is important to note that the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS were prepared using the best information that was publicly available at the time the documents were prepared. This Supplemental EIS is deemed appropriate to supplement the documents cited above for proposed WPA Lease Sales 246 and 248 in order to consider new circumstances and information arising from, among other things, the *Deepwater Horizon* explosion, oil spill, and response. This Supplemental EIS's analysis focuses on updating the baseline conditions and potential environmental effects of oil and natural gas leasing, exploration, development, and production in the WPA since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. This Supplemental EIS will also assist decisionmakers in making informed, future decisions regarding the approval of operations, as well as leasing. This Supplemental EIS is the final National Environmental Policy Act (NEPA) review conducted for proposed WPA Lease Sale 246. A separate NEPA review will be conducted prior to proposed WPA Lease Sale 248 to address any newly available significant information relevant to that proposed action.

BOEM's Gulf of Mexico OCS Region and its predecessors have been conducting environmental analyses of the effects of OCS oil and gas development since the inception of NEPA. We have prepared and published more than 50 draft and 50 final EISs. Our goal has always been to provide factual, reliable, and clear analytical statements in order to inform decisionmakers and the public about the environmental effects of proposed OCS oil- and gas-related activities and their alternatives. We view the EIS process as providing a balanced forum for early identification, avoidance, and resolution of potential conflicts. It is in this spirit that we welcome comments on this document from all concerned parties.

John L. Rodi
Regional Director
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

COVER SHEET

Supplemental Environmental Impact Statement
for
Proposed OCS Oil and Gas Lease Sales 246 and 248
in the Western Planning Area of the Gulf of Mexico

Draft ( ) **Final (x)**

Type of Action: Administrative (x) Legislative ( )

Area of Potential Impact: Offshore Marine Environment and Coastal Counties/Parishes of Texas and Louisiana

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ABSTRACT

This Supplemental Environmental Impact Statement (EIS) addresses two proposed Federal actions: proposed Outer Continental Shelf (OCS) oil and gas Lease Sales 246 and 248 in the Western Planning Area (WPA) of the Gulf of Mexico, as scheduled in the *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program: 2012-2017* (Five-Year Program) (USDOI, BOEM, 2012a).

This Supplemental EIS updates the baseline conditions and potential environmental effects of oil and natural gas leasing, exploration, development, and production in the WPA since publication of *Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247, Final Environmental Impact Statement* (2012-2017 WPA/CPA Multisale EIS) (USDOI, BOEM, 2012b); *Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231, Final Supplemental Environmental Impact Statement* (WPA 233/CPA 231 Supplemental EIS) (USDOI, BOEM, 2013a); and *Gulf of Mexico OCS Oil and Gas Lease Sales: 2014-2016; Western Planning Area Lease Sales 238, 246, and 248, Final Supplemental Environmental Impact Statement* (WPA 238/246/248 Supplemental EIS) (USDOI, BOEM, 2014). This Supplemental EIS analyzes the potential impacts of a WPA proposed action on sensitive coastal environments, offshore marine resources, and socioeconomic resources both onshore and offshore. It is important to note that this Supplemental EIS was prepared using the best information that was publicly available at the time the document was prepared. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives and if so, it was either acquired or in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place.

The proposed actions are considered to be major Federal actions requiring an EIS. This document provides the following information in accordance with the National Environmental Policy Act (NEPA)

and its implementing regulations, and it will be used in making decisions on the proposal. This Supplemental EIS is the final NEPA review conducted for proposed WPA Lease Sale 246. A separate NEPA review will be conducted prior to BOEM's decision on whether or how to proceed with proposed WPA Lease Sale 248. This document includes the purpose of and need for a WPA proposed action, identification of the alternatives, description of the affected environment, and an analysis of the potential environmental impacts of a WPA proposed action, alternatives, and associated activities, including proposed mitigating measures and their potential effects. Potential contributions to cumulative impacts resulting from activities associated with the WPA proposed actions are also analyzed.

Hypothetical scenarios were developed on the levels of activities, accidental events (such as oil spills), and potential impacts that might result if a WPA proposed action is adopted. Activities and disturbances associated with the WPA proposed actions on biological, physical, and socioeconomic resources are considered in the analyses.

Additional copies of this Supplemental EIS, 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, WPA 238/246/248 Supplemental EIS, and the other referenced publications may be obtained from the Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, Public Information Office (GM 335A), 1201 Elmwood Park Boulevard, Room 250, New Orleans, Louisiana 70123-2394, by telephone at 504-736-2519 or 1-800-200-GULF, or on BOEM's website at http://www.boem.gov/nepaprocess/.

SUMMARY

This Supplemental Environmental Impact Statement (EIS) addresses two proposed Federal actions that offer for lease an area on the Gulf of Mexico Outer Continental Shelf (OCS) that may contain economically recoverable oil and gas resources. Under the *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program*: *2012-2017* (Five-Year Program) (USDOI, BOEM, 2012a), five proposed lease sales are scheduled for the Western Planning Area (WPA). The remaining two proposed lease sales within the WPA are proposed WPA Lease Sales 246 and 248, which are tentatively scheduled to be held in August 2015 and 2016, respectively. Federal regulations allow for several related or similar proposals to be analyzed in one EIS (40 CFR § 1502.4). Since each lease sale proposal and projected activities are very similar for the proposed WPA lease sale area, a single EIS is being prepared for the two remaining proposed WPA lease sales. At the completion of this Supplemental EIS process, a decision will be made on whether or how to proceed with proposed WPA Lease Sale 246. A separate National Environmental Policy Act (NEPA) review, in a form to be determined by the Bureau of Ocean Energy Management (BOEM), will be conducted prior to BOEM's decision on whether or how to proceed with proposed WPA Lease Sale 248.

This Supplemental EIS updates the baseline conditions and potential environmental effects of oil and natural gas leasing, exploration, development, and production in the WPA since publication of *Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247, Final Environmental Impact Statement* (2012-2017 WPA/CPA Multisale EIS) (USDOI, BOEM, 2012b); *Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231, Final Supplemental Environmental Impact Statement* (WPA 233/CPA 231 Supplemental EIS) (USDOI, BOEM, 2013a); and *Western Planning Area Lease Sales 238, 246, and 248, Final Supplemental Environmental Impact Statement* (WPA 238/246/248 Supplemental EIS) (USDOI, BOEM, 2014a).

This Supplemental EIS analyzes the potential impacts of a WPA proposed action on sensitive coastal environments, offshore marine resources, and socioeconomic resources both onshore and offshore. It is important to note that this Supplemental EIS was prepared using the best information that was publicly available at the time this document was prepared. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives and if so, it was either acquired or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place.

This summary section provides only a brief overview of the proposed WPA lease sales, alternatives, significant issues, potential environmental and socioeconomic effects, and proposed mitigating measures contained in this Supplemental EIS. To obtain the full perspective and context of the potential environmental and socioeconomic impacts discussed, it is necessary to read the entire Supplemental EIS. Relevant discussion of specific topics can be found in the chapters and appendices of this Supplemental EIS as described below.

- **Chapter 1**, The Proposed Actions, describes the purpose of and need for the proposed lease sales, the prelease process, postlease activities, and other OCS oil- and gas-related activities.
- **Chapter 2**, Alternatives Including the Proposed Actions, describes the environmental and socioeconomic effects of a proposed WPA lease sale and alternatives. Also discussed are potential mitigating measures to avoid or minimize impacts.
- **Chapter 3**, Impact-Producing Factors and Scenario, describes activities associated with a proposed lease sale and the OCS Program, and other foreseeable activities that could potentially affect the biological, physical, and socioeconomic resources of the Gulf of Mexico.

Chapter 3.1, Impact-Producing Factors and Scenario—Routine Operations, describes offshore infrastructure and activities (impact-producing factors) associated with a proposed lease sale that could potentially affect the biological, physical, and socioeconomic resources of the Gulf of Mexico.

Chapter 3.2, Impact-Producing Factors and Scenario—Accidental Events, discusses potential accidental events (i.e., oil spills, losses of well control, vessel collisions, and spills of chemicals or drilling fluids) that may occur as a result of activities associated with a proposed lease sale.

Chapter 3.3, Cumulative Activities Scenario, describes past, present, and reasonably foreseeable future human activities, including non-OCS oil- and gas-related activities, as well as all OCS oil- and gas-related activities, that may affect the biological, physical, and socioeconomic resources of the Gulf of Mexico.

- **Chapter 4**, Description of the Environment and Impact Analysis, describes the affected environment and provides analysis of the routine, accidental, and cumulative impacts of a WPA proposed action and the alternatives on environmental and socioeconomic resources of the Gulf of Mexico.

  Chapter 4.1, Proposed Western Planning Area Lease Sales 246 and 248, describes the impacts of a WPA proposed action and two alternatives to a WPA proposed action on the biological, physical, and socioeconomic resources of the Gulf of Mexico.

  Chapter 4 also includes **Chapter 4.2**, Unavoidable Adverse Impacts of the Proposed Actions; **Chapter 4.3**, Irreversible and Irretrievable Commitment of Resources; and **Chapter 4.4**, Relationship Between the Short-term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity.

- **Chapter 5**, Consultation and Coordination, describes the consultation and coordination activities with Federal, State, and local agencies and other interested parties that occurred during the development of this Supplemental EIS, and includes copies of the comments received on the Draft Supplemental EIS and BOEM's responses to those comments.

- **Chapter 6**, References Cited, is a list of literature cited throughout this Supplemental EIS.

- **Chapter 7**, Preparers, is a list of names of persons who were primarily responsible for preparing and reviewing this Supplemental EIS.

- **Chapter 8**, Glossary, is a list of definitions of selected terms used in this Supplemental EIS.

- **Appendix A**, Commonly Applied Mitigating Measures, is a list and description of standard postlease mitigating measures that may be required by BOEM or BSEE as a result of plan and permit review processes for the Gulf of Mexico OCS Region.

- **Appendix B**, Catastrophic Spill Event Analysis, is a technical analysis of a potential low-probability catastrophic event to assist BOEM in meeting the Council on Environmental Quality's (CEQ) requirements for evaluating low-probability catastrophic events under NEPA. The CEQ regulations address impacts with catastrophic consequences in the context of evaluating reasonably foreseeable significant adverse effects in an EIS when they address the issue of incomplete or unavailable information (40 CFR § 1502.22). For NEPA purposes, "'[r]easonably foreseeable' impacts include impacts that have catastrophic consequences even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason" (40 CFR § 1502.22(b)(4)). Therefore, this analysis, which is based on credible scientific evidence, identifies the most likely and most significant impacts from a high-volume blowout and oil spill that continues for an extended period of time. The scenario and impacts discussed in this analysis should not be confused with the scenario and impacts anticipated to result from routine activities or more reasonably foreseeable accidental events of a WPA proposed action.

- **Keyword Index** is a list of descriptive terms and the pages on which they can be found in this Supplemental EIS.

Proposed Action and Alternatives

The following alternatives were included for analysis in this Supplemental EIS.

Alternatives for Proposed Western Planning Area Lease Sales 246 and 248

Alternative A—The Proposed Action (Preferred Alternative): This alternative would offer for lease all unleased blocks within the proposed WPA lease sale area for oil and gas operations (**Figure 2-1**), with the following exception:

(1) whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary (i.e., the boundary as of the publication of this Supplemental EIS).

The U.S. Department of the Interior (DOI) is conservative throughout the NEPA process and includes the total area within the WPA for environmental review even though the leasing of portions of the WPA (subareas or blocks) can be deferred during a Five-Year Program.

The proposed WPA lease sale area encompasses about 28.58 million acres (ac). As of November 2014, approximately 21.9 million ac of the proposed WPA lease sale area are currently unleased. This information is updated monthly and can be found on BOEM's website at http://www.boem.gov/Gulf-of-Mexico-Region-Lease-Map/. The estimated amount of natural resources projected to be developed as a result of a proposed WPA lease sale is 0.116-0.200 billion barrels of oil (BBO) and 0.538-0.938 trillion cubic feet (Tcf) of gas (**Table 3-1**; refer to **Chapter 2.3.1** for further details).

Alternative B—Exclude the Unleased Blocks Near Biologically Sensitive Topographic Features: This alternative would offer for lease all unleased blocks within the proposed WPA lease sale area, as described for a proposed action (Alternative A), but it would exclude from leasing any unleased blocks subject to the Topographic Features Stipulation under Alternative A. The estimated amount of resources projected to be developed is 0.116-0.200 BBO and 0.538-0.938 Tcf of gas. Refer to **Chapters 2.3.3 and 4.1.3** for further details.

Alternative C—No Action: This alternative is the cancellation of a single proposed WPA lease sale. If this alternative is chosen, the opportunity for development of the estimated 0.116-0.200 BBO and 0.538-0.938 Tcf of gas that could have resulted from a proposed WPA lease sale would be precluded during the current Five-Year Program, but it could again be contemplated as part of a future Five-Year Program. Any potential environmental impacts arising out of a proposed WPA lease sale would not occur, but activities associated with existing leases in the WPA would continue. Refer to **Chapters 2.3.3 and 4.1.3** for further details.

Mitigating Measures

Proposed lease stipulations and other mitigating measures designed to reduce or eliminate environmental risks and/or potential multiple-use conflicts between OCS operations and U.S. Department of Defense activities may be applied to the chosen alternative. Five lease stipulations are proposed for a WPA proposed lease sale—the Topographic Features Stipulation, the Military Areas Stipulation, the Protected Species Stipulation, the United Nations Convention on the Law of the Sea Royalty Payment, and the Stipulation on the Agreement between the United States of America and the United Mexican States Concerning Transboundary Hydrocarbon Reservoirs in the Gulf of Mexico. The United Nations Convention on the Law of the Sea Royalty Payment is applicable to the proposed WPA lease sales even though it is not an environmental or military stipulation.

Application of lease stipulations will be considered by the Assistant Secretary of the Interior for Land and Minerals (ASLM). The inclusion of the stipulations as part of the analysis of a WPA proposed action does not ensure that the ASLM will make a decision to apply the stipulations to leases that may result from a proposed lease sale, nor does it preclude minor modifications in wording during subsequent steps in the prelease process if comments indicate changes are necessary or if conditions warrant. Any lease stipulations or mitigating measures to be included in a lease sale will be described in the Final Notice of Sale. Mitigating measures in the form of lease stipulations are added to the lease terms and are therefore enforceable as part of the lease. In addition, mitigations may be added to plans and/or permits for OCS oil- and gas-related activities. For more information on mitigating measures that are added at the postlease stage, refer to **Appendix A** ("Commonly Applied Mitigating Measures").

Scenarios Analyzed

Offshore activities are described in the context of scenarios for a WPA proposed action (**Chapter 3.1**) and for the OCS Program (**Chapter 3.3**). BOEM's Gulf of Mexico OCS Region developed these scenarios to provide a framework for detailed analyses of potential impacts of a proposed WPA lease sale. The scenarios are presented as ranges of the amounts of undiscovered, unleased hydrocarbon resources estimated to be leased and discovered as a result of a WPA proposed action. The analyses are based on a traditionally employed range of activities (e.g., the installation of platforms, wells, and pipelines, and the number of helicopter operations and service-vessel trips) that would be needed to develop and produce the amount of resources estimated to be leased.

The cumulative analysis (**Chapter 4.1**) considers environmental and socioeconomic impacts that may result from the incremental impact of a WPA proposed action when added to all past, present, and reasonably foreseeable future activities, including non-OCS oil- and gas-related activities such as import tankering and commercial fishing, as well as all OCS oil- and gas-related activities (OCS Program). The OCS Program scenario includes all activities that are projected to occur from past, proposed, and future lease sales during the 40-year analysis period (2012-2051). This includes projected activity from lease sales that have been held, but for which exploration or development has not yet begun or is continuing. In addition to human activities, impacts from natural occurrences, such as hurricanes, are analyzed.

Significant Issues

The major issues that frame the environmental analyses in this Supplemental EIS, the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS are the result of concerns raised during years of scoping for the Gulf of Mexico OCS Program. Issues related to OCS oil and gas exploration, development, production, and transportation activities include the potential for oil spills, wetlands loss, air emissions, discharges, water quality degradation, trash and debris, structure and pipeline emplacement activities, platform removal, vessel and helicopter traffic, multiple-use conflicts, support services, population fluctuations, demands on public services, land-use planning, impacts to tourism, aesthetic interference, cultural impacts, environmental justice, and conflicts with State coastal zone management programs. Environmental resources and activities identified during the scoping process that warrant environmental analyses include air quality, water quality, coastal barrier beaches and associated dunes, wetlands, seagrass communities, topographic features, *Sargassum* communities, deepwater benthic communities, soft bottom benthic communities, marine mammals, sea turtles, diamondback terrapins, coastal and marine birds, fish resources and essential fish habitat, commercial fisheries, recreational fishing, recreational resources, archaeological resources, and socioeconomic conditions.

Other relevant issues include impacts from the *Deepwater Horizon* explosion, oil spill, and response; impacts from past and future hurricanes on environmental and socioeconomic resources; and impacts on coastal and offshore infrastructure. During the past few years, both the Gulf Coast States' and Gulf of Mexico oil and gas activities have been impacted by major hurricanes. The description of the affected environment (**Chapter 4.1**) includes impacts from these storms on the physical environment, biological environment, and socioeconomic activities, and on OCS oil- and gas-related infrastructure. This Supplemental EIS also considers baseline data in the assessment of impacts from a WPA proposed action on the resources and the environment (**Chapter 4.1**).

Impact Conclusions

The full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action and a WPA proposed action's incremental contribution to the cumulative impacts are described in **Chapter 4.1**. A summary of the potential impacts from a WPA proposed action on each environmental and socioeconomic resource and the conclusions of the analyses can be found below.

Air Quality: Emissions of pollutants into the atmosphere from the routine activities associated with a WPA proposed action are projected to have minimal impacts to onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline, and are expected to be well within the National Ambient Air Quality Standards. While regulations are in place to reduce the risk of impacts from hydrogen sulfide (H_2S) and while no H_2S-related deaths have occurred on the OCS, accidents involving high concentrations of H_2S could result in deaths as well as environmental damage. These emissions from routine activities and accidental events associated with a WPA proposed action are not expected to occur at concentrations that would change onshore air quality classifications.

Water Quality (Coastal and Offshore Waters): Impacts from routine activities associated with a WPA proposed action would be minimal if all existing regulatory requirements are met. Coastal water impacts associated with routine activities include increases in turbidity resulting from pipeline installation and navigation canal maintenance, discharges of bilge and ballast water from support vessels, and run-off from shore-based facilities. Offshore water impacts associated with routine activities result from the discharge of drilling muds and cuttings, produced water, residual chemicals used during workovers, structure installation and removal, and pipeline placement. The discharge of drilling muds and cuttings causes temporary increased turbidity and changes in sediment composition. The discharge of produced water results in increased concentrations of some metals, hydrocarbons, and dissolved solids within an area of about 100 meters (m) (328 feet [ft]) adjacent to the point of discharge. Structure installation and removal and pipeline placement disturb the sediments and cause increased turbidity. In addition, offshore water impacts result from supply and service-vessel bilge and ballast water discharges. Accidental events associated with a WPA proposed action that could impact coastal and offshore water quality include spills of oil and refined hydrocarbons, releases of natural gas and condensate, spills of chemicals or drilling fluids, loss of well control, pipeline failures, collisions, or other malfunctions that would result in such spills. Although response efforts may decrease the amount of oil in the environment, the response efforts may also impact the environment through, for example, increased vessel traffic, hydromodification, and the application of dispersants. Natural degradation processes will also decrease the amount of spilled oil over time.

Coastal Barrier Beaches and Associated Dunes: Routine activities associated with a WPA proposed action, such as increased vessel traffic, maintenance dredging of navigation canals, and pipeline installation, would cause negligible impacts. Such impacts would be expected to be restricted to temporary and localized disturbances and not deleteriously affect barrier beaches and associated dunes. Indirect impacts from routine activities are negligible and indistinguishable from direct impacts of onshore activities. The potential impacts from accidental events (primarily oil spills) associated with a WPA proposed action are anticipated to be minimal. Should a spill (other than a low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected) contact a barrier beach, oiling is expected to be light and sand removal during cleanup activities minimized. No significant long-term impacts to the physical shape and structure of barrier beaches and associated dunes are expected to occur as a result of a WPA proposed action.

Wetlands: Impacts on wetlands from routine activities associated with a WPA proposed action are expected to be minimal because most of the activities affecting wetlands will be minor, localized, and temporary. Such activities may include the projected placement of short lengths of onshore pipeline across wetlands, the placement of dredge spoil from maintenance dredging activities into minimal areas of wetlands, and the disposal of OCS wastes. Mitigating measures would be used to further reduce these impacts. Indirect impacts from wake erosion and saltwater intrusion are expected to result in low impacts that are indistinguishable from direct impacts from inshore activities. The potential impacts from accidental events (primarily oil spills, other than a low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected) are anticipated to be minimal. Overall, impacts to wetland habitats from an oil spill associated with activities related to a WPA proposed action would be expected to be small and temporary because of the nature of the system, regulations, and specific cleanup techniques.

Seagrass Communities: Turbidity impacts from pipeline installation and maintenance dredging associated with a WPA proposed action would be temporary and localized due to regulations and mitigating measures. The increment of impacts from service-vessel transit associated with a WPA proposed action would be minimal. Should an oil spill occur near a seagrass community, impacts from the spill and cleanup would be considered short term in duration and minor in scope. Close monitoring and restrictions on the use of bottom-disturbing equipment to clean up the spill would be needed to avoid or minimize those impacts.

Topographic Features: The routine activities associated with a WPA proposed action that would impact topographic feature communities include anchoring, infrastructure and pipeline emplacement, infrastructure removal, drilling discharges, and produced-water discharges. However, adherence to the proposed Topographic Features Stipulation would make damage to the ecosystem unlikely. Contact with accidentally spilled oil would cause lethal and sublethal effects in benthic organisms, but the oiling of benthic organisms is not likely because of the small area of the banks, the scattered occurrence of spills, the depth of the features, and because the proposed Topographic Features Stipulation, if applied, would keep subsurface sources of spills away from the immediate vicinity of topographic features.

Sargassum Communities: A WPA proposed action is expected to cause only minor impacts to *Sargassum* because the effects from OCS oil- and gas-related activities would occur within a small portion of the *Sargassum* community as a whole. Limited portions of the *Sargassum* community could suffer mortality if it contacted spilled oil or occurred in an area where cleanup activities were being conducted. The *Sargassum* community lives in pelagic waters with generally high water quality and would be resilient to the minor accidental effects predicted. It has a yearly cycle that promotes quick recovery from impacts.

Chemosynthetic and Nonchemosynthetic Deepwater Benthic Communities: Chemosynthetic and nonchemosynthetic communities are susceptible to physical impacts from structure placement, anchoring, and pipeline installation associated with a WPA proposed action. However, the policy requirements described in Notice to Lessees and Operators (NTL) 2009-G40 greatly reduce the risk of these physical impacts by clarifying the measures that must be taken to ensure avoidance of potential sensitive deepwater benthic communities and, by consequence, avoidance of other hard bottom communities. Potential accidental events associated with a WPA proposed action are expected to cause little damage to the ecological function or biological productivity of the widespread, low-density chemosynthetic communities and the widespread, typical, deep-sea benthic communities.

Soft Bottom Benthic Communities: The routine activities associated with a WPA proposed action that would impact soft bottom benthic communities (i.e., bottom disturbance from anchoring and infrastructure emplacement, and accumulation of drill cuttings on the seafloor) generally occur within a few hundred meters of platforms, and the greatest impacts are seen in communities closest to the platform. Although localized impacts to comparatively small areas of soft bottom benthic communities would occur, impacts would be relatively minor since soft bottom benthic communities are ubiquitous throughout the seafloor of the WPA, an area spanning 115,645 square kilometers (44,651 square miles). Even in situations where substantial burial of typical benthic infaunal communities occurred, recolonization by populations from widespread, neighboring soft bottom substrate would be expected over a relatively short period of time for all size ranges of organisms.

Marine Mammals: Routine events related to a WPA proposed action are not expected to have adverse effects on the size and productivity of any marine mammal species or population in the northern Gulf of Mexico. Characteristics of impacts from accidental events depend on whether the exposure is chronic or acute, but any level of exposure may result in harassment, harm, or mortality to marine mammals. Exposure to dispersed hydrocarbons is likely to result in sublethal impacts.

Sea Turtles: Routine activities resulting from a WPA proposed action have the potential to harm sea turtles, although this potential is unlikely to rise to a level of significance due to the activity already present in the Gulf of Mexico and due to mitigating measures that are in place. Accidental events associated with a WPA proposed action have the potential to impact small to large numbers of sea turtles. Sea turtles in the northern Gulf of Mexico may be exposed to residuals of oils spilled as a result of a WPA proposed action during their lifetimes. While chronic or acute exposure from accidental events may result in the harassment, harm, or mortality to sea turtles, in the most likely scenarios, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick are expected to most often result in sublethal impacts (e.g., decreased health and/or reproductive fitness and increased vulnerability to disease) to sea turtle individuals. The incremental contribution of a WPA proposed action would not be likely to result in a significant incremental impact on sea turtle populations within the WPA; in comparison, impacts from non-OCS energy-related activities, including overexploitation, commercial fishing, and pollution, have historically proven to be a greater threat to sea turtle species.

Diamondback Terrapins: The routine activities of a WPA proposed action are unlikely to have significant adverse effects on the size and recovery of terrapin species or populations in the Gulf of Mexico. Impacts on diamondback terrapins from smaller accidental events are likely to affect individual diamondback terrapins in the spill area, but they are unlikely to rise to the level of population effects (or significance) given the probable size and scope of such spills. Due to the distance of most terrapin habitat from offshore OCS energy-related activities, impacts associated with activities occurring as a result of a WPA proposed action are not expected to impact terrapins or their habitat. The incremental effect of a WPA proposed action on diamondback terrapin populations is not expected to be significant when compared with historic and current non-OCS energy-related activities, such as habitat loss, overharvesting, crabbing, and fishing.

Coastal and Marine Birds: The majority of impacts resulting from routine activities associated with a WPA proposed action on threatened and endangered and nonthreatened and nonendangered avian species are expected to be adverse, but not significant. These impacts include behavioral effects, exposure to or intake of OCS oil- and gas-related contaminants and discarded debris, disturbance-related impacts, and displacement of birds from habitats that are destroyed, altered, or fragmented, making these areas otherwise unavailable. Impacts from potential oil spills associated with a WPA proposed action and the effects related to oil-spill cleanup are expected to be adverse, but not significant. Oil spills, irrespective of size, can result in some mortality as well as sublethal, chronic short- and long-term effects, in addition to potential impacts to food resources. Cumulative activities on coastal and marine birds are expected to result in discernible changes to avian species composition, distribution, and abundance; however, the incremental contribution of a WPA proposed action to the cumulative impact is considered adverse but not significant because the effects of the most probable impacts, such as lease sale-related operational discharges and helicopters and service-vessel noise and traffic, are expected to be sublethal. Some displacement of local individuals or flocks to other habitat may occur if habitat is available.

Fish Resources and Essential Fish Habitat: Fish resources and essential fish habitat could be impacted by coastal environmental degradation potentially caused by canal dredging, increases in infrastructure, and inshore spills, and by marine environmental degradation possibly caused by pipeline trenching, offshore discharges, and offshore spills. Impacts of routine dredging and discharges are localized in time and space and are regulated by Federal and State agencies through permitting processes; therefore, there would be minimal impact to fish resources and essential fish habitat from these routine activities associated with a WPA proposed action. Accidental events that could impact fish resources and essential fish habitat include blowouts and oil or chemical spills. If a spill were to occur as a result of a WPA proposed action and if it was proximate to mobile fishes, the impacts of the spill would depend on multiple factors, including the amount spilled, the areal extent of the spill, the distance of the spill from particular essential fish habitats (e.g., nursery habitats), and the type and toxicity of oil spilled. Impacts from oil spills on sensitive essential fish habitat would be low because most sensitive essential fish habitats are located at depths greater than 20 m (65 ft) and the spilled substances would, at the most, reach the seafloor in minute concentrations. In addition, sensitive essential fish habitats would likely be distanced from OCS oil- and gas-related activities due to regulations, stipulations, and NTLs. An oil spill is expected to cause a minimal decrease in Gulf of Mexico standing fish stocks of any population because most spill events would be localized, therefore affecting a small portion of fish populations.

Commercial Fisheries: Routine OCS oil- and gas-related activities in the WPA, such as seismic surveys and pipeline trenching, would cause negligible impacts and would not deleteriously affect commercial fishing activities. Indirect impacts from routine OCS oil- and gas-related activities to inshore habitats are negligible and indistinguishable from direct impacts of inshore non-OCS oil- and gas-related activities on commercial fisheries. The potential impacts from accidental events, such as a well blowout or an oil spill, associated with a WPA proposed action are anticipated to be minimal. Commercial fishermen are anticipated to avoid the area of a well blowout or an oil spill. Large spills may impact commercial fisheries by forcing area closures. The overall impact depends on the areal extent and length of the closure. The impact of spills on catch or value of catch would depend on the volume and location (i.e., distance from shore) of the spill, as well as the physical properties of the oil spilled.

Recreational Fishing: There could be minor and short-term, space-use conflicts with recreational fishermen during the initial phases of a WPA proposed action. A WPA proposed action could also lead to low-level environmental degradation of fish habitat, which would also negatively impact recreational fishing activity. However, these minor negative effects would be offset by the beneficial role that oil platforms serve as artificial reefs for fish populations. An oil spill would likely lead to recreational fishing closures in the vicinity of the oil spill. Except for a low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected (e.g., the *Deepwater Horizon* oil spill), oil spills should not affect recreational fishing to a large degree due to the likely availability of substitute fishing sites in neighboring regions.

Recreational Resources: Routine OCS oil- and gas-related activities can cause minor disturbances to recreational resources, particularly beaches, through increased levels of noise, debris, and rig visibility. Any oil spills that might result from a WPA proposed action would be small in area affected, of short duration, distantly located, and not likely to impact Gulf Coast recreational resources. Should an oil spill occur and contact a beach area or other recreational resource, it could cause some disruption during the physical oiling impact and cleanup phases of the spill. However, except for a low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected (e.g., the *Deepwater Horizon* oil spill), these effects are likely to be small in scale and of short duration.

Archaeological Resources (Historic and Prehistoric): The greatest potential impact to an archaeological resource as a result of routine OCS oil- and gas-related activities associated with a WPA proposed action would result from direct contact between an offshore activity (e.g., platform installation, drilling rig emplacement, structure removal or site clearance operation, and dredging or pipeline project) and a historic or prehistoric site. The archaeological survey and archaeological clearance of sites, where required prior to an operator beginning oil and gas activities on a lease, are expected to be highly effective at identifying possible offshore archaeological sites; however, should contact occur with archaeological resources, there would be localized damage to or loss of significant and/or unique archaeological information. It is expected that coastal archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities. It is not very likely that accidental events associated with a WPA proposed action, including a large oil spill, would impact coastal prehistoric or historic archaeological sites. If a spill were to occur and make contact with a prehistoric archaeological site, damage might include loss of radiocarbon-dating potential, direct impact from oil-spill cleanup equipment, and/or looting resulting in the irreversible loss of unique or significant archaeological information. The major effect from an oil-spill impact on coastal historic archaeological sites would be visual contamination, which, while reversible, could result in additional impacts to fragile cultural materials from the cleaning process.

Land Use and Coastal Infrastructure: A WPA proposed action would not require additional coastal infrastructure, with the possible exception of one new gas processing facility and one new pipeline landfall, and it would not alter the current land use of the analysis area. The existing oil and gas infrastructure is expected to be sufficient to handle development associated with a WPA proposed action. There may be some expansion at current facilities, but the land in the analysis area is sufficient to handle such development. There is also sufficient land to construct a new gas processing plant in the analysis area, should it be needed. Accidental events such as oil or chemical spills, blowouts, and vessel collisions would have no effects on land use. Coastal or nearshore spills, as well as vessel collisions, could have short-term adverse effects on coastal infrastructure, requiring cleanup of any oil or chemicals spilled.

Demographics: A WPA proposed action is projected to minimally affect the demography of the analysis area. Population impacts from a WPA proposed action are projected to be minimal (<1% of total population) for any economic impact area in the Gulf of Mexico region. The baseline population patterns and distributions are expected to remain unchanged as a result of a WPA proposed action. The increase in employment is expected to be met primarily with the existing population and available labor force, with the exception of some in-migration (from elsewhere within or outside the U.S.), which is projected to move into focal areas such as Port Fourchon. Accidental events associated with a WPA proposed action, such as oil or chemical spills, blowouts, and vessel collisions, would likely have no effects on the demographic characteristics of the Gulf coastal communities.

Economic Factors: A WPA proposed action is expected to generate a <1 percent increase in employment in any of the coastal subareas, even when the net employment impacts from accidental events are included. Most of the employment related to a WPA proposed action is expected to occur in Louisiana and Texas. The demand would be met primarily with the existing population and labor force.

Environmental Justice: Environmental justice implications arise indirectly from onshore activities conducted in support of OCS oil and gas exploration, development, and production. Because the onshore infrastructure support system for the OCS oil- and gas-related industry (and its associated labor force) is highly developed, widespread, and has operated for decades within a heterogeneous Gulf of Mexico population, a WPA proposed action is not expected to have disproportionately high or adverse environmental or health effects on minority or low-income populations. A WPA proposed action would help to maintain ongoing levels of activity**,** which may or may not result in the expansion of existing infrastructure. For a detailed discussion of scenario projections and the potential for expansion at existing facilities and/or construction of new facilities, refer to **Chapter 3.1.2**.

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ABBREVIATIONS AND ACRONYMS

°C	degree Celsius
°F	degree Fahrenheit
2012-2017 WPA/CPA Multisale EIS	*Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247; Final Environmental Impact Statement; Volumes I-III*
2D	two dimensional
3D	three dimensional
ac	acre
Agreement	Agreement between the United States of America and the United Mexican States Concerning Transboundary Hydrocarbon Reservoirs in the Gulf of Mexico
AL	Alabama
API	American Petroleum Institute
ASLM	Assistant Secretary of the Interior for Land and Minerals
bbl	barrel
BBO	billion barrels of oil
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	blowout preventer
BSEE	Bureau of Safety and Environmental Enforcement
Call	Call for Information
CD	Consistency Determination
CEQ	Council on Environmental Quality
CEWAF	chemically enhanced (dispersed) water-accommodated fractions
CFR	Code of Federal Regulations
CG	Coast Guard (also: USCG)
CH_4	methane
CMP	Coastal Management Program
CO	carbon monoxide
CO_2	carbon dioxide
COE	Corps of Engineers (U.S. Army)
CPA	Central Planning Area
CPA 235/241/247 Supplemental EIS	*Gulf of Mexico OCS Oil and Gas Lease Sales: 2015-2017; Central Planning Area Lease Sales 235, 241, and 247; Final Supplemental Environmental Impact Statement*
CSA	Continental Shelf Associates
CYP1A	cytochrome P-4501A
CZMA	Coastal Zone Management Act
dB	decibel
DOI	Department of the Interior (U.S.) (also: USDOI)
EFH	essential fish habitat
e.g.	for example
EIA	Economic Impact Area
EIS	environmental impact statement
EPA	Eastern Planning Area
EPA 225/226 EIS	*Gulf of Mexico OCS Oil and Gas Lease Sales: 2014 and 2016; Eastern Planning Area Lease Sales 225 and 226; Final Environmental Impact Statement*
EPAct	Energy Policy Act of 2005
ERMA	Environmental Response Management Application
ESA	Endangered Species Act of 1973
et al.	and others

et seq.	and the following
Five-Year Program	*Proposed Final Outer Continental Shelf Oil & Gas Leasing Program: 2012-2017*
Five-Year Program EIS	*Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017, Final Environmental Impact Statement*
FL	Florida
FR	*Federal Register*
ft	feet
FWS	Fish and Wildlife Service
G&G	geological and geophysical
g	gram
GAP	General Activities Plan
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
H_2S	hydrogen sulfide
i.e.	specifically
km	kilometer
LA	Louisiana
LNG	liquefied natural gas
m	meter
MAG-PLAN	MMS Alaska-GOM Model Using IMPLAN
MARAD	Maritime Administration (U.S. Department of Transportation)
Mcf	thousand cubic feet
mi	mile
MMbbl	million barrels
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MODU	mobile offshore drilling unit
MS	Mississippi
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NGL	natural gas liquids
NMFS	National Marine Fisheries Service
nmi	nautical-mile
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent to Prepare an EIS
NOS	National Ocean Service
NPDES	National Pollutant and Discharge Elimination System
NRC	National Research Council
NRDA	Natural Resource Damage Assessment
NTL	Notice to Lessees and Operators
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
ODMDS	ocean dredged-material disposal site
OSAT	Operational Science Advisory Team
OSHA	Occupational Safety and Health Administration
OSRA	Oil Spill Risk Analysis
OSRP	oil-spill response plan
OSV	offshore supply vessel
P.L.	Public Law
PAH	polycyclic aromatic hydrocarbons

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
PSD	Prevention of Significant Deterioration
ROD	Record of Decision
SAP	Site Assessment Plan
SBF	synthetic-based fluid
Secretary	Secretary of the Interior
SMART	Special Monitoring of Applied Response Technologies
SO_2	sulphur dioxide
SO_x	sulphur oxides
Stat.	Statute
Tcf	trillion cubic feet
Trustee Council	Natural Resource Damage Assessment Trustee Council
TX	Texas
U.S.	United States
U.S.C.	United States Code
UME	unusual mortality event
USCG	U.S. Coast Guard (also: CG)
USDHS	U.S. Department of Homeland Security
USDOC	U.S. Department of Commerce
USDOE	U.S. Department of Energy
USDOI	U.S. Department of the Interior (also: DOI)
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VGP	Vessel General Permit
VOC	volatile organic compound
VSP	vertical seismic profiling
W.	west
WAF	water-accommodated fraction
WPA	Western Planning Area
WPA 233/CPA 231 Supplemental EIS	*Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231; Final Supplemental Environmental Impact Statement*
WPA 238/246/248 Supplemental EIS	*Gulf of Mexico OCS Oil and Gas Lease Sales: 2014-2016; Western Planning Area Lease Sales 238, 246, and 248; Final Supplemental Environmental Impact Statement*

CONVERSION CHART

To convert from	To	Multiply by
centimeter (cm)	inch (in)	0.3937
millimeter (mm)	inch (in)	0.03937
meter (m)	foot (ft)	3.281
meter^2 (m^2)	foot^2 (ft^2)	10.76
meter^2 (m^2)	yard^2 (yd^2)	1.196
meter^2 (m^2)	acre (ac)	0.0002471
meter^3 (m^3)	foot^3 (ft^3)	35.31
meter^3 (m^3)	yard^3 (yd^3)	1.308
kilometer (km)	mile (mi)	0.6214
kilometer^2 (km^2)	mile^2 (mi^2)	0.3861
hectare (ha)	acre (ac)	2.47
liter (L)	gallons (gal)	0.2642
degree Celsius (°C)	degree Fahrenheit (°F)	°F = (1.8 x °C) + 32
1 barrel (bbl) = 42 gal = 158.9 L = approximately 0.1428 metric tons 1 nautical mile (nmi) = 1.15 mi (1.85 km) or 6,076 ft (1,852 m) tonnes = 1 long ton or 2,240 pounds		

CHAPTER 1

THE PROPOSED ACTIONS

1. THE PROPOSED ACTIONS

1.1. PURPOSE OF AND NEED FOR THE PROPOSED ACTIONS

The proposed Federal actions addressed in this Supplemental Environmental Impact Statement (EIS) are to offer for lease certain Outer Continental Shelf (OCS) blocks located in the Western Planning Area (WPA) of the Gulf of Mexico (GOM) (**Figure 1-1**). Under the *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program: 2012-2017* (Five-Year Program) (USDOI, BOEM, 2012a), proposed WPA Lease Sales 246 and 248 are tentatively scheduled to be held in August 2015 and 2016, respectively. The proposed Federal action is to offer for lease those areas that may contain economically recoverable oil and gas resources in accordance with the Outer Continental Shelf Lands Act (OCSLA) of 1953 (67 Stat. 462), as amended (43 U.S.C. §§ 1331 *et seq*.).

The purpose of the proposed action is to further the orderly development of OCS oil and gas resources. The proposed WPA lease sales will provide qualified bidders the opportunity to bid upon and lease acreage in the Gulf of Mexico OCS in order to explore, develop, and produce oil and natural gas. Under the OCLSA, for each proposed lease sale in the Five-Year Program, the Bureau of Ocean Energy Management (BOEM) makes individual decisions on whether and how to proceed with a proposed lease sale. Although the analyses cover more than one proposed lease sale, this Supplemental EIS will be used by BOEM to make an informed decision on proposed WPA Lease Sale 246. An additional National Environmental Policy Act (NEPA) review, as appropriate, will be prepared prior to proposed WPA Lease Sale 248 to address any newly available significant information relevant to that proposed action (refer to **Chapter 2.1**), and a separate decision will be made at the time scheduled for proposed WPA Lease Sale 248. That NEPA review will tier from and incorporate by reference the analyses from previous lease sale EISs.

The United States (U.S.) still has a great demand for oil and gas resources and, therefore, there is a need for continued oil and gas resource development. The WPA, together with the Central Planning Area (CPA) of the GOM, constitutes one of the world's major oil- and gas-producing areas and has proved a steady and reliable source of crude oil and natural gas for more than 50 years. Oil serves as the feedstock for liquid hydrocarbon products, including gasoline, aviation and diesel fuel, and various petrochemicals. Oil from the WPA would help reduce the Nation's need for oil imports and lessen the dependence on foreign oil. The U.S. consumed 18.9 million barrels (MMbbl) of oil per day (USDOE, Energy Information Administration, 2014a) and 25.68 trillion cubic feet (Tcf) of natural gas per day (USDOE, Energy Information Administration, 2014b) in 2013. The Energy Information Administration projects the total U.S. consumption of liquid fuels, including fossil fuels and biofuels, to fall slightly from 19.03 MMbbl per day in 2013 to 18.73 MMbbl by 2040 (USDOE, Energy Information Administration, 2014c). The Energy Information Administration also projects the total U.S. consumption of natural gas to rise from 25.68 Tcf to 31.48 Tcf by 2040 (USDOE, Energy Information Administration, 2014b). The U.S. net imports of natural gas accounted for 1.34 percent of our total natural gas consumption in 2013 and are projected to decrease to 0.04 percent by 2017 (USDOE, Energy Information Administration, 2014b). Altogether, net imports of crude oil and petroleum products (imports minus exports) accounted for 34 percent of our total petroleum consumption in 2013 and are projected to decrease to 32 percent by 2040 (USDOE, Energy Information Administration, 2014d). The U.S. crude oil imports stood at 7.7 MMbbl per day in 2013, and the petroleum product imports were 2.1 MMbbl per day in 2013 (USDOE, Energy Information Administration, 2014e). Exports totaled 2.9 MMbbl per day in 2013, mainly in the form of distillate fuel oil, petroleum coke, and residual fuel oil (USDOE, Energy Information Administration, 2014f). The net exports of natural gas are projected to be 0.66 percent in 2018 and rise to 5.78 percent in 2040 (USDOE, Energy Information Administration, 2014b). In 2013, the Nation's biggest supplier of crude oil and petroleum-product imports was Canada (32%), with countries in the Persian Gulf being the second largest source (21%) (USDOE, Energy Information Administration, 2014e). In 2013, the Nation's biggest supplier of natural gas was Canada (97%), with Trinidad being the second largest source (2.4%) (USDOE, Energy Information Administration, 2014g). Oil produced from the WPA would also reduce the environmental risks associated with transoceanic oil tankering from sources overseas. Natural gas is not easily transported, making domestic production especially desirable. The need for domestic natural gas reserves is also based upon its use as an environmentally preferable alternative to oil or coal for generating electricity.

The Secretary of the Interior (Secretary) has designated BOEM as the administrative agency responsible for the mineral leasing of submerged OCS lands and for the supervision of most offshore operations after lease issuance. BOEM is responsible for managing development of the Nation's offshore resources in an environmentally and economically responsible way. The functions of BOEM include leasing, exploration and development, plan administration, environmental studies, NEPA analysis, resource evaluation, economic analysis, and the renewable energy program. The Bureau of Safety and Environmental Enforcement (BSEE) is responsible for enforcing safety and environmental regulations. The functions of BSEE include all field operations, including permitting and research, inspections, offshore regulatory programs, oil-spill response, and training and environmental compliance functions.

This Supplemental EIS tiers from and incorporates by reference all of the relevant analyses from *Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247, Final Environmental Impact Statement* (2012-2017 WPA/CPA Multisale EIS) (USDOI, BOEM, 2012b); *Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231, Final Supplemental Environmental Impact Statement* (WPA 233/CPA 231 Supplemental EIS) (USDOI, BOEM, 2013a); and *Gulf of Mexico OCS Oil and Gas Lease Sales: 2014-2016; Western Planning Area Lease Sales 238, 246, and 248, Final Supplemental Environmental Impact Statement* (WPA 238/246/248 Supplemental EIS) (USDOI, BOEM, 2014a). The 2012-2017 WPA/CPA Multisale EIS notes that two sales may be held each year during the Five-Year Program—one in the WPA and one in the CPA. An additional lease sale (i.e., Lease Sale 226) in the Eastern Planning Area (EPA) is proposed for 2016.

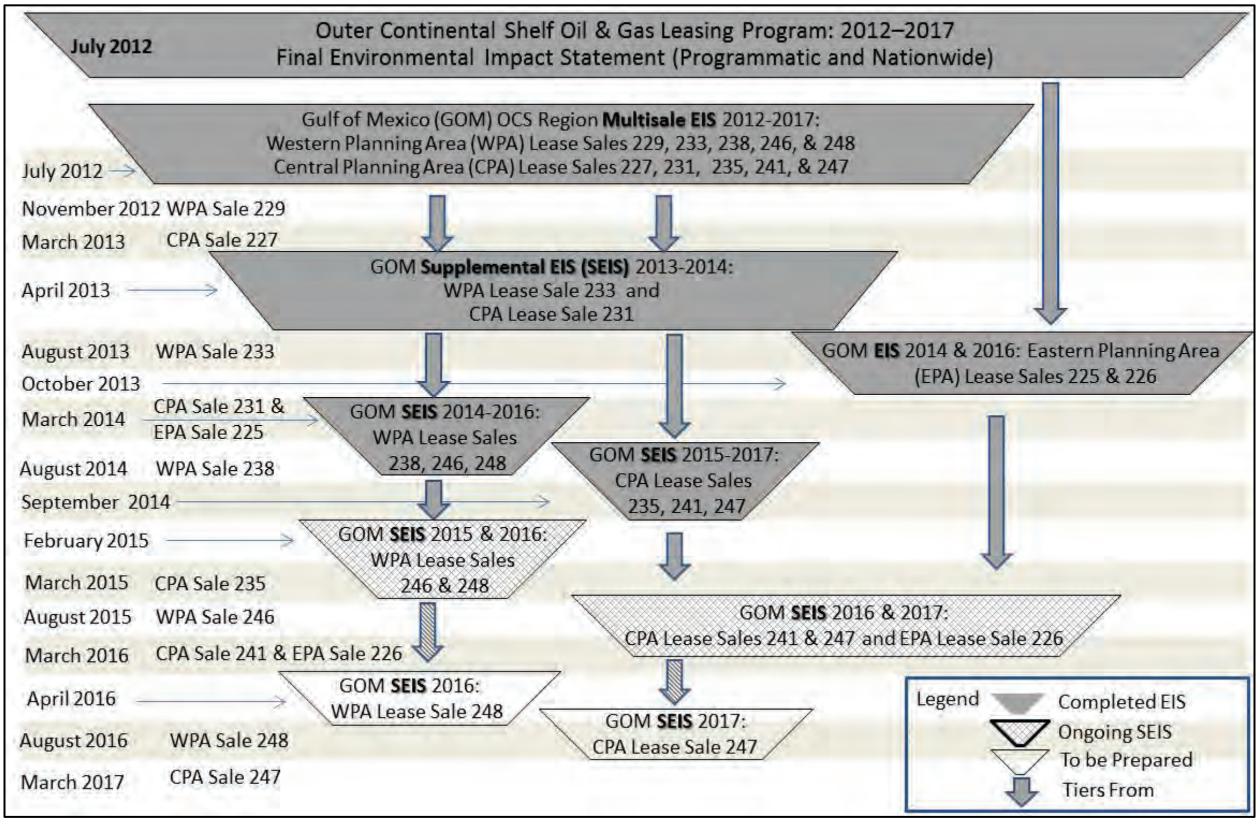
Other Pertinent Environmental Reviews or Documentation

This Supplemental EIS supplements and incorporates by reference all of the relevant analyses from the Multisale EIS and Supplemental EISs listed below.

Proposed WPA Lease Sales 246 and 248

- July 2012 – *Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247, Final Environmental Impact Statement* (2012-2017 WPA/CPA Multisale EIS) (USDOI, BOEM, 2012b)
- April 2013 – *Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231, Final Supplemental Environmental Impact Statement* (WPA 233/CPA 231 Supplemental EIS) (USDOI, BOEM, 2013a)
- March 2014 – *Gulf of Mexico OCS Oil and Gas Lease Sales: 2014-2016; Western Planning Area Lease Sales 238, 246, and 248, Final Supplemental Environmental Impact Statement* (WPA 238/246/248 Supplemental EIS) (USDOI, BOEM, 2014a)

The NEPA documents listed above are part of the Five-Year Program, and their relationship (tiering and supplementing) and timing with their respective proposed actions (lease sales) are illustrated in the figure below.



Each subsequent Supplemental EIS, regardless of the planning area, updates the potential environmental effects of oil and natural gas leasing, exploration, development, and production in the GOM in **Chapter 4.1.1** and updates the cumulative impacts from the most recent Supplemental EIS. Within each specific planning area, the baseline conditions for that planning area are updated to reflect the most recent technical and scientific information available.

This Supplemental EIS focuses on updating the baseline conditions and potential environmental effects of oil and natural gas leasing, exploration, development, and production in the WPA since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. This Supplemental EIS analyzes the potential impacts of a WPA proposed action on the marine, coastal, and human environments. This Supplemental EIS will also assist decisionmakers in making informed, future decisions regarding the approval of operations, as well as leasing. At the completion of the NEPA process, a decision will be made only for proposed WPA Lease Sale 246. A separate NEPA review, in a form to be determined by BOEM (e.g., an environmental assessment or another Supplemental EIS), will be conducted prior to BOEM's decision on whether or how to proceed with proposed WPA Lease Sale 248. The analysis in this Supplemental EIS also focuses on the potential environmental effects of oil and natural gas leasing, exploration, development, and production in the areas identified through the Area Identification (Area ID) procedure as the proposed lease sale area. In addition to the No Action alternative (i.e., cancel a proposed lease sale), other alternatives may be considered for a proposed WPA lease sale, such as deferring certain areas from a proposed lease sale.

1.2. DESCRIPTION OF THE PROPOSED ACTIONS

The proposed actions are the next two oil and gas lease sales in the WPA as scheduled in the Five-Year Program. Federal regulations allow for several related or similar proposals to be analyzed in one EIS (40 CFR § 1502.4). Since the proposed WPA lease sales are in the same area and their projected activities are very similar, BOEM has decided to prepare a single EIS for proposed WPA Lease Sales 246 and 248. The analyses contained in this Supplemental EIS examine impacts from a single, typical WPA lease sale. The findings of these analyses can be applied individually to each of the proposed lease sales, i.e., WPA Lease Sales 246 and 248. While the impact analyses can be applied to each proposed lease sale, this Supplemental EIS is a decision document for only proposed WPA Lease Sale 246. An additional NEPA review will be conducted for proposed WPA Lease Sale 248 to address any newly available significant information relevant to that proposed action (refer to **Chapter 2.1**).

Proposed WPA Lease Sales 246 and 248 are tentatively scheduled to be held in August 2015 and 2016, respectively. The proposed WPA lease sale area encompasses virtually all of the WPA's approximately 28.58 million acres (ac). This area begins 3 marine leagues (9 nautical miles [nmi]; 10.36 miles [mi]; 16.67 kilometers [km]) offshore Texas and extends seaward to the limits of the United States' jurisdiction over the continental shelf (often the Exclusive Economic Zone) in water depths up to approximately 3,346 meters (m) (10,978 feet [ft]) (**Figure 1-1**). As of November 2014, approximately 21.9 million ac of the proposed WPA lease sale area are currently unleased. This information is updated monthly and can be found on BOEM's website at http://www.boem.gov/Gulf-of-Mexico-Region-Lease-Map/.

The estimated amount of resources projected to be developed as a result of a single, typical lease sale (e.g., proposed WPA Lease Sale 246) is 0.116-0.200 billion barrels of oil (BBO) and 0.538-0.938 trillion cubic feet (Tcf) of gas. A proposed WPA lease sale includes proposed lease stipulations designed to reduce environmental risks; these stipulations are discussed in **Chapter 2.3.1.3** of this Supplemental EIS and in Chapter 2.3.1.3 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

1.3. Regulatory Framework

Federal laws mandate the OCS leasing program (i.e., the OCSLA) and the environmental review process (i.e., NEPA). Several Federal regulations establish specific consultation and coordination processes with Federal, State, and local agencies (e.g., Coastal Zone Management Act, Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act, and the Marine Mammal Protection Act). In addition, the OCS leasing process and all activities and operations on the OCS must comply with other applicable Federal, State, and local laws and regulations. A detailed list of the major, applicable Federal laws, regulations, and Executive Orders are listed below.

Regulation, Law, and Executive Order	Citation
Outer Continental Shelf Lands Act	43 U.S.C. §§ 1331 *et seq*.
National Environmental Policy Act of 1969	42 U.S.C. §§ 4321-4347 40 CFR § 1500-1508
Coastal Zone Management Act of 1972	16 U.S.C. §§ 1451 *et seq*. 15 CFR part 930
Endangered Species Act of 1973	16 U.S.C. §§ 1531 *et seq.*
Magnuson-Stevens Fishery Conservation and Management Act	16 U.S.C. §§ 1251 *et seq.*
Essential Fish Habitat Consultation (in 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act)	P.L. 94-265 16 U.S.C. §§ 1801-1891 50 CFR part 600 subpart K
Marine Mammal Protection Act	16 U.S.C. §§ 1361 *et seq.*
Clean Air Act	42 U.S.C. §§ 7401 *et seq*. 40 CFR part 55
Clean Water Act	33 U.S.C. § 1251 *et seq.*
Harmful Algal Bloom and Hypoxia Research and Control Act	P.L. 105-383
Oil Pollution Act of 1990	33 U.S.C. §§ 2701 *et seq*. Executive Order 12777
Comprehensive Environmental Response, Compensation, and Liability Act of 1980	42 U.S.C. §§ 9601 *et seq*.
Resource Conservation and Recovery Act	42 U.S.C. §§ 6901 *et seq*.

Regulation, Law, and Executive Order	Citation
Marine Plastic Pollution Research and Control Act	33 U.S.C. §§ 1901 *et seq*.
National Fishing Enhancement Act of 1984	33 U.S.C. §§ 2601 *et seq*.
Fishermen's Contingency Fund	43 U.S.C. §§ 1841-1846
Ports and Waterways Safety Act of 1972	33 U.S.C. §§ 1223 *et seq*.
Marine and Estuarine Protection Acts	33 U.S.C. §§ 1401 *et seq*.
Marine Protection, Research, and Sanctuaries Act of 1972	P.L. 92-532
National Estuarine Research Reserves	16 U.S.C. § 1461, Section 315
National Estuary Program	P.L. 100-4
Coastal Barrier Resources Act	16 U.S.C. §§ 3501 *et seq*.
National Historic Preservation Act	54 U.S.C. §§ 300101 *et seq*.
Rivers and Harbors Act of 1899	33 U.S.C. §§ 401 *et seq*.
Occupational Safety and Health Act of 1970	29 U.S.C. §§ 651 *et seq.*
Energy Policy Act of 2005	P.L. 109-58
Gulf of Mexico Energy Security Act of 2006	P.L. 109-432
Marine Debris Research, Prevention, and Reduction Act	P.L. 109-449
American Indian Religious Freedom Act of 1978	P.L. 95-341 42 U.S.C. §§ 1996 and 1996a
Migratory Bird Treaty Act of 1918	16 U.S.C. §§ 703 *et seq*.
Submerged Lands Act of 1953	43 U.S.C. §§ 1301 *et seq*.
49 U.S.C. 44718: Structures Interfering with Air Commerce	49 U.S.C. § 44718
Marking of Obstructions	14 U.S.C. § 86
Wilderness Act of 1964	P.L. 88-577 16 U.S.C. §§ 1131-1136 78 Stat. 890
Toxic Substances Control Act	P.L. 94-469 15 U.S.C. §§ 2601-2697 Stat. 2003
Bald Eagle Protection Act of 1940	P.L. 86-70 16 U.S.C. §§ 668-668d
Executive Order 11988: Floodplain Management	42 FR 26951 (1977); amended by Executive Order 12148 (7/20/79)
Executive Order 11990: Protection of Wetlands	42 FR 26961 (1977); amended by Executive Order 12608 (9/9/87)
Executive Order 12114: Environmental Effects Abroad	44 FR 1957 (1979)
Executive Order 12898: Environmental Justice	59 FR 5517 (1994)
Executive Order 13007: Indian Sacred Sites	61 FR 26771-26772 (1996)
Executive Order 13089: Coral Reef Protection	63 FR 32701-32703 (1998)
Executive Order 13175: Consultation and Coordination with Indian Tribal Governments	65 FR 67249-67252 (2000)
Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds	66 FR 3853 (2001)

1.3.1. Recent BOEM/BSEE Rule Changes

In light of the *Deepwater Horizon* explosion, oil spill, and response, the Federal Government, along with industry, increased their rules and safety measures related to oil-spill prevention, containment, and response. Additionally, the Federal Government and industry have increased their research and reform in response to the *Deepwater Horizon* explosion, oil spill, and response through government-funded research, industry-funded research, and joint partnerships. These joint partnerships are often between government agencies, industry, and nongovernmental organizations. For more information about the BOEM/BSEE rule changes prior to this Supplemental EIS, refer to Chapters 1.3 and 1.5 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

1.3.1.1. Recent and Ongoing Regulatory Reform and Government-Sponsored Research

BOEM and BSEE have already instituted regulatory reforms responsive to many of the recommendations expressed in the various reports prepared following the *Deepwater Horizon* explosion, oil spill, and response. To date, regulatory reform has occurred through both prescriptive and performance-based regulation and guidance, as well as OCS safety and environmental protection requirements, as described in the 2012-2017 WPA/CPA Multisale EIS. The reforms strengthen the requirements for all aspects of OCS operations. Ongoing reform and research endeavors to improve workplace safety and to strengthen oil-spill prevention planning, containment, and response are described in detail in Chapter 1.3.1.2 of the 2012-2017 WPA/CPA Multisale EIS, with updated information in Chapter 1.3.2.2 of the WPA 233/CPA 231 Supplemental EIS and Chapter 1.3.1.1 of the WPA 238/246/248 Supplemental EIS. Since publication of the WPA 238/246/248 Supplemental EIS, no substantive rule changes have been implemented that would affect potential environmental impacts from OCS oil- and gas-related activities in the Gulf of Mexico. However, new and modified Notices to Lessees and Operators (NTLs) and other policies applicable to OCS oil and gas operations in the Gulf of Mexico are summarized below.

NTL 2014-BSEE-G01, "New Addresses for New Orleans and Houma District Offices and Measurement Inspection Unit"

This NTL provides lessees up-to-date addresses and contact information for the New Orleans and Houma District Offices, as well as the new Measurement Inspection Unit.

NTL 2014-BSEE-N01, "Elimination of Expiration Dates on Certain Notices to Lessees and Operators Pending Review and Reissuance"

This NTL informs lessees that certain NTLs (published on BSEE's website) will remain in effect until BSEE revises, reissues, or withdraws the NTLs, regardless of any stated expiration date.

NTL 2014-BSEE-N02, "Performance Measures for OCS Operators and Form BSEE-0131"

This NTL gives lessees information about when and how to file their Performance Measures Data with the Bureau.

NTL 2012-BSEE-N07, "Oil Discharge Written Follow-up Reports"

The BSEE issued this NTL to address the oil discharge reports (30 CFR § 254.46(b)(2)) that are required to be submitted by a responsible party to BSEE for spills >1 barrel (bbl) within 15 days after a spill has been stopped or ceased. The responsible party is encouraged to report the cause, location, volume, remedial action taken, sea state, meteorological conditions, and size and appearance of the slick.

2014 BSEE Domestic and International Standards Workshop

In January 2014, BSEE hosted the Domestic and International Standards Workshop. The BSEE Standards Development Program collaborates with national and international Standards Development Organizations to develop and revise existing standards for safety and environmental protection on the OCS. This collaboration enables BSEE to minimize the time needed to identify and incorporate new and updated industry standards into its regulatory program.

BSEE's Proposed Changes to 30 CFR part 250 subpart H—Oil and Gas Production Safety Systems

This regulatory action will ensure that the regulations are keeping pace with industry's recent technological advancements, which often rely of the use of equipment that is located on the seabed. These new technologies are more complex than those that were traditionally used for shallow-water drilling on shelf areas, where safety equipment was traditionally placed on the rig itself rather than on the seafloor. With the shift to deeper water in the past decade, more specialized requirements and regulations are required for these newer and emerging safety technologies.

Gulf of Mexico Environmental Studies Program

The Division of Environmental Sciences manages the Environmental Studies Program for BOEM. The Environmental Studies Program develops, conducts, and oversees world-class scientific research specifically to inform policy decisions regarding the development of OCS energy and mineral resources. Research covers physical oceanography, atmospheric sciences, biology, protected species, social sciences and economics, submerged cultural resources, and environmental fates and effects. BOEM is a leading contributor to the growing body of scientific knowledge about the Nation's marine and coastal environment. Studies published by the Environmental Studies Program, Gulf of Mexico OCS Region, since publication of the WPA 238/246/248 Supplemental EIS are shown in the table below. For a list of studies published by the Environmental Studies Program, Gulf of Mexico OCS Region, prior to those listed below (i.e., 2006-2013), refer to Appendix E of the WPA 238/246/248 Supplemental EIS.

Publications of the Environmental Studies Program, Gulf of Mexico OCS Region,
Since Publication of the WPA 238/246/248 Supplemental EIS

Study Number	Title
BOEM 2013-011110	*Archaeological Analysis of Submerged Sites on the Gulf of Mexico Outer Continental Shelf*
  BOEM 2013-214 BOEM 2013-215	*Long-Term Monitoring at the East and West Flower Gardens Banks National Marine Sanctuary, 2009-2010* *Volume I: Technical Report* *Volume II: Appendices*
BOEM 2014-011	*Determining the Geographical Distribution and Genetic Affinities of Corals on Offshore Platforms, Northern Gulf of Mexico*
BOEM 2014-040	*Analysis of Ocean Current Data from Gulf of Mexico Oil and Gas Platforms*
BOEM 2014-058	*Ecospatial Information Database: U.S. Atlantic Region*
BOEM 2014-606	*User's Guide for the 2014 Gulfwide Offshore Activities Data System (GOADS-2014)*
BOEM 2014-607	*Forcing Functions Governing Salt Transports in Coastal Navigation Canals and Connectivity to Surrounding Wetland Landscapes in South Louisiana Using Houma Navigation Canal as a Surrogate*
BOEM 2014-608	*Characterization and Potential Impacts of Noise Producing Construction and Operation Activities on the Outer Continental Shelf: Data Synthesis*
  BOEM 2014-617 BOEM 2014-618	*Offshore Oil and* Deepwater Horizon*: Social Effects on Gulf Coast Communities* *Volume I: Methodology, Timeline, Context, and Communities* *Volume II: Key Economic Sectors, NGOs, and Ethnic Groups*

BOEM 2014-650 BOEM 2014-651	*Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico* *Volume I: Final Report* *Volume II: Appendix*
BOEM 2014-657	*Onshore Oil and Gas Infrastructure to Support Development in the Mid-Atlantic OCS Region*

1.3.1.2. Recent and Ongoing Industry Reform and Research

Since the preparation of the WPA 238/246/248 Supplemental EIS, the oil and gas industry and engineering trade groups have continued to prepare new standards and develop best practices for the safe and environmentally responsible development of OCS oil and gas. As an example, the American Petroleum Institute (API) has produced several Recommended Practices and Standards that have become part of State and Federal regulations. In May 2014, API completed Standard 17F, "Standard for Subsea Production Control Systems" (API, 2014). This standard covers the design, fabrication, testing, installation, and operation of subsea production control systems, including surface control systems, subsea-installed control systems, and control fluids, and it can be applicable to multi-well systems.

1.4. PRELEASE PROCESS

Scoping for this Supplemental EIS was conducted in accordance with the Council on Environmental Quality's (CEQ) regulations implementing NEPA (40 CFR § 1501.7). Scoping provides those with an interest in the OCS Program an opportunity to provide input on the significant issues and potential impact of the proposed actions, alternatives, and mitigating measures to reduce or eliminate impacts. In addition, scoping provides BOEM an opportunity to update the Gulf of Mexico OCS Region's environmental and socioeconomic information base. BOEM conducted early coordination with appropriate Federal, State, and local government agencies; federally recognized Indian Tribes; nongovernmental organizations; and other concerned parties to discuss and coordinate the prelease process for proposed WPA Lease Sales 246 and 248 and for this Supplemental EIS. While scoping is an ongoing process, it officially commenced on April 4, 2014, with the publication of the Notice of Intent to Prepare an EIS (NOI) in the *Federal Register* (2014b). Additional public notices were distributed via local newspapers, the U.S. Postal Service, and the Internet. A 30-day comment period was provided; it closed on May 5, 2014. Federal, State, and local governments, along with other interested parties, were invited to send written comments to the Gulf of Mexico OCS Region on the scope of this Supplemental EIS. Comments were received in response to the NOI from Federal, State, and local government agencies; interest groups; industry; businesses; and the general public on the scope of this Supplemental EIS, significant issues that should be addressed, alternatives that should be considered, and mitigating measures. All scoping comments received were considered in the preparation of the Draft Supplemental EIS. The comments are summarized in **Chapter 5.3**, "Development of the Draft Supplemental EIS."

In addition to BOEM's consideration of scoping comments received for this Supplemental EIS, this document tiers from and incorporates by reference all of the relevant scoping comments and responses to the comments from the 2012-2017 WPA/CPA Multisale EIS (USDOI, BOEM, 2012b), WPA 233/CPA 231 Supplemental EIS (USDOI, BOEM, 2013a), and WPA 238/246/248 Supplemental EIS (USDOI, BOEM, 2014a). A summary of scoping comments incorporated by reference can be found in Chapter 5.3, "Development of the Draft Supplemental EIS," of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

At the beginning of each Five-Year Program, the Gulf of Mexico OCS Region releases an Area Identification (Area ID) for each planning area, defining the lease sale areas. On October 4, 2012, BOEM released its Area ID decision. The Area ID is an administrative prelease step that describes the geographical area of the proposed actions (proposed lease sale area) and identifies the alternatives, mitigating measures, and issues to be analyzed in the appropriate NEPA document. As mandated by NEPA, this Supplemental EIS analyzes the potential impacts of the WPA proposed actions on the marine, coastal, and human environments.

On September 5, 2014, BOEM released the Draft Supplemental EIS for review and public comment. BOEM mailed copies of the Draft Supplemental EIS for review and comment to Federal, State, and local government agencies; federally recognized Indian Tribes; interest groups; industry; nongovernmental organizations; the general public; and local libraries. To initiate the public review and comment period on the Draft Supplemental EIS, BOEM published a Notice of Availability (NOA) in the *Federal Register* on September 5, 2014. The public comment period ended on October 22, 2014. In addition, public notices were mailed with the Draft Supplemental EIS and were placed on BOEM's website (http://www.boem.gov/nepaprocess).

A consistency review will be performed in accordance with the Coastal Zone Management Act (CZMA), and a Consistency Determination (CD) will be prepared for each affected State prior to each proposed WPA lease sale. To prepare the CDs, BOEM reviews each State's Coastal Management Program (CMP) and analyzes the potential impacts as outlined in this Supplemental EIS, new information, and applicable studies as they pertain to the enforceable policies of each CMP. Based on the analyses, BOEM's Gulf of Mexico OCS Region's Regional Director makes an assessment of consistency, which is then sent to the States of Texas and Louisiana for WPA lease sales. If a State disagrees with the Bureau of Ocean Energy Management's CD, the State is required to do the following under the CZMA: (1) indicate how BOEM's presale proposal is inconsistent with its CMP; (2) suggest alternative measures to bring BOEM's proposal into consistency with their CMP; or (3) describe the need for additional information that would allow a determination of consistency. Unlike the consistency process for specific OCS plans and permits, there is not a procedure for administrative appeal to the Secretary of Commerce for a Federal CD for presale activities. In the event of a disagreement between a Federal agency and the State's CMP regarding consistency of the proposed lease sales, either BOEM or the State may request mediation. The regulations provide for an opportunity to resolve any differences with the State, but the CZMA allows BOEM to proceed with a proposed lease sale despite any unresolved disagreements if the Federal agency clearly describes, in writing, how the activity is consistent to the maximum extent practicable with the State's CMP.

Proposed WPA Lease Sale 246 is tentatively scheduled for August 2015. BOEM must publish this Final Supplemental EIS at least 30 days prior to a decision on whether and/or how to proceed with proposed WPA Lease Sale 246. BOEM will publish an NOA for the Final Supplemental EIS in the *Federal Register* and will send copies of the Final Supplemental EIS for review to Federal, State, and local agencies; federally recognized Indian Tribes; interest groups; industry; nongovernmental organizations; the general public; and local libraries. In addition, public notices will be mailed with the Final Supplemental EIS and will be placed on BOEM's website (http://www.boem.gov/nepaprocess/). At the completion of this Supplemental EIS process, a decision will be made for proposed WPA Lease Sale 246. A separate NEPA review will be conducted prior to proposed WPA Lease Sale 248.

The Final Supplemental EIS is not a decision document. The Assistant Secretary of the Interior for Land and Minerals Management (ASLM) will make a decision on whether to hold each proposed lease sale (i.e., one each for proposed WPA Lease Sales 246 and 248) and, if the decision is made to hold the lease sale, then any particulars relevant to the lease sale including, but not limited to, the lease sale area and any mitigations. A NEPA Record of Decision (ROD) will memorialize the decision and will identify BOEM's preferred alternative for each lease sale, as well as the environmentally preferable alternative, if different. The ROD will summarize the proposed action and the alternatives evaluated in this Supplemental EIS, the information considered in reaching the decision, and the adopted mitigations. An NOA for the ROD will be published in the *Federal Register* and will be made available on BOEM's website at http://www.boem.gov/nepaprocess.

A Proposed Notice of Sale (NOS) will become available to the public 4-5 months prior to each proposed lease sale. A notice announcing the availability of the Proposed NOS will appear in the *Federal Register*, initiating a 60-day comment period. Comments received will be analyzed during preparation of the decision documents that are the basis for the Final NOS, including lease sale configuration and terms and conditions.

If the ASLM decides to hold a proposed lease sale, a Final NOS will be published in the *Federal Register* at least 30 days prior to the lease sale date, as required by the OCSLA.

Measures to Enhance Transparency and Effectiveness in the Leasing and Tiering Process

The following discussion is from the *Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017, Final Environmental Impact Statement* (Five-Year Program EIS) (USDOI, BOEM, 2012c) and has been incorporated into this Supplemental EIS for information purposes.

BOEM realizes that each region is different in terms of mineral resources and dependent economies, the relative state of infrastructure and support industries, and the sensitivity of ecosystems, environmental resources, and communities; and that a leasing strategy needs to be sensitive to those differences, but also that it must be consistent with OCSLA principles. BOEM envisions a phased OCSLA process that minimizes multiple-use and environmental conflicts to the extent possible during the Five-Year Program implementation, that makes lease sale decisions in the context of the best available information, and that discloses clear reasons for those decisions, even in the face of uncertainty. This vision is consistent with the National Ocean Policy Implementation Plan and related Marine Planning initiatives, all of which provide a complementary framework for space-use conflict considerations.

BOEM is committing to several process enhancements to ensure transparency during the phased OCSLA and tiered NEPA processes of this Five-Year Program. Although specific approaches to implementation may be tailored to the different needs of the Regions and their stakeholders, BOEM is determined to improve the effectiveness of the tiering process through the following:

- **Alternative and Mitigation Tracking Table.** BOEM has established an alternative and mitigation tracking table to provide increased visibility into the consideration of recommendations for deferrals, mitigations, and alternatives at different stages of the leasing process. Beginning with the Five-Year Program EIS, the table tracks the lineage and treatment of suggestions for spatial exclusions, temporal deferrals, and/or mitigation from the Five-Year Program to the lease sale phase and on to the plan phase. This table allows commenters to see how and at what stage of the process their concerns are being considered. BOEM will maintain a table that will be updated as deferral requests are considered at the lease sale and plan stages, and as new requests are made. The alternative and mitigation tracking table has been placed on BOEM's website at http://www.boem.gov/5-year/2012-2017/Tracking-Table/. A link to the table will be provided in the lease sale documents and in the annual report, which is discussed below.

- **Strengthening the Prelease Sale Process.** BOEM is taking a number of steps to enhance opportunities for members of the public to comment and provide new information in the prelease sale planning process. Historically, the Call for Information (Call), which is the first step in the Prelease Sale Process, has generally asked for industry to nominate specific blocks or descriptions of areas within the Five-Year Program area for which they have the most interest, while the NOI requests comments on issues that should be addressed and alternatives that should be considered in the NEPA documents that will be prepared for the action.

- **Annual Progress Report.** BOEM will publish an annual progress report on the approved Five-Year Program that includes an opportunity for stakeholders and the public to comment on the Five-Year Program's implementation. Under Section 18(e) of the OCSLA, the Secretary must review annually the approved Five-Year Program. Historically, this has been an internal review process that reported to the Secretary any information or events that might result in a revision to the Five-Year Program. If the revision is considered significant under the OCSLA, the Five-Year Program can only be revised and reapproved by following the same Section 18 steps used to originally develop the Program. However, once the Section 18 process has been initiated for the next Five-Year Program, the annual review is subsumed in that process, as the same substantive and procedural requirements are being addressed.

  The findings of this progress report may lead the Secretary to revise the Five-Year Program by reducing the size of, delaying, or canceling scheduled lease sales. If the desired revisions are considered significant, such as including new areas for consideration or more lease sales in areas already included, the entire Section 18 process must be followed, in essence resulting in the preparation of a new Program.

- **Systematic Planning.** BOEM is committed to engaging in systematic planning opportunities that foster improved governmental coordination, communication, and information exchange. As the only agency authorized to grant renewable energy, marine mineral, and oil and gas leases on the OCS, the Bureau of Ocean Energy Management has been assigned as the Federal co-lead, along with the U.S. Coast Guard, for systematic regional planning efforts in the Mid-Atlantic. Additionally, BOEM will participate on Regional Planning Bodies in the Northeast, Mid-Atlantic, and West Coast as the Department of the Interior (DOI) lead. In the Gulf of Mexico OCS Region, BOEM representatives will assist the U.S. Fish and Wildlife Service (FWS), the DOI regional lead, with various working group activities. This will facilitate data and information availability, provide research of new technologies, and identify conflict resolution and avoidance strategies. BOEM anticipates that its Marine Planning engagement will enhance regulatory efficiency through improved coordination and collaboration, and, in the long term, enhance the stewardship of ocean and coastal resources.

These strategies will allow BOEM to not only address the activities that take place under the 2012-2017 Five-Year Program but also to lay the groundwork for decisions that will be faced in subsequent Five-Year Programs. BOEM will improve efforts to gather information while enhancing opportunities for stakeholders and other interested parties to participate in and be engaged in the decisionmaking process. The initiation of studies and long-term planning will now facilitate future decisions by ensuring that the best information is available when making leasing decisions on the approved program and before the development of future OCS Programs.

1.5. POSTLEASE ACTIVITIES

BOEM and BSEE are responsible for managing, regulating, and monitoring oil and natural gas exploration, development, and production operations on the Federal OCS to promote the orderly development of mineral resources and to prevent harm or damage to, or waste of, any natural resource, any life or property, or the marine, coastal, or human environment. Regulations for oil, gas, and sulphur lease operations are specified in 30 CFR parts 550, 551 (except those aspects that pertain to drilling), and 554.

Measures to minimize potential impacts are an integral part of the OCS Program. These measures are implemented through lease stipulations, operating regulations, NTLs, and project-specific requirements or approval conditions. The NTLs provide clarifications and additional information on some of these measures. Mitigating measures address concerns such as endangered and threatened species, geologic and manmade hazards, military warning and ordnance disposal areas, archaeological sites, air quality, oil-spill response planning, chemosynthetic communities, artificial reefs, operations in hydrogen sulfide (H_2S) -prone areas, and shunting of drill effluents in the vicinity of biologically sensitive features. Refer to **Appendix A** ("Commonly Applied Mitigating Measures") for more information on the mitigations that BOEM and BSEE apply to plans and/or permits as applicable.

BOEM issues NTLs to provide clarification, description, or interpretation of a regulation; to provide guidelines on the implementation of a special lease stipulation or regional requirement; or to convey administrative information. A detailed listing of the current Gulf of Mexico OCS Region NTLs is available through BOEM's Gulf of Mexico OCS Region's website at http://boem.gov/Regulations/Notices-Letters-and-Information-to-Lessees-and-Operators.aspx or through the Region's Public Information Office at 504-736-2519 or 1-800-200-GULF.

Formal plans must be submitted to BOEM for review and approval before any project-specific activities, except for ancillary activities (such as geological and geophysical [G&G] activities or studies that model potential oil and hazardous substance spills), can begin on a lease. Conditions of approval are mechanisms to control or mitigate potential safety or environmental problems associated with proposed operations. Conditions of approval are based on BOEM's technical and environmental evaluations of the proposed operations. Comments from Federal and State agencies (as applicable) are also considered in establishing conditions. Conditions may be applied to any OCS plan, permit, right-of-use of easement, or pipeline right-of-way grant.

Some BOEM-identified mitigating measures are implemented through cooperative agreements or coordination with the oil and gas industry and Federal and State agencies. These measures include the National Marine Fisheries Service's (NMFS's) Observer Program to protect marine mammals and sea turtles when OCS structures are removed using explosives, labeling of operational supplies to track sources of accidental debris loss, development of methods of pipeline landfall to eliminate impacts to barrier beaches, and semiannual beach cleanup events.

Refer to Chapter 1.5 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS for descriptions of postlease activities including G&G surveys; exploration and development plans; permits and applications; inspection and enforcement; pollution prevention, oil spill response plans, and financial responsibility; air emissions; flaring and venting; hydrogen sulfide contingency plans; archaeological resources regulation; coastal zone management consistency review and appeals for plans; best available and safest technologies, including at production facilities; personnel training and education; structure removal and site clearance; marine protected species NTLs; and the Rigs-to-Reefs program.

1.6. OTHER OCS OIL- AND GAS-RELATED ACTIVITIES

BOEM and BSEE have programs and activities that are OCS -related but not specific to the oil and gas leasing process or to the management of exploration, development, and production activities. These programs include both environmental and technical studies, and cooperative agreements with other Federal and State agencies for NEPA work, joint jurisdiction over cooperative efforts, inspection activities, and regulatory enforcement. BOEM also participates in industry research efforts and forums. In January 2014, BSEE hosted the Domestic and International Standards Workshop. The BSEE Standards Development Program collaborates with national and international Standards Development Organizations to develop and revise existing standards for safety and environmental protection on the OCS. This collaboration enables BSEE to minimize the time needed to identify and incorporate new and updated industry standards into its regulatory program.

Chapter 1.6 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS contains descriptions of the other OCS oil- and gas-related activities, including the Environmental Studies Program, Technology Assessment and Research Program, and interagency agreements. Refer to **Chapter 1.3.1.1** for the list of recent Gulf of Mexico Environmental Studies Program publications.

CHAPTER 2

ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

2. ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

This Supplemental EIS addresses two proposed Federal actions: proposed OCS oil and gas Lease Sales 246 and 248 in the WPA of the Gulf of Mexico (**Figure 1-1**), as scheduled in the Five-Year Program (USDOI, BOEM, 2012a). The proposed actions (proposed lease sales) assume compliance with applicable regulations and lease stipulations in place at the time a ROD is signed for each proposed action.

2.1. SUPPLEMENTAL EIS NEPA ANALYSIS

Since proposed WPA Lease Sales 246 and 248 and their projected activities are very similar, this Supplemental EIS encompasses the two proposed lease sales as authorized under 40 CFR § 1502.4, which allows related or similar proposals to be analyzed in one EIS. In addition, one Area ID was prepared for the proposed WPA lease sales. The Multisale EIS approach is intended to focus the NEPA/EIS process on the differences between the proposed lease sales and on new issues and information. It also lessens duplication and saves agency resources. At the completion of the NEPA process for this Supplemental EIS, a decision will be made on whether or how to proceed with proposed WPA Lease Sale 246. An additional NEPA review will be conducted prior to proposed WPA Lease Sale 248 to address any relevant significant new information. This additional NEPA review could take the form of a determination of NEPA adequacy, an environmental assessment, or if BOEM deems necessary, a supplemental EIS. Informal and formal consultation with other Federal agencies, the affected States, federally recognized Indian Tribes, nongovernmental organizations, and the public will be carried out to assist in the determination of whether or not the information and analysis contained in this Supplemental EIS is still valid. Specifically, information requests will be issued soliciting input on proposed WPA Lease Sale 248.

2.2. ALTERNATIVES, MITIGATING MEASURES, AND ISSUES

2.2.1. Alternatives

The alternatives to be considered for proposed WPA Lease Sales 246 and 248 are detailed in **Chapter 2.3** below. These suggested alternatives have been derived from both the historical comments submitted to BOEM and the scoping performed for the analyses in this Supplemental EIS.

Through our scoping efforts for this Supplemental EIS and previous EISs, numerous issues and topics were identified for consideration. During the scoping period for the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, a number of alternatives or deferral options were suggested and examined for inclusion in those EISs (Chapter 2.2.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS). Those alternative and deferral options were also reexamined during the preparation of this Supplemental EIS. These suggestions included additional deferrals, policy changes, and suggestions beyond the scope of this Supplemental EIS. BOEM has not identified any new significant information that changes its conclusions in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, or that indicates that the proposed alternatives or deferral options are not appropriate for further in-depth analysis. The justifications for not carrying those suggestions through detailed analyses in this Supplemental EIS are the same as those used in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

The analyses of environmental impacts from the proposed alternatives summarized in **Chapter 2.3.1.2** below and described in detail in **Chapter 4.1.1** are based on the development scenario, which is a set of assumptions and estimates on the amounts, locations, and timing for OCS oil and gas exploration, development, and production operations and facilities, both offshore and onshore. A detailed discussion of the development scenario and major related impact-producing factors is included in **Chapter 3**.

2.2.1.1. Alternatives for Proposed Western Planning Area Lease Sales 246 and 248

Alternative A—The Proposed Action (Preferred Alternative): This alternative would offer for lease all unleased blocks within the proposed WPA lease sale area for oil and gas operations (**Figure 2-1**), with the following exception:

(1) whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary (i.e., the boundary as of the publication of this Supplemental EIS).

The DOI is conservative throughout the NEPA process and includes the total area within the WPA for environmental review even though the leasing of portions of the WPA (subareas or blocks) can be deferred during a Five-Year Program.

The proposed WPA lease sale area encompasses about 28.58 million ac. As of November 2014, approximately 21.9 million ac of the proposed WPA lease sale area are currently unleased. This information is updated monthly and can be found on BOEM's website at http://www.boem.gov/Gulf-of-Mexico-Region-Lease-Map/. The estimated amount of resources projected to be developed as a result of a proposed WPA lease sale is 0.116-0.200 BBO and 0.538-0.938 Tcf of gas (**Table 3-1**).

Alternative B—Exclude the Unleased Blocks Near Biologically Sensitive Topographic Features: This alternative would offer for lease all unleased blocks within the proposed WPA lease sale area, as described for a proposed action (Alternative A), but it would exclude from leasing any unleased blocks subject to the Topographic Features Stipulation. The estimated amount of resources projected to be developed is 0.116-0.200 BBO and 0.538-0.938 Tcf of gas. The number of blocks that would not be offered under Alternative B represents only a small percentage of the total number of blocks to be offered under Alternative A; therefore, it is assumed that the levels of activity for Alternative B would be essentially the same as those projected for a WPA proposed action. Refer to **Chapters 2.3.2 and 4.1.2** for further details.

Alternative C—No Action: This alternative is the cancellation of a single proposed WPA lease sale. If this alternative is chosen, the opportunity for development of the estimated 0.116-0.200 BBO and 0.538-0.938 Tcf of gas that could have resulted from a proposed WPA lease sale would be precluded during the current 2012-2017 Five-Year Program, but it could again be contemplated as part of a future Five-Year Program. Any potential environmental impacts arising out of a proposed WPA lease sale would not occur, but activities associated with existing leases in the WPA would continue. Refer to **Chapters 2.3.3 and 4.1.3** for further details.

Alternatives and Deferrals Considered but Not Analyzed in Detail

Chapter 2.2.1.1 of the 2012-2017 WPA/CPA Multisale EIS includes a detailed description of alternatives considered, but not analyzed in this Supplemental EIS, including the following: exclude deep water and limit leasing to shallow waters; delay leasing until drilling safety is improved; do not allow drilling in areas with strong ocean currents such as the Loop Current; delay leasing until the state of the Gulf of Mexico environmental baseline is known; and identify and protect sensitive ecosystems. The justifications for not engaging in detailed analysis of these alternatives and deferrals in this Supplemental EIS are the same as those used in the 2012-2017 WPA/CPA Multisale EIS, and BOEM has identified no new information that changes these conclusions. One alternative was proposed during the scoping period; this alternative suggested that all drilling be stopped until all studies on the impacts of the *Deepwater Horizon* explosion, oil spill, and response are complete (refer to **Chapter 5.3.2** for a summary of the scoping comments). This alternative was previously addressed in Chapter 2.2.1.1 of the 2012-2017 WPA/CPA Multisale EIS, which is incorporated by reference.

2.2.2. Mitigating Measures

The NEPA process is intended to help public officials make decisions that are based on an understanding of environmental consequences and to take actions that protect, restore, and enhance the environment. Agencies are required to identify and include in an EIS those appropriate mitigating measures not already included in the proposed action or alternatives. The CEQ regulations (40 CFR § 1508.20) define mitigation as follows:

- Avoidance—Avoiding an impact altogether by not taking a certain action or part of an action.
- Minimization—Minimizing impacts by limiting the intensity or magnitude of the action and its implementation.
- Restoration—Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
- Maintenance—Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
- Compensation—Compensating for the impact by replacing or providing substitute resources or environments.

2.2.2.1. Proposed Mitigating Measures Analyzed

The potential lease stipulations and mitigating measures included for analysis in this Supplemental EIS were developed as a result of numerous scoping efforts for the continuing OCS Program in the Gulf of Mexico. Five lease stipulations (described in Chapter 2.3.1.3 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS) are proposed for WPA Lease Sales 246 and 248—the Topographic Features Stipulation, the Military Areas Stipulation, the Protected Species Stipulation, the United Nations Convention on the Law of the Sea Royalty Payment Stipulation, and the Stipulation on the Agreement between the United States of America and the United Mexican States Concerning Transboundary Hydrocarbon Reservoirs in the Gulf of Mexico. The United Nations Convention on the Law of the Sea Royalty Payment Stipulation is applicable to a proposed WPA lease sale even though it is not an environmental or military stipulation.

These measures will be considered for adoption by the ASLM, under authority delegated by the Secretary. The analysis of any stipulations for Alternative A does not ensure that the ASLM will make a decision to apply the stipulations to leases that may result from a proposed WPA lease sale nor does it preclude minor modifications in wording during subsequent steps in the prelease process if comments indicate changes are necessary or if conditions change.

Any lease stipulations or mitigating measures to be included in a lease sale will be described in the ROD for that lease sale. Mitigating measures in the form of lease stipulations are added to the lease terms and are therefore enforceable as part of the lease. In addition, each exploration and development plan, as well as any pipeline applications that result from a lease sale, will undergo a NEPA review, and additional project-specific mitigations will be applied as conditions of plan approval. The BSEE has the authority to monitor and enforce these conditions, and under 30 CFR part 250 subpart N, may seek remedies and penalties from any operator that fails to comply with those conditions, stipulations, and mitigating measures.

2.2.2.2. Existing Mitigating Measures

Mitigating measures have been proposed, identified, evaluated, or developed through previous BOEM lease sale NEPA review and analysis. Many of these mitigating measures have been adopted and incorporated into regulations and/or guidelines governing OCS oil and gas exploration, development, and production activities. All plans for OCS oil- and gas-related activities (e.g., exploration and development plans, pipeline applications, and structure-removal applications) go through rigorous BOEM review and approval to ensure compliance with established laws and regulations. Existing mitigating measures must be incorporated and documented in plans submitted to BOEM. Operational compliance of the mitigating measures is enforced through BSEE's onsite inspection program.

Mitigating measures are a standard part of BOEM's program to ensure that operations are conducted in an environmentally sound manner (with an emphasis on minimizing any adverse impact of routine operations on the environment). For example, certain measures ensure site clearance, and survey procedures are carried out to determine potential snags to commercial fishing gear and to avoid archaeological sites and biologically sensitive areas such as pinnacles, topographic features, and chemosynthetic communities. In addition, all BOEM-regulated activities and operations must comply with the requirements of other agencies having jurisdiction. Refer to **Chapter 5** for more information on applicable consultation and coordination requirements.

Some BOEM-identified mitigating measures are incorporated into OCS operations through cooperative agreements or efforts with industry and State and Federal agencies. These mitigating measures include mandating compliance with NMFS's Observer Program to protect marine mammals and sea turtles during the use of explosives for structure removal, labeling operational supplies to track possible sources of debris or equipment loss, developing methods of pipeline landfall to eliminate impacts to beaches or wetlands, and requiring beach cleanup events.

Site-specific mitigating measures are also applied by BOEM during plan and permit reviews. BOEM realized that many of these site-specific mitigations were recurring and developed a list of "standard" mitigations. There are currently over 120 standard mitigations. The wording of a standard mitigation is developed by BOEM in advance and may be applied whenever conditions warrant. Standard mitigation text is revised as often as is necessary (e.g., to reflect changes in regulatory citations, agency/personnel contact numbers, and internal policy). Site-specific mitigation "categories" include air quality, archaeological resources, artificial reef material, chemosynthetic communities, Flower Garden Banks, topographic features, hard bottoms/pinnacles, military warning areas and Eglin Water Test Areas, hydrogen sulfide, drilling hazards, remotely operated vehicle surveys, geophysical survey reviews, and general safety concerns. Site-specific mitigation "types" include advisories, conditions of approval, hazard survey reviews, inspection requirements, notifications, post-approval submittals, and safety precautions. In addition to standard mitigations, BOEM may also apply nonrecurring mitigating measures that are developed on a case-by-case basis. Refer to **Appendix A** ("Commonly Applied Mitigating Measures") for more information on some of the mitigations that BOEM and BSEE typically apply to plans and/or permits.

BOEM is continually revising applicable mitigations to allow the Gulf of Mexico OCS Region to more easily and routinely track mitigation compliance and effectiveness. A primary focus of this effort is requiring post-approval submittal of information within a specified timeframe or after a triggering event (e.g., end of operations reports for plans, construction reports for pipelines, and removal reports for structure removals).

2.2.3. Issues

Issues are defined in CEQ Guidance as the principal "effects" that an EIS should evaluate in-depth. Selection of environmental and socioeconomic issues to be analyzed was based on the following criteria:

- the issue is identified in CEQ regulations as subject to evaluation;
- the relevant resource/activity was identified through agency expertise, through the scoping process, or from comments on past EISs;
- the resource/activity may be vulnerable to one or more of the impact-producing factors associated with the OCS Program;
- a reasonable probability of an interaction between the resource/activity and impact-producing factor should exist; or
- the information that indicates a need to evaluate the potential impacts to a resource/activity has become available.

2.2.3.1. Issues to be Analyzed

Chapter 2.2.3.1 of the 2012-2017 WPA/CPA Multisale EIS addresses the issues related to potential impact-producing factors and the environmental and socioeconomic resources and activities that could be affected by OCS oil and gas exploration, development, production, and transportation activities (i.e., accidental events; drilling fluids and cuttings; visual and aesthetic interference; air emissions; water quality degradation and other wastes; structure and pipeline emplacement; platform removals; OCS oil- and gas-related support services, activities, and infrastructure; and regional cultures and socioeconomics).

Chapter 4.1.1 of this Supplemental EIS and Chapter 4.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS describe the resources and activities that could be affected by the impact-producing factors listed above and include the following resource topics:

- Air Quality
- Archaeological Resources (Historic and Prehistoric)
- Coastal Barrier Beaches and Associated Dunes
- Coastal and Marine Birds
- Commercial Fisheries
- Deepwater Benthic Communities (Chemosynthetic and Nonchemosynthetic)
- Diamondback Terrapins
- Fish Resources and Essential Fish Habitat
- Human Resources and Land Use (Land Use and Coastal Infrastructure, Demographics, Economic Factors, and Environmental Justice)
- Marine Mammals
- Recreational Fishing
- Recreational Resources
- *Sargassum* Communities
- Sea Turtles
- Seagrass Communities
- Soft Bottom Benthic Communities
- Topographic Features
- Water Quality (Coastal and Offshore)
- Wetlands

2.2.3.2. Issues Considered but Not Analyzed

As previously noted, the CEQ regulations for implementing NEPA instruct agencies to adopt an early process (termed “scoping”) for determining the scope of issues to be addressed and for identifying significant issues related to a proposed action. As part of this scoping process, agencies shall identify and eliminate from detailed study the issues that are not significant to a WPA proposed action or have been covered by prior environmental review.

Additional issues identified during scoping are addressed in this Supplemental EIS. Comments received during scoping are summarized in **Chapter 5.3.2**. The first four comments listed in **Chapter 5.3.2** are issues that are considered in this Supplemental EIS. The fifth comment is a suggested alternative that is addressed in **Chapter 2.2.1.1** of this Supplemental EIS and Chapter 2.2.1.1 of the 2012-2017 WPA/CPA Multisale EIS, which is incorporated by reference.

2.3. PROPOSED WESTERN PLANNING AREA LEASE SALES 246 AND 248

2.3.1. Alternative A—The Proposed Action

2.3.1.1. Description

Alternative A would offer for lease all unleased blocks within the proposed WPA lease sale area for oil and gas operations (**Figure 2-1**), with the following exception:

(1) whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary (i.e., the boundary as of the publication of this Supplemental EIS).

The DOI is conservative throughout the NEPA process and includes the total area within the WPA for environmental review even though the leasing of portions of the WPA (subareas or blocks) can be deferred during a Five-Year Program.

The proposed WPA lease sale area encompasses about 28.58 million ac. As of November 2014, approximately 21.9 million ac of the proposed WPA lease sale area are currently unleased. This information is updated monthly and can be found on BOEM’s website at http://www.boem.gov/Gulf-of-Mexico-Region-Lease-Map/. The estimated amount of resources projected to be developed as a result of a proposed WPA lease sale is 0.116-0.200 BBO and 0.538-0.938 Tcf of gas (**Table 3-1**).

The analyses of impacts summarized below and described in detail in **Chapter 4.1.1** are based on the development scenario, which is a set of assumptions and estimates on the amounts, locations, and timing for OCS oil and gas exploration, development, and production operations and facilities, both offshore and onshore. A detailed discussion of the development scenario and major related impact-producing factors is included in **Chapter 3**.

Alternative A has been identified as BOEM's preferred alternative; however, this does not mean that another alternative may not be selected in the Record of Decision.

2.3.1.2. Summary of Impacts

A search by BOEM's subject-matter experts was conducted for each resource to consider new information made available since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS and to consider new information on the *Deepwater Horizon* explosion, oil spill, and response. It must also be emphasized that, in arriving at the overall conclusions for certain environmental resources (e.g., coastal and marine birds, fisheries, and wetlands), the conclusions are not based on impacts to individuals, small groups of animals, or small areas of habitat, but on impacts to the resources/populations as a whole. Any new information discovered was analyzed by BOEM's subject-matter experts to determine if the impact conclusions presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS were altered as a result of the new information.

For the following resources, BOEM's subject-matter experts determined through literature searches and communications with other agencies and academia that there was no new information made available since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS that was relevant to a WPA proposed action. Therefore, the impact conclusions for these resources remain the same as those that were presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. These impact conclusions are presented in **Chapter 4.1.1**. For ease of review, the individual chapter numbers for each resource are provided in the following list.

- Seagrass Communities (**Chapter 4.1.1.5**)
- Diamondback Terrapins (**Chapter 4.1.1.13**)
- Archaeological Resources (Prehistoric) (**Chapter 4.1.1.19.2**)
- Species Considered due to U.S. Fish and Wildlife Service Concerns (**Chapter 4.1.1.21**)

For the following resources, BOEM's subject-matter experts determined through literature searches and communications with other agencies and academia that there was new information made available since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS that was relevant to a WPA proposed action. BOEM's subject-matter experts have reexamined the analyses for these resources based on new information made available; however, none of the new information was deemed significant enough to alter any of the impact conclusions presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. These impact conclusions are presented in **Chapter 4.1.1**. For ease of review, the individual chapter numbers for each resource are provided in the following list.

- Air Quality (**Chapter 4.1.1.1**)
- Water Quality (Coastal and Offshore Waters) (**Chapters 4.1.1.2.1 and 4.1.1.2.2**, respectively)
- Coastal Barrier Beaches and Associated Dunes (**Chapter 4.1.1.3**)
- Wetlands (**Chapter 4.1.1.4**)
- Topographic Features (**Chapter 4.1.1.6**)
- *Sargassum* Communities (**Chapter 4.1.1.7**)

- Chemosynthetic Deepwater Benthic Communities (**Chapter 4.1.1.8**)
- Nonchemosynthetic Deepwater Benthic Communities (**Chapter 4.1.1.9**)
- Soft Bottom Benthic Communities (**Chapter 4.1.1.10**)
- Marine Mammals (**Chapter 4.1.1.11**)
- Sea Turtles (**Chapter 4.1.1.12**)
- Coastal and Marine Birds (**Chapter 4.1.1.14**)
- Fish Resources and Essential Fish Habitat (**Chapter 4.1.1.15**)
- Commercial Fisheries (**Chapter 4.1.1.16**)
- Recreational Fishing (**Chapter 4.1.1.17**)
- Recreational Resources (**Chapter 4.1.1.18**)
- Archaeological Resources (Historic) (**Chapter 4.1.1.19.1**)
- Human Resources and Land Use (Land Use and Coastal Infrastructure, Demographics, Economic Factors, and Environmental Justice) (**Chapters 4.1.1.20.1, 4.1.1.20.2, 4.1.1.20.3, and 4.1.1.20.4**, respectively)

Ultimately, no new significant information was discovered that would alter the impact conclusions for any of the resources analyzed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analyses and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS remain valid and, as such, apply for proposed WPA Lease Sales 246 and 248.

In accordance with CEQ regulations to provide decision-makers with a robust environmental analysis, **Appendix B** ("Catastrophic Spill Event Analysis") provides an analysis of the potential impacts of a low-probability catastrophic oil spill, which is not a part of a WPA proposed action and not likely expected, to the environmental and cultural resources and the socioeconomic conditions analyzed in **Chapter 4.1.1**.

2.3.1.3. Mitigating Measures

The following lease stipulations may be applied to a WPA proposed action as mitigating measures. If the decision is to hold a lease sale, the lease stipulations applicable to the lease sale will be announced in the Final Notice of Sale and Record of Decision.

2.3.1.3.1. Topographic Features Stipulation

The topographic features located in the WPA provide habitat for hard bottom communities of high biomass and diversity (**Chapter 4.1.1.6**). Without the Topographic Features Stipulation and mitigating measures, these communities could be severely and adversely impacted by oil and gas activities resulting from a WPA proposed action if such activities took place on blocks that are within the boundaries of a topographic feature, a No Activity Zone surrounding a topographic feature, or a shunting zone (1,000-Meter, 1-Mile, 3-Mile, and/or 4-Mile) surrounding a topographic feature. The DOI has recognized this problem for some years and, since 1973, has made lease stipulations a part of leases on or near these biotic communities so that impacts from nearby oil and gas activities were mitigated. This stipulation would not prevent the recovery of oil and gas resources within a Topographic Features Stipulation block, but it would serve to protect valuable and sensitive biological resources from routine OCS oil- and gas-related activity by distancing bottom-disturbing activity (e.g., anchors, chains, cables, and wire ropes) 152 m (500 ft) from the No Activity Zone that surrounds topographic features and by requiring that drill muds and cuttings be shunted to the seafloor if a well is within a shunting zone (1,000-Meter, 1-Mile, 3-Mile, and/or 4-Mile) surrounding a topographic feature.

The Topographic Features Stipulation was formulated based on consultation with various Federal agencies and comments solicited from the States, industry, environmental organizations, and academic representatives. The Topographic Features Stipulation has been updated over time, using years of scientific information collected since the stipulation was first proposed. This information includes numerous Agency-funded studies of topographic features in the GOM; numerous stipulation-imposed, industry-funded monitoring reports; and the National Research Council (NRC) report entitled *Drilling Discharges in the Marine Environment* (1983). BOEM and the National Oceanic and Atmospheric Administration (NOAA) also co-sponsor an ongoing long-term monitoring program at the Flower Garden Banks in order to determine if continued offshore oil and gas activity in the GOM has impacted the reef habitat of these features. The Topographic Features Stipulation protects these biotic communities from routine OCS oil and gas activities resulting from a WPA proposed action, while allowing the development of nearby oil and gas resources. This stipulation would not prevent adverse effects of an accident such as a large blowout on a nearby oil or gas operation from impacting these biotic communities; however, it would distance the activity at least 152 m (500 ft) from the No Activity Zone surrounding topographic features, thereby reducing the possibility of physical oiling. The location of the blocks affected by the Topographic Features Stipulation is shown on **Figure 2-1**. A more detailed discussion and definition of this stipulation and its effectiveness are found in Chapter 2.3.1.3.1 of the 2012-2017 WPA/CPA Multisale EIS.

2.3.1.3.2. Military Areas Stipulation

The Military Areas Stipulation has been applied to all blocks leased in military areas since 1977 and reduces potential impacts, particularly in regards to safety. However, this stipulation does not reduce or eliminate the actual physical presence of oil and gas operations in areas where military operations are conducted. The stipulation contains a "hold harmless" clause (holding the U.S. Government harmless in case of an accident involving military operations) and requires lessees to coordinate their activities with appropriate local military contacts. **Figure 2-2** shows the military warning areas in the Gulf of Mexico. A more detailed discussion and definition of this stipulation and its effectiveness are found in Chapter 2.3.1.3.2 of the 2012-2017 WPA/CPA Multisale EIS.

2.3.1.3.3. Protected Species Stipulation

The Protected Species Stipulation has been applied to all blocks leased in the GOM since December 2001. This stipulation was developed in consultation with the Department of Commerce, National Oceanic and Atmospheric Administration, NMFS, and the Department of the Interior, FWS in accordance with Section 7 of the Endangered Species Act, and it is designed to minimize or avoid potential adverse impacts to federally protected species. A more detailed discussion and definition of this stipulation and its effectiveness are found in Chapter 2.3.1.3.3 of the 2012-2017 WPA/CPA Multisale EIS.

2.3.1.3.4. United Nations Convention on the Law of the Sea Royalty Payment Stipulation

The United Nations Convention on the Law of the Sea Royalty Payment Stipulation has been applied to blocks or portions of blocks beyond the U.S. Exclusive Economic Zone (generally greater than 200 nmi [230 mi; 370 km] from the U.S. coastline). Leases on these blocks may be subject to special royalty payments under the provisions of the 1982 United Nations Convention on the Law of the Sea Royalty Payment Stipulation (consistent with Article 82) if the U.S. becomes a party to the Convention prior to or during the life of the lease. A more detailed discussion and definition of this stipulation and its effectiveness are found in Chapter 2.3.1.3.4 of the 2012-2017 WPA/CPA Multisale EIS.

2.3.1.3.5. Stipulation on the Agreement between the United States of America and the United Mexican States Concerning Transboundary Hydrocarbon Reservoirs in the Gulf of Mexico

The "Agreement Between the United States of America and the United Mexican States Concerning Transboundary Hydrocarbon Reservoirs in the Gulf of Mexico" has now entered into force, making it possible for U.S. lessees to enter into voluntary agreements with a licensee of the United Mexican States to develop transboundary reservoirs. The stipulation has been applied to blocks or portions of blocks located wholly or partially within the 3 statute miles (4.8 km) of the maritime or continental shelf boundary with Mexico. The stipulation incorporates by reference the Agreement and notifies lessees that, among other things, activities in this boundary area will be subject to the Agreement and that approval of plans, permits, and unitization agreements will be conditioned upon compliance with the terms of the Agreement. For more information, refer to the Agreement itself, which is available on BOEM's website at http://www.boem.gov/BOEM-Newsroom/Library/Publications/Agreement-between-the-United-States-and-Mexico-Concerning-Transboundary-Hydrocarbon-Reservoirs-in-the-Gulf-of-Mexico.aspx.

2.3.2. Alternative B—Exclude the Unleased Blocks Near the Biologically Sensitive Topographic Features

2.3.2.1. Description

Alternative B differs from Alternative A by not offering the unleased blocks that are subject to the proposed Topographic Features Stipulation under Alternative A (**Chapter 2.3.1.3.1** of this Supplemental EIS and Chapter 2.3.1.3.1 of the 2012-2017 WPA/CPA Multisale EIS). Blocks subject to the Topographic Features Stipulation include any unleased block in which a No Activity Zone or Shunting Zone Topographic Features Stipulation may be applied. These unleased blocks will not be available for lease under Alternative B. The number of unleased blocks that would not be offered under Alternative B represents only a small percentage of the total number of blocks to be offered under Alternative A; therefore, it is assumed that the levels of activity for Alternative B would be essentially the same as those projected for a WPA proposed action (refer to **Chapter 4.1.2** for further details). The estimated amount of resources projected to be developed under Alternative B is within the same scenario range as for Alternative A, i.e., 0.116 0.200 BBO and 0.538-0.938 Tcf of gas.

All of the assumptions, including the four other potential mitigating measures (i.e., the Military Areas Stipulation, Protected Species Stipulation, United Nations Convention on the Law of the Sea Royalty Payment Stipulation, and the Stipulation on the Agreement between the United States of America and the United Mexican States Concerning Transboundary Hydrocarbon Reservoirs in the Gulf of Mexico, as described in **Chapter 2.2.1.3**), are the same as for Alternative A. A description of Alternative A is presented in **Chapter 2.3.1.1**. The Topographic Features Stipulation would not be applicable with Alternative B because the blocks that could be subject to the Topographic Features Stipulation would not be offered for lease.

2.3.2.2. Summary of Impacts

The analyses of impacts summarized in **Chapter 2.3.1.2** and described in detail in **Chapter 4.1.1** are based on the development scenario, which is a set of assumptions and estimates on the amounts, locations, and timing for OCS oil and gas exploration, development, and production operations and facilities, both offshore and onshore. A detailed discussion of the development scenario and major related impact-producing factors is included in **Chapter 3**.

The difference between the potential impacts described for Alternative A and those under Alternative B is that under Alternative B no oil- and gas-related activity would take place in the blocks subject to the Topographic Features Stipulation under Alternative A (**Figure 2-1**). The number of blocks that would not be offered under Alternative B represents only a small percentage of the total number of blocks to be offered under Alternative A; therefore, it is assumed that the levels of activity for Alternative B would be essentially the same as those projected for a WPA proposed action. As a result, the impacts expected to result from Alternative B would be very similar to those described under a WPA proposed action (**Chapter 4.1.1**). Therefore, the regional impact levels for all resources, except for the topographic features, would be similar to those described under a WPA proposed action. This alternative, if adopted, would prevent any oil- and gas-related activity whatsoever in the affected blocks; thus, it would eliminate any potential direct impacts to the biota of those blocks from oil- and gas-related activities, which otherwise would be conducted within the blocks.

2.3.3. Alternative C—No Action

2.3.3.1. Description

Alternative C is the cancellation of a single proposed WPA lease sale. If this alternative is chosen, the opportunity for development of the estimated 0.116-0.200 BBO and 0.538-0.938 Tcf of gas that could have resulted from a proposed WPA lease sale would be precluded or postponed to a future WPA lease sale. Any potential environmental impacts arising out of a proposed WPA lease sale would not occur, but activities associated with existing leases in the WPA would continue. The No Action alternative, therefore, encompasses the same potential impacts as a decision to delay the leasing of unleased blocks in the WPA to a later scheduled lease sale under the Five-Year Program, when another decision on whether to hold that future lease sale would be made. Because delay of a proposed WPA lease sale would yield essentially the same results as the No Action alternative (i.e., most impacts related to Alternative A would not occur), delay of a proposed WPA lease sale was not considered as a separate alternative under this Supplemental EIS.

2.3.3.2. Summary of Impacts

Canceling a proposed WPA lease sale would eliminate the effects described for Alternative A (**Chapter 4.1.3**). The incremental contribution of a WPA proposed lease sale to the cumulative effects would also be foregone, but the effects from other activities, including other OCS lease sales, would remain. Moreover, if a proposed WPA lease sale was canceled, the resulting development of oil and gas could be reevaluated under a future lease sale. Therefore, the overall level of OCS oil- and gas-related activity in the WPA would only be reduced by a small percentage, if any, and the cancellation of a proposed WPA lease sale would not significantly change the environmental impacts of overall OCS oil- and gas-related activity. However, the cancellation of a proposed WPA lease sale could result in direct economic impacts to the individual companies. Revenues collected by the Federal Government (and thus revenue disbursements to the States) also would be adversely affected.

If a proposed WPA lease sale was cancelled, then other sources of energy could potentially be substituted for the lost production. Principal substitutes would be additional imports, conservation, additional domestic production, and switching to other fuels. These alternatives, except conservation, have significant negative environmental impacts of their own. For example, the tankering of fuels from alternate sources over longer distances would also have significant potential negative impacts, including through the increased risk of spills in the Gulf of Mexico.

CHAPTER 3

IMPACT-PRODUCING FACTORS AND SCENARIO

3. IMPACT-PRODUCING FACTORS AND SCENARIO

3.1. IMPACT-PRODUCING FACTORS AND SCENARIO—ROUTINE OPERATIONS

3.1.1. Offshore Impact-Producing Factors and Scenario

Chapter 3.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS describe in detail the offshore infrastructure and activities (impact-producing factors) associated with a WPA proposed action (i.e., a typical lease sale that would result from a proposed action) within the WPA that could potentially affect the biological, physical, and socioeconomic resources of the Gulf of Mexico. In addition, Chapter 3.1.1 of the 2012-2017 WPA/CPA Multisale EIS and Chapter 3.1.1 of the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2014 and 2016; Eastern Planning Area Lease Sales 225 and 226; Final Environmental Impact Statement* (EPA 225/226 EIS) (USDOI, BOEM, 2013b) also describe the OCS Program's cumulative activity scenario resulting from past and future lease sales in the WPA, CPA, and EPA that could potentially affect the biological, physical, and socioeconomic resources of the GOM within the WPA. Note that offshore and onshore impact-producing factors and scenarios associated with a CPA or an EPA proposed action (i.e., a typical lease sale that would result from a proposed action within the CPA or EPA) as well as OCS Program activity resulting from past and future lease sales in the CPA or EPA are disclosed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, CPA 235/241/247 Supplemental EIS (*Gulf of Mexico OCS Oil and Gas Lease Sales: 2015-2017; Central Planning Area Lease Sales 235, 241, and 247; Final Supplemental Environmental Impact Statement*; USDOI, BOEM, 2014b), and EPA 225/226 EIS.

Offshore is defined, for the purposes of this Supplemental EIS, as the OCS portion of the GOM that begins 3 marine leagues (9 nmi; 10.36 mi; 16.67 km) offshore Texas and Florida and 3 nmi (3.45 mi; 5.56 km) offshore Louisiana, Mississippi, and Alabama. The OCS extends seaward to the limits of the United States' jurisdiction over the continental shelf in water depths up to approximately 3,346 m (10,978 ft), which comprises the Exclusive Economic Zone (**Figure 1-1**). Coastal infrastructure and activities associated with a WPA proposed action are described in **Chapter 3.1.2** of this Supplemental EIS and in Chapter 3.1.2 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

BOEM projects that the overwhelming majority of the oil and natural gas fields discovered as a result of a WPA proposed action will reach the end of their economic lives within a time span of 40 years following a lease sale. Therefore, activity levels are projected to 40 years for this Supplemental EIS. Although unusual cases exist where activity on a lease may continue beyond 40 years, BOEM's forecasts indicate that most significant activities associated with exploration, development, production, and abandonment of leases in the GOM occur well within the 40-year analysis period. For the cumulative case analysis, total OCS Program exploration and development activities are also forecast over a 40-year period. For modeling purposes and quantitative OCS Program activity analyses, a 40-year analysis period is also used. Exploration and development activity forecasts become increasingly more uncertain as the length of time of the forecast increases and the number of influencing factors increases.

BOEM uses a series of spreadsheet-based data analysis tools to develop the forecasts of oil and gas exploration, discovery, development, and production activity for a proposed action and OCS Program scenarios presented in this Supplemental EIS. BOEM's analyses incorporate all relevant historical activity and infrastructure data, and BOEM's resulting forecasts are analyzed and compared with actual historical data to ensure that historical precedent and recent trends are reflected in each activity forecast.

BOEM is confident that its analysis methodology, with adjustments and refinements based on recent activity levels, adequately projects Gulf of Mexico OCS oil- and gas-related activities in both the short term and the long term for the EIS analyses.

The WPA proposed actions and the Gulfwide OCS Program scenarios are based on the following factors:

- resource estimates developed by BOEM;
- recent trends in the amount and location of leasing, exploration, and development activity;

- estimates of undiscovered, unleased, economically recoverable oil and gas resources in each water-depth category and each planning area;
- existing offshore and onshore oil and/or gas infrastructure;
- published data and information;
- industry information; and
- oil and gas technologies, and the economic considerations and environmental constraints of these technologies.

Proposed WPA Lease Sales 246 and 248 each represent 4-5 percent of the OCS Program activities expected in the WPA from 2012 through 2051 based on barrels of oil equivalent (BOE) resource estimates and 1 percent of the total OCS Program (WPA, CPA, and EPA) from 2012 through 2051.

Specific projections for activities associated with a WPA proposed action are discussed in the following scenario sections. The potential impacts of the activities associated with a proposed "typical" WPA lease sale are considered in the environmental analysis sections (**Chapter 4.1.1** of this Supplemental EIS and Chapter 4.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS).

The OCS Program scenario includes all activities that are projected to occur from past, proposed, and future lease sales during the analysis period. This includes projected activity from lease sales that have been held but for which exploration or development has either not yet begun or is continuing. Activities that take place beyond the analysis timeframe as a result of future lease sales are not included in this analysis. The impacts of activities associated with the OCS Program on biological, physical, and socioeconomic resources are analyzed in the cumulative environmental analysis sections (**Chapters 4.1.1** of this Supplemental EIS and Chapter 4.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS).

3.1.1.1. Resource Estimates and Timetables

A WPA proposed action and the cumulative oil and gas program have not changed since last analyzed for the 2012-2017 WPA/CPA Multisale EIS. BOEM has not identified any new information or change in circumstances since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, or WPA 238/246/248 Supplemental EIS that would change the estimates and timetables.

3.1.1.1.1. Proposed Action

The proposed action scenario is used to assess the potential impacts of a proposed "typical" lease sale. The resource estimates for a proposed action are based on two factors: (1) the conditional estimates of undiscovered, unleased, conventionally recoverable oil and gas resources in the proposed lease sale area; and (2) estimates of the portion or percentage of these resources assumed to be leased, discovered, developed, and produced as a result of a proposed action. Due to the inherent uncertainties associated with an assessment of undiscovered resources, probabilistic techniques were employed and the results were reported as a range of values corresponding to different probabilities of occurrence. The estimates of the portion of the resources assumed to be leased, discovered, developed, and produced as a result of a proposed action are based upon logical sequences of events that incorporate past experience, current conditions, and foreseeable development strategies. Historical databases and information derived from oil and gas exploration and development activities are available to BOEM and were used extensively. The undiscovered, unleased, conventionally recoverable resource estimates for a proposed action are expressed as ranges, from low to high. This range provides a reasonable expectation of oil and gas production anticipated from a "typical" lease sale held as a result of a proposed action based on an actual range of historic observations.

Table 3-1 presents the projected oil and gas production for a WPA proposed action and for the OCS Program. **Table 3-2** provides a summary of the major scenario elements of a WPA proposed action, a "typical" lease sale, and related impact-producing factors. To analyze impact-producing factors for a WPA proposed action and the OCS Program, the proposed WPA lease sale area was divided into offshore subareas based upon ranges in water depth. **Figure 3-1** depicts the location of the offshore subareas. The water-depth ranges reflect the technological requirements and related physical and economic impacts as a consequence of the oil and gas potential, exploration and development activities, and lease terms unique to each water-depth range. Estimates of resources and facilities are distributed into each of the subareas.

Proposed Action Scenario (WPA Typical Lease Sale): The estimated amounts of resources projected to be leased, discovered, developed, and produced as a result of a typical proposed WPA lease sale are 0.116-0.200 BBO and 0.538-0.938 Tcf of gas.

The number of exploration and delineation wells, production platforms, and development wells projected to develop and produce the estimated resources for a WPA proposed action is given in **Table 3-2**. The table shows the distribution of these factors by offshore subareas in the proposed lease sale area. **Table 3-2** includes estimates of the major impact-producing factors related to the projected levels of exploration, development, and production activity.

Exploratory drilling activity generally takes place over an 8-year period, beginning within 1 year after a lease sale. Development activity generally takes place over a 39-year period, beginning with the installation of the first production platform and ending with the drilling of the last development wells. Production of oil and gas begins by the third year after a lease sale and continues to the 40^{th} year; however, in rare cases, production could continue beyond the 40^{th} year.

3.1.1.1.2. OCS Program

OCS Program Cumulative Scenario (WPA, CPA, and EPA): Projected reserve/resource production for the OCS Program is 18.335-25.64 BBO and 75.886-111.627 Tcf of gas and represents anticipated production from lands currently under lease plus anticipated production from future lease sales over the 40-year analysis period. The OCS Program cumulative scenario includes WPA, CPA, and EPA production estimates. **Table 3-3** presents all anticipated production from lands currently under lease in the WPA, CPA, and EPA plus all anticipated production from future total OCS Program (WPA, CPA, and EPA) lease sales over the 40-year analysis period.

WPA Cumulative Scenario: Projected reserve/resource production for the OCS Program in the WPA (2.510-3.696 BBO and 12.539-18.434 Tcf of gas) represents anticipated production from lands currently under lease in the WPA plus anticipated production from future WPA lease sales over the 40-year analysis period. Projected production under the cumulative scenario represents approximately 14 percent of the oil and 17 percent of the gas of the total Gulfwide OCS Program. **Table 3-4** presents all anticipated production from lands currently under lease in the WPA plus all anticipated production from future WPA lease sales over the 40-year analysis period. The impact-producing factors, affected environment, and environmental consequences related to a WPA proposed lease sale are disclosed in this Supplemental EIS and in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

CPA Cumulative Scenario: Projected reserve/resource production for the OCS Program in the CPA (15.825-21.733 BBO and 63.347-92.691 Tcf of gas) represents anticipated production from lands currently under lease in the CPA plus anticipated production from future CPA lease sales over the 40-year analysis period. Projected production under the cumulative scenario represents approximately 85-86 percent of the oil and 83 percent of the gas of the total Gulfwide OCS Program. Table 3-6 of the 2012-2017 WPA/CPA Multisale EIS presents all anticipated production from lands currently under lease in the CPA plus all anticipated production from future CPA lease sales over the 40-year analysis period. The impact-producing factors, affected environment, and environmental consequences related to CPA proposed lease sales are disclosed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and CPA 235/241/247 Supplemental EIS.

EPA Cumulative Scenario: Projected reserve/resource production for the OCS Program in the EPA (0-0.211 BBO and 0-0.502 Tcf of gas) represents all anticipated production from lands currently under lease in the EPA plus all anticipated production from future EPA lease sales over the 40-year analysis period. Projected production represents approximately 1 percent of the oil and <1 percent of the gas of the total Gulfwide OCS Program. Table 3-3 of the EPA 225/226 EIS presents all anticipated production from lands currently under lease in the EPA plus all anticipated production from future EPA lease sales over the 40-year analysis period. The impact-producing factors, affected environment, and environmental consequences related to EPA proposed lease sales are disclosed in the EPA 225/226 EIS.

3.1.1.2. Exploration and Delineation

3.1.1.2.1. Seismic Surveying Operations

Prelease surveys are comprised of seismic work performed on or off leased areas, focused most commonly (but not always) on deeper targets and collectively authorized under BOEM's geological and geophysical permitting process. Postlease, high-resolution seismic surveys collect data on surficial or near-surface geology used to identify potential shallow geologic hazards for engineering and site planning for bottom-founded structures. Noise associated with OCS oil and gas development results from seismic surveys, the operation of fixed structures such as offshore platforms and drilling rigs, and helicopter and service-vessel traffic. These noise sources are discussed in **Chapter 3.1.1.6** of this Supplemental EIS and in Chapter 3.1.1.6 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS), and WPA 238/246/248 Supplemental EIS.

WPA Proposed Action Scenario (Typical Lease Sale): Because of the cyclic nature in the acquisition of seismic surveys, a prelease seismic survey would be attributable to lease sales held up to 7-9 years after the survey. Based on an amalgam of historical trends in G&G permitting and industry input, BOEM projects that proposed lease sales within the EPA, WPA, and CPA would result in 29,197 OCS blocks surveyed by two-dimensional (2D) and three-dimensional (3D) deep seismic operations for the years 2012-2017. Broken down per planning area, this yields approximately 583 blocks surveyed in the EPA, approximately 21,314 blocks surveyed in the CPA, and approximately 7,300 blocks surveyed in the WPA. It should be noted that the number of blocks could include multiple surveys on a single block that would then be counted each time as a unique block survey. For postlease seismic surveys, information obtained from high-resolution seismic contractors operating in the GOM project a proposed action would result in about 50 vertical seismic profiling (VSP) operations and 629 high-resolution surveys covering approximately 226,400 line miles (364,420 km) of near-surface and shallow penetration seismic during the life of a proposed action. The impact-producing factors, affected environment, and environmental consequences related to WPA proposed lease sales are disclosed and addressed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Chapter 3.1.1.2.1 of the 2012-2017 WPA/CPA Multisale EIS describes in detail ocean-bottom surveys.

OCS Program Cumulative Scenario: Seismic surveys are projected to follow the same trend as exploration activities, which peaked in 2008-2010, will steadily decline until 2027 and will remain relatively steady throughout the second half of the 40-year analysis period. It is important to note that the cycling of G&G data acquisition is not driven by the 40-year life cycle of productive leasing, but instead will tend to respond to new production or potential new production driven by new technology. Consequently, some areas will be resurveyed in 2-year cycles, while other areas, considered nonproductive, may not be surveyed for 20 years or more.

Assuming that acoustic-sourced seismic will remain the dominant exploration tool used by industry in the future and that a number of surveyed blocks will be resurveyed several more times, BOEM makes the following projections. During the first 5 years (2012-2017) of the 40-year analysis period (2012-2051), BOEM projects the following annual activities: 50 VSP operations; 226,400 lines miles (364,420 km) surveyed by high-resolution seismic; and 29,197 blocks surveyed by deep seismic, including areas that will be resurveyed. Expanding this analysis to the first 20 years (2012-2032), the annual projections would be 60 VSP operations, 400,000 mi (740,800 km) surveyed by high-resolution seismic, and 33,000 blocks of 2D/3D deep seismic (10% in the EPA, 60% in the CPA, and 30% in the WPA). During the second half of the 40-year analysis period, the annual projection would be approximately 40 VSP operations, 240,000 mi (444,480 km) surveyed by high-resolution seismic, and 15,000-20,000 blocks surveyed by deep seismic annually (50% in the CPA, 30% in the WPA, and 20% in the EPA).

3.1.1.2.2. Exploration and Delineation Plans and Drilling

Chapter 3.1.1.2.2 of the 2012-2017 WPA/CPA Multisale EIS describes in detail exploration and delineation plans and drilling.

Oil and gas operators use drilling terms that represent stages in the discovery and exploitation of hydrocarbon resources. An exploration well generally refers to the first well drilled on a prospective geologic structure to confirm that a resource exists. If a resource is discovered in quantities appearing to be economically viable and in circumstances when reservoirs are large, one or more follow-up delineation wells help define the amount of resource or the extent of the reservoir. Following a discovery, an operator will often temporarily plug and abandon a discovery to allow time to generate a development scenario and to build or procure equipment.

In the GOM, exploration and delineation wells are typically drilled with mobile offshore drilling units (MODUs); e.g., jack-up rigs, semisubmersible rigs, submersible rigs, platform rigs, or drillships. Non-MODUs, such as inland barges, are also used. The type of rig chosen to drill a prospect depends primarily on water depth. Because the water-depth ranges for each type of drilling rig overlap to a degree, other factors such as rig availability and daily operation rates play a large role when an operator decides upon the type of rig to contract. The depth ranges for exploration rigs used in this analysis for Gulf of Mexico MODUs are indicated below.

MODU or Drilling Rig Type	Water-Depth Range
Jack-up, submersible, and inland barges	≤100 m (328 ft)
Semisubmersible and platform rig	100-3,000 m (328-9,843 ft)
Drillship	≥600 m (1,969 ft)

Historically, drilling rig availability has been a limiting factor for activity in the GOM and is assumed to be a limiting factor for activity projected as a result of a proposed lease sale. Drilling activities may also be constrained by the availability of rig crews, shore-based facilities, risers, and other equipment.

The scenario for a WPA proposed action assumes that an average exploration well will require 30-120 (mean of 60) days to drill. The actual time required for each well depends on a variety of factors, including the depth of the prospect's potential target zone, the complexity of the well design, and the directional offset of the wellbore needed to reach a particular zone. This scenario assumes that the average exploration or delineation well depth will be approximately 4,572-7,010 m (15,000-23,000 ft) below the mudline (i.e., surface of the seafloor).

Some delineation wells may be drilled using a sidetrack technique. In sidetracking a well, a portion of the existing wellbore is plugged back to a specific depth, directional drilling equipment is installed, and a new wellbore is drilled to a different geologic location. The lessee may use this technology to better understand their prospect and to plan future wells. Use of this technology may also reduce the time and exploration expenditures needed to help evaluate the prospective horizons on a new prospect.

The cost of an average exploration well can be $40-$150 million, or more, without certainty that objectives can be reached (i.e., an actual discovery and/or confirmation of hydrocarbons). Some recent ultra-deepwater exploration wells (>6,000 ft [1,829 m] water depth) in the GOM have been reported to cost upwards of $200 million. The actual cost for each well depends on a variety of factors, including the depth of the prospect's potential target zone, the complexity of the well design, and the directional offset of the wellbore needed to reach a particular zone.

Subpart D of BSEE's regulations (30 CFR part 250) specifies requirements for drilling activities. Refer to **Chapter 1.3.1** of this Supplemental EIS, Chapter 1.3.1 and Table 1-2 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 1.3.2 of the WPA 233/CPA 231 Supplemental EIS, and Chapter 1.3.1 WPA 238/246/248 Supplemental EIS, which provide a summary of new and updated safety requirements.

Tables 3-2 through 3-4 show the estimated range of exploration and delineation wells by water-depth range for the WPA typical lease sale cases; for the WPA, CPA, and EPA total OCS Program case; and for the WPA cumulative cases, respectively.

WPA Proposed Action Scenario (Typical Lease Sale): BOEM estimates that 53-89 exploration and delineation wells would be drilled as a result of a WPA proposed action. **Table 3-2** shows the estimated range of exploration and delineation wells by water-depth range. Approximately 55 percent of the projected wells are expected to be on the continental shelf (0-200 m [0-656 ft] water depth), and a little less than 45 percent are expected in the intermediate water-depth ranges and deeper (>200 m; 656 ft).

OCS Program Cumulative Scenario (WPA, CPA, and EPA): BOEM estimates that 6,910-9,827 exploration and delineation wells would be drilled in the WPA, CPA, and EPA as a result of all past OCS lease sales and projected activity for future lease sales associated with this Five-Year Program. **Tables 3-3 and 3-4** of this Supplemental EIS and Table 3-6 of the 2012-2017 WPA/CPA Multisale EIS show the estimated range of exploration and delineation wells by water-depth range. Of these wells, approximately 55 percent are expected to be on the continental shelf (0-200 m [0-656 ft] water depth) and approximately 45 percent are expected in intermediate water-depth ranges and deeper

(>200 m; 656 ft). Note that offshore and onshore impact-producing factors and scenarios associated with a CPA or an EPA proposed action (i.e., a typical lease sale that would result from a proposed action within the CPA or EPA) as well as OCS Program activity resulting from past and future lease sales in the CPA or EPA are disclosed in the 2012-2017 Multisale EIS, WPA 233/CPA 231 Supplemental EIS, CPA 235/241/247 Supplemental EIS, and EPA 225/226 EIS.

3.1.1.3. Development and Production

Development and Production Drilling

Chapter 3.1.1.3.1 of the 2012-2017 WPA/CPA Multisale EIS and Chapter 3.1.1.3 of the WPA 233/CPA 231 Supplemental EIS describes in detail development and production drilling and development operations and coordination documents.

Delineation and production wells are sometimes collectively termed development wells. A development well is designed to extract resource from a known hydrocarbon reservoir. After a discovery, the operator must decide whether or not to complete the well without delay, to delay completion with the rig on station so that additional tests may be conducted, or to temporarily abandon the well site and move the rig off station to a new location and drill another well. Sometimes an operator will decide to drill a series of development wells, move off location, and then return with a rig to complete all the wells at one time. If an exploration well results in a dry hole, the operator permanently abandons the well without delay.

When the decision is made to complete the well, a new stage of activity begins. Completing a well involves preparing the well for production. BOEM estimates that approximately 90 percent of development wells will become producing wells. The typical process includes setting and cementing the production casing, installing some downhole production equipment, perforating the casing and surrounding cement, treating the formation, setting a gravel pack (if needed), and installing production tubing.

One form of well completion involves a process known as “induced hydraulic fracturing,” commonly referred to as “fracking.” The term is used colloquially to refer to a number of activities; however, for the OCS oil and gas program, induced hydraulic fracturing refers to a process used to fracture a reservoir rock around the wellbore using pressurized liquid. The technique is used to increase flow rate and maximize production. The pressurized fluid is typically a mixture of water, well treatment chemicals, and a mechanical agent or proppant. The mechanical agents or proppants, such as sand, man-made ceramics, or small microspheres (tiny glass beads), are designed to keep open the induced hydraulic fractures that are created by the pressurized fluids so that they can perform as conduits to assist the flow of hydrocarbons from the reservoir formation to the wellbore. Well treatment chemicals are commonly used to improve well productivity. For example, acidizing a reservoir to dissolve cementing agents and improve fluid flow is the most common well treatment in the GOM. During production activities, additional waste streams include produced water, produced sand, and well treatment, workover, and completion fluids (refer to Chapter 3.1.1.4 of the 2012-2017 WPA/CPA Multisale EIS). Chapter 3.1.1.4.2 of the 2012-2017 WPA/CPA Multisale EIS discusses well treatment, workover, and completion fluids and notes that these fluids include fracturing fluids. Both USEPA Regions 4 and 6 prohibit the discharge of well treatment, completion, and workover fluids that exceed oil and grease limitations or that contain priority pollutants or free oil. However, some well treatment, workover, and completion chemicals are discharged with the drilling muds and cuttings or with the produced-water streams. Both of these waste streams may only be discharged if they meet the discharge criteria of the Region 6 or Region 4 NPDES permits as appropriate to the location of the operation. Chapter 3.1.1.4.4 of the 2012-2017 WPA/CPA Multisale EIS explains that produced sands can result from hydraulic fracturing as well as other practices. Both USEPA Region 4 and Region 6 NPDES permits prohibit the discharge of produced sand. Since discharges from drilling and production platforms are regulated by USEPA through the NPDES permit process, the effects from these discharges should be limited.

In contrast to the large-scale, induced hydraulic fracturing procedures used in onshore oil and gas operations for low-permeability “tight gas,” “tight oil,” “shale gas,” and “coal gas” reservoirs, completions that include induced hydraulic fracturing carried out on the OCS in the GOM are small scale by comparison. Completions using hydraulic fracturing on the OCS are most commonly used for high-permeability formations to repair formation damage caused during drilling operations and also to prevent formation damage during production. Since damage to the formation caused by OCS drilling operations does not extend for large distances away from the reservoir-borehole interface, the fracturing induced by the procedure is also designed to remain in close proximity to the borehole, extending distances of only a few feet to 40 or 60 ft (12 or 18 m) from the borehole, rarely extending for more than 100 ft (305 m) from the borehole. After a production test determines the desired production rate to avoid damaging the reservoir, the well is ready to go online and produce.

The development operations and coordination document is the chief planning document that lays out an operator's specific intentions for development. The range of postlease development plans is discussed in Chapter 1.5 of the 2012-2017 WPA/CPA Multisale EIS and WPA 233/CPA 231 Supplemental EIS. **Table 3-2** shows the estimated range of development wells and production structures by water-depth subarea for a WPA proposed action.

WPA Proposed Action Scenario (Typical Lease Sale): BOEM estimates that 77-121 development and production wells would be drilled as a result of a WPA proposed action. **Table 3-2** shows the estimated range of development and production wells by water-depth subarea. Approximately 55 percent of the projected wells (oil and gas combined) are expected to be on the continental shelf (0-200 m [656 ft] water depth) and 45-47 percent are expected in intermediate water-depth ranges and deeper (>200 m; 656 ft). Trends between the oil and gas development wells are markedly different. For the 27-40 oil wells projected as a result of a WPA proposed action, 55-60 percent of those wells fall within the intermediate water-depth ranges and deeper (200-1,600 m; 656-5,249 ft). The percent of oil wells in the other water-depth categories each range from around 7 to 15 percent. For 36-62 gas wells projected as a result of a WPA proposed action, nearly 80 percent of gas wells are projected to be located on the continental shelf (0-200 m [0-656 ft] water depth). The percent of gas wells in the other water-depth categories is much less, and each range from 3 to 6 percent.

OCS Program Cumulative Scenario (WPA, CPA, and EPA): It is estimated that 8,530-12,180 development and production wells will be drilled in the WPA, CPA, and EPA as a result of the proposed lease sales and all OCS oil- and gas-related activity associated with previous lease sales. **Table 3-3** shows the estimated range of development wells by water depth.

The 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, CPA 235/241/247 Supplemental EIS, and EPA 225/226 EIS detail the offshore and onshore impact-producing factors and scenarios associated with a CPA or an EPA proposed action, i.e., a typical lease sale that would result from a proposed action within the CPA or EPA, as well as OCS Program activity resulting from past and future lease sales in the CPA or EPA.

Infrastructure Emplacement/Structure Installation and Commissioning Activities

Chapter 3.1.1.3.2 of the 2012-2017 WPA/CPA Multisale EIS describes in detail infrastructure emplacement/structure installation and commissioning activities.

Bottom-founded or floating structures may be placed over development wells to facilitate production from a prospect. These structures provide the means to access and control the wells. They serve as a staging area to process and treat produced hydrocarbons from the wells, initiate export of the produced hydrocarbons, conduct additional drilling or reservoir stimulation, conduct workover activities, and carry out eventual abandonment procedures. There is a range of offshore infrastructure installed for hydrocarbon production. Among these are pipelines, fixed and floating platforms, caissons, well protectors, casing, wellheads, and conductors.

WPA Proposed Action Scenario (Typical Lease Sale): It is estimated that 15-23 production structures will be installed as a result of a WPA proposed action. **Table 3-2** shows the projected number of structure installations for a WPA proposed action by water-depth range. About 67-74 percent of the production structures installed for a WPA proposed action are projected to be on the continental shelf (0-60 m; 0-197 ft).

OCS Program Cumulative Scenario (WPA, CPA, and EPA): It is estimated that 1,435-2,026 production structures would be installed in the WPA, CPA, and EPA as a result of the proposed lease sales and all OCS oil- and gas-related activity associated with previous lease sales. **Tables 3-2 and 3-3** of this Supplemental EIS and Table 3-6 of the 2012-2017 WPA/CPA Multisale EIS show the projected number of structure installations by water-depth range for the OCS Program.

The 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, CPA 235/241/247 Supplemental EIS, and EPA 225/226 EIS detail the offshore and onshore impact-producing factors and scenarios associated with a CPA or an EPA proposed action, i.e., a typical lease sale that would result from a proposed action within the CPA or EPA, as well as OCS Program activity resulting from past and future lease sales in the CPA or EPA.

Bottom Area Disturbance

Chapter 3.1.1.3.2.1 of the 2012-2017 WPA/CPA Multisale EIS describes in detail bottom area disturbances. Structures emplaced or anchored on the OCS to facilitate oil and gas exploration and production include drilling rigs or MODUs (jack-ups, semisubmersibles, and drillships), pipelines, and fixed surface, floating, and subsea production systems, and are described in **Chapter 3.1.1.3** of this Supplemental EIS and in Chapters 3.1.1.3.1 and 3.1.1.3.2 of the 2012-2017 WPA/CPA Multisale EIS. The emplacement or removal of these structures disturbs small areas of the sea bottom beneath or adjacent to the structure. If mooring lines of steel, chain, or synthetic polymer are anchored to the sea bottom, areas around the structure can also be directly affected by their emplacement. This disturbance includes physical compaction or crushing beneath the structure or mooring lines and the resuspension and settlement of sediment caused by the activities of emplacement. Movement of floating types of facilities will also cause the movement of the mooring lines in its array. Small areas of the sea bottom will be affected by this kind of movement. Impacts from bottom disturbance are of concern near sensitive areas such as topographic features, pinnacles, low-relief live bottom features, chemosynthetic communities, high-density biological communities in water depths ≥400 m (1,312 ft), and archaeological sites.

Sediment Displacement

Chapter 3.1.1.3.2.2 of the 2012-2017 WPA/CPA Multisale EIS describes in detail sediment displacement. Displaced sediments are those that have been physically moved “in bulk.” Displaced sediments will cover or bury an area of the seafloor, while resuspended sediments will cause an increase in turbidity of the adjacent water column. Resuspended sediments eventually settle, covering the surrounding seafloor. Resuspended sediments may include entrained heavy metals or hydrocarbons.

Infrastructure Presence

Chapter 3.1.1.3.3 of the 2012-2017 WPA/CPA Multisale EIS describes in detail impact-producing factors due to infrastructure presence. The installation and maintenance of infrastructure may include, but is not limited to, the following:

- anchoring;
- offshore production systems;
- space-use requirements (deployment of survey equipment or bottom-founded production equipment);
- aesthetic quality (presence and visibility of equipment, vessels, and air traffic); and
- workovers and abandonments.

3.1.1.4. Operational Waste Discharged Offshore

Chapter 3.1.1.4 of the 2012-2017 WPA/CPA Multisale EIS describes in detail impacting factors due to operational wastes discharged offshore, and Chapter 3.1.1.4 of the WPA 233/ CPA 231 Supplemental EIS provides a summary as well as detailed updated information on more recent, stricter regulations regarding vessel discharges. Operational wastes discharged offshore include the following:

- drilling muds and cuttings;
- produced waters;
- well treatment, workover, and completion fluids;

- production solids and equipment;
- bilge, ballast, and fire water;
- cooling water;
- deck drainage;
- treated domestic and sanitary wastes;
- minor discharges;
- vessel operational discharges; and
- distillation and reverse osmosis brine.

BOEM maintains records of the volume of water produced from each block on the OCS and its disposition—injected on lease, injected off lease, transferred off lease, or discharged overboard. The amount discharged overboard for the years 2000-2013 is summarized by water depth in **Table 3-5**, with new data provided for the year 2013. The total volume for all water depths during this 13-year period ranged from 489.0 to 648.2 MMbbl, with the largest contribution (68-88%) coming from operations on the shelf. The total volume of produced water generally decreased after 2004, reflecting an overall decrease in contributions from operations on the shelf. The contribution of produced water from operations in deep water (>400-m [1,312-ft] water depth) and ultra-deepwater (>1,600-m [5,249-ft] water depth) production has been increasing. From 2000 to 2013, the contribution from these operations (deep and ultra-deepwater together) increased from 6 percent (37.8 MMbbl) to 28 percent (142.8 MMbbl) of the total produced-water volume (calculated from data in **Table 3-5**). The updated annual amounts and depth distributions of produced water discharged by depth are within the range of or similar to data presented in the 2012-2017 WPA/CPA Multisale EIS and WPA 233/CPA 231 Supplemental EIS. Thus, this new information did not change the validity of the operational wastes discussion previously presented.

3.1.1.5. Air Emissions

In 1990, pursuant to Section 328 of the Clean Air Act Amendments and following consultation with the Commandant of the U.S. Coast Guard (USCG) and the Secretary of the Interior, the U.S. Environmental Protection Agency (USEPA) assumed air quality responsibility for the OCS waters east of 87.5^{o} W., this Agency retained National Ambient Air Quality Standards (NAAQS) air quality jurisdiction for OCS operations west of the same longitude in the GOM. Air quality regulations are under a comprehensive review in 2014 to replace obsolete provisions and to ensure that updates in regulations are following improvements in scientific and technological information.

There are many air emissions sources related to OCS oil and gas exploration, development, and production in the GOM. During the exploration stage, most of the OCS non-platform emissions are from combustion from the equipment used on a drilling rig or from fuel usage of a support vessel. During the production stage, platform emission sources include boilers, diesel engines, combustion flares, fugitives, glycol dehydrators, natural gas engines, turbines, pneumatic pumps, pressure/level controllers, storage tanks, cold vents, and others. During the development stage, most of the OCS non-platform emissions are from fuel usage of support or survey vessels to lay pipelines, install facilities, or map geologic formations and seismic properties.

Pollutants released by OCS sources include the NAAQS pollutants carbon monoxide (CO), nitrogen oxides (NO_x), particulate matter (PM), and sulfur dioxide (SO_2). Pollutants also released by OCS sources (NO_x and volatile organic compounds [VOC]) are precursors to ozone, which is formed by photochemical reactions in the atmosphere and is another NAAQS pollutant. Lastly, OCS sources release greenhouse gas emissions, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

The *Year 2008 Gulfwide Emissions Inventory Study* (Wilson et al., 2010) indicates that, for calendar year 2008, OCS oil and gas production platforms and non-platform sources emit the majority of criteria pollutants and greenhouse gases in the GOM on the OCS, with the exception of PM and SO_2 (primarily emitted from commercial marine vessels) and N_2O (from biological sources). The OCS oil and gas production platform and non-platform sources account for 93 percent of the total CO emissions, 74 percent of NO_x emissions, 76 percent of VOC emissions, 99 percent of the CH_4 emissions, and

84 percent of the CO_2 emissions on the OCS. Natural gas engines on platforms represented the largest CO emission source, accounting for 60 percent of the total estimated OCS oil- and gas-related CO emissions; and OCS oil- and gas-related support vessels were the highest emitters of NO_x, accounting for 35 percent of the total estimated emissions. Oil and natural gas production platform vents and fugitive sources account for the highest percentage of VOC and CH_4 emissions. Support vessels (29% of total emissions), production platform natural gas turbines (15% of total emissions), and drilling rigs (12% of total emissions) emit the majority of the CO_2 emissions attributable to oil and gas production on the OCS. An update to Wilson et al. (2010), which is currently in progress, is built upon previous studies to develop a base year 2011 air pollution emissions inventory for all OCS oil and gas production-related sources in the GOM. This study combines the most recent emissions factors released by the USEPA and the updated estimations methods to develop a comprehensive criteria pollutant and greenhouse gases emissions inventory.

3.1.1.6. Noise

Noise associated with OCS oil and gas development results from seismic surveys, the operation of fixed structures such as offshore platforms and drilling rigs, and helicopter and service-vessel traffic. Noise generated from these activities can be transmitted through both air and water, and may be long-lived or temporary. Offshore drilling and production involve various activities that produce a composite underwater noise field. The intensity level and frequency of the noise emissions are highly variable, both between and among the various industry sources. Noise from proposed OCS oil- and gas-related activities may affect resources near the activities. Whether a sound is or is not detected by marine organisms depends both on the acoustic properties of the source (spectral characteristics, intensity, and transmission patterns) and the sensitivity of the hearing system in the marine organism. Noise can cause varying degrees of harassment to an exposed animal and may cause “take” of endangered and threatened species as defined in the Endangered Species Act of 1973 (ESA). Source levels within hearing thresholds may alter hearing or induce behavioral changes (Richardson et al., 1995). Chapter 3.1.1.6 of the 2012-2017 WPA/CPA Multisale EIS describes in detail noise impact-producing factors associated with OCS oil and gas development.

3.1.1.7. Major Sources of Oil Inputs in the Gulf of Mexico

Petroleum hydrocarbons can enter the GOM from a wide variety of sources. The major sources of oil inputs in the GOM are natural seepage, permitted produced-water discharges, land-based discharges, and accidental spills. Numerical estimates of the contributions for these sources to the GOM coastal and offshore waters are shown in Tables 3-8 and 3-9 of the 2012-2017 WPA/CPA Multisale EIS. Chapter 3.1.1.7 of the 2012-2017 WPA/CPA Multisale EIS describes in detail major sources of oil inputs in the Gulf of Mexico, including natural seepage, produced water, land-based discharges, and spills.

Chapter 3.1.1.7.4 of the 2012-2017 WPA/CPA Multisale EIS and Chapter 3.1.1.7 of the WPA 238/246/248 Supplemental EIS also provide the following information related to oil spills:

- trends in reported spill volumes and numbers;
- projections of future spill events;
- OCS oil- and gas-related offshore oil spills;
- non-OCS oil- and gas-related offshore spills;
- OCS oil- and gas-related coastal spills;
- non-OCS oil- and gas-related coastal spills; and
- other sources of oil.

3.1.1.8. Offshore Transport

Offshore transport includes both movements of oil and gas products, as well as the transportation of equipment and personnel. Chapter 3.1.1.8 of the 2012-2017 WPA/CPA Multisale EIS describes in detail sources of offshore transport and proposed action scenarios, including pipelines (installation and maintenance; landfalls), barges, oil tankers, and projections related to floating production, storage, and offloading systems, service vessels, and helicopter trips. Updated information on total traffic (OCS- and non-OCS Program-related) on navigation channels for 2011 can be found in Table 3-7 of the WPA 238/246/248 Supplemental EIS. This information did not alter the projections or conclusions made in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, or WPA 238/246/248 Supplemental EIS.

3.1.1.9. Safety Issues

Safety issues related to OCS oil and gas development include the presence of hydrogen sulfide and sulfurous petroleum and shallow hazards. These safety issues are described in detail in Chapters 3.1.1.9.1 and 3.1.1.9.2 of the 2012-2017 WPA/CPA Multisale EIS. Technologies continue to evolve to meet the technical, environmental, and economic challenges of deepwater development. These new and unusual technologies are described in Chapter 3.1.1.9.3 of the 2012-2017 WPA/CPA Multisale EIS.

3.1.1.10. Decommissioning and Removal Operations

During exploration, development, and production operations, the seafloor around activity sites within a proposed lease sale area becomes the repository of temporary and permanent equipment and structures. In compliance with Section 22 of BOEM's Oil and Gas Lease Form (BOEM-2005) and BSEE regulations (30 CFR §§ 250.1710 *et seq.—Permanently Plugging Wells* and 30 CFR §§ 250.1725 *et seq.—Removing Platforms and Other Facilities*), lessees are required to remove all seafloor obstructions from their leases within 1 year of lease termination or relinquishment. These regulations require lessees to sever bottom-founded structures and their related components at least 5 m (15 ft) below the mudline to ensure that nothing would be exposed that could interfere with future lessees and other activities in the area. The structures are generally grouped into two main categories depending upon their relationship either to the platform/facility (piles, jackets, caissons, templates, mooring devises, etc.) or to the well (wellheads, casings, casing stubs, etc.). Decommissioning and removal operations, including a WPA proposed action and OCS Program scenarios, are described in detail in Chapter 3.1.1.10 of the 2012-2017 WPA/CPA Multisale EIS.

3.1.2. Coastal Impact-Producing Factors and Scenario

3.1.2.1. Coastal Infrastructure

A full description of coastal impact-producing factors and scenario is presented in the 2012-2017 WPA/CPA Multisale EIS. No new significant information was discovered that would alter impact conclusions based upon these operations. The following is a summary. For more details, refer to Chapter 3.1.2 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, which describes coastal impact-producing factors. These coastal impact-producing factors could potentially affect the biological, physical, and socioeconomic resources of the GOM. Chapter 3.1.2.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS provides a summary as well as detailed updated information on OCS oil- and gas-related coastal infrastructure types, which include the following, but are not limited to:

- service bases;
- helicopter hubs;
- construction facilities;
- processing facilities;
- terminals;
- coastal pipelines;

- coastal barging; and
- navigation channels (refer to the updated information on navigation channels in Table 3-7 of the WPA 238/246/248 Supplemental EIS).

This OCS oil- and gas-related infrastructure has been developed over many decades, and it is an extensive and mature system that provides support for offshore activities. The expansive presence of this coastal infrastructure is the result of long-term industry offshore and onshore trends and is not subject to rapid fluctuations. The routine activities of built infrastructure associated with a WPA proposed action are regulated by Federal and State agencies through permitting processes, routine inspections, and a structured enforcement regime. Permit requirements largely mitigate any air and water quality impacts that can result from these activities. Because these impacts occur whether a WPA proposed action is implemented or not, a WPA proposed action would account for only a small percentage of these impacts. A detailed description of the baseline affected environment for land use and coastal infrastructure in the WPA can be found in **Chapter 4.1.1.20.1** of this Supplemental EIS, Chapter 4.1.1.20.1.1 of the 2012-2017 WPA/CPA Multisale EIS, and Chapter 4.1.1.20.1 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS.

BOEM projects no new coastal infrastructure with the exception of up to one new pipeline landfall and up to one new gas processing facility as a result of an individual proposed action. While offshore projects may add additional miles of pipeline to transport product, it is not likely that these projects would transport natural gas or crude oil directly onshore, but rather interconnect with existing systems. Generally, it is more cost effective for companies to tie into the existing offshore pipeline network. Pipeline safety regulations govern the entire life of pipeline operations, including design, construction, inspection, recordkeeping, worker qualification, and emergency preparedness; and any new pipeline landfalls would be subject to regulatory requirements. In 2008, projections indicated that the U.S. would need to increase its imports of natural gas, and industry began constructing liquefied natural gas (LNG) containers along Gulf ports to accommodate the influx in imports. Onshore unconventional natural gas production increased to the point that existing Gulf Coast LNG facilities were seeking to export natural gas to foreign countries. In 2011, Cheniere Energy's Sabine Pass, Louisiana, facility received approval from the Department of Energy to export natural gas to any country in the world (Helman, 2013; U.S. Dept. of Energy, Federal Energy Regulatory Commission, 2013). Twelve additional project sponsors have applied to DOE for authorization to export domestically produced LNG to free trade agreement and non-free trade agreement countries (Dismukes, 2013a and 2013b; U.S. Dept. of Energy, Federal Energy Regulatory Commission, 2013). In 2014, New Orleans-based Harvey Gulf International Marine broke ground on a Port Fourchon based LNG terminal. The first of its kind in the United States, the LNG facility will provide LNG fuel to the growing supply of LNG-operated vessels servicing the OCS as well as over-the-road vehicles fueled by LNG (Workboat, 2014a).

Chapter 3.1.2.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS describes the activities and coastal impact factors of the following infrastructure types in the GOM. The GOM ports vary considerably by size, specialty, and defining characteristics. In general, however, there are two major types of port facilities: deep-draft seaports and inland river and intra-coastal waterways port facilities. A service base is a community of businesses that load, store, and supply equipment, supplies, and personnel that are needed at offshore work sites. Supply and service bases can range from large yards offering a range of services from full logistics management to smaller shops that supply one or many of the items needed on an offshore platform or marine vessel (Dismukes, 2011). While no proposed action is projected to significantly change existing OCS oil- and gas-related service bases or ports, or require any additional ports or service bases, a WPA proposed action would contribute to the use of these coastal infrastructure types. Round-trip service vessel trips as a result of a WPA proposed action are projected between 64,000 and 75,000 over the 40-year planning period (**Table 3-2**). For a more in depth discussion of service vessels, refer to **Chapter 3.1.1.8**. If activity levels increase, it is reasonable to assume that these facilities will expand to meet demand. Helicopter hubs or "heliports" are facilities where helicopters can land, load, and offload passengers and supplies, refuel, and be serviced. These hubs are used primarily as flight support bases to service the offshore oil and gas industry. Most of the helicopter operations originate at helicopter hubs in coastal Texas and Louisiana. There are 233 identified heliports within the analysis area that support OCS oil- and gas-related activities; that is, 118 in Texas and 115 in Louisiana (Dismukes, 2011). Helicopter operations for a WPA proposed action are projected between 290,000 and 605,000 round-trip operations over the 40-year planning period (**Table 3-2**). No new heliports are projected as a result of the OCS Program; however, if activity levels increase, they may expand at current locations.

The U.S. Energy Information Administration updates national energy projections annually, including refinery capacity. A crude oil refinery is a group of industrial facilities that turns crude oil and other inputs into finished petroleum products. A refinery's capacity refers to the maximum amount of crude oil designed to flow into the distillation unit of a refinery, also known as the crude unit. Most of the GOM region's refineries are located in Texas and Louisiana (Table 3-13 of the 2012-2017 WPA/CPA Multisale EIS). Texas has 27 operable refineries, with an operating capacity of over 5.1 MMbbl/day, which is over 28 percent of the total U.S. capacity. Louisiana follows closely behind Texas, with 19 operable refineries, with an operational capacity of over 3.27 MMbbl/day, which is 18 percent of the total U.S. capacity (USDOE, Energy Information Administration, 2013a). The estimated amounts of crude oil projected to be leased, discovered, developed, and produced as a result of a typical proposed WPA lease sale are between 0.116 and 0.200 BBO (Table 3-1 of the 2012-2017 WPA/CPA Multisale EIS), which would require only 0.09-0.16 percent of the current combined Texas and Louisiana refinery capacity over the 40-year planning period.

For all domestic refineries, distillation capacity is expected to stay at a steady rate of 17.5 MMbbl/day, and the capacity utilization rate is expected to hover between 88 and 90 percent over the Economic Impact Areas' 29-year analysis period, which projects to 2040 (USDOE, Energy Information Administration 2013b). For many years, financial, environmental, and legal considerations have prevented the construction of new refineries in the U.S., thereby forcing companies to expand and retrofit existing facilities. Domestic refinery expansions are largely being driven by unconventional sources of oil, primarily Canadian oil sands (Sreekumar, 2013). The Canadian heavy crude is cheaper to purchase but costlier to refine, and many refineries planning to take advantage of the newest discoveries are expanding their facilities to handle higher volumes of impurities associated with heavier crude oils (Rigzone, 2013). Again, the expansive presence of this coastal infrastructure is the result of long-term offshore and onshore industry trends.

3.1.2.2. Discharges and Wastes

Chapter 3.1.2.2 of the 2012-2017 WPA/CPA Multisale EIS describes in detail coastal discharges and wastes and Chapter 3.1.2.2 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS provide a summary and updates to coastal discharges and wastes, which include the following:

- disposal and storage for offshore operational wastes;
- onshore facility discharges;
- coastal service-vessel discharges;
- offshore wastes disposed onshore; and
- beach trash and debris.

The USEPA, through general permits issued by the USEPA Region with jurisdictional oversight, regulates all waste streams generated from offshore oil and gas activities. The USEPA Region 6 has jurisdiction over the CPA off the Louisiana coast and all of the WPA. The USEPA Region 4 has jurisdiction over the eastern portion of the GOM, including all of the EPA and part of the CPA off the coasts of Alabama and Mississippi. Each region has promulgated general permits for discharges that incorporate the 1993 effluent guidelines as a minimum. In some instances, a site-specific permit is required. The USEPA also regulates vessel discharges with the Vessel General Permit (VGP), which is a Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit that authorizes, on a nationwide basis, discharges incidental to the normal operation of nonmilitary and nonrecreational vessels greater than or equal to 79 ft (24 m) in length. On March 28, 2013, USEPA reissued the 2008 VGP for another 5 years; the reissued permit, the 2013 VGP, now contains numeric ballast water discharge limits for most vessels. The VGP also contains more stringent effluent limits for oil-to-sea interfaces and exhaust gas scrubber washwater (USEPA, 2013a). The VGP, geographically, covers inland waters out to

3 mi (5 km) and applies to vessels acting as a means of transportation. If the vessel is moored to a rig generating an amount of water that is greater than what it takes for the normal operation of a vessel, the VGP would not apply to brine production.

The BSEE policy regarding marine debris prevention is outlined in NTL 2012-JOINT-G01, "Marine Trash and Debris Awareness and Elimination." The NTL instructs OCS operators to post informational placards that outline the legal consequences and potential ecological harms of discharging marine debris. The NTL also states that OCS workers should complete annual marine debris prevention training and instructs operators to develop a certification process for the completion of this training by their workers. These various laws, regulations, and NTL will likely minimize the discharge of marine debris from OCS operations.

3.2. IMPACT-PRODUCING FACTORS AND SCENARIO—ACCIDENTAL EVENTS

3.2.1. Oil Spills

Oil spills are unplanned accidental events, and historical data provide the most relevant data for use in predicting future oil-spill frequency and volume in the GOM on a programmatic level. The following sections discuss spill prevention and spill response, and analyze the risk of spills that could occur as a result of activities associated with a WPA proposed action. Public input through public scoping meetings, Federal and State agencies' input through consultation and coordination, and industry and nongovernmental organizations input indicate that oil spills are perceived to be a major concern, especially in the wake of the *Deepwater Horizon* oil spill. The following discussion analyzes the risk of spills that could occur as a result of a typical WPA proposed action, as well as information on the number and sizes of spills from non-OCS oil- and gas-related sources. Although not reasonably expected as a result of a WPA proposed action, the potential occurrence of a catastrophic spill is exceedingly low, but it cannot be ruled out entirely; refer to **Appendix B** for the "Catastrophic Spill Event Analysis."

3.2.1.1. Spill Prevention

Over the years, BOEM has established comprehensive pollution-prevention requirements that include redundant safety systems, as well as inspection and testing requirements to confirm that these devices are working properly (**Chapter 1.5**). Until the *Deepwater Horizon* oil spill, an overall reduction in spill volume had occurred during the previous 40 years, while oil production had generally increased. A characterization of spill rates, average and median volumes from 1995 to 2009 compared with 1996 to 2010, which includes the *Deepwater Horizon* oil spill, is provided in *Update of Occurrence Rates for Offshore Oil Spills* (Anderson et al., 2012). BOEM attributes this improvement to its operational requirements, ongoing efforts by the oil and gas industry to enhance safety and pollution prevention, and the evolution and improvement of offshore technology.

3.2.1.2. Past OCS Spills

The BSEE spill-event database includes records of past spills from activities that are regulated by BSEE. These data include oil spills >1 bbl that occurred in Federal waters from OCS facilities and pipeline operations. Spills from facilities include spills from drilling rigs, drillships, and storage, processing, or production platforms that occurred during OCS drilling, development, and production operations. Spills from pipeline operations are those that have occurred on the OCS and are directly attributable to the transportation of OCS oil. Anderson et al. (2012) was utilized in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS to characterize spill rates and to provide analysis for average and median volumes. The Anderson et al. (2012) analysis examined spill data for the period 1964 to 2010, including the *Deepwater Horizon* oil spill.

A search of BSEE's oil-spill database (USDOI, BSEE, 2013) was performed to assess new spill information during the 2011-2013 period and to provide an update to the Anderson et al. (2012) analysis. During the period 2011 to 2013, there were 46 spills from OCS oil- and gas-related activities of <1,000 bbl in size. The breakdown of the 46 spills <1,000 bbl that occurred from 2011 to 2013 from OCS oil- and gas-related activities into size classes is as follows: 28 spills of 1-4 bbl; 6 spills of 5-9 bbl; 10 spills of 10-49 bbl; 1 spill of 50-99 bbl; 1 spill of 100-999 bbl; and 0 spills of ≥1,000 bbl. The combined total of oil spilled in these 46 events was 857 bbl. The BSEE database (USDOI, BSEE, 2013) indicated that there were two spills (one in 2011 and one in 2012) that were between 50 and 500 bbl in size, both of which occurred in the CPA. The spill in 2011 equaled 67 bbl and was the result of equipment failure from a platform leak located in Garden Banks Block 72. The spill in 2012 was estimated at 480 bbl and resulted from an explosion on a platform located in West Delta Block 32. There have been zero spills >50 bbl since the 480 bbl spill in 2012. In summary, two spills >50 bbl occurred during the period 2011 to 2013. This is an outcome that is well within the range of spills estimated to occur in Table 3-12 of the 2012-2017 WPA/CPA Multisale EIS, which serves as an estimate of the number and size of spills likely to occur as a result of a WPA proposed action over a 40-year time period. Thus, the additional information provided by the review of BSEE's oil-spill database (USDOI, BSEE 2013) did not change the validity of the scenario previously presented.

The majority of the 2011-2013 spills are attributed to OCS platforms/rigs, followed by vessels, and lastly by OCS pipelines. These data were compared with the estimated number and sizes of spills presented in Table 3-12 of the 2012-2017 WPA/CPA Multisale EIS (derived in part from Anderson et al., 2012), and it was found that the new spill data were well within the spill numbers estimated in the 2012-2017 WPA/CPA Multisale EIS. The new data also concurred with the previous finding that the most likely source of a spill would be from platforms, rigs, or vessels. Thus, a review of recent information does not change the risk analyses for spills <1,000 bbl previously provided in the 2012-2017 WPA/CPA Multisale EIS and WPA 233/CPA 231 Supplemental EIS. As estimated in Table 3-12 of the 2012-2017 WPA/CPA Multisale EIS, no spills have occurred in the ≥1,000-bbl size class since the *Deepwater Horizon* oil spill in 2010.

3.2.1.3. Characteristics of OCS Oil

The physical and chemical properties of oil greatly affect its transport and its ultimate fate in the environment and determine the following: how oil will behave on the water surface (surface spills) or in the water column and sediments (subsea spills); the persistence of the slick on the water; the type and speed of weathering processes; the degree and mechanisms of toxicity; the effectiveness of containment and recovery equipment; and the ultimate fate of the spill residues. Crude oils are a natural mixture of hundreds of different compounds, with liquid hydrocarbons accounting for up to 98 percent of the total composition. The chemical composition of crude oil can vary significantly from different producing areas; thus, the exact composition of oil being produced in OCS waters varies throughout the Gulf. The American Petroleum Institute gravity (API gravity) is a measure of the relative density of oil compared with water and is expressed in degrees (°). Oils with an API gravity <10 are heavier and typically sink, whereas oils with an API gravity >10 are lighter and typically float. Following an oil spill, the composition of the released oil can change substantially due to weathering processes such as evaporation, emulsification, dissolution, and oxidation. More details on the properties and persistence of different types of oils are provided in Table 3-7 of the WPA 233/CPA 231 Supplemental EIS.

Extensive laboratory testing has been performed on various oils from the GOM to determine their physical and chemical characteristics. For example, numerous oils collected from the GOM (U.S. waters) are included in Environment Canada's (2013) oil properties database. The database provides details of an oils chemical composition including hydrocarbon groups (i.e., saturates, aromatics, resins, asphaltenes), VOCs (such as benzene, toluene, ethylbenzene, and xylene), sulfur content, biomarkers, and metals. The database also includes API gravities, of which GOM oils are in the range of 15° to 60°. Since the *Deepwater Horizon* oil spill, new data have been collected from the approximately 450 deepwater exploration plans and development operations and coordination documents that were submitted to BOEM/BSEE. These data are available through BOEM's Exploration and Development Plans Online Query (refer to USDOI, BOEM, 2013c). Statistics on these API gravities result in a similar range (16° to 58°) as previously reported, with a mean value of 36°. These new data corroborate the information previously presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

3.2.1.4. Overview of Spill Risk Analysis

There are many factors that BOEM evaluates to determine the risk of impact occurring from an oil spill, including likely spill sources, likely spill locations, likely spill sizes, the likelihood and frequency of occurrence for different size spills, timeframes for the persistence of spilled oil, volumes of oil removed due to weathering and cleanup, and the likelihood of transport by wind and waves resulting in contact to specified environmental features. Sensitivity of the environmental resources and potential effects are addressed in the analyses for the specific resources of concern (**Chapter 4.1.1**). BOEM uses data on past OCS production and spills, along with estimates of future production, to evaluate the risk of future spills. Additionally, BOEM uses a numerical model to calculate the likely trajectory of spills (i.e., transport pathways) and analyzes historical data of occurrence rates for oil spills (refer to Anderson et al., 2012) to make projections of future oil-spill frequency and size. A more detailed description of the spill risk analysis and the trajectory model, called OSRA (oil-spill risk analysis) model, were provided in Chapter 3 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, as well as in the Ji et al. (2012) OSRA report. **Appendix C** of this Supplemental EIS also contains the OSRA model's catastrophic spill event results to estimate the risks associated with a possible future catastrophic or high-volume, long-duration oil spill.

The OSRA model results and estimated spill size/frequency tables as presented and discussed in the 2012-2017 WPA/CPA Multisale EIS remain applicable because the basic assumptions inherent in the model and calculations are still valid. The latest analysis available for the characterization of spill rates and for average and median volumes (Anderson et al., 2012) inputted into the model is still valid because the more recent small OCS spills (2011-2013) were within spill scenario estimates developed using the past data. In addition, the physical forcing (e.g., ocean currents and wind fields) and environmental resources input (e.g., locations and seasonality of various biological resources) to the OSRA model are still representative of our current state of knowledge regarding both ocean modeling and potential environmental resources at risk. Numerous efforts are underway since the *Deepwater Horizon* oil spill to further improve trajectory modeling in the Gulf of Mexico, including several BOEM environmental studies (e.g., refer to Section 4.2 in Ji et al., 2013). The results of these new research activities are not yet available or fully tested for incorporation into BOEM's oil-spill risk analysis for this Supplemental EIS. However, the OSRA analysts have chosen to take a more environmentally conservative approach by presuming persistence of oil over the selected time duration of the trajectories. As such, the trajectories simulated by the OSRA model do not involve any direct consideration of cleanup, dispersion, or weathering processes that could alter the quantity or properties of oil that might eventually contact the environmental resource locations. So in lieu of missing information and with the understanding that the OSRA model is overly conservative, BOEM can conclude that the unavailable information is not essential to an analysis of, or reasoned choice among, alternatives. Thus, new information did not change the results of previous spill risk analyses provided in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

The following discussions provide separate risk information for offshore and coastal spills that may result from a WPA proposed action. This analysis is divided into discussions of offshore spills ≥1,000 bbl, offshore spills <1,000 bbl, and coastal spills of any spill volume. Only spills ≥1,000 bbl are addressed using OSRA because smaller spills typically do not persist long enough to be simulated by trajectory modeling.

3.2.1.5. Risk Analysis for Offshore Spills ≥1,000 bbl

Chapter 3.2.1.5 of the 2012-2017 WPA/CPA Multisale EIS addressed the risk of spills ≥1,000 bbl that could occur from accidents associated with activities resulting from a WPA proposed action. The risk analyses included the following:

- estimated number of offshore spills ≥1,000 bbl and probability of occurrence;
- most likely source of offshore spills ≥1,000 bbl;
- most likely size of an offshore spill ≥1,000 bbl;
- fate of offshore spills ≥1,000 bbl;
- transport of spills ≥1,000 bbl by winds and currents;

- length of coastline affected by offshore spills ≥1,000 bbl; and
- likelihood of an offshore spill ≥1,000 bbl occurring and contacting modeled locations of environmental resources.

Specifically, the 2012-2017 WPA/CPA Multisale EIS estimated for a WPA proposed action that the mean number of spills was estimated at <1 spill (mean equal to 0.1-0.2) total from both OCS oil- and gas-related platforms and pipelines. Based on historical data, the most likely source of an offshore spill was determined to be a potential pipeline break at the seafloor.

The analysis presented in Anderson et al. (2012) remains applicable and up to date for characterizing spill rates and average and median spill volumes in this Supplemental EIS considering that no spills ≥1,000 bbl in size have occurred during 2011-2013. In terms of weathering, fate, and transport of oil spills in the Gulf of Mexico, a variety of ongoing studies are providing more insights in the aftermath of the *Deepwater Horizon* oil spill. For example, recent studies have provided further evidence that the diverse microbial communities in both the water column (e.g., Mason et al., 2012) and sediments (Kimes et al., 2013) of the GOM can play an active role in metabolizing and bioremediating crude oil from offshore spills. Further research is also being conducted regarding what impact chemical dispersant application may have on this biodegradation process. Other research on oil fates also suggests that marine snow formation in the aftermath of a large oil-spill event (such as the *Deepwater Horizon* oil spill) may play a key role in the fate of surface oil (e.g., Passow et al., 2012). Many of the recent findings related to the quantitative modeling of fate and transport of large oil spills in the Gulf of Mexico are part of the ongoing Natural Resource Damage Assessment (NRDA) process and have not yet been publicly released. However, the OSRA analysts have chosen to take a more environmentally conservative approach by presuming persistence of oil over the selected time duration of the trajectories. As such, the trajectories simulated by the OSRA model do not involve any direct consideration of cleanup, dispersion, or weathering processes that could alter the quantity or properties of oil that might eventually contact the environmental resource locations. So in lieu of missing information and with the understanding that the OSRA model is overly conservative, BOEM can conclude that the unavailable information is not essential to an analysis of, or reasoned choice among, alternatives. Thus, a review of recent information does not change the quantitative risk analyses for spills ≥1,000 bbl previously provided the 2012-2017 WPA/CPA Multisale EIS and WPA 233/CPA 231 Supplemental EIS.

3.2.1.6. Risk Analysis for Offshore Spills <1,000 bbl

Chapter 3.2.1.6 of the 2012-2017 WPA/CPA Multisale EIS addressed the risk of spills <1,000 bbl resulting from a WPA proposed action. Analysis of historical data shows that most offshore OCS oil spills fall within this category, with the majority of spills falling within the significantly smaller range of ≤1 bbl (Anderson et al., 2012). Although spills of ≤1 bbl amount to 96 percent of all OCS oil- and gas-related spill occurrences, they have contributed very little to the total volume of oil spilled. The risk analyses addressed in Chapter 3.2.1.6 of the 2012-2017 WPA/CPA Multisale EIS included the following:

- estimated number of offshore spills <1,000 bbl and total volume of oil spilled;
- most likely source and type of offshore spills <1,000 bbl;
- most likely size of offshore spills <1,000 bbl;
- persistence, spreading, and weathering of offshore oil spills <1,000 bbl;
- transport of spills <1,000 bbl by winds and currents; and
- likelihood of an offshore spill <1,000 bbl occurring and contacting modeled locations of environmental resources.

A search of BSEE's oil-spill database (USDOI, BSEE, 2013a) was performed to assess new spill information during 2011-2013, a period that was not analyzed in Anderson et al. (2012). During 2011-2013, there were 46 spills from OCS oil- and gas-related activities of <1,000 bbl in size, totaling 857 bbl overall. The breakdown of these spills into size classes is provided in **Chapter 3.2.1.2**. As noted above, the 2011-2013 spill data were compared with the estimated number and sizes of spills presented in Table 3-12 of the 2012-2017 WPA/CPA Multisale EIS and were found to be well within the spill numbers estimated in the 2012-2017 WPA/CPA Multisale EIS. The new data also supported previous findings that the most likely source of a spill of <1,000 bbl would be from platforms, rigs, or vessels. Thus, a review of recent information does not change the risk analyses for spills <1,000 bbl previously provided in Chapter 3.2.1.6 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

3.2.1.7. Risk Analysis for Coastal Spills

Spills in coastal waters could occur at storage or processing facilities supporting the OCS oil and gas industry or from the transportation of OCS-produced oil through State offshore waters and along navigation channels, rivers, and through coastal bays. BOEM projects that almost all (>99%) oil produced as a result of a WPA proposed action will be brought ashore via pipelines to oil pipeline shore bases, stored at these facilities, and eventually transferred via pipeline or barge to Gulf coastal refineries. Because oil is commingled at shore bases and cannot be directly attributed to a particular lease sale, this analysis of coastal spills addresses spills that could occur prior to the oil arriving at the initial shoreline facility. It is also possible that non-OCS oil may be commingled with OCS oil at these facilities or during subsequent secondary transport. Chapter 3.2.1.7 of the 2012-2017 WPA/CPA Multisale EIS describes in detail the estimated number and most likely sizes of coastal spills and the likelihood of coastal spill contact.

The number and most likely spill sizes to occur in coastal waters in the future are expected to resemble the patterns that have occurred in the past, as long as the level of hydrocarbon use by commercial and recreational activities remains the same. As discussed in Chapter 3.2.1.7 of the WPA 238/246/248 Supplemental EIS, estimates of future coastal spills are based on the number and location of historical coastal spills reported to USCG. Based on the USCG's historical data for the GOM region, Louisiana and Texas are the states with the highest probability of having a spill ≥1,000 bbl occur in coastal waters.

3.2.1.8. Risk Analysis by Resource

BOEM previously analyzed the risk to resources from oil spills and oil slicks that could occur as a result of a WPA proposed action in the 2012-2017 WPA/CPA Multisale EIS. The risk results were based on BOEM's estimates of likely spill locations, sources, sizes, frequency of occurrence, physical fates of different types of oil slicks, and probable transport that were described in more detail in specific spill scenarios. For offshore spills ≥1,000 bbl, combined probabilities were calculated using the OSRA model, which includes both the likelihood of a spill from a WPA proposed action occurring and the likelihood of the oil slick reaching areas where known environmental resources exist. The analysis of the likelihood of direct exposure and interaction of a resource with an oil slick and the sensitivity of a resource to the oil is provided under each resource category in **Chapter 4.1.1** of this Supplemental EIS and was provided in Chapter 4.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, WPA 238/246/248 Supplemental EIS, and in Chapter 3.2.1.8 and Figures 3-8 through 3-28 of the 2012-2017 WPA/CPA Multisale EIS.

3.2.1.9. Spill Response

For a WPA proposed action, Chapter 3.2.1.9 of the 2012-2017 WPA/CPA Multisale EIS describes in detail issues related to offshore spill-response requirements and initiatives; offshore response, containment, and cleanup technology; and onshore response and cleanup. Additional information and updates to the 2012-2017 WPA/CPA Multisale EIS have been included within respective sections of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS.

As a result of the Oil Pollution Act of 1990 and the reorganization of the Bureau of Ocean Energy Management, Regulation and Enforcement into BOEM and BSEE, BSEE was tasked with a number of oil-spill response duties and planning requirements. The following requirements are implemented according to BSEE's regulations at 30 CFR parts 250 and 254:

- requires immediate notification for spills >1 bbl—all spills require notification to USCG, and BSEE receives notification from the USCG of all spills ≥1 bbl;
- conducts investigations to determine the cause of a spill;
- assesses civil and criminal penalties, if needed;
- oversees spill source control and abatement operations by industry;
- sets requirements and reviews and approves oil spill response plans (OSRPs) for offshore facilities;
- conducts unannounced drills to ensure compliance with OSRPs;
- requires operators to ensure that their spill-response operating and management teams receive appropriate spill-response training;
- conducts inspections of oil-spill response equipment;
- requires industry to show financial responsibility to respond to possible spills; and
- provides research leadership to improve the capabilities for detecting and responding to an oil spill in the marine environment.

BOEM also has regulatory requirements addressing site-specific OSRPs and spill response information. As required by BOEM at 550.219 and 550.250, operators are required to provide BOEM an OSRP that is prepared in accordance with 30 CFR part 254 subpart B with their proposed exploration, development, or production plan for the facilities that they will use to conduct their activities; or to alternatively reference their approved regional OSRP by providing the following information:

- a discussion of the approved OSRP;
- the location of the primary oil-spill equipment base and staging area;
- the name of the oil-spill equipment removal organization(s) for both equipment and personnel;
- the calculated volume of the worst-case discharge scenario in accordance with 30 CFR § 254.26(a) and a comparison of the worst-case discharge scenario in the approved regional OSRP with the worst-case discharge calculated for these proposed activities; and
- a description of the worst-case discharge to include the trajectory information, potentially impacted resources, and a detailed discussion of the spill response proposed to the worst-case discharge in accordance with 30 CFR §§ 254(b)-(d).

All OSRPs are reviewed and approved by BSEE, whether submitted with a BOEM-associated plan or directly to BSEE in accordance with 30 CFR part 254. Hence, BOEM relies heavily upon BSEE's expertise to ensure that the OSRP complies with all pertinent laws and regulations, and demonstrates the ability of an operator to respond to a worst-case discharge. Site-specific OSRPs are required to be submitted to BOEM with a proposed exploration, development, or production plan, and BOEM's regulations require that an operator must have an approved OSRP prior to BOEM's approval of an operator-submitted exploration, development, or production plan.

The NTLs and guidance documents that clarify additional oil-spill requirements since the *Deepwater Horizon* explosion, oil spill, and response occurred have been issued. The spill-response-related NTLs issued prior to 2012 and the guidance documents issued by BOEM and BSEE are described in detail in Chapter 3.2.1.9 of the 2012-2017 WPA/CPA Multisale EIS, the WPA 233/CPA 231 Supplemental EIS, and the WPA 238/246/248 Supplemental EIS.

The NTL 2012-BSEE-N06, "Guidance to Owners and Offshore Facilities Seaward of the Coast Line Concerning Regional Oil Spill Response Plans," which was effective on August 10, 2012, provides clarification, guidance, and information concerning the preparation and submittal of a regional OSRP for owners and operators of oil handling, storage, or transportation facilities, including pipelines located seaward of the coastline. A regional OSRP is defined as a spill response plan covering multiple facilities or leases of an owner, or operator, or their affiliates, which are located in the same BSEE region. Site-specific OSRPs submitted with BOEM exploration, development, or production plans can either be prepared using the 30 CFR part 254 regulations or the guidance outlined in NTL 2012-BSEE-N06.

Some of the clarifications and encouraged practices identified in NTL 2012-BSEE-N06 are based upon lessons learned from the *Deepwater Horizon* oil-spill response. This NTL indicates that BSEE's review of OSRPs will also be based, in part, upon information obtained during the *Deepwater Horizon* oil-spill response. For example, during the *Deepwater Horizon* oil-spill response, it was discovered that the total estimated de-rated recovery capacity for all equipment listed in the OSRP overestimated the amount of oil that could be removed from the water. The NTL 2012-BSEE-N06 therefore states that the OSRP should be developed considering (1) a fully developed response strategy that includes the identification of the available dedicated recovery equipment as well as the actual operating characteristics of the systems associated with each skimmer and (2) the use of new technology and response systems that will increase the effectiveness of mechanical recovery tactics.

The NTL is designed to encourage owners and operators of offshore facilities to include innovative offshore oil-spill response techniques, particularly for a continuous high-rate spill. The NTL 2012-BSEE-N06 includes requirements for the submittal of information regarding subsea containment equipment and subsea dispersant application among other provisions. This NTL also encourages the inclusion of options that will improve spill-response capabilities, such as

- using remote-sensing techniques as a tool for safe night operations to increase oil-spill detection and to improve thickness determinations for ascertaining the effectiveness of response strategies;
- increasing spill-response operational time by reducing transit times to disposal locations and decontamination equipment;
- identifying sources for supplies and materials, such as fire boom and dispersants, that can support a response to an uncontrolled spill lasting longer than 30 days or for the duration of the spill response; and
- the use and specification of primary and secondary communications technology and software for coordinating and directing spill-response operations systems and/or providing a common operating picture to all spill management and response personnel, including the Federal On-Scene Coordinator and participating Federal and State government officials.

The BSEE has also issued NTL 2013-BSEE-N02, "Significant Change to Oil Spill Response Plan Worst Case Discharge Scenario" to clarify what BSEE considers a significant change in a worst-case discharge scenario, which requires that a revision to an OSRP be submitted. The guidance issued by this NTL states that a significant change in worst-case discharge may occur when calculating a new worst-case discharge based upon the following:

- the addition of a new facility installation or well;
- a modification to an existing facility; or
- a change in any assumptions and calculations used to determine the prior estimated worst-case discharge.

The NTL 2013-BSEE-N02 identifies the process an owner or operator of a facility should utilize to determine whether the newly calculated worst-case discharge represents a significant change. The BSEE considers a change in worst-case discharge as significant and thus requiring revision when the process identifies the need for additional onshore or offshore response equipment beyond what is included in an approved OSRP. Although information to make this determination is submitted to BOEM and forwarded to BSEE with a proposed exploration, development, or production plan, pursuant to NTL 2013-

BSEE-N02, the 15-day timeframe for notification of a significant change will be enforced by BSEE as beginning no later than the date that the operator submitted an Application for Permit to Drill to BSEE.

Typically, for OSRP revisions, once BSEE approves an OSRP, it must be reviewed at least every 2 years, and modifications must be submitted in accordance with 30 CFR § 254.30(a). If no modifications are deemed necessary, the owner or operator must inform BSEE in writing that there are no changes. A separate revision to an OSRP must be submitted to BSEE within 15 days when the following conditions are met:

- there is a change that significantly reduces operator response capabilities;
- a significant change occurs in the worst-case discharge or in the type of oil being handled, stored, or transported at a facility;
- there is a change in the names or capabilities of the oil-spill removal organizations cited in the plan; or
- there is significant change to the area contingency plan.

The BSEE also issued NTL 2012-BSEE-N07, "Oil Discharge Written Follow-up Reports," to address the oil discharge reports (30 CFR § 254.46(b)(2)) that are required to be submitted by a responsible party to BSEE for spills >1 bbl within 15 days after a spill has been stopped or ceased. The responsible party is encouraged to report cause, location, volume, remedial action taken, sea state, meteorological conditions, and the size and appearance of the slick.

Mechanical Cleanup

As previously indicated, BSEE oversees a research program to improve the capabilities for detecting and responding to an oil spill in the marine environment. One of BSEE's recently completed research projects suggested an alternative to improve the present regulatory requirements at 30 CFR § 254.44 for determining the effective daily recovery capacity of spill-response skimming equipment. This suggested alternative would consider the encounter rate of a skimming system with spilled oil instead of the presently used de-rated pump capacity of a skimmer. This project was undertaken because the *Deepwater Horizon* oil-spill response highlighted that the existing regulation may not be an effective or accurate planning standard and predictor of oil-spill response equipment recovery capacity. The project was completed in 2012 and the National Academy of Sciences completed a peer review in 2013. The BSEE is currently determining if any significant revisions to the report or to BSEE's oil-spill program are appropriate based upon the National Academy of Sciences' review (USDOI, BSEE, 2014a). The USCG has indicated that the guidance generated by this research is applicable for offshore use but that a separate standard would still need to be developed for nearshore response capability determinations.

There have been some changes to the spill-response equipment staging locations previously reported in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Due to these changes, it is expected that the oil-spill response equipment needed to respond to an offshore spill in a proposed lease sale area could be called out from one or more of the following oil-spill equipment base locations: New Iberia, Belle Chasse, Baton Rouge, Sulphur, Morgan City, Port Fourchon, Harvey, Leeville, Fort Jackson, Venice, Grand Isle, or Lake Charles, Louisiana; La Porte, Corpus Christi, Port Arthur, Aransas Pass, Ingleside, Galveston, or Houston, Texas; Pascagoula or Kiln, Mississippi; Mobile or Bayou La Batre, Alabama; and/or Panama City, Pensacola, Tampa, and/or Miami, Florida (Clean Gulf Associates, 2014; Marine Spill Response Corporation, 2014; National Response Corporation, 2014).

Dispersants

The USEPA updated the National Contingency Plan (NCP) product schedule in 2014. The 2014 NCP Product Schedule lists the following types of products that are authorized for use on oil discharges:

- dispersants;
- surface washing agents;

- surface collecting agents;
- bioremediation agents; and
- miscellaneous oil-spill control agents.

In February 2014, the USEPA published an NCP Product Schedule Notebook that presents manufacturers' summary information that describes (1) the conditions under which each of the products is recommended for use, (2) handling and worker precautions, (3) storage information, (4) recommended application procedures, (5) physical properties, (6) toxicity information, and (7) effectiveness information (USEPA, 2014).

Due to the unprecedented volume of dispersants applied for an extended period of time in situations not previously envisioned or incorporated in existing dispersant use plans during the *Deepwater Horizon* oil-spill response, the National Response Team (NRT) has developed guidance for monitoring atypical dispersant operations. The guidance document, which was approved on May 30, 2013, is titled *Environmental Monitoring for Atypical Dispersant Operations: Including Guidance for Subsea Application and Prolonged Surface Application*. The subsea guidance generally applies to the subsurface ocean environment and focuses on operations in waters below 300 m (984 ft) and below the pycnocline. The surface application guidance supplements and complements the existing protocols as outlined within the existing Special Monitoring of Applied Response Technologies (SMART) monitoring program where the duration of the application of dispersants on discharged oil extends beyond 96 hours from the time of the first application (U.S. National Response Team, 2013). This guidance is provided to the Regional Response Teams by the NRT to enhance existing SMART protocols and to ensure that their planning and response activities will be consistent with national policy.

Shoreline Cleanup Countermeasures

In addition, the USCG has worked diligently to improve coastal oil-spill response since the *Deepwater Horizon* oil spill by replacing the One Gulf Plan with separate Area Contingency Plans (ACPs) for each coastal USCG sector. The ACPs cover subregional geographic areas and represent the third tier of the National Response Planning System mandated by the Oil Pollution Act of 1990. The ACPs are a focal point of response planning. The Gulf of Mexico OCS Region's ACPs also include separate Geographic Response Plans, which are developed jointly with local, State, and other Federal entities to better focus spill-response tactics and priorities. These Geographic Response Plans contain the resources initially identified for protection during a spill, response priorities, procedures, and appropriate spill-response countermeasures.

3.2.2. Losses of Well Control

All losses of well control must be reported to BSEE. The BSEE clarified its procedure for loss of well control incident reporting in NTL 2010-N05, "Increased Safety Measures for Energy Development on the OCS," which became effective on June 8, 2010. The BSEE Drilling Safety Rule (*Federal Register*, 2012a) became effective on October 22, 2012. This rule implements certain additional safety measures recommended in NTL 2010-N05 by incorporating the recommendations contained in the DOI report *Increased Safety Measures for Energy Development on the Outer Continental Shelf* (Safety Measures Report; USDOI, 2010), and the *Deepwater Horizon* Joint Investigation Team report (USDOI, BOEMRE and USDHS, CG, Joint Investigation Team, 2013). The BSEE amended the drilling, well-completion, well-workover, and decommissioning regulations related to well control, including subsea and surface blowout preventers, well casing and cementing, secondary intervention, unplanned disconnects, recordkeeping, and well plugging. The Drilling Safety Rule also enhanced the description and classification of well-control barriers, defined testing requirements for cement, clarified requirements for the installation of dual mechanical barriers, and extended requirements for BOPs and well-control fluids to well-completions, workovers, and decommissioning operations. Operators are required to document any loss of well-control event, even if temporary, and the cause of the event, and they are required to furnish that information by mail or email to the addressee indicated in the NTL. The operator does not have to provide information on 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.

A loss of well control can occur during any phase of development, i.e., exploratory drilling, development drilling, well completion, production, or workover operations. A loss of well control can occur when improperly balanced well pressure results in sudden, uncontrolled releases of fluids from a wellhead or wellbore (PCCI Marine and Environmental Engineering, 1999; Neal Adams Firefighters, Inc., 1991). From 2007 to 2013, of the 41 loss of well-control events reported in the GOM, 22 (54%) resulted in loss of fluids at the surface or underground (USDOI, BSEE, 2014b). In addition to spills, the loss of well control can resuspend and disperse bottom sediments. Historically, since 1971, most OCS blowouts have resulted in the release of gas, while blowouts resulting in the release of oil have been rare.

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 may cut through or pinch shut casing and sever tool strings. The BOPs were invented in the early 1920's and have been instrumental in ending dangerous, costly, and environmentally damaging oil blowouts 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 1940's.

The BOPs are actuated as a last resort upon imminent threat to the integrity of the well or the surface rig. For a cased well, which is the typical well configuration, the hydraulic ram of a BOP may be closed if oil or gas from an underground zone enters the wellbore to destabilize the well. 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. Chapter 3.2.1.9.2 of the 2012-2017 WPA/CPA Multisale EIS provides information on subsea well containment that could be utilized if a loss of well control occurred and resulted in a loss of fluids.

3.2.3. Pipeline Failures

The potential mechanisms for damage to OCS pipeline infrastructure include mass sediment movements and mudslides that can exhume or push the pipelines into another location, impacts from anchor drops or boat collisions, and accidental excavation or breaching because the exact whereabouts of a pipeline is uncertain. Pipeline failures could also be by rig/platform and pipeline activities supporting a WPA proposed action. Chapter 3.2.3 of the 2012-2017 WPA/CPA Multisale EIS describes previous incidents of OCS oil- and gas-related pipeline failures.

Any one of the mechanisms listed above could cause an OCS oil- and gas-related oil spill ≥1,000 bbl. Any resulting spill size would be limited by the size of the pipeline and the ability of an operator to quickly shut off flow from the source. The median spill size estimated from a pipeline failure is 2,200 bbl (Table 3-12 of the 2012-2017 WPA/CPA Multisale EIS). For a WPA proposed action, up to one spill of this size is estimated to occur during the 40-year analysis period.

3.2.4. Vessel Collisions

The BSEE revised operator incident reporting requirements in a final rule effective July 17, 2006 (*Federal Register*, 2006). The incident reporting rule more clearly defines what incidents must be reported, broadens the scope to include incidents that have the potential to be serious, and requires the reporting of standard information for both oral and written reports. As part of the incident reporting rule, BSEE's regulations at 30 CFR § 250.188(a)(6) require an operator to report all collisions that result in property or equipment damage greater than $25,000. "Collision" is defined as the act of a moving vessel (including an aircraft) striking another vessel or striking a stationary vessel or object (e.g., a boat striking a drilling rig or platform). Chapter 3.2.4 of the 2012-2017 WPA/CPA Multisale EIS provides data related to vessel collisions and discusses methods of prevention and avoidance of vessel collisions. No new data have emerged that would cause BSEE to reevaluate its analysis for this Supplemental EIS.

3.2.5. Chemical and Drilling-Fluid Spills

Chapter 3.2.5 of the 2012-2017 WPA/CPA Multisale EIS describes OCS oil- and gas-related chemical and synthetic-based fluid spills. Below is a brief summary of that information.

Chemicals are stored and used to condition drill muds during production and in well completions, stimulation, and workover procedures. The most common chemicals spilled are methanol, ethylene glycol, and zinc bromide. Methanol and ethylene glycol may be used as a treatment to prevent the formation of gas hydrates while zinc bromide may be used in completion fluids. The chemicals that are used the most are also the chemicals that are spilled in the greatest volume. Completion fluids are used in the largest quantity and constitute the largest volume of accidental releases. Completion fluids consist of brines made from seawater mixed with calcium chloride, calcium bromide, and/or zinc bromide. A study of chemical spills from OCS oil- and gas-related activities determined that only two chemicals could potentially impact the marine environment—zinc bromide and ammonium chloride (Boehm et al., 2001). Both of these chemicals are used for well treatment or completion and, therefore, are not in continuous use. Most other chemicals are either nontoxic or used in small quantities. There are some differences in the operational needs for chemicals in deepwater versus shallow-water operations. Higher volumes of treatment chemicals (e.g., defoamers and hydrate inhibitors) are used in deepwater environments due to the conditions encountered there (Boehm et al., 2001).

Synthetic-based fluids (SBFs) or synthetic-based muds have been used since the mid-1990's. In deepwater drilling, SBFs are preferred over water-based muds because of the SBFs superior performance properties. The synthetic oils used in SBFs are relatively nontoxic to the marine environment and have the potential to biodegrade. However, it should be noted that SBFs are not permitted to be discharged into the marine environment; only cuttings wetted with SBF may be discharged after the majority of synthetic fluid has been removed. Additionally, accidental riser disconnects could result in the release of large quantities of drilling fluids and are of particular concern when SBFs are in use. For further discussion on this topic, refer to Chapter 3.1.1.4.1 of the 2012-2017 WPA/CPA Multisale EIS. Refer to Chapter 3.2.5 of the WPA 238/246/248 Supplemental EIS for the most recent information on BSEE's counts and summaries for spills ≥50 bbl.

3.3. CUMULATIVE ACTIVITIES SCENARIO

3.3.1. OCS Program

The OCS Program scenario includes all activities that are projected to occur from past, proposed, and future lease sales during the 40-year analysis period. Projected reserve/resource production for the OCS Program (**Table 3-1**; WPA, CPA, and EPA) is 18.34-25.64 BBO and 75.886-111.627 Tcf of gas. **Table 3-3** presents projections of the major activities and impact-producing factors related to future Gulf of Mexico OCS Program activities.

The level of OCS oil- and gas-related activity is connected to oil prices, resource potential, cost of development, and rig availability rather than just, or even primarily to, the amount of acreage leased. The cumulative impacts of activities associated with the OCS Program on biological, physical, and socioeconomic resources are analyzed in **Chapter 4.1.1** of this Supplemental EIS, Chapters 4.1.1 and 4.2.1 of the 2012-2017 WPA/CPA Multisale EIS and WPA 233/CPA 233 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS.

Note that offshore and onshore impact-producing factors and scenarios associated with a CPA or an EPA proposed action (i.e., a typical lease sale that would result from a proposed action within the CPA or EPA) as well as OCS Program activity resulting from past and future lease sales in the CPA or EPA, are disclosed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, CPA 235/241/247 Supplemental EIS, and EPA 225/226 EIS.

3.3.2. State Oil and Gas Activity

All five Gulf Coast States have had some historical oil and gas exploration activity and, with the exception of Florida and Mississippi, currently produce oil and gas in State waters. The coastal infrastructure that supports the OCS 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 facilities 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. Chapter 3.3.2 of the 2012-2017 WPA/CPA Multisale EIS provides a reference for relevant historical information on State leasing programs. The most recent lease sale information for Texas and Louisiana has been updated below.

Texas

The most recent State oil and gas lease sale occurred on July 1, 2014. Thirteen parcels containing more than 21,520 ac of State lands were offered for oil and gas leasing in the offshore area by Texas State University Lands (State of Texas, General Lands Office, 2014). BOEM expects that Texas will conduct regular oil and gas lease sales during the 40-year cumulative activities scenario for OCS oil- and gas-related activity, although the lease sale's regularity could differ from current practices.

Louisiana

The most recent State oil and gas lease sale occurred on April 12, 2014. Forty-four leases containing more than 29,698 ac were offered for oil and gas leasing by the Office of Mineral Resources on the behalf of the State Mineral Board for Louisiana. The April 12, 2014, State lease sale offered no leases in offshore areas. During the 2013-2014 Fiscal Year, 99 offshore leases containing more than 164,154 ac were offered; of these, only 28 leases were awarded. BOEM expects that Louisiana will conduct regular oil and gas lease sales during the 40-year cumulative activities scenario for OCS oil- and gas-related activity, although the lease sale's regularity could differ from current practices (State of Louisiana, Dept. of Natural Resources, 2014).

Mississippi

BOEM expects Mississippi to institute a State lease sale program in the near future and to begin leasing in State waters during the 40-year cumulative activities scenario for OCS oil- and gas-related activity analyzed in this Supplemental EIS. Recent efforts to open Mississippi State waters for seismic and leasing activities have been challenged in court (Davis, 2014).

Alabama

Alabama has no established schedule of State 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 40-year cumulative activities scenario for OCS oil- and gas-related activity following a CPA proposed action (Mobile Area Chamber of Commerce, 2011).

Florida

BOEM does not expect Florida to institute a State lease sale program in the near future, although it is possible that a change in policy could lead to leasing on the OCS or in State waters during the 40-year cumulative activities scenario for OCS oil- and gas-related activity analyzed in this Supplemental EIS. For more information, refer to Chapter 3.3.2 of the 2012-2017 WPA/CPA Multisale EIS.

Pipeline Infrastructure

A mature pipeline network exists in the GOM to transport oil and gas produced on the OCS to shore (**Chapter 4.1.1.20.1**). 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, Figure 4.1). 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. Any new larger-diameter pipelines would likely be constructed to support onshore and offshore LNG terminals. Refer to Chapter 3.3.2 of the 2012-2017 WPA/CPA Multisale EIS for information on pipeline infrastructure activities within the State waters of Texas, Louisiana, Mississippi, and Alabama.

3.3.3. Other Major Factors Influencing Offshore Environments

Other influencing factors occur concurrently with OCS oil- and gas-related activity in the offshore areas of the Gulf Coast States. These factors include (1) dredged material disposal, (2) OCS sand borrowing, (3) marine transportation, (4) military activities, (5) artificial reefs and rigs-to-reefs development, (6) offshore LNG projects, (7) development of gas hydrates, and (8) renewable energy and alternative use.

Cumulative impacts to biological, physical, and socioeconomic resources from these types of non-OCS oil- and gas-related activities are analyzed in **Chapter 4.1.1** of this Supplemental EIS, Chapters 4.1.1 and 4.2.1 of the 2012-2017 WPA/CPA Multisale EIS and WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS.

3.3.3.1. Dredged Material Disposal

BOEM anticipates that, over the next 40 years, the amount of dredged material disposed at ocean dredged-material disposal sites (ODMDSs) will fluctuate but that it will generally follow historical trends of the practice utilized to date by the Galveston and New Orleans Districts. Over the last 10 years, the Galveston District has averaged about 6.9 million yd^3 (5.3 million m^3) of material dredged per year disposed at ODMDSs, while the New Orleans District has averaged about 21.7 million yd^3 (16.6 million m^3) of material dredged per year disposed at ODMDSs. Quantities may decrease slightly as various entities identify additional onshore sites for the beneficial uses of dredged material. The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention), to which the U.S. is a signatory, requires annual reporting of the amount of materials disposed at sea. The U.S. Army Corps of Engineers (COE) prepares the dredged material disposed portion of the report to the International Maritime Organization; these yearly reports are available on the COE's Ocean Disposal Database (U.S. Dept. of the Army, COE, 2010). For a more complete and detailed discussion of maintenance dredging and Federal channels, refer to **Chapter 4.1.1.3** of this Supplemental EIS, Chapters 3.3.3.1 and 3.3.4.3 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS, and Chapter 3.3.4.4 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS.

3.3.3.2. OCS Sand Borrowing

If OCS sand is requested for coastal restoration or beach nourishment, BOEM uses the following two types of lease instruments: a noncompetitive negotiated agreement that can only be used for obtaining sand and gravel for public works projects funded in part or whole by a Federal, State, or local government agency, and a competitive lease in which any qualified person may submit a bid through a lease sale. BOEM has issued 43 noncompetitive negotiated agreements, but it has never held a competitive lease sale for OCS sand and gravel resources. BOEM's Marine Minerals Program continues to focus on identifying sand resources for coastal restoration, investigating the environmental implications of using those resources, and processing noncompetitive use requests.

BOEM is expected to issue one new agreement in Louisiana for the *Deepwater Horizon* NRDA Whiskey Island Restoration Project in Terrebonne Parish using sand from Ship Shoal Block 88. In March 2014, BOEM issued a noncompetitive agreement for Phase Two of the Caminada Headland Restoration Project in Lafourche and Jefferson Parishes using sand from South Pelto Blocks 13 and 14.

BOEM has outlined its responsibility as steward of significant sand resources on the OCS in NTL 2009-G04 ("Significant OCS Sediment Resources in the Gulf of Mexico"), which states the following: "If it is determined that significant OCS sediment resources may be impacted by a proposed activity, the MMS GOMR may require you to undertake measures deemed economically, environmentally, and technically feasible to protect the resources to the maximum extent practicable. Measures may include modification of operations and monitoring of pipeline locations after installation." This NTL also provides guidance for the avoidance and protection of significant OCS sediment resources essential to coastal restoration initiatives in BOEM's Gulf of Mexico OCS Region. Over the next 40 years, increased use of OCS sand for Louisiana restoration projects is likely. Currently, no Texas restoration projects have been specifically identified. For more information on OCS Sand Borrowing, refer to Chapter 3.3.3.2 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS.

3.3.3.3. Marine Transportation

Under current conditions, freight and cruise ship passenger marine transportation within the analyzed area should continue to grow at a modest rate or remain relatively unchanged based on historical freight and cruise traffic statistics. In 2011, the Port of Houston was the second largest port in the United States, while the Port of New Orleans was the sixth largest. Tankers carrying mostly petrochemicals account for about 60 percent of the vessel calls in the Gulf of Mexico. Dry-bulk vessels, including bulk vessels, bulk containerships, cement carriers, ore carriers, and wood-chip carriers, account for another 17 percent of the vessel calls. The GOM also supports a popular cruise industry. In 2011, there were 149 cruise ship departures from Galveston, 139 cruise ship departures from New Orleans, and 199 cruise ship departures from Tampa (USDOT, MARAD, 2012).

Total port calls, or vessel stops at a port, in the U.S. is increasing as a whole, and total port calls within the GOM is also increasing. Gulf of Mexico port calls represent approximately 32 percent of total U.S. port calls. Trends for GOM port calls relative to total U.S. port calls shows an approximate 3 percent average increase of GOM port calls over the last decade, from 17,673 to 22,989 (USDOT, MARAD, 2013a) (Table 3-10 in the WPA 238/246/248 Supplemental EIS).

Table 3-2 presents the estimated number of vessel trips that would occur as a result of a WPA proposed action. Annual OCS oil- and gas-related vessel traffic due to a WPA proposed action represents a small proportion (<1%) of the total vessel traffic in the GOM (**Chapter 3.1.1.8** of this Supplemental EIS, Chapter 3.1.1.8.4 of the 2012-2017 WPA/CPA Multisale EIS, and Chapter 3.1.1.8 of the WPA 238/246/248 Supplemental EIS). Annual OCS oil- and gas-related vessel traffic due to cumulative OCS oil- and gas-related activity represents between 9 and 12 percent of the total traffic in the GOM.

Cumulative Activities Scenario: It is expected that the usage of GOM ports will continue to increase by approximately 3 percent annually over the next 40 years. As such, it is anticipated that port calls by all ship types will be bounded annually by a lower limit of current use and an upper limit of approximately 85,000 vessel port calls.

3.3.3.4. Military Activities

Twelve military warning areas and six Eglin Water Test Areas are located within the GOM (**Figure 2-2**). The air space over the WPA is used by the U.S. Department of Defense for conducting various air-to-air and air-to-surface operations. The WPA includes all or parts of the following military warning areas: W-147, W-228, and W-602. These warning and water test areas are multiple-use areas where military operations and oil and gas development have coexisted without conflict for many years. Several military stipulations are planned for leases issued within identified military areas.

Naval Mine Warfare Command Operational Area D contains 17 blocks in the WPA and is used by the Navy for mine warfare testing and training. In addition to Naval Mine Warfare Command Operational Area D, the WPA has four warning areas that are used for military operations. The areas total approximately 21.3 million ac or 75 percent of the total acreage of the WPA.

Chapter 3.3.3.4 of the 2012-2017 WPA/CPA Multisale EIS describes military activities within the OCS.

Cumulative Activities Scenario: BOEM anticipates that, over the next 40 years, the military use areas currently designated in the WPA will remain the same and that none of them will be released for nonmilitary use. Over the cumulative activities scenario, BOEM expects to continue to require military coordination stipulations in these areas. The intensity of the military's use of these areas, or the type of activities conducted in them, is anticipated to fluctuate according to the operational needs of the military.

3.3.3.5. Artificial Reefs and Rigs-to-Reefs Development

A full description of artificial reefs and Rigs-to-Reefs operations is presented in the 2012-2017 WPA/CPA Multisale EIS. No new significant information was discovered that would alter impact conclusions based upon these operations. The following is a summary this information. For more details, refer to **Chapter 3.1.1.10** of this Supplemental EIS and Chapter 3.1.1.10 of the 2012-2017 WPA/CPA Multisale EIS.

Artificial reefs have been used along the coastline of the U.S. since the early 19th century. Stone (1974) documented that the use of obsolete materials to create artificial reefs has provided valuable habitat for numerous species of fish in areas devoid of natural hard bottom. Some studies have indicated artificial reefs in marine waters not only attract fish but, in some instances, may also enhance the production of fish (Stone et al., 1979; Carr and Hixon, 1997; Dance et al., 2011). All of the five Gulf Coast States—Texas, Louisiana, Mississippi, Alabama, and Florida—have artificial reef programs and plans.

Many OCS oil and gas platforms have the potential to serve as artificial reefs. Offshore oil and gas platforms have been contributing hard substrate to the GOM since the first platform was installed in 1942. Approximately 12 percent of the platforms decommissioned from the Gulf OCS have been used in the Rigs-to-Reefs Program. Scientific and public interest in the ecology of offshore structures and the potential benefits of contributing substantial quantities of hard substrate to a predominantly soft bottom environment may lead to increased emphasis on the creation of artificial reefs through the Rigs-to-Reefs Program. At present, Texas, Louisiana, and Mississippi participate in the Rigs-to-Reefs Program.

WPA Proposed Action Scenario (Typical Lease Sale): The number of platform removals projected for a WPA proposed action is 14-22 platforms (**Table 3-2** of this Supplemental EIS and Table 3-2 of the 2012-2017 WPA/CPA Multisale EIS). BOEM anticipates that approximately 1-2 of the WPA platforms removed or 10 percent of the projected 14-22 platform removals will enter the Rigs-to-Reefs Program as a result of a proposed action.

OCS Program Scenario: Over the course of the 40-year cumulative activities scenario for the OCS Program (2012-2051), BOEM projects that a total of 1,279-1,837 platforms will be removed (**Table 3-3**). If approximately 10 percent of these structures are accepted into the Rigs-to-Reefs Program, there may be as many as 128-184 additional artificial reefs installed in the WPA, CPA, and EPA.

3.3.3.6. Offshore Liquefied Natural Gas Projects and Deepwater Ports

There are currently no LNG terminals operating on the OCS in the GOM. The following provides updates to the status of LNG projects and deepwater ports in the GOM as provided in Chapter 3.3.3.6 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS.

Florida

Port Dolphin. On March 29, 2007, Port Dolphin Energy LLC filed an application with the Maritime Administration to construct a deepwater port located in Federal waters approximately 28 mi (45 km) offshore of Tampa, Florida. The applicant is a wholly owned subsidiary of Höegh LNG. The proposed port will consist of two submerged turret loading (STL) buoys similar to those used in the Northeast Gateway and Neptune projects. On October 26, 2009, the Maritime Administration issued a Record of Decision approving, with conditions, the Port Dolphin Energy Deepwater Port License application, and on April 19, 2010, the official license was issued. Port Dolphin is currently working with the relevant Federal and State of Florida agencies to obtain the required authorizations and permits for construction and operation of the facility. Due to market considerations and commercial potential of the project, Port Dolphin requested on October 17, 2014, that the Commission extend the deadline until December 31, 2018, for constructing and placing into operation the facilities authorized by the December 3, 2009, Federal Energy Regulatory Commission Certificate (Port Dolphin Energy, 2014).

3.3.3.7. Development of Gas Hydrates

Chapter 3.3.3.7 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS describes the development of gas hydrates in detail. BOEM still anticipates that, within 40 years, it is likely that the first U.S. domestic production from hydrates may occur in Alaska. Gas obtained from onshore hydrates in Alaska will either support local oil and gas field operations or be available for commercial sale if and when a gas pipeline is constructed to the lower 48 states. However, Moridis et al. (2008) stated that one should not discount the possibility that the first U.S. domestic production of gas hydrates could occur in the GOM. Despite the substantially increased complexity and cost of offshore operations, there is a mature network of available pipeline capacity and easier access to markets in the Gulf of Mexico.

3.3.3.8. Renewable Energy and Alternative Use

On August 8, 2005, President George W. Bush signed the Energy Policy Act of 2005 (EPAct) into law. Section 388 (a) of EPAct amended Section 8 of the OCSLA (43 U.S.C. § 1337) to authorize DOI to grant leases, easements, or rights-of-way on the OCS for the development and support of energy resources other than oil and gas and to allow for alternate uses of existing structures on OCS lands.

A final programmatic EIS for the OCS renewable energy program was published by this Agency in October 2007 (USDOI, MMS, 2007a) and a Record of Decision was published in the *Federal Register* on January 10, 2008 (*Federal Register*, 2008). The Act authorized this Agency to develop a comprehensive program and regulations to implement the new authority. Final rules for the BOEM renewable energy program were published on April 29, 2009, as 30 CFR part 285 (*Federal Register*, 2009).

The two primary categories of renewable energy that have the potential for development in the coastal and OCS waters of the U.S. are (1) wind turbines and (2) marine hydrokinetic systems. The first and most technologically mature renewable energy is wind energy, a popular source of clean and renewable energy that has been in use for centuries. The two primary categories of renewable energy that have the potential for development in the coastal and OCS waters of the U.S. are (1) wind turbines and (2) marine hydrokinetic systems. The first and most technologically mature renewable energy is wind energy, a popular source of clean and renewable energy that has been in use for centuries. The DOE released a strategic plan for creating an offshore wind industry in the U.S. (USDOE, 2011). In this plan, DOE determined that offshore wind energy can help the Nation reduce its greenhouse gas emissions, diversify its energy supply, provide cost-competitive electricity to key coastal regions, and stimulate economic revitalization of key sectors of the economy. However, if the Nation is to realize these benefits, key barriers to the development and deployment of offshore wind technology must be overcome, including the relatively high cost of energy, technical challenges surrounding installation and grid interconnection, and the permitting processes governing deployment in both Federal and State waters. There are two critical objectives to realize the strategic plan's goals: (1) reduce the cost of offshore wind energy; and (2) reduce the timeline for deploying offshore wind energy (USDOE, 2011, page 2). Since April 29, 2009, when the regulations governing renewable energy on the OCS were publicized, no wind park developments have been proposed in OCS waters of the GOM; however, there have been proposals in Texas coastal waters.

In Fiscal Year 2010, the U.S. Department of Energy instituted the Offshore Wind Innovation and Demonstration (OSWInD) initiative to consolidate and expand its efforts to promote and accelerate responsible commercial offshore wind development in the United States. In 2012, the U.S. Department of Energy's Wind Program announced Federal funding nationwide in three major categories: technology development; market acceleration; and advanced technology demonstration. The Wind Program is working with BOEM to advance a national strategy for offshore wind research and development (Navigant Consulting, Inc., 2013). According to the Navigant Consulting, Inc. report, there is a potential of 594 gigawatts of potential wind energy available in the GOM. Offshore wind could create approximately 20.7 direct jobs per annual megawatt (or 20,700 jobs per annual gigawatt) installed in U.S. waters. Baryonyx Rio Grande Wind Farms received $4 million to produce three demonstration turbines in State waters (refer to "Renewable Energy Projects in Texas State Waters" below).

The second category of potential offshore renewable energy technologies is marine hydrokinetic systems, which are in a more developmental stage relative to wind turbines. The marine hydrokinetic systems consist of devices capable of capturing energy from ocean waves and currents. There has been no interest expressed in wave or current technologies in the GOM because the conditions necessary for their deployment are not suitable to the Gulf. The marine hydrokinetic current technologies are actively being considered for the east coast of Florida where the Gulf Stream provides a strong and continuous source of energy to turn underwater turbines.

The EPAct clarifies the Secretary's authority to allow the existing oil and gas structures on OCS lands to remain in place after production activities have ceased and to transfer liability and extend the life of these facilities for non-oil and gas purposes, such as research, renewable energy production, aquaculture, etc., before being removed. With approximately 1,900 bottom-founded platform structures located in OCS waters, the GOM would seem to have some potential for the reuse of these facilities.

Cumulative Activities Scenario: BOEM expects that, over the next 40 years, a limited number of alternative use projects will be proposed in the WPA. It is also likely that these alternative use projects will consist of wind energy projects, based on the current development of that technology. BOEM's expectation is based on the fact that known projects are being proposed in Texas State waters. Likewise, the potential alternative use projects could consist of a combination of integrated existing GOM infrastructure with new-built facilities.

Renewable Energy Projects in Texas State Waters

Chapter 3.3.3.8 of the 2012-2017 WPA/CPA Multisale EIS provides a detailed description of Texas' renewable energy and alternative use programs. Below are updates to the status of the previously reported projects:

Project Name	Proposed Capacity (megawatts)	Number of Turbines	Status Notes	Target Completion Date
Galveston Offshore Wind (Coastal Point Energy)	150	55-75	Received lease from Texas General Land Office in 2007. Announced intention to install a 750-kilowatt test turbine.	2018
Baryonyx Rio Grande Wind Farms (North and South)	1,000	100-200	Received lease from Texas General Land Office in 2009. COE environmental studies are underway. Received DOE Wind Program grant to produce 3 demonstration turbines by 2017.	2019

Source: Navigant Consulting, Inc., 2013.

3.3.4. Other Major Factors Influencing Coastal Environments

The GOM is a dynamic, constantly changing system where natural and human-caused factors simultaneously impact both the coastal areas of the Gulf Coast States and OCS oil- and gas-related activities. These factors include (1) sea-level rise and subsidence, (2) Mississippi Delta hydromodification, (3) maintenance dredging and Federal channels, and (4) coastal restoration programs.

Cumulative impacts to biological, physical, and socioeconomic resources from these types of non-OCS oil- and gas-related activities are analyzed in **Chapter 4.1.1** of this Supplemental EIS, Chapters 4.1.1 and 4.2.1 of the 2012-2017 WPA/CPA Multisale EIS and WPA 233/CPA 231 Supplemental EIS, and Appendix D of WPA 238/246/248 Supplemental EIS.

3.3.4.1. Sea-Level Rise and Subsidence

Given the results from the National Assessment of Coastal Vulnerability to Sea-Level Rise, BOEM anticipates that, over the next 40 years, the northern GOM will likely experience a minimum relative sea-level rise of 55.2 millimeters (2.17 inches) and a maximum relative sea-level rise of 384 millimeters (15.1 inches) (Pendleton et al., 2010). Sea-level rise and subsidence together have the potential to affect many important areas, including the OCS oil and gas industry, oil and gas infrastructure, waterborne commerce, commercial fishery landings, and important habitat for biological resources (State of Louisiana, Coastal Protection and Restoration Authority, 2012). Chapter 3.3.4.1 of the 2012-2017

WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS describes sea-level rise and subsidence in detail. Programmatic aspects of climate change relative to the environmental baseline for the Gulf of Mexico OCS Program are discussed in Appendix G.3 of the 2012-2017 WPA/CPA Multisale EIS.

3.3.4.2. Mississippi River Hydromodification

BOEM anticipates that, over the next 40 years, there might be minor sediment additions resulting from new and continuing freshwater diversion projects managed by the COE. Chapter 3.3.4.2 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS describes Mississippi River hydromodification in detail.

3.3.4.3. Maintenance Dredging and Federal Channels

Along the Texas Gulf Coast there are eight federally maintained navigation channels in addition to the Gulf Intracoastal Waterway. 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. Ocean disposal locations along the Texas coast are situated so that materials are placed on the downdrift side of the channel (U.S. Dept. of the Army, COE, 1992). The construction of Federal channels is not a growth industry that would lead to future direct taking of wetlands, and at least one Louisiana channel (Mississippi River Gulf Outlet) has been decommissioned and sealed with a rock barrier as of July 2009 (Shaffer et al., 2009). For a more complete and detailed discussion of maintenance dredging and Federal channels, refer to **Chapters 4.1.1.3 and 3.3.4.4** of this Supplemental EIS, Chapter 4.1.1.3 and 3.3.4.4 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS, and Chapter 3.3.4.3 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS. For more information on coastal restoration programs, refer to **Chapter 3.3.4.4** of this Supplemental EIS and Chapter 3.3.4.4 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS.

3.3.4.4. Coastal Restoration Programs

Coastal restoration programs are taking place on both the State and Federal level. Current Federal efforts include the Coastal Wetlands Planning Protection and Restoration Act program; the Coastal Impact Assistance Program, which was formed in response to the Energy Policy Act of 2005; and the Gulf Coast Ecosystem Restoration Council, which was formed in response to the Resources and Ecosystems Sustainability, Tourist Opportunities and Revived Economies of the Gulf Coast States Act (RESTORE Act). For more information on coastal restoration programs, refer to Chapter 3.3.4.4 of the 2012-2017 WPA/CPA Multisale EIS and WPA 238/246/248 Supplemental EIS.

3.3.5. Natural Events and Processes

Chapter 3.3.5 of the 2012-2017 WPA/CPA Multisale EIS describes in detail natural events and processes in the Gulf of Mexico, including physical oceanography and hurricanes.

Since 2009, most of the extreme atmospheric events in GOM have been categorized as tropical storms with strong winds, heavy rain, and storm surges causing coastal flooding. However, on August 28, 2012, Hurricane Isaac made landfall in southeastern Louisiana as a Category 1 hurricane. While there were no reports of moderate or extensive damage to offshore oil or gas infrastructure in the GOM, Hurricane Isaac did result in the suspension of small amounts of tarballs and some oil from sediments (Mulabagal et al., 2013). This conforms with predictions in the 2012-2017 WPA/CPA Multisale EIS analysis and is discussed more fully in **Chapter 4.1.1.2.1** of this Supplemental EIS.

3.3.6. Non-OCS Oil- and Gas-Related Oil Spills

Oil spills related to non-OCS oil- and gas-related activities such as State oil and gas activity or vessel collisions (including tankering, barging, or State oil and gas vessels) can result in the contamination of offshore or coastal environments. The Oil Pollution Act of 1990 strengthens planning and prevention activities in waters by (1) providing for the establishment of spill contingency plans for all areas of the U.S., (2) mandating the development of response plans for individual tank vessels and certain facilities for responding to a worst-case discharge or a substantial threat of such a discharge, and (3) providing requirements for spill-removal equipment and periodic inspections. Oil spills associated with a WPA proposed action are discussed in **Chapter 3.2.1** of this Supplemental EIS and Chapter 3.2.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Refer to **Chapter 3.2.1.9** of this Supplemental EIS and Chapter 3.2.1.9 of the 2012-2017 WPA/CPA Multisale EIS for more information on the Oil Spill Pollution Act and other response requirements and initiatives regarding oil spills. Spills from tankers involve the spillage of crude oil, whereas barge spills involve spills of both crude oil and other petroleum products. Anderson et al. (2012) noted that tanker spill rates have continued to have a substantial decline since 2000. Most likely, tanker spills have declined due to major regulatory changes in the early 1990's that substantially eliminated the use of single-hull tankers by requiring double hulls or their equivalent (Anderson et al., 2012). A majority of spills from tankers occurred in coastal areas (37 spills) verses offshore (16 spills) between 1974 and 2008. Barge spill rates for the last 15 years (1994 through 2008) declined dramatically as compared with the entire time period of available data (1974 through 2008), especially for crude oil barges and for both spill sizes ≥1,000 bbl and >10,000 bbl (Anderson et al., 2012). From 1974 through 2008, 197 petroleum spills ≥1,000 bbl (28 of which were crude oil spills) occurred from barges in U.S. coastal, offshore, and inland waters (including U.S. territorial waters). Because the data available on barge transport in U.S. waters do not differentiate between inland and coastal/offshore transport, inland transport was included.

CHAPTER 4

DESCRIPTION OF THE ENVIRONMENT AND IMPACT ANALYSIS

4. DESCRIPTION OF THE ENVIRONMENT AND IMPACT ANALYSIS

The impacts of 10 proposed WPA and CPA lease sales were analyzed in the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247, Final Environmental Impact Statement* (2012-2017 WPA/CPA Multisale EIS) (USDOI, BOEM, 2012b); the impacts of 2 lease sales were analyzed in the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231, Final Supplemental Environmental Impact Statement* (WPA 233/CPA 231 Supplemental EIS) (USDOI, BOEM, 2013a); and the impacts of 3 lease sales were analyzed in the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2014-2016; Western Planning Area Lease Sales 238, 246, and 248 Final Supplemental Environmental Impact Statement* (WPA 238/246/248 Supplemental EIS) (USDOI, BOEM, 2014a). An analysis of the routine, accidental, and cumulative impacts of a WPA proposed action on the environmental, socioeconomic, and cultural resources of the Gulf of Mexico can be found in Chapter 4.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS are hereby incorporated by reference.

The purpose of this Supplemental EIS is to determine if there are significant new circumstances or information bearing on the WPA proposed actions or their impacts, as previously discussed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS and, if so, to disclose those changes and conclusions. This includes all relevant new information available since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. As will be demonstrated within each environmental, socioeconomic, and cultural resources chapter in this Supplemental EIS, the new circumstances and new information identified and discussed herein do not alter the discussions provided in or the conclusions reached in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

4.1. PROPOSED WESTERN PLANNING AREA LEASE SALES 246 AND 248

Proposed WPA Lease Sales 246 and 248 are tentatively scheduled to be held in August 2015 and 2016, respectively. The proposed WPA lease sale area encompasses about 28.58 million ac. This area begins 3 marine leagues (9 nmi; 10.35 mi; 16.67 km) offshore Texas and extends seaward to the limits of the United States' jurisdiction over the continental shelf (often the Exclusive Economic Zone) in water depths up to approximately 3,346 m (10,978 ft) (**Figure 1-1**). As of November 2014, approximately 21.9 million ac of the proposed WPA lease sale area are currently unleased. This information is updated monthly and can be found on BOEM's website at http://www.boem.gov/Gulf-of-Mexico-Region-Lease-Map/. A WPA proposed action would offer for lease all unleased blocks within the proposed WPA lease sale area for oil and gas operations (**Figure 2-1**), with the following exception:

(1) whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary (i.e., the boundary as of the publication of this Supplemental EIS).

The DOI is conservative throughout the NEPA process and includes the total area within the WPA for environmental review even though the leasing of portions of the WPA (subareas or blocks) can be deferred during a Five-Year Program.

Chapter 4.1.1 presents a brief summary of the baseline data for the physical, biological, and socioeconomic resources that would potentially be affected by a WPA proposed action or the alternatives. For additional information on the baseline data for the physical, biological, and socioeconomic resources that would potentially be affected by a WPA proposed action or the alternatives, refer to Chapter 4.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

Chapter 4.1.1 also presents analyses of the potential impacts of routine events, accidental events, and cumulative activities associated with a WPA proposed action or the alternatives on these resources. Baseline data are considered in the assessment of impacts from proposed WPA Lease Sales 246 and 248 on these resources. In addition, **Appendix B** ("Catastrophic Spill Event Analysis") serves as a complement to this chapter and provides additional analysis of the potential impacts of a low-probability catastrophic oil spill, which is not reasonably expected and not part of a WPA proposed action, to the environmental and cultural resources and the socioeconomic conditions analyzed below. For additional information on environmental impacts of the cumulative case for the Gulf of Mexico resources, refer to Chapter 4.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, as well as Appendix D of the WPA 238/246/248 Supplemental EIS.

The *Deepwater Horizon* explosion resulted in the largest oil spill in U.S. history. An event such as this has the potential to adversely affect multiple resources over a large area. The level of adverse effect depends on many factors, including the sensitivity of the resource as well as the sensitivity of the environment in which the resource is located. All effects may not initially be seen and some could take years to fully develop. The following analyses of impacts from the *Deepwater Horizon* explosion, oil spill, and response on the physical, biological, and socioeconomic resources are based on post-*Deepwater Horizon* credible scientific information that was publicly available at the time this Supplemental EIS was prepared. This credible scientific information was applied using accepted methodologies, including numerical modeling of data and scientific writing methods to convey the information of BOEM's subject-matter experts' technical knowledge and experience. However, the Trustee Council of the NRDA for the *Deepwater Horizon* oil spill continues to study, measure, and interpret impacts arising out of that spill. Because the NRDA information has not yet been made available to BOEM or the general public, there are thus instances in which BOEM is faced with incomplete or unavailable information that may be relevant to evaluating reasonably foreseeable significant adverse impacts on the human environment. While incomplete or unavailable information could conceivably result in potential future shifts in baseline conditions of habitats that could affect BOEM's decisionmaking, BOEM has determined that there is sufficient basis to proceed with this Supplemental EIS while operating on the basis of the most current available data and expertise of BOEM's subject-matter experts. **Chapter 4.1.1 and Appendix B** provide a summary of existing credible scientific evidence related to this issue and BOEM's evaluation of potential impacts based upon theoretical approaches or research methods generally accepted in the scientific community. Despite the unavailability of complete information from the NRDA process, BOEM has determined that it can make an informed decision even without this incomplete or unavailable information because BOEM utilizes the best available scientifically credible information in its decisionmaking process and because BOEM cannot speculate as to the results of ongoing NRDA studies. Moreover, BOEM will continue to monitor these resources for effects caused by the *Deepwater Horizon* explosion, oil spill, and response, and will ensure that future BOEM environmental reviews take into account any new information that may emerge.

Chapter 3.2.1 of this Supplemental EIS provides a brief summary of the information on accidental spills that could result from all operations conducted under the OCS Program, as well as information on the number and sizes of spills from non-OCS sources. Table 3-12 of the 2012-2017 WPA/CPA Multisale EIS provides the number of spills ≥1,000 bbl and <1,000 bbl estimated to occur as a result of a WPA proposed action. BOEM estimates that the mean number of spills ≥1,000 bbl for a WPA proposed action is up to one spill. Table 3-12 of the 2012-2017 WPA/CPA Multisale EIS provides spill rates for several spill-size categories. Chapter 3.2.1.8 and Figures 3-8 through 3-28 of the 2012-2017 WPA/CPA Multisale EIS describe the probabilities of a spill ≥1,000 bbl occurring and contacting modeled environmental resources. For additional information on accidental spills that could result from all operations conducted under the OCS Program, as well as information on the number and sizes of spills from non-OCS oil- and gas-related sources, refer to **Chapter 3.2.1** of this Supplemental EIS and to Chapter 3.2.1 of the 2012-2017 WPA/CPA Multisale EIS.

Analytical Approach

The analyses of potential effects to the wide variety of physical, environmental, and socioeconomic resources in the vast area of the GOM and adjacent coastal areas is complex. Specialized education, experience, and technical knowledge are required, as well as familiarity with the numerous impact-producing factors associated with oil and gas activities and other activities that can cause cumulative impacts in the area. Knowledge and practical working experience of major environmental laws and regulations such as NEPA, the Clean Water Act, Clean Air Act, Coastal Zone Management Act (CZMA), Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), Magnuson-Stevens Fishery Conservation and Management Act, and others are also required.

In order to accomplish this task, BOEM has assembled a multidisciplinary staff with hundreds of years of collective experience. The vast majority of this staff has advanced degrees with a high level of knowledge related to the particular resources discussed in this chapter. This staff prepares the input to BOEM's lease sale EISs and a variety of subsequent postlease NEPA reviews, and they are also involved with ESA, essential fish habitat, and CZMA consultations. In addition, this same staff is also directly involved with the development of studies conducted by BOEM's Environmental Studies Program. The results of these studies feed directly into the Bureau of Ocean Energy Management's NEPA analyses.

For this Supplemental EIS, BOEM developed a set of assumptions with an accompanying scenario and described impact-producing factors that could occur from both routine oil and gas activities and from accidental events. These assumptions, scenario, and factors are summarized in **Chapter 3** of this Supplemental EIS and are discussed in detail in Chapter 3 of the 2012-2017 WPA/CPA Multisale EIS. On the basis of these assumptions, scenario, and factors, BOEM's multidisciplinary staff applies its knowledge and experience to analyze the potential effects that could arise out of proposed WPA Lease Sales 246 and 248.

For most resources, the conclusions developed by BOEM's subject-matter experts regarding the potential effects of proposed WPA Lease Sales 246 and 248 are necessarily qualitative in nature; however, these conclusions are based on the expert opinion and judgment of highly trained subject-matter experts. BOEM's staff approaches this effort in good faith utilizing credible scientific information including, but not limited to, information available since the *Deepwater Horizon* explosion, oil spill, and response, and applying this information using accepted methodologies, including numerical modeling of data and scientific writing methods to convey the information of the subject-matter experts' technical knowledge and experience. It must also be emphasized that, in arriving at the overall conclusions for certain environmental resources (e.g., coastal and marine birds, fisheries, and wetlands), the conclusions are not based on impacts to individuals, small groups of animals, or small areas of habitat, but on impacts to the resources/populations as a whole. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives. If BOEM's subject-matter experts determined that the incomplete or unavailable information was essential, BOEM made good faith efforts to acquire the information. In the event that BOEM was unable to obtain essential information (e.g., due to exorbitant cost or the impossibility of obtaining the information within a known time period), BOEM applied accepted scientific methodologies in place of that information. This approach is described in the next subsection on "Incomplete or Unavailable Information."

Over the years, BOEM has developed a suite of lease stipulations and mitigating measures to eliminate or ameliorate potential environmental effects. In many instances, these lease stipulations and mitigating measures were developed in coordination with other natural resource agencies such as NMFS and FWS.

Throughout its effort to prepare this Supplemental EIS, BOEM has made painstaking efforts to comply with the spirit and intent of NEPA, to avoid being arbitrary and capricious in its analyses of potential environmental effects, and to use adaptive management to respond to new developments related to the OCS Program.

Incomplete or Unavailable Information

In the following analyses of physical, environmental, and socioeconomic resources, BOEM identifies situations in which its analysis contains incomplete or unavailable information. The major area where BOEM is faced with incomplete or unavailable information is in relation to the *Deepwater Horizon* explosion, oil spill, and response. Information related to the explosion, oil spill, and response is still being collected, interpreted, and analyzed by a myriad of Federal and State agencies. With respect to some of this information, including much of the data related to the NRDA process, those in charge of analyzing impacts from the spill have not yet shared their data and findings with BOEM or made this information publicly available. Therefore, in situations in which BOEM's subject-matter experts were faced with incomplete or unavailable information, the subject-matter experts for each resource utilized the most recent publicly available, scientifically credible information from other sources to support the conclusions contained in this Supplemental EIS. This information is identified and summarized in

Chapter 4.1.1 of this Supplemental EIS, is discussed in detail for each resource in Chapter 4.1.1 of the 2012-2017 WPA/CPA Multisale EIS, and is updated in Chapter 4.1.1 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. In certain circumstances, identified and described in more detail in **Chapter 4.1.1** of this Supplemental EIS, BOEM's subject-matter experts were required to utilize accepted methodologies to extrapolate conclusions from existing or new information and to make reasoned estimates and developed conclusions regarding the current WPA baseline for resource categories and expected impacts from a WPA proposed action given any baseline changes. For reasons described below, there are no changes to the conclusions as presented in the 2012-2017 WPA\CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

It is important to note that, barring another catastrophic oil spill, which is a low-probability event that is not reasonably expected and not considered part of a WPA proposed action, the adverse impacts associated with a proposed WPA lease sale are small, even in light of the *Deepwater Horizon* explosion, oil spill, and response. This is because of draft lease sale stipulations and because of BOEM's and other Federal and State entities' mitigating measures. BOEM also imposes site-specific mitigations that become conditions of plan or permit approval at the postlease stage. Collectively, these measures further reduce the likelihood and/or severity of adverse impacts.

For the following resources, as with the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, the subject-matter experts determined that there is incomplete or unavailable information that is relevant to reasonably foreseeable significant adverse impacts; however, it is not essential to a reasoned choice among alternatives.

- *Physical Resources in the WPA*: Physical resources (i.e., water quality and air quality) within the WPA were likely not affected to any discernible degree by the *Deepwater Horizon* explosion, oil spill, and response, based on the best available information and the WPA's distance from the *Macondo* well (485.2 km; 301.5 mi). BOEM has determined that the incomplete or unavailable information is not essential to a reasoned choice among alternatives because BOEM utilizes the best available scientifically credible information in its decisionmaking process and cannot speculate as to the results of ongoing NRDA studies. In any event, much of the information related to the *Deepwater Horizon* explosion, oil spill, and response may not be available for some time, regardless of the costs necessary to obtain this information, as there are numerous task forces and interagency groups involved in the production of the information. It is not expected that these data would become publicly available in the near term, and certainly not within the timeline contemplated in the NEPA analysis of this Supplemental EIS.

- *Nonmobile Biological Resources within the WPA*: Coastal and offshore biological and benthic habitats (i.e., barrier beaches, wetlands, seagrasses, soft bottom benthic communities, topographic features, and chemosynthetic and nonchemosynthetic communities) and nonmobile benthic species that would be expected to spend their entire life cycle in the WPA were likely not affected to any discernible degree by the *Deepwater Horizon* explosion, oil spill, and response, based on the WPA's distance from the *Macondo* well (485.2 km; 301.5 mi) and currently available data indicating that the spill did not reach WPA waters or sediments. Similarly to the analysis of physical resources in the WPA described in the preceding paragraph, BOEM has determined that the incomplete or unavailable information regarding nonmobile biological resources is not essential to a reasoned choice among alternatives because BOEM utilizes the best available scientifically credible information in its decisionmaking process and cannot speculate as to the results of ongoing NRDA studies.

- *Mobile Biological Resources within or Migrating through the WPA*: Certain mobile biological resources (i.e., birds, fish, marine mammals, and sea turtles) having ranges and/or habitats that may include different areas in the GOM may have individually been affected by exposure to oil and/or spill-response activities, provided they were in the vicinity of the *Deepwater Horizon* explosion, oil spill, and response during spill conditions. Precise information on the impacts on mobile biological resources within or migrating through the WPA is therefore not known, and it is not expected that this data would become publicly available within the timeline contemplated in the NEPA analysis of this Supplemental EIS. BOEM has concluded that this incomplete or unavailable information is not essential to a reasoned choice among the alternatives because the adverse impacts from routine activities associated with a WPA proposed action are expected to be small, even in light of how baseline conditions may have been changed by the *Deepwater Horizon* explosion, oil spill, and response. Moreover, based on the scientifically credible information that was available and applied in **Chapter 4.1.1**, such as peer-reviewed journals and government reports, this incomplete or unavailable information is not essential to a reasoned choice among the alternatives because the subject-matter experts for this Supplemental EIS have already evaluated the probability and severity of these potential impacts and because this incomplete or unavailable information is not essential to understand every particular mechanism by which these significant impacts could occur. With regard to future potentially low-probability catastrophic spills, any incomplete or unavailable information regarding the nature of a very large spill would not be essential to a reasoned choice among the alternatives. This is because a low-probability catastrophic oil spill and its impacts are not "expected" as a result of a WPA proposed action since such a spill remains a low-probability event, particularly in light of improved safety and oil-spill response requirements that have been put in place since the spill.

- *Endangered and Threatened Species*: BOEM and BSEE reinitiated consultation with NMFS and FWS in light of new information that may become available on these species and in light of effects from the *Deepwater Horizon* explosion, oil spill, and response. Pending the completion of the reinitiated ESA Section 7 Consultation, BOEM has prepared an ESA Section 7(d) determination (50 CFR § 402.09). Section 7(d) of the ESA requires that, after initiation or reinitiation of consultation under Section 7(a)(2), the Federal agency "shall not make any irreversible or irretrievable commitment of resources with respect to the agency action which has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures which would not violate" Section 7(a)(2). BOEM has determined that the proposed action during the reinitiated Section 7 consultation period is consistent with the requirements of ESA Section 7(d) because (1) approving and/or conducting a proposed WPA lease sale will not foreclose the formulation or implementation of any Reasonable and Prudent Alternative measures that may be necessary to avoid jeopardy (or the likely destruction or adverse modification of critical habitat) and (2) the Secretary of the Interior retains the discretion under OCSLA to deny, suspend, or rescind plans and permits authorized under OCSLA at any time, as necessary to avoid jeopardy. Lease sales alone do not constitute an irreversible and irretrievable commitment of resources. In addition, the results of consultation and any additional relevant information on endangered and threatened species can be employed during postlease activities to ensure that Reasonable and Prudent Alternative measures are not foreclosed. BOEM and BSEE have developed an interim coordination program with NMFS and FWS for individual consultations on postlease activities requiring permits or plan approvals while formal consultation and development of new Biological Opinions are ongoing.

- *Natural Resource Damage Assessment (NRDA) Data*: In response to the *Deepwater Horizon* explosion, oil spill, and response, a major NRDA is underway to assess impacts to all natural resources in the GOM that may have been impacted by the resulting spill from the *Macondo* well, as well as impacts from the spill-response operations. The NRDA is mandated by the Oil Pollution Act of 1990. The U.S. Department of the Interior is a co-Trustee in the NRDA process, and BOEM is a cooperating agency on a Programmatic EIS being prepared as part of the NEPA analysis for the *Deepwater Horizon* NRDA. However, the *Deepwater Horizon*

NRDA process is being led by the NRDA Trustees, which include NOAA and DOI (FWS and National Park Service), but not BOEM. BOEM is listed as an affected party for NRDA purposes. At this time, limited data compiled in the *Deepwater Horizon* NRDA process have been made publicly available. Because limited data have been made publicly available, most *Deepwater Horizon* NRDA datasets are not available for BOEM to use in its NEPA analyses. BOEM acknowledges that the ability to obtain and use the NRDA data in its NEPA analyses could be relevant to reasonably foreseeable significant adverse impacts; however, the *Deepwater Horizon* NRDA data are not essential to a reasoned choice among the alternatives because impacts identified through the *Deepwater Horizon* NRDA process would likely be the same under any alternative and obtaining the data would not help inform the decisionmaker. In addition and as discussed above, the adverse impacts associated may have been changed by the *Deepwater Horizon* explosion, oil spill, and response. The impacts are expected to be small because of BOEM's lease sale stipulations and mitigating measures, site-specific mitigations that become conditions of plan or permit approval at the postlease stage, and mitigations required by other State and Federal agencies. Even if the NRDA data were essential to a reasoned choice among the alternatives, it is not publicly available and much of the data may not become available for many years. The NEPA allows for decisions to be made based on available scientifically credible information (e.g., peer-reviewed journals and studies, and government reports) applied using accepted methodologies where the incomplete information cannot be obtained or the cost of obtaining it is exorbitant. The NRDA process is ongoing and there is no timeline on when this information will be released. It is not within BOEM's authority to obtain this information. Cost is not an issue in obtaining the information, regardless of whether the cost would be exorbitant or not. Instead, the limitations on the NRDA process, including statutory requirements under the Oil Pollution Act of 1990, are the determining factors on the availability of this information. In light of the fact that the NRDA data may not be available for years, BOEM has used accepted scientific methodologies to evaluate each resource, as described in this chapter. These include numerical modeling of data and scientific writing methods to convey the information of BOEM's subject-matter experts' technical knowledge and experience. Since the spill, BOEM's Gulf of Mexico OCS Region's Environmental Studies Program has continually modified its Studies Plan to reflect the Agency's current information needs for studies that address impacts and recovery from the oil spill. The scientific studies conducted by the Environmental Studies Program provide some of the data that BOEM relies on in making decisions in this Supplemental EIS. BOEM's proposed studies attempt to avoid duplication of study efforts while striving to fill information gaps where *Deepwater Horizon* NRDA studies may not address particular resources and their impacts from the oil spill.

- *Socioeconomic and Cultural Resources*: Incomplete or unavailable information related to socioeconomic and cultural impacts (i.e., commercial and recreational fishing, recreational resources, archaeological resources, land use and coastal infrastructure, demographics, economic factors, and environmental justice) may be relevant to reasonably foreseeable adverse impacts on these resources. With regard to the *Deepwater Horizon* explosion, oil spill, and response, BOEM has determined that the incomplete or unavailable information would not be essential to a reasoned choice among alternatives because BOEM utilizes the best available scientifically credible information in its decisionmaking process and cannot speculate as to the results of ongoing *Deepwater Horizon* NRDA studies.

This chapter has thoroughly examined the existing credible scientific evidence that is relevant to evaluating the reasonably foreseeable significant adverse impacts of the proposed WPA lease sales on the human environment. The subject-matter experts that prepared this Supplemental EIS conducted a diligent search for pertinent information, and BOEM's evaluation of such impacts is based upon theoretical approaches or research methods generally accepted in the scientific community. All reasonably foreseeable impacts were considered, including oil-spill impacts that could have catastrophic consequences, even if their probability of occurrence is low (**Appendix B**). Throughout this chapter, where information was incomplete or unavailable, BOEM complied with its obligations under NEPA to determine if the information was relevant to reasonably foreseeable significant adverse impacts; if so, whether it was essential to a reasoned choice among alternatives; and, if it was essential, whether it could be obtained and whether the cost of obtaining the information was exorbitant, as well as whether generally accepted scientific methodologies could be applied in its place (40 CFR § 1502.22).

4.1.1. Alternative A—The Proposed Action

4.1.1.1. Air Quality

BOEM has reexamined the analysis for air quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for air quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of air quality, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.1.1, 4.1.1.1.2, and 4.1.1.1.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.1 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.1.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.1 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. Details of air quality modeling are discussed in Appendix A of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

The following routine activities associated with a WPA proposed action would potentially affect air quality: platform construction and emplacement; platform operations; drilling activities; flaring; seismic-survey and support-vessel operations; pipeline laying and burial operations; evaporation of volatile petroleum hydrocarbons during transfers; and fugitive emissions. These activities could result in emissions that are released to the atmosphere and then influenced by meteorology on air quality. This impact analysis is based on four parameters—emission rates, surface winds, atmospheric stability, and the mixing height. Refer to Chapter 4.1.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS and to Appendix A of the WPA 238/246/248 Supplemental EIS for details on air quality modeling. Emissions of pollutants into the atmosphere from the activities associated with a WPA proposed action are projected to have minimal effects on onshore air quality because of the distance from shore where the emissions are released and dilution before they reach shore, as well as the prevailing atmospheric conditions; emission rates and mixing heights; and the resulting pollutant concentrations.

Accidental events that may cause impacts to air quality include the release of oil, condensate, natural gas, chemicals used offshore, or pollutants from the burning of these products, as well as blowouts and fires. The accidental release of hydrocarbons related to a WPA proposed action may result in the emission of air pollutants. The air pollutants include criteria NAAQS pollutants, volatile and semi-volatile organic compounds, H_2S, and methane. If a fire was associated with the accidental event, it could produce a broad array of pollutants, including all NAAQS-regulated primary pollutants, including nitrogen dioxide (NO_2), CO, SO_x, VOC, PM_{10}, and $PM_{2.5}$. Response activities to an accidental event that could impact air quality include in-situ burning, the use of flares to burn gas and oil, and the use of dispersants applied from aircraft. Measurements taken during an in-situ burning show that a major portion of compounds was consumed in the burn (Fingas et al., 1995), and it was found that, during the burn, the pollutants were measured only at background levels; therefore, pollutant concentrations would be expected to be within the NAAQS. These response activities are temporary in nature and occur offshore; therefore, there are little expected impacts from these actions to onshore air quality. Accidents involving high concentrations of H_2S could result in human deaths as well as environmental damage. Regulations and NTLs mandate safeguards and protective measures, which are in place to protect workers from H_2S releases. Overall, since blowouts and fires are rare events and are of short duration, potential impacts to air quality are not expected to be significant.

The cumulative analysis considers OCS oil- and gas-related and non-OCS oil- and gas-related activities that could occur and adversely affect onshore air quality from OCS sources during the 40-year analysis period. The OCS oil- and gas-related activities that could impact air quality include the following: platform construction and emplacement; platform operations; drilling activities; flaring; seismic-survey and support-vessel operations; pipeline laying and burial operations; evaporation of volatile petroleum hydrocarbons during transfers; fugitive emissions; the release of oil, condensate, natural gas, and chemicals used offshore, or pollutants from the burning of these products; blowouts; a low-probability catastrophic spill, which is not reasonably foreseeable and not part of a WPA proposed action (refer to **Appendix B** for more details); and fires. Emissions of pollutants into the atmosphere from activities associated with the OCS Program are not projected to have significant effects on onshore air quality because of the prevailing atmospheric conditions, emission rates and heights, and the resulting pollutant concentrations, which result in dilution of the emissions offshore before they reach the shoreline. In the WPA, the impacts of the OCS emissions on the onshore air quality are below the U.S. Environmental Protection Agency's Significant Impact Levels (SILs) and BOEM's Significance Levels, and they are well below the NAAQS. The only potential exception is for ozone, where there may be some minimal contribution to ozone at the shoreline. However, onshore impacts on air quality from emissions from OCS oil- and gas-related activities are estimated to be within the Prevention of Significant Deterioration (PSD) Class II allowable increments.

Non-OCS oil- and gas-related activity includes both marine and onshore industries and activities that are unrelated to oil and gas exploration and production. The non-OCS oil- and gas-related activities in the cumulative scenario that could potentially impact onshore air quality include State oil and gas programs, other major offshore but non-OCS oil- and gas-related factors influencing offshore environments (such as sand borrowing and transportation), onshore non-OCS oil- and gas-related activities such as emissions from industry (including major stationary sources, e.g., power plants, petroleum refineries and chemical plants) and mobile sources (cars/trucks) related to human activities, onshore non-OCS oil- and gas-related sources unrelated to human activities such as forest fires, accidental releases from an oil spill, accidental releases of hydrogen sulfide, and natural events (e.g., hurricanes). Non-OCS oil- and gas-related activity on the water that would most likely contribute to cumulative impacts to air quality would be the marine shipping or transportation industry. Industrial activity in Texas and Louisiana and vehicle emissions in highly populated areas are the onshore sources that would contribute to the cumulative impact to air quality. These offshore and onshore emissions sources generate greater amounts of pollutants than OCS oil- and gas-related activity. Human populations residing near these same industries may encounter air contaminants as a result of non-OCS oil- and gas-related activities. These non-OCS oil- and gas-related sources would represent the majority of the cumulative emissions that are present at onshore locations.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search of State and Federal databases, including updates to regulations, was conducted to determine the availability of recent information. The search revealed new information on the hydrofracking of oil onshore and intercontinental sources of fine particles in the atmosphere since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. This information is pertinent to this Supplemental EIS because it details new information on non-OCS oil- and gas-related impacts to the environment.

New information indicates that intercontinental dust from Central America has been found in the Texas atmosphere. Fine particulates ($PM_{2.5}$), such as ammonium sulfate, can be suspended in the atmosphere and can impair visibility and adversely affect human health. Once in the atmosphere, these fine particulates can be transported for long distances. It has been observed that a substantial amount of the fine particulates observed in Texas comes from Mexico and Central America, and enters into the United States across Texas' southern border. As a result, it reduces the visibility at Big Bend and Guadalupe Mountains National Parks, both Class I (pristine with respect to visibility) areas. The results of air dispersion modeling indicate that as much as half of the visibility impairment (occurring on 20% of the most visibility impaired days) at Big Bend comes from international transport (Texas Commission on Environmental Quality, 2014a). These results indicate that an increase in visibility impairment in Texas is likely due to international transport of dust rather than OCS emission sources, which occur far enough offshore that they are diluted before they reach land. New information indicates that hydrofracking of oil in Texas may also cause potential health and environmental effects. Some of the pollutants released by hydrofracking include benzene, toluene, xylene and ethyl benzene (BTEX); particulate matter and dust; ground-level ozone; nitrogen oxides; carbon monoxide; formaldehyde; and metals contained in diesel fuel combustion. These pollutants can travel in the atmosphere. The exposure to these chemicals could cause short-term effects to human health and the environment (Climate Science Watch, 2014). This information indicates that hydrofracking may result in more impacts to human health and the environment onshore than offshore OCS oil- and gas-related activities. The Offshore and Coastal Dispersion modeling results, which are discussed in Appendix A of the WPA 238/246/248 Supplemental EIS and which are incorporated by reference here, indicate that typical operations on the OCS do not generate pollutants in an amount that would significantly impact or significantly contribute to air quality degradation in Texas and that the same applies to emissions that are generated from isolated events (e.g., accidents, which are temporary sources).

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. However, as discussed in this document, as well as in Chapter 4.1.1.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete or unavailable information regarding air impacts from the *Deepwater Horizon* explosion, oil spill, and response in the WPA, as well as limitations resulting from air quality modeling.

Although final summary information and reports on air quality impacts from the *Deepwater Horizon* explosion, oil spill, and response may be forthcoming, the final and conclusive information is not available at this time and will not be available within the timeline contemplated in the NEPA analysis of this Supplemental EIS. This unavailable information may be relevant to adverse effects and possible long-term effects because air emissions could have reached land or dispersed throughout the WPA before oil-spill response was activated. BOEM used reasonably accepted scientific methodologies to extrapolate from available information on air quality measurements taken by Federal agencies in completing the relevant analysis to determine air impacts (USEPA, 2010a; de Gouw et al., 2011). Limited data released to the public and obtained from USEPA, NOAA, and other agencies indicating that air impacts tended to be minor and below USEPA's health-based standards were extrapolated to come to the conclusion that air quality impacts in the WPA resulting from the *Deepwater Horizon* explosion, oil spill, and response were minor because of its distance from the WPA. Data obtained from USEPA, NOAA, and other agencies do not reveal reasonably foreseeable significant adverse impacts, and because there are no continuing sources of air pollution related to the *Deepwater Horizon* explosion, oil spill, and response, BOEM would not expect any additional measurements or information to alter the conclusions from currently existing data. Therefore, BOEM has determined that the information is not essential to a reasoned choice among alternatives.

In addition, as noted in Appendix A of the WPA 238/246/248 Supplemental EIS, there are a number of competing methods and available models for estimating and tracking potential air emissions and impacts. Each of these methods and models has inherent limitations, particularly with regard to the offshore environment in which a WPA proposed action would take place. BOEM's Offshore and Coastal Dispersion Model, which was used for this environmental impact assessment (Appendix A of the WPA 238/246/248 Supplemental EIS), has limitations such that it is a short-range dispersion model and it does not involve the reactive chemical. In acknowledgement of these limitations, BOEM's subject-matter experts, using their best professional judgment and experience, have developed conservative assumptions and modeling parameters so as to ensure that the impact conclusions herein are reasonable and not underestimated (refer to Appendix A of the WPA 238/246/248 Supplemental EIS for the modeling analysis). The modeling that was conducted was overly conservative. All of the emissions during 1 year for the entire WPA, which would actually be dispersed throughout the WPA, were modeled as if they originated in a single block, East Breaks Block 446. This block was selected because it represented a location where the water is deep enough that a dynamically positioned drillship would be used and where hydrocarbons are probably present. Although there are limitations in air quality modeling, the evidence currently available and that was used to develop conservative assumptions supports past analyses and does not indicate severe adverse impacts to air quality. Therefore, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for air quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. Emissions of pollutants into the atmosphere from the routine and accidental activities associated with a WPA proposed action are projected to have minimal impacts to onshore air quality, and emissions of pollutants into the atmosphere from activities associated with the OCS Program are also not projected to have significant effects on onshore air quality. The non-OCS oil- and gas-related emission sources of intercontinental origin and the hydrofracking of oil may have the potential to impact onshore air quality and human health. However, the new information does not alter previous impact conclusions for air quality. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.2. Water Quality

4.1.1.2.1. Coastal Waters

Coastal waters within the WPA, as defined by BOEM, include all the bays and estuaries from the Rio Grande River to the Louisiana/Texas border. BOEM has reexamined the analysis for coastal water quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for coastal water quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of coastal water quality, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.2.1.1, 4.1.1.2.1.2, and 4.1.1.2.1.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.2.1 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.2.1.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.2.1 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

The routine activities associated with proposed WPA Lease Sales 246 and 248 that would impact water and associated sediment quality include the following: discharges during drilling of exploration and development wells; structure installation and removal; discharges during production; installation of pipelines; workovers of wells; maintenance dredging of existing navigational canals; service-vessel discharges; and nonpoint-source runoff from platforms and OCS Program-related vessels. The primary impacting sources to water quality in coastal waters are point-source and storm-water discharges from support facilities, vessel discharges, and nonpoint-source runoff. The impacts to coastal water quality from routine activities associated with a WPA proposed action should be minimal because of the distance to shore of most routine activities, USEPA and USCG regulations that regulate the discharge of pollutants, and the few, if any, new pipeline landfalls or onshore facilities that would be constructed as a result of a WPA proposed action.

Accidental events associated with a WPA proposed action that could impact coastal water quality include spills of oil and refined hydrocarbons, releases of natural gas and condensate, spills of chemicals or drilling fluids, loss of well control, pipeline failures, vessel collisions, or other malfunctions that would result in such spills. Oil, gas, and chemical releases may degrade water quality and reduce oxygen in the water column. Pipeline breaks and vessel collisions in bays and estuaries would be the greatest risk for delivering concentrated contaminants to coastal waters. For coastal spills (those that occur in bays and estuaries), two additional factors that must be considered for the impacts of water quality on habitats are the shallowness of the area where the oil spill occurred and the proximity of the spill to shore because these spills are less likely to be diluted before they reach the shore and can impact sediment quality. However, spills from vessel collisions are not expected to be significant because vessel collisions occur infrequently. Those spills occurring in OCS waters would be diluted before they reached the bays and estuaries, and natural degradation processes will also decrease the concentration of spilled oil over time. Although response efforts to accidental releases may decrease the amount of oil in the environment, the response efforts may also impact the environment through, for example, increased vessel traffic, hydromodification (e.g., dredging, berm building, boom deployment, etc.), and application of dispersants. Chemicals spills are not a significant risk because the chemicals used by the OCS oil and gas industry are either nontoxic, used in minor quantities, or only used on a noncontinuous basis. Therefore, the impact of routine OCS oil- and gas-related activities on coastal water quality from smaller accidental spills is expected to be minimal.

Coastal waters are vulnerable to impacts from OCS oil- and gas-related activities, including erosion and runoff, sediment disturbance and turbidity from dredging, vessel discharges, and accidental releases of oil, gas, or chemicals. Erosion and runoff may degrade water quality; however, OCS oil- and gas-related activities are not the leading source of contaminants that impair coastal water quality. The leading source of contaminants that impair coastal water quality is urban runoff, which is discussed in the next paragraph. Increased turbidity and discharge from a WPA proposed action would be temporary in nature and minimized by regulations and mitigation. Accidental oil, gas, and chemical spills in bays and estuaries can result in degraded water quality in the coastal environment. Water and sediment quality degradation would be greater for spills that occurred in the bays and estuaries than those that occurred in OCS waters and traveled to the bays and estuaries because the spills traveling from OCS waters would be dispersed or diluted before they reached the coastal waters. A catastrophic OCS Program-related accident would be rare and not expected to occur in coastal waters. An oil spill as a result of a low-probability catastrophic event, which is not part of a WPA proposed action and not likely expected, is discussed in **Appendix B**.

Coastal waters are vulnerable to impacts from non-OCS oil- and gas-related activities or activities not related to a WPA proposed action or the OCS Program, including State oil and gas activities, alternative energy activities, alternate use programs for platforms (e.g., aquaculture), sand borrowing, the activities of other Federal agencies (including the military), natural events or processes, and activities related to the direct or indirect use of land and waterways by the human population and industry. These activities may result in runoff, sediment disturbance and turbidity, vessel discharges, and accidental releases of oil, gas, or chemicals. Many of these factors have a major impact on water quality, but the greatest threat to coastal water quality is urban runoff.

The impacts resulting from a WPA proposed action would not significantly contribute to the cumulative impacts on the coastal waters of the Gulf because non-OCS oil- and gas-related activities, including vessel traffic, erosion, and nonpoint source runoff, are cumulatively responsible for the majority of coastal water impacts. Additionally, a catastrophic OCS Program-related accident is not expected to occur in coastal waters. Furthermore, the impact on coastal water quality resulting from smaller accidental spills is expected to be minimal in comparison to the cumulative impacts from other sources. Therefore, the incremental contribution of the routine activities associated with a WPA proposed action to the cumulative impacts on coastal water quality is not expected to be significant.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

Various Internet sources were examined and literature searches conducted in order to assess the availability of new information regarding the water quality and sediment quality in coastal waters that may be pertinent to a WPA proposed action. The searches included, but were not limited to, Google,

Google Scholar, several USEPA websites, and the NOAA Central Library *Deepwater Horizon*: A Preliminary Bibliography of Published Research and Expert Commentary website. New information was found on the affected environment after the *Deepwater Horizon* explosion, oil spill, and response.

Liu and Liu (2013) investigated bacterial communities present in oil mousses collected from impacted salt marshes during the *Deepwater Horizon* explosion, oil spill, and response. *Vibrio* bacteria, a human pathogen, represented 57 percent of the community, suggesting that this indigenous genus is particularly responsive to weathered oil in the salt marshes (for more information on salt marshes, refer to **Chapter 4.1.1.4**). Tao et al. (2011) found high numbers of *Vibrio vulnificus* in surface residual balls composed of weathered oil from the *Deepwater Horizon* oil spill. A study by Stephens et al. (2013) found that levels of *Vibrio vulnificus* were higher after the *Deepwater Horizon* explosion, oil spill, and response. They state that vibrios are found naturally in the marine environment and prefer brackish water (e.g., 5-10 parts per thousand for *Vibrio vulnificus* and 17-23 parts per thousand for *Vibrio parahaemolyticus*). However, a study by Smith et al. (2012) found that *Vibrio parahaemolyticus* did not grow on or oxidize naphthalene or phenanthrene, and a degradation product of naphthalene was found to inhibit growth. The authors concluded that an increase in human health risks from consuming shellfish due to stimulation of *Vibrio parahaemolyticus* by oil-derived polycyclic aromatic hydrocarbons (PAHs) is unlikely. The study did not address *Vibrio vulnificus*. These studies present information on the affected coastal environment (i.e., marshes, beaches, and shellfish beds) following the *Deepwater Horizon* explosion, oil spill, and response and how certain bacterial communities responded to the presence of oil in their environment.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS, as well as in Chapter 4.1.1.2 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete or unavailable information that may be relevant to reasonably foreseeable impacts on coastal water quality. Much of this information relates to the *Deepwater Horizon* explosion, oil spill, and response and is continuing to be collected and developed through the NRDA process. These research projects may be years from completion. It is not possible for BOEM to obtain this information and incorporate it within the timeline contemplated in the NEPA analysis of this Supplemental EIS regardless of the costs or resources needed. Few conclusions have been released to the public to date, though, extensive datasets have now been released to the public (refer to USDOC, NOAA, 2013), and peer-reviewed academic research has been and continues to be published relevant to this topic. The Federal Government's reports and peer-reviewed journal articles that are available at this time have been discussed in Chapters 4.1.1.2.1 and 4.2.1.2.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. In particular, a portion of the recently released dataset was discussed as part of published Federal Government reports, e.g., the Operational Science Advisory Team (OSAT) report (OSAT, 2010). As noted in Chapter 4.2.1.2.1 of the 2012-2017 WPA/CPA Multisale EIS, more than 6,000 water and sediment samples were collected in coastal waters during the *Deepwater Horizon* response by USEPA, USGS, and the Center for Toxicology and Environmental Health (a British Petroleum contractor), as well as by other Federal and State agencies. These samples were analyzed against the USEPA's human health benchmarks and/or the USEPA's aquatic life benchmarks, and the results were reported in the OSAT (2010) report. The report explained that none of the water samples exceeded the USEPA's benchmark for human health while water samples revealed that there were 41 exceedances of the USEPA's aquatic life benchmarks. Of those exceedances, only nine samples were consistent with Mississippi Canyon Block 252 oil. There were 24 exceedances of sediment benchmarks for aquatic life; only 4 of those samples were consistent with Mississippi Canyon Block 252 oil. No water or sediment benchmark exceedances in the nearshore were measured after August 3, 2010 (the last overflight observation of surface oil). BOEM used reasonably accepted scientific methodologies to extrapolate from existing information in completing this analysis and formulating the conclusions presented here. Given the available data on coastal sediments and water quality that have been released and evaluated, as described above and in Chapters 4.1.1.2.1 and 4.2.1.2.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, with the water and sediment samples discussed in the

OSAT report serving as an example, as well as the distance of the WPA from the *Macondo* well, water and sediment quality within the WPA were likely not affected to any discernible degree by the *Deepwater Horizon* explosion, oil spill, and response. Therefore, BOEM believes that this incomplete or unavailable information is not essential to a reasoned choice among alternatives for the reasons stated herein and in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

Summary and Conclusion

BOEM has reexamined the analysis for coastal water quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for coastal water quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.2.2. Offshore Waters

Offshore waters within the WPA, as defined by BOEM, include both Texas offshore waters and Federal OCS waters, which includes everything outside any barrier islands to the Exclusive Economic Zone. BOEM has reexamined the analysis for offshore water quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for offshore water quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS, and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS, still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of offshore water quality, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.2.2.1, 4.1.1.2.2.2, and 4.1.1.2.2.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.2.2 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.2.2.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.2.2 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

The routine activities associated with proposed WPA Lease Sales 246 and 248 that would impact offshore water quality may include the following: discharges during drilling of exploration and development wells; structure installation and removal; discharges during production; installation of pipelines; workovers of wells; service-vessel discharges; and nonpoint-source runoff. During exploratory activities, the primary impacting sources to offshore water quality are discharges of drilling fluids and cuttings. During platform installation and removal activities, the primary impacting sources to water quality are sediment disturbance and temporarily increased turbidity. Impacting discharges during production activities are produced water and supply-vessel discharges. Regulations are in place to limit the toxicity of the discharge components, the levels of incidental contaminants in these discharges, and in some cases, the discharge rates and discharge locations. Pipeline installation can also affect water quality by sediment disturbance and increased turbidity. Service-vessel discharges might include water with an oil concentration of approximately 15 parts per million. Impacts to offshore waters from routine activities associated with a WPA proposed action should be minimal due to regulations that limit the pollutant concentrations and toxicity of discharges.

Accidental events associated with a WPA proposed action that could impact offshore water quality include spills of oil and refined hydrocarbons, releases of natural gas and condensate, spills of chemicals or drilling fluids, loss of well control, pipeline failures, collisions, or other malfunctions that would result in such spills. Oil, gas, and chemical releases may degrade water quality and reduce oxygen in the water column. Spills from platforms and pipelines would be the greatest risk for delivering concentrated contaminants to coastal waters. Overall, since major losses of well control and blowouts are rare events, potential impacts to offshore water quality are not expected to be significant. Spills from collisions are not expected to be significant. Although response efforts may decrease the amount of oil in the environment, the response efforts may also impact the environment through, for example, increased vessel traffic and the application of dispersants. Natural degradation processes in both surface and subsurface waters would decrease the amount of spilled oil over time through natural processes that can physically, chemically, and biologically degrade oil (NRC, 2003). Chemicals used in the oil and gas industry are not a significant risk for a spill because they are either nontoxic, are used in minor quantities, or are only used on a noncontinuous basis. Therefore, the impact of accidental events is expected to be small.

Offshore waters are vulnerable to impacts from OCS oil- and gas-related activities including sediment disturbance and turbidity, vessel discharges, discharges from exploration and production activities, and accidental releases of oil, gas, or chemicals. Routine activities that increase turbidity and discharges are temporary in nature and are regulated; therefore, these activities would not have a lasting adverse impact on water quality. In the case of a large-scale spill event, degradation processes in both surface and subsurface waters would decrease the concentration of spilled oil over time. An oil spill as a result of a low-probability catastrophic event, which is not part of a WPA proposed action and is not likely expected, could impact coastal water quality. Low-probability catastrophic spills are discussed in **Appendix B**. The impacts resulting from a WPA proposed action are a small addition to the cumulative impacts on the offshore waters of the Gulf of Mexico.

Offshore waters are also vulnerable to impacts from activities not related to a WPA proposed action or the OCS Program, including State oil and gas activities, alternative uses of platforms (e.g., aquaculture), sand borrowing, renewable energy activities, the activities of other Federal agencies (including the military), natural events or processes, and activities related to the direct or indirect use of land and waterways by the human population (e.g., urbanization, agricultural practices, coastal industry, and municipal wastes). These activities may result in erosion and runoff, sediment disturbance and turbidity, vessel discharges, natural releases of oil and gas (e.g., seeps), and accidental releases of oil, gas, or chemicals. Although some of these impacts are likely to affect coastal areas to a greater degree than offshore waters, coastal pollutants that are transported away from shore will also affect offshore environments. Many of these factors have a major impact on water quality.

The impacts resulting from a WPA proposed action would be a small addition to the cumulative impacts on the offshore waters of the Gulf when compared with inputs from natural hydrocarbon inputs (seeps), coastal factors (such as erosion and runoff), and other non-OCS oil- and gas-related industrial discharges. Since a catastrophic accident is rare, the probability of impact from such accidents is expected to be small. Also, such an accident in offshore waters allows more opportunity to mitigate impacts before the spill enters coastal waters where it could pose a higher risk of harm. The incremental contribution of the routine activities associated with a WPA proposed action to the cumulative impacts on coastal water quality is not expected to be significant.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

Various Internet sources were examined and literature searches conducted in order to assess the availability of new information regarding the water quality and sediment quality in coastal waters that may be pertinent to the WPA. The searches included, but were not limited to, Google, Google Scholar, several USEPA websites, and the NOAA Central Library *Deepwater Horizon*: A Preliminary Bibliography of Published Research and Expert Commentary website. New information was found in relation to the affected offshore environment following the *Deepwater Horizon* explosion, oil spill, and response and oil degradation. Several researchers reported on biodegradation and photodegradation processes of crude oil related to the *Deepwater Horizon* explosion, oil spill, and response. The *Deepwater Horizon* explosion, oil spill, and response did not impact the WPA. However, the WPA and

CPA contain natural seeps at the seafloor that contribute oil and gas to the offshore marine environment; therefore, new research discussed below pertaining to hydrocarbon degradation processes applies to both the WPA and CPA.

Liu et al. (2014) evaluated impacts of the *Deepwater Horizon* explosion, oil spill, and response on concentrations of petroleum hydrocarbons in surface water near the release. Concentrations of total dissolved *n*-alkanes in surface water were more than an order of magnitude higher in May 2010 than in August 2010 or May 2011, indicating that the contamination was due to the release. In contrast, even-numbered *n*-alkanes dominated the dissolved fraction in the May 2011 samples, but they were generally not prevalent in the suspended particulate fraction. The authors concluded that the dissolved even-numbered *n*-alkanes originated from bacteria or were transported to the sample location from elsewhere. Concentrations of PAHs in suspended particles were on average 5 times higher in the May 2010 sample than in the May 2011 sample. The results taken together indicate that surface waters of the sampling area in May 2010 were contaminated by the oil spill and that rapid weathering and/or physical dilution quickly reduced hydrocarbon levels by August 2010. These results show the rapid degradation of oil in the water column following the *Deepwater Horizon* explosion, oil spill, and response, as well as help in understanding of processes that also act on natural oil seeps in the WPA.

Zhou et al. (2013) investigated the photochemical and biological degradation of crude oil from the *Deepwater Horizon* explosion, oil spill, and response under controlled laboratory conditions. Naphthalene, phenanthrene, fluoranthene, and chrysene, in order from lower to higher molecular weight, were the most dominant PAHs in the samples. Photochemical degradation caused a large decline in the aromatic fraction of oil, a preferential loss of low molecular weight alkanes and PAHs, and decreased degradation indexes such as n-C_{17}/pristine ratio. Biodegradation of these compounds was also observed in the absence of light. This type of degradation would be expected to take place in areas near natural oil seeps.

Yang et al. (2014) evaluated bacterial populations in the water column during and after the *Deepwater Horizon* explosion, oil spill, and response. They found that the bacterial community was temporarily dominated in May 2010 by *Oceanospirillales* responding to oil in the water column. By October 2010, this bacterial bloom had been replaced by a diversified bacterial community that resembled its predecessor prior to the release. However, even after the deep hydrocarbon plume was no longer detectable in the wellhead area in October 2010, small populations of *Oceanospirillales* remained. These biodegradation processes also act in response to natural oil seeps in the WPA.

A *Deepwater Horizon* oil spill dataset, including extensive chemical analyses of sediment and water, is available online through NOAA (USDOC, NOAA, 2013). The dataset as a whole is not fully interpreted or discussed in context to the condition of the Gulf of Mexico, but since the data are the work of other Federal agencies, State environmental management agencies, and British Petroleum and its contractors that has been compiled by NOAA, at least some of the data were discussed in the Inter-Agency Joint Analysis Group reports as well as the OSAT reports discussed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. BOEM expects the data to be considered by the scientific community and further incorporated into additional reports and published in peer-reviewed literature in the future, at which time BOEM will analyze the information made available and, as appropriate, will incorporate such to its future NEPA analysis processes.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS and in Chapter 4.1.1.2 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete or unavailable information that may be relevant to reasonably foreseeable impacts on offshore water quality. Much of this information relates to the *Deepwater Horizon* explosion, oil spill, and response and is continuing to be collected and developed through the NRDA process. These research projects may be years from completion. Few conclusions have been released to the public to date, and peer-reviewed academic research has been and continues to be published relevant to this topic. The Federal Government's reports and peer-reviewed journal articles that are available at this time have been discussed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. In particular, a portion of the recently released dataset was discussed as part of published Federal Government reports, e.g., the OSAT report (OSAT, 2010). Given the available data on offshore sediments and water quality that have been released and evaluated, with the water and sediment samples discussed in the OSAT report serving as an example, as well as the distance of the WPA from the *Macondo* well, water and sediment quality within the WPA were likely not affected to any discernible degree by the *Deepwater Horizon* explosion, oil spill, and response. Therefore, BOEM believes that this incomplete or unavailable information is not essential to a reasoned choice among alternatives for the reasons stated herein and in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

Summary and Conclusion

BOEM has reexamined the analysis for offshore water quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for offshore water quality presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.3. Coastal Barrier Beaches and Associated Dunes

BOEM has reexamined the analysis for coastal barrier beaches and associated dunes presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for coastal barrier beaches and associated dunes previously presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of coastal barrier beaches and associated dunes, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.3.1, 4.1.1.3.2, and 4.1.1.3.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.3 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.3.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.3 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

The major routine impact-producing factors associated with a WPA proposed action that could affect coastal barrier beaches and associated dunes include navigational traffic, maintenance dredging of navigational canals, pipeline emplacements/landfalls, and construction and expansion of navigational canals and port facilities. Effects on coastal barrier beaches and associated dunes from pipeline emplacements, navigation channel use and dredging, and construction or continued use of infrastructure in support of a WPA proposed action are expected to be restricted to temporary and localized disturbances such as land loss and erosion. The 0-1 pipeline landfalls projected in support of a WPA proposed action are not expected to cause significant impacts to barrier beaches because of the use of nonintrusive installation methods and regulations. Impacts could be reduced or eliminated through modern techniques, such as horizontal, directional (trenchless) drilling, to avoid damages to these sensitive wetland habitats. Any new gas processing facilities would not be expected to be constructed on barrier beaches. A WPA proposed action may contribute to the continued use of gas processing facilities that already exist. Existing pipelines, in particular those that are parallel and landward of beaches and that had been placed on barrier islands using older techniques that left canals or shore protection structures, have caused and could continue to cause barrier beaches to narrow and breach.

Maintenance dredging of barrier inlets and bar channels is expected to occur, which, when combined with channel jetties, generally causes minor and localized impacts on adjacent barrier beaches downdrift of the channel. Navigational channels that support the OCS Program are listed in Table 3-11 of the WPA 238/246/248 Supplemental EIS. Dredging activities in these channels for both vessel traffic and pipeline emplacement are permitted, regulated, and coordinated by the COE with the appropriate State and Federal resource agencies. Impacts from these operations are minimal due to requirements for the beneficial use of the dredged material for wetland and beach construction and restoration. Permit requirements further mitigate dredged material placement in approved disposal areas by requiring the dredged material to be placed in such a manner that it neither disrupts hydrology nor changes elevation in the surrounding marsh. Because these impacts occur whether a WPA proposed action is implemented or not, a WPA proposed action would only account for a small percentage of such impacts. A WPA proposed action is not expected to adversely alter barrier beach configurations much beyond existing, ongoing impacts in localized areas downdrift of artificially jettied and maintained channels.

Accidental disturbances resulting from a WPA proposed action, including oil spills and blowouts, have the potential to impact coastal barrier beaches and associated dunes of the WPA. Potential impacts from oil spills to barrier islands seaward of the barrier-dune system are discussed below, while potential impacts to barrier islands landward of the barrier-dune system are considered in the wetlands analysis (refer to **Chapter 4.1.1.4**). Due to the proximity of spills in a river, bay, or estuary to barrier islands and beaches, these spills pose the greatest threat because of the concentration and lack of weathering of the oil by the time it hits the shore and because dispersants applied to such spills are not an effective means of spill response because they do not break the oil down sufficiently before it hits the shoreline. Such spills may result from either vessel collisions that release fuel and lubricants or from pipelines that rupture. Crude oil from a spill that occurs in OCS waters would be lessened in toxicity if it reaches the coastal environments due to its distance from shore, weathering, the time oil remains offshore, and possibly the dispersant used, if any. Equipment and personnel used in cleanup efforts can generate the greatest direct impacts to an oiled area. Close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize impacts. The cleanup impacts of these spills could result in a short-term (up to 2 years) adjustment in beach profiles and configurations during cleanup operations. Some impact as a result of physical contact to lower areas of sand dunes is expected. These contacts would not result in significant destabilization of the dunes. The long-term stressors to barrier beach communities caused by the physical effects and chemical toxicity of an oil spill may lead to decreased primary production, plant dieback, and further erosion, particularly if oil is carried onto dunes by hurricanes.

Currently available information suggests that impacts on barrier islands and beaches from accidental events associated with a WPA proposed action would be minimal due to the projected spill rates, small additional risk from a WPA sale, distance of most activity from shore, and anticipated weathering of oil spilled in OCS waters before it reaches shore. Should a spill other than a low-probability catastrophic spill contact a barrier beach, oiling is expected to be light and sand removal during cleanup activities minimized. No significant long-term impacts to the physical shape and structure of barrier beaches and associated dunes are expected to occur as a result of a WPA proposed action. Therefore, a WPA proposed action would not pose a significant increase in risk to barrier island or beach resources.

Specific OCS oil- and gas-related impact-producing factors considered in this cumulative analysis include dredging, construction and expansion of navigational canals and port facilities, pipeline emplacement/landfalls, vessel traffic, oil spills, and oil-spill response and cleanup activities. Under the cumulative scenario, 0-1 OCS oil- and gas-related pipeline landfalls are projected. These pipelines are expected to be installed using modern techniques, which cause little to no impacts to the barrier islands and beaches. Impacts from existing infrastructure could continue to cause barrier beaches to narrow and breach. The impacts of oil spills from OCS oil- and gas-related sources to the Texas coast should not result in long-term alteration of landforms if the beaches are cleaned using techniques that do not significantly remove sand from the beach or dunes. Barrier beaches in the region around Galveston have the greatest risks of sustaining impacts from oil-spill landfalls because of the high concentrations of oil production near that coast and the high volume of oil transported by ships in that area. Oil spills as a result of a low-probability catastrophic event, which are not part of the proposed action and not likely expected, are discussed in **Appendix B**.

Non-OCS oil- and gas-related impacts include non-OCS oil- and gas-related vessel traffic, beach protection and stabilization projects, sea-level rise, subsidence, development and urbanization, tourism, recreational activities, and potential for nearshore salinity modifications (such as preparation of salt domes for oil storage). In addition, oil spills and oil-spill response and cleanup activities can originate from non-OCS oil- and gas-related activities, i.e., international tankers. River channelization, sediment deprivation, tropical and extra-tropical storm activity, sea-level rise, and rapid submergence have resulted in erosion of most of the barrier and shoreline landforms along the Louisiana coast. The Texas coast has experienced land loss due to a decrease in the volume of sediment delivered to the coast because of channelization and damming of coastal rivers, a natural decrease in sediment supply as a result of climatic changes during the past several thousand years, and subsidence along the coast. Storm-induced changes in hydrology have, in some cases, changed the current regime responsible for stabilizing the barrier islands. Some beach stabilization projects are considered by coastal geomorphologists and engineers to accelerate coastal erosion. The beneficial use of maintenance dredged materials and other restoration techniques could be required to mitigate some of these impacts. Recreational use of many barrier beaches in the WPA is intense due to their accessibility by roads (refer to **Chapter 4.1.1.18**). These activities can cause changes to the beach landscapes. There are ongoing restoration efforts to minimize damages to beaches from both natural and human impacts.

Coastal barrier beaches have experienced severe adverse cumulative impacts from natural processes and human activities. Natural processes are generally considered the major contributor to these impacts, whereas human activities cause severe local impacts and accelerate the natural processes that deteriorate coastal barriers. Human activities that have caused the greatest adverse impacts are river channelization and damming, pipeline canals, navigation channel stabilization and maintenance, and beach stabilization structures. Deterioration of Gulf barrier beaches is expected to continue in the future. Federal, State (Texas), and county governments have made efforts through the Texas Coastal Erosion Planning and Response Act program and Coastal Management Plan program to restore or protect the sensitive and vulnerable barrier islands and mainland beaches.

A WPA proposed action is not expected to adversely alter barrier beach configurations significantly. A WPA proposed action is not expected to increase the probabilities of oil spills beyond the current estimates. Strategic placement of dredged material from channel maintenance, channel deepening, and related actions can mitigate adverse impacts upon those localized areas. Thus, the incremental contribution of a WPA proposed action to the cumulative impacts on coastal barrier beaches and associated dunes is expected to be small.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental SEIS

A search was conducted for information published on barrier beaches and dunes, and various sources were examined to determine any recent information regarding barrier beaches and dunes. Sources investigated include BOEM; the U.S. Department of the Interior, Geological Survey (USGS); National Wetlands Research Center; the USGS Gulf of Mexico Integrated Science Data Information Management System; Gulf of Mexico Alliance; State environmental agencies; USEPA; and coastal universities. Scientific publication databases (including Science Direct, Elsevier, the NOAA Central Library National Oceanographic Data Center, and JSTOR) were checked for new information using general Internet searches based on major themes. New information has been found on oiled beaches following the *Deepwater Horizon* explosion, oil spill, and response as well as on the ecological resilience of hardened beaches, which provides baseline information for the affected environment.

Urbano et al. (2013) examined small surface residue balls (also called tarballs) of oil on Fourchon Beach and Elmer's Island, Louisiana, and found that the position with respect to the tidal zone affected the rate of biodegradation, with the most efficient degradation occurring in the Fourchon supratidal samples and in some intertidal small surface residue balls. Newton et al. (2013) sampled beach sands at seven Gulf Coast beaches and found that, while individual beaches had unique bacterial communities, oil contamination increased the variability in community composition. Daylander et al. (2014) evaluated mobility and redistribution patterns of surface residual balls. They found that, under calm conditions, small surface residue balls are unlikely to move alongshore, but that mobility and transport was likely during storms, and that inlets probably serve as traps for small surface residue balls. These studies serve to expand our understanding of the baseline environment following the *Deepwater Horizon* explosion, oil spill, and response. They also provide information about the continuing impacts in the years following oil contamination of beaches.

Another recent study has investigated the impacts of non-OCS oil- and gas-related activity, such as reduced ecological resilience observed as sandy beach ecosystems are squeezed between fortifications and increasing sea levels (Berry et al., 2013). They found that hard- and soft-engineered options impede sand transport and storage systems and prevent retreat from advancing seas. This study helps to provide a context for the threats to beaches from sources other than OCS oil- and gas-related activities.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As identified in the resource analyses in this Supplemental EIS and in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete or unavailable information on impacts to beaches from the *Deepwater Horizon* explosion, oil spill, and response. Other unknowns are future benefits from restoration projects and future impacts of coastal development. This incomplete or unavailable information may be relevant to reasonably foreseeable significant adverse effects because recent events such as the *Deepwater Horizon* explosion, oil spill, and response may have caused changes to baseline conditions for coastal barrier beaches and associated dunes of the Gulf of Mexico. A large body of information regarding impacts of the *Deepwater Horizon* explosion, oil spill, and response upon coastal beaches and associated dunes is being developed through the NRDA process, but this information is not yet available. BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis (e.g., Urbano et al., 2013; Newton et al., 2013; Daylander, 2014; and Berry et al., 2013). These and other studies show that bacterial communities present in coastal beaches gradually degraded the oil that was stranded on beaches following the *Deepwater Horizon* explosion, oil spill, and response (Bik et al. 2012; Kostka et al., 2011). These studies provided information about weathering and mobility of tarballs on and adjacent to the oiled beaches. None of the sources identify any reasonably foreseeable impacts that are significantly greater to coastal beaches and associated dunes with the implementation of an Action alternative as compared with the impacts of the No Action alternative. The WPA is an active oil and gas region with ongoing exploration, drilling, and production activities. In addition, non-OCS energy-related factors will continue to occur in the WPA irrespective of a WPA proposed action (i.e., development, urbanization, recreational activities, etc.). The potential for effects from changes to the affected environment (post-*Deepwater Horizon*), routine activities, accidental spills (including low-probability catastrophic spills), and cumulative effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on coastal barrier beaches and associated dunes from either smaller accidental events or low-probability catastrophic events will remain nearly the same. Although the body of available information is incomplete, the evidence currently available supports past analyses and does not indicate severe adverse impacts to coastal barrier beaches and associated dunes as a result of a WPA proposed action. Therefore, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives.

There are also data gaps regarding the future restoration efforts being planned, such as what projects will ultimately be constructed and how successful they may be. The extent of other impacts to beaches in the future from coastal development is likewise unknown. This information will not be available until such projects are constructed, which is not within the timeline contemplated in the NEPA analysis of this Supplemental EIS. However, BOEM used existing information regarding the effects of past projects, the plans for restoration projects currently being considered under the RESTORE Act, and past effects of coastal development on coastal beaches to anticipate the benefit of restoration projects in the WPA (Gulf Coast Ecosystem Restoration Council, 2014; Texas Commission on Environmental Quality, 2014b; State of Louisiana, Coastal Protection and Restoration Authority, 2014; State of Mississippi, Dept. of Environmental Quality, 2014; Alabama Gulf Coast Recovery Council, 2014; State of Florida, Dept. of Environmental Protection, 2014). BOEM has determined that the scope of the planned restoration projects would likely only partially restore what was present historically along the Gulf Coast, although any restoration of coastal barrier beaches and associated dunes would reduce the land loss rates.

However, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives because the scope of the planned restoration projects would likely only partially restore what was present historically along the Gulf Coast, and BOEM can extrapolate the effects of a WPA proposed action based on the effects of past lease sales on earlier baselines.

Summary and Conclusion

BOEM has reexamined the analysis for coastal barrier beaches and associated dunes presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for beaches and dunes. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.4. Wetlands

BOEM has reexamined the analysis for wetlands presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for wetlands previously presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of wetlands, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.4.1, 4.1.1.4.2, and 4.1.1.4.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.4 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.4.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.4 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

The primary routine impact-producing activities associated with a WPA proposed action that could affect wetlands and marshes include pipeline emplacement, channel maintenance and construction, disposal of OCS oil- and gas-related wastes, increased vessel traffic, and the use and construction of support infrastructure in these coastal areas. Potential impacts from these factors include land and wake erosion from pipeline emplacement, channel dredging, and navigation traffic, and additional onshore development encouraged by increased capacities of navigation channels. A WPA proposed action is projected to contribute to the construction of 0-1 new onshore pipelines. If new pipelines are needed, impacts to wetlands are reduced by modern construction techniques and mitigating measures, which would result in zero to negligible impacts on wetland habitats. Modern construction techniques avoid wetlands through the use of directional drilling to eliminate additional trenching in wetlands. Regulations require the avoidance of wetlands through selective emplacement in existing corridors and the restoration and revegetation of the impacted areas. In addition, the potential impacts from a WPA proposed action would be reduced through the continued use of armored channels and modern erosion-control techniques. If channel dredging is required, the dredged material will require disposal. However, it may be beneficially used for marsh creation to mitigate for land loss. Creation of OCS wastes and drilling by-products would require disposal, but they should be delivered to existing facilities. Because of existing facility capacity, no additional facility expansion into wetland areas is expected. Secondary impacts to wetlands caused by existing pipeline and vessel traffic corridors will continue to cause land loss because pipelines canals were constructed before modern techniques were implemented and many reaches of current vessel traffic corridors are not armored. However, because of permit requirements, modern construction techniques, and mitigation, routine OCS oil- and gas-related activities associated with a WPA proposed action are expected to cause negligible impacts to wetlands.

The main accidental impact-producing factor that would affect wetlands is oil spills, which could result in the physical oiling of wetlands. The most likely cause of a spill ≥1,000 bbl is a pipeline break at the seafloor; other sources include platform or vessel accidents. Wetland impacts from spills originating on the OCS would be minimized due to the distance of wells and production facilities to the coastal wetlands and the protection provided by the barrier islands, peninsulas, sand spits, and currents. These factors, combined with the potential for only highly-weathered or treated oil reaching the shoreline, greatly minimize or eliminate the impacts of spills originating on the OCS. However, if an oil spill related to a WPA proposed action occurs in a river, bay, or estuary, some impact to wetland habitat could be expected. Although the probability of occurrence is low, the greatest threat of an oil spill to wetland habitat is from an oil spill in a river, bay, or estuary as a result of a vessel accident or pipeline rupture. Wetlands in the northern Gulf of Mexico are in moderate- to high-energy environments, and tidal movement should reduce the chances of oil persisting in these areas. While a resulting oil slick may cause minor impacts to wetland habitat, the equipment and personnel used to clean up the spill can generate the greatest impacts to the area. Associated foot traffic can work oil farther into the sediment than would otherwise occur. Close monitoring and restrictions on cleanup activities using bottom-disturbing equipment would be needed to avoid or minimize those impacts. Overall, impacts to wetland habitats from an oil spill associated with activities related to a WPA proposed action would be expected to be minimal and temporary because of the distance of most of the activity from shore, the weathering of spilled oil, and the ability of vegetation to recover from exposure to crude oil (Khanna et al., 2013).

The cumulative analysis considers the effects of impact-producing factors related to a WPA proposed action, prior and future OCS lease sales in the Gulf of Mexico, and non-OCS oil- and gas-related activities such as State oil and gas activities, other governmental and private projects and activities, and natural processes that may affect wetlands. Several OCS oil- and gas-related cumulative impact-producing factors could potentially impact wetland resources, including the following: oil spills and cleanup activity; OCS oil- and gas-related vessel traffic; construction of OCS oil- and gas-related infrastructure and support structure (including pipelines); and waste disposal.

The primary impact-producing factors attributable to a WPA proposed action are pipeline landfalls, canal widening, and maintenance dredging of navigation canals because they result in land loss. However, modern construction techniques and regulations reduce impacts to wetlands as a result of these activities. In addition, because the increase in pipelines, dredging, and vessel traffic from a WPA proposed action are predicted to be minimal, impacts related to these factors are also expected to be minimal. The possibility of physical oiling of wetlands from a WPA proposed action as a result of an oil spill originating in OCS waters is minimal compared with an oil spill that is closer to the wetlands and that could occur in State waters or in rivers, bays, or estuaries. The effects from a spill have the highest probability of occurring in Galveston and Matagorda Counties, Texas. These are the primary areas where oil produced in the WPA is transported and distributed, while oil produced in the CPA is handled in Lafourche, Cameron, Plaquemines, and St. Bernard Parishes, Louisiana. If any oil spills occur in rivers, bays, or estuaries from pipelines or vessels, they will likely be small and at service bases or other support facilities, and these small-scale local spills would not be expected to severely affect wetlands. Accidental spills as a result of a low-probability catastrophic event, which are not part of the proposed action not likely expected, may have impacts on wetlands. Low-probability catastrophic events are discussed in **Appendix B**.

Non-OCS oil- and gas-related cumulative impact-producing factors that could potentially impact wetland resources include the following: State oil and gas; non-OCS oil- and gas-related vessel traffic; coastal infrastructure and development; maintenance of navigation canals; natural processes (including hurricane and tropical storms); and sea-level rise. Non-OCS oil- and gas-related impacts from residential, commercial, agricultural, and silvicultural (forest expansion) developments are expected to continue in coastal regions around the Gulf of Mexico. Wetlands are most vulnerable to oil spills that may occur in State waters or in rivers, bays, or estuaries, the impacts of which would be primarily localized in nature. Many such spills are from non-OCS oil- and gas-related sources, such as State oil and gas activities, which can include vessel collisions, pipeline breaks, and shore-based transfer, refining, and production facilities. Insignificant adverse impacts upon wetlands from maintenance dredging are expected because the large majority of the material would be placed in existing disposal areas or used beneficially for marsh restoration or creation. Hurricanes and tropical storms can cause extensive damage to wetlands, including conversion of large acreages of wetlands to open water. Marine vegetation deposited by storms can rest on wetland plants, resulting in mortality. One benefit of storms is that they can be capable of delivering sediment from offshore or interior bays into wetland areas, partially offsetting erosion. Sea-level rise can impact coastal wetlands by the drowning of plants. Relative sea-level rise, which includes local factors such as subsidence, can increase salinity and flooding, resulting in reduced productivity of wetland plants (Spalding and Hester, 2007).

Development pressures in the coastal regions of Texas have been primarily the result of tourism and residential beachside development in the Galveston and Bolivar Peninsula areas. In Galveston, recreation and tourist developments have been particularly destructive. Development pressures in the coastal regions of Louisiana, Mississippi, Alabama, and Florida have caused the destruction of large areas of wetlands. In coastal Louisiana, the most destructive developments have been the inland oil and gas industry projects, which have resulted in the dredging of huge numbers of access channels. Agricultural, residential, and commercial developments have caused the most destruction of wetlands in Mississippi, Alabama, and Florida. In Florida, recreational and tourist developments have been particularly destructive. Groundwater extraction, vessel traffic, the drainage of wetland soils, and the construction of buildings, roads, and levees have also caused the loss of wetlands. The cumulative effects of human and natural activities in the coastal area have severely degraded the deltaic processes and have shifted the coastal area from a condition of net land building to one of net land loss; therefore, wetland loss is expected to continue.

A WPA proposed action represents a small (<5%) portion of the OCS oil- and gas-related impacts that will occur over the 40-year analysis period. Impacts associated with a WPA proposed action are a minimal part of the overall OCS oil- and gas-related impacts. The incremental contribution of a WPA proposed action to the cumulative impacts to coastal wetlands is minimal compared with the impacts associated with non-OCS oil- and gas-related activities in the GOM.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search was conducted for information published on northern Gulf of Mexico wetland communities, and various sources were examined to determine any recent information regarding these communities. Sources investigated include BOEM, the USGS National Wetlands Research Center, the USGS Gulf of Mexico Integrated Science Data Information Management System, Gulf of Mexico Alliance, State environmental agencies, USEPA, and coastal universities. Other scientific publication databases (including Science Direct, Elsevier, the NOAA Central Library National Oceanographic Data Center, and JSTOR) were checked for new information using general Internet searches based on major themes. New information was found on the affected environment, including information on in the impacts and recovery from the *Deepwater Horizon* explosion, oil spill, and response as well as information on marsh populations in Texas and wetland loss.

Numerous studies have been published regarding impacts of the *Deepwater Horizon* explosion, oil spill, and response. Zengel et al. (2014) compared treatment options for oiled marshes in Barataria Bay, Louisiana, 3 years after the initial oiling. They found that mechanical treatment (including vegetation raking, cutting, and using "squeegees" to skim thick oil mousse from the marsh surface), coupled with the planting of *Spartina alterniflora*, resulted in improved habitat recovery, compared with no treatment and mechanical treatment alone. Judy et al. (2014) studied impacts of oil from the *Deepwater Horizon* oil spill on *Phragmites australis* and found strong resistance to negative impacts when oil was applied to shoots alone, and greater impacts when oil was applied to the soil or with repeated shoot oiling. Sublethal effects were observed from application of oil to the soil, but mortality was not observed. This study indicates that *Phragmites australis* may have experienced greater impacts from oiled soil than oiled shoots alone as a result of the *Deepwater Horizon* explosion, oil spill, and response. This information can be used to assess the impact of oil spills to wetlands.

Michel and Rutherford (2014) reviewed 32 oil spills and field experiments and found that, in many cases, recovery of marshes occurred within 1-2 growing seasons, even without treatment. Recovery was shortest for spills in a warm climate, light to heavy oiling of the vegetation only (not the marsh surface), medium crude oils, and less intensive treatment. Michel and Rutherford (2014) offered treatment recommendations for spills based on several related criteria. This information can be also used to assess the impact of oil spills to wetlands, as well as provide insight into how oil-spill response can influence recovery.

Liu and Liu (2013) investigated bacterial communities present in oil mousses collected from impacted salt marshes during the *Deepwater Horizon* explosion, oil spill, and response. *Vibrio* bacteria, a human pathogen, represented 57 percent of the community, suggesting that this indigenous genus is particularly responsive to weathering oil in the salt marshes.

Khanna et al. (2013) used Advanced Visible Infrared Imaging Spectrometer (AVIRIS) data from Barataria Bay, Louisiana, in September 2010 and August 2011 to map oil contamination and examine the impacts to vegetation. They found that vegetation stress was restricted to the tidal zone, extending 14 m (46 ft) inland from the shoreline in 2010, with the highest stress at the shoreline, and decreasing with distance from the water. Khanna et al. (2013) also found varying degrees of revegetation in 2011, with the poorest recovery adjacent to shorelines, which is where oil stress was the highest. This study showed salt marsh recovery the year following the *Deepwater Horizon* explosion, oil spill, and response, with the slowest recovery in the most heavily oiled areas.

Other recent research focused on issues other than oil-spill impacts. Staszak and Armitage (2013) evaluated the results of salt marsh restoration projects in Galveston Bay, Texas. They found that the restored areas had relatively high ecological value and contributed to the integrity of the regional wetland landscape. This information can be used to understand the net effect of oil spills to wetlands that are impacted but later restored.

Glick et al. (2013) investigated the potential impact of current and accelerating sea-level rise rates on key coastal wetland habitats in southeastern Louisiana, using the Sea Level Affecting Marshes Model. Results indicate a range of potential wetland losses from 9 to 24 percent of the 2007 wetland area by 2100, depending on whether the lowest or highest sea-level-rise scenario was used. Cypress-tupelo swamp is projected to be heavily impacted by permanent flooding, thereby affecting regeneration. This information helps to project the future status of the affected environment.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As identified in the resource analyses in this Supplemental EIS and in Chapter 4.1.1.4 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete or unavailable information regarding wetlands in the WPA. This incomplete or unavailable information may be relevant to this analysis because recent events such as the *Deepwater Horizon* explosion, oil spill, and response may have caused changes to baseline conditions for coastal wetlands of the Gulf of Mexico. A large body of information regarding impacts of the *Deepwater Horizon* explosion, oil spill, and response upon coastal wetlands is being developed through the NRDA process, but this information is not yet available. Other unknowns are future benefits from restoration projects and future impacts of sea-level rise. BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis, e.g., Michel and Rutherford (2014), Zengel et al. (2014), Judy et al. (2014), Khanna et al. (2013), Moody et al. (2013), Staszak and Armitage (2013), and Glick et al. (2013). These studies provide insight into the extent of impacts that could be expected from a low-probability catastrophic oil spill, which is not part of a WPA proposed action and not likely expected, and potential recovery. However, none of these sources reveal reasonably foreseeable significantly greater adverse impacts from an Action alternative or the No Action alternative because the WPA is an active oil and gas region with ongoing exploration, drilling, and production activities. In addition, non-OCS energy-related factors will continue to occur in the WPA irrespective of a WPA proposed action (e.g., commercial development, subsidence, and hurricanes). The potential for effects from changes to the affected environment (post-*Deepwater Horizon*), routine activities, accidental spills (including low-probability catastrophic spills), and cumulative effects remains whether or not the No Action or an Action alternative is chosen under this EIS. Impacts on wetlands from either smaller accidental events or low-probability catastrophic events will remain the same. Therefore, BOEM has determined that the information is not essential to a reasoned choice among alternatives.

There are also data gaps regarding the future restoration efforts being planned in coastal states, such as what projects will ultimately be constructed and how successful they may be. This information will not be available until such projects are constructed, which is not within the timeline contemplated in the NEPA analysis of this Supplemental EIS. However, BOEM used existing information regarding the effects of past projects, the plans for restoration projects currently being considered under the RESTORE Act, and past effects of coastal development on coastal wetlands to anticipate the benefit of restoration projects in the WPA (Gulf Coast Ecosystem Restoration Council, 2014; Texas Commission on Environmental Quality, 2014b; State of Louisiana, Coastal Protection and Restoration Authority, 2014; State of Mississippi, Dept. of Environmental Quality, 2014; Alabama Gulf Coast Recovery Council, 2014; State of Florida, Dept. of Environmental Protection, 2014). BOEM has determined that the scope of the planned restoration projects would likely only partially restore what was present historically along the Gulf Coast, although any restoration of wetlands would reduce the land loss rates. However, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives because BOEM can extrapolate the effects of a WPA proposed action based on the effects of past lease sales on earlier baselines and can reasonably use the extrapolation in current analyses.

The rate of future sea-level rise is unknown (Hausfather, 2013), but BOEM has used studies of the effects of sea-level rise on wetland plants, as well as a study that used a likely range of projections of sea-level rise (Glick et al., 2013) to assess the likely impacts of sea-level rise to the baseline environment. BOEM used this existing information to determine possible impacts of a natural non-OCS oil- and gas-related activity on an altered coast and compare it with the possible impacts of a WPA proposed action. BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives because BOEM can extrapolate the effects of a WPA proposed action on expected reduced future acreages of wetlands based on the effects of past lease sales on earlier baselines.

Summary and Conclusion

BOEM has reexamined the analysis for wetlands presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/246 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for wetlands presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238, 246, and 248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.5. Seagrass Communities

BOEM has reexamined the analysis for seagrass communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for seagrass communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of seagrass communities, as well as the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.5.1, 4.1.1.5.2, and 4.1.1.5.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.5 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.5.4 the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.5 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

The potential routine-impact producing factors on seagrass communities of the WPA include the construction of pipelines, canals, navigation channels, and onshore facilities; maintenance dredging; and vessel traffic (e.g., propeller scars). These factors could result in submerged vegetation beds being uprooted, scarred, or lost; decreased oxygen in the water; turbidity; and the burial of plants from suspended sediment. However, routine OCS oil- and gas-related activities in the WPA that may impact seagrasses are not predicted to significantly increase in occurrence and range in the near future. Only a single potential new pipeline landfall is expected as a result of a WPA proposed action. Requirements of other Federal and State programs, such as avoidance of seagrass and submerged vegetation communities or the use of turbidity curtains, reduce undesirable effects on submerged vegetation beds from potentially harmful activities. Local programs decrease the occurrence of prop scarring in grass beds, and generally, channels used by OCS oil- and gas-related vessels are away from exposed submerged vegetation beds. Because of these requirements and implemented programs, along with the beneficial effects of natural flushing (e.g., from winds and currents), any potential effects from routine OCS oil- and gas-related activities on submerged vegetation in the WPA are expected to be short term, localized, and not significantly adverse.

Accidental disturbances resulting from a WPA proposed action, including oil spills and blowouts, have the potential to change community structure, decrease growth rates, cause death, or cause a decline in ecological services by seagrass communities of the WPA. Although the size would be small and the duration would be short term, the greatest threat to inland, submerged vegetation communities would be from an inland spill resulting from a vessel accident or pipeline rupture. Because pipelines can be shut off, ships carry limited amounts of oil, and response vessels can more easily access nearshore areas, it is expected that the resulting spill would be smaller and shorter than an uncontrolled offshore spill or blowout, resulting in short-term and localized impacts. There is also the remote possibility of an offshore spill to reach an extent that it could affect submerged vegetation beds, and this would have similar effects as an inshore spill. The resulting impacts to seagrass from contacting oil could range from the sloughing of epiphytes to plant death. Further, an offshore spill could result in more sinking oil (e.g., tarballs and patties) than an inshore spill, and oil could become entrained within seagrass root and leaf complex near the seafloor. Because prevention and cleanup measures can have negative effects on submerged vegetation, close monitoring and restrictions on the use of bottom-disturbing equipment would be needed to avoid or minimize those impacts. The floating nature of nondispersed crude oil, the regional microtidal range, the dynamic climate with mild temperatures, and the amount of microorganisms that consume oil would alleviate prolonged effects on submerged vegetation communities. Also, safety and spill-prevention technologies are expected to continue to improve and will minimize effects to submerged vegetation from a WPA proposed action. Impacts to submerged vegetation from an accidental event related to a WPA proposed action are expected to be minimal due to the distance of most activities from the submerged vegetation beds and because the likelihood of an accidental event reaching submerged vegetation beds remains small.

The cumulative OCS oil- and gas-related activities that present the greatest threat of impacts to submerged vegetation communities are dredging, oil spills, and pipeline installation. In general, a WPA proposed action would cause a minor incremental contribution to impacts on submerged vegetation from related dredging, pipeline installations, and oil spills. Of those mentioned, dredging generates the greatest overall risk to submerged vegetation by uprooting and burying plants, decreasing oxygen in the water, and reducing water clarity in an area. A low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected, could also impact seagrass communities. Refer to **Appendix B** for more details on the impacts of a low-probability catastrophic spill. Further, non-OCS oil- and gas-related dredging and vessel traffic, boat scarring, changes in salinity and nutrient inputs (Waycott et al., 2009; Orth et al., 2006), changes to natural flow regimes from constructed structures, and storm events could continue to cause direct damage to seagrass beds by physical destruction, increased turbidity and burial of plants, and reduction in favorable environmental conditions for seagrass bed growth. However, the incremental contribution of stress from a WPA proposed action to submerged vegetation is reduced by the implementation of proposed lease stipulations, mitigating measures currently in place, and the small probability of an oil spill.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search of various printed and Internet sources was conducted for any recent information published regarding submerged vegetation. Sources investigated include BOEM, USDOC/NOAA, the USGS National Wetlands Research Center, the USGS Gulf of Mexico Integrated Science Data Information Management System, Seagrass Watch, Gulf of Mexico Alliance, State environmental agencies, USEPA, and coastal universities. Other websites from scientific publication databases (including Science Direct, Elsevier, CSA Illumina now ProQuest, and JSTOR) were checked for new information using general Internet searches based on major themes. No new information that would add to the analyses or change the conclusions was discovered since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231, and WPA 238/246/248 Supplemental EISs.

Incomplete or Unavailable Information

After evaluating the information above, BOEM has determined that the previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS are still valid because no new information on seagrass communities pertinent to a WPA proposed action has been published since the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. With regards to the *Deepwater Horizon* oil spill, BOEM extrapolated existing information using reasonably accepted scientific methodologies to come to the conclusion that oil did not reach the seagrass communities in the WPA. The NOAA has estimated that the westernmost extent of visible sheens related to oil from the *Deepwater Horizon* explosion extended no farther than Cameron Parish, Louisiana, which is to the east of the WPA boundary (Figure 1-2 of the 2012-2017 WPA/CPA Multisale EIS), and data collected by OSAT indicate that the *Deepwater Horizon* oil spill did not reach WPA waters or sediments (OSAT, 2010). In addition, BOEM has not identified any other data gaps in its evaluation of seagrasses and impacts to seagrasses as a result of a WPA proposed action. Therefore, BOEM has determined that there is no incomplete or unavailable information for seagrasses at this time.

Summary and Conclusion

BOEM has reexamined the analysis for seagrass communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. With the understanding that no new information on seagrass communities has been published since the WPA 238/246/248 Supplemental EIS, no new information was discovered that would alter the previously presented impact conclusion for seagrass communities. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.6. Topographic Features

BOEM has reexamined the analysis for topographic features (high relief features that provide habitat for corals and other hard bottom communities) presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for topographic features presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts discussed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of topographic features, along with the full analysis of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.6.1, 4.1.1.6.2, and 4.1.1.6.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.6 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.6.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.6 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Because of the recognized importance of the topographic features, BOEM proposes attaching the Topographic Features Stipulation (as described in NTL 2009-G39) to OCS oil and gas leases within the Topographic Feature Stipulation blocks. When applied, this stipulation would prevent most of the potential impacts on topographic features from bottom-disturbing activities (structure removal and emplacement) and operational discharges associated with a WPA proposed action through avoidance. In addition, it would distance topographic features from possible accidental events. The stipulation would require that bottom-disturbing activities be located at least 152 m (500 ft) from a topographic feature's No Activity Zone and that drill cuttings and fluids from wells within designated shunting zones must be shunted to the seafloor, although shunting requirements can vary among features.

The potential routine impact-producing factors on topographic features of the WPA could include bottom-disturbing activities like anchoring, infrastructure emplacement or removal, and drilling-effluent and produced-water discharges. These factors could result in crushing and smothering of sensitive organisms and exposure to concentrated discharges. If the Topographic Features Stipulation is applied, it will minimize the potential impacts to the topographic features by distancing bottom-disturbing activities from the sensitive habitat. The distancing eliminates the possibility of anchors, pipelines, and structures being placed on top of the features, and structure-removal activity will be distanced enough to minimize impacts to topographic features. If any contaminants reach topographic features, they would be diluted from their original concentration, and impacts that may occur should be minimal. In addition to the mitigations, discharges or activities that could harm topographic features are regulated by other agencies, including discharge permit restrictions from USEPA and essential fish habitat restrictions from NOAA. Furthermore, the high-energy environment and prevailing water currents associated with topographic features would help protect the features by enabling rapid turnover of the water column.

Adverse effects from accidental disturbances resulting from a WPA proposed action could include surface and subsurface oil spills and blowouts. Each has the potential to disrupt and alter the environmental, commercial, recreational, and aesthetic values of topographic features of the WPA through oiling and sedimentation. The proposed Topographic Features Stipulation would assist in preventing most of the possible accidental impacts on topographic feature communities by increasing the distance of such events from the topographic features. It is expected that the majority of subsurface oil released during an accidental event would rise rapidly to the surface and that the most heavily oiled sediments in the water column would likely be deposited on the seafloor before reaching the topographic features. In the event that diluted oil from a subsurface spill did reach the biota of a topographic feature, the effects would be primarily sublethal and impacts would be at the community level. Any turbidity, sedimentation, and oil adsorbed to sediment particles would also be at low concentrations by the time the topographic features were reached, likely resulting in primarily sublethal impacts. Impacts from a surface oil spill on topographic features are also lessened by the distance of the spill to the features, the depth of the features, and the prevailing water currents that sweep around the features.

The cumulative impact from routine OCS oil- and gas-related operations includes effects resulting from a WPA proposed action, as well as those resulting from past and future OCS leasing. These operations include anchoring, structure emplacement, muds and cuttings discharge, effluent discharge, blowouts, oil spills, and structure removal. Without mitigation, these factors could result in the crushing and smothering of organisms on topographic features or exposure to concentrated discharges or oil. Low-probability catastrophic spills could also potentially cause damage to benthic biota (refer to **Appendix B** for more details). Potential non-OCS oil- and gas-related factors include vessel anchoring, SCUBA diving, treasure-hunting activities, import tankering, heavy storms and hurricanes, the collapse of the tops of the topographic features due to dissolution of the underlying salt structure, and fishing activities. Many of these non-OCS oil- and gas-related factors may result in physical damage to topographic features as well. The OCS and non-OCS oil- and gas-related activities causing mechanical disturbance represent the greatest threat to the topographic features. Impacts from OCS oil- and gas-related activities would, however, be mitigated by the continued application of the proposed Topographic Features Stipulation. This stipulation would preclude mechanical damage caused by oil and gas leaseholders from impacting the benthic communities of the topographic features and would protect them from operational discharges by establishing a buffer around the features. As such, little impact would be incurred by the biota of the topographic features as a result of OCS oil- and gas-related activities. The USEPA discharge regulations and permits would further reduce discharge-related impacts. With the application of stipulations and regulations, the incremental contribution of a WPA proposed action to the cumulative impact is negligible when compared with non-OCS oil- and gas-related impacts.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search of Internet information sources (e.g., the NOAA Gulf Spill Restoration Publications website, the Environmental Response Management Application [ERMA] Gulf Response website; NOAA's *Deepwater Horizon* Archive Publications and Factsheets; the Gulf of Mexico Sea Grant *Deepwater Horizon* Oil Spill Research and Monitoring Activities Database; RestoreTheGulf.gov website, and the *Deepwater Horizon* Oil Spill Portal) and public search engines to search published journal articles, Federal documents, and research reports was conducted to determine the availability of recent information on topographic features. The search revealed new information on the affected environment that is pertinent to this Supplemental EIS.

Newly published research related to the corals found a high degree of population connectivity among the Flower Garden Banks and other coral reefs in the Florida Reef Tract and the Caribbean (Goodbody-Gringley et al., 2011; Serrano 2013). Genetic similarities for shallow-water *Montastraea cavernosa* populations suggest that the Flower Gardens may be an important larval source and/or that there is an unidentified source providing larvae throughout the region. Differences among populations in appearance are phenotypic rather than genetic (Goodbody-Gringley et al., 2011; Serrano 2013). As such, if further research determines that the Flower Gardens Banks are a larval source for the Florida Reef Tract, then these source corals may be more important to the ecology of the Gulf of Mexico at the landscape scale than previously suggested.

For the Flower Gardens, BOEM has published a study, in conjunction with the Flower Garden Banks National Marine Sanctuary, that monitored multiple species of vertebrates and invertebrates found on the topographic structures (Johnston et al., 2013). They found that the reefs are among the healthiest in the Gulf of Mexico, with high coral cover and high species diversity. They also state that the reefs have maintained this status throughout a time period when OCS development has occurred in nearby blocks.

Additionally, Nash et al. (2013) reviewed the species diversity at the topographic features located off the southern Texas coast and found that each of these banks exhibited a high degree of diversity, but that research on these features has not been updated in decades. They also noted that Southern Bank was a good surrogate for understanding trends in biodiversity among the other banks in the region and that it could be used as a sentinel site to detect landscape scale changes. They also suggest that these reefs may have a high degree of connectivity with the Tuxpan Reef System in Mexico, emphasizing their role in regional ecological processes.

At Stetson Bank, a topographic feature in the WPA, DeBose et al. (2012) found that the feature has undergone two shifts in population structure since 1999. The result is that the community has changed from a coral-sponge community to an algal-dominated community. The exact causes of the shifts are undetermined, but it is suggested that the increased hurricane activity in 2005 and a regionwide coral bleaching event may have been threshold events preventing recovery of the coral-sponge community. This study does not implicate development of any OCS oil- and gas-related resources as a potential cause of the community shifts.

With respect to the actual concentration of PAHs in the *Macondo* samples collected during the NRDA process, questions have been raised about the sampling methodology used during the NRDA sampling cruises. Sammarco et al. (2013) criticized the technique of using Niskin bottles to collect at discrete positions within the water column in favor of techniques that collected or filtered larger quantities of water using other sampling media. Their results suggest that PAH concentrations may be more prevalent and more concentrated than reported by NRDA. Although the only topographic feature they sampled was in the CPA (Sackett Bank), if exposure was higher there, the possibility exists that exposure to other topographic feature in the CPA and WPA may have been greater than previously thought.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined the new information does not change the conclusions found in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. However, working in deep marine systems is complex and requires substantial resources; as such, research on these features has been limited. Thus, there is a substantial amount of information that remains unknown about these features. All analyses discussed in this Supplemental EIS, as well as in Chapter 4.1.1.6 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, are based on incomplete information. Because topographic features are not unique to the WPA, information collected throughout the GOM has been used in this analysis. For example, our understanding of the possible impacts of surface oil spills to topographic features in the GOM was determined by combining research on the depth and concentration of physical mixing of surface oil with the known depths of WPA topographic features. These results suggest that, although oil measurements were not collected at every feature under every condition, topographic features exist at depths deeper than lethal concentrations of oil would be expected (Lange, 1985; McAuliffe et al., 1975 and 1981; Tkalich and Chan, 2002; Rezak et al., 1983; Wyers et al., 1986). Additionally, continuous monitoring of the Flower Garden Banks since the 1970's for impacts related to OCS development suggests that BOEM's Topographic Features Stipulation may achieve the stated objective of minimizing damage to topographic features from OCS oil- and gas-related activities (refer to Johnston et al., 2013, and references therein). At the Flower Garden Banks, corals have flourished while OCS development has occurred, and in some cases, activities have taken place just outside the No Activity Zone. Since corals are generally considered to be more fragile than most other organisms found in the WPA, it is reasonable to conclude that topographic features in the WPA with more resilient organisms than the Flower Garden Banks have not been negatively impacted by OCS development in the GOM.

With respect to unavailable information in relation to the *Deepwater Horizon* explosion, oil, spill, and response, the majority of this information cannot be obtained because it has not been released. Relevant data on the status of topographic features may take years to acquire and analyze. This unavailable information may be relevant to adverse effects because the *Deepwater Horizon* explosion, oil spill, and response may have caused changes to baseline conditions for topographic features in the Gulf of Mexico. While outstanding reports are not expected to reveal reasonably foreseeably significant effects, BOEM nonetheless determined that additional information could not be timely acquired and incorporated into the current analysis. For example, if sampling techniques show that oil concentration were greater at topographic features in the CPA (Sammarco, 2013), then it is possible that more oil reached the topographic features in the WPA than previously reported. However, until this information is made available, it is impossible to make this determination.

BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing this analysis and formulating the conclusions presented here. Although the body of available information is incomplete, the evidence currently available supports past analyses and does not indicate severe adverse impacts to topographic features. Therefore, BOEM has determined that the incomplete or unavailable information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for topographic features presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/ 248 Supplemental EIS, based on the additional information provided above. The new information presented here would not alter the previous impact conclusion for topographic features. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.7. Sargassum *Communities*

BOEM has reexamined the analysis for *Sargassum* communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for *Sargassum* communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

A detailed description of *Sargassum* communities, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.7.1, 4.1.1.7.2, and 4.1.1.7.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.7 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.7.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.7 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Impact-producing factors associated with routine events for a WPA proposed action that could affect *Sargassum* may include the following: drilling discharges (muds and cuttings); produced water and well treatment chemicals; operational discharges (deck drainage, sanitary and domestic water, bilge and ballast water); and physical disturbance from vessel traffic and the presence of exploration and production structures (i.e., rigs, platforms, and MODUs). Because *Sargassum*, a pelagic algae, is widely distributed in the upper water column near the sea surface, it may be contacted by routine discharges from oil and gas operations, including drilling discharges, produced water, and operational discharges (e.g., deck runoff, bilge water, sanitary effluent, etc., from service vessels, working platforms, and drillships). However, the quantity and volume of these discharges are relatively small compared with the volume of water in the WPA (115,645 km^2; 44,651 mi^2), and the discharges are highly regulated as well as diluted with distance from the source, therefore reducing possible toxicity. Transiting vessels may pass through *Sargassum* mats, producing slight impacts to the *Sargassum* community from propellers and possible impingement on cooling water intakes. None of these impacts associated with a WPA proposed action are expected to have more than minor localized effects to *Sargassum* mats and limited effects to the *Sargassum* community as a whole. *Sargassum* would be resilient to the minor effects predicted because it has a yearly cycle that promotes quick recovery from impacts. No measurable impacts are expected to the overall population of the *Sargassum* community.

Impact-producing factors associated with accidental events that may be associated with a WPA proposed action that could affect *Sargassum* and its associated communities include surface oil and fuel spills and underwater well blowouts, spill-response activities, and chemical spills. These impact-producing factors would have varied effects depending on the intensity of the spill and the presence of *Sargassum* in the area of the spill. All types of spills, including surface oil and fuel spills, underwater well blowouts, and chemical spills, could potentially contact *Sargassum* algae. The quantity and volume of most of these spills would be relatively small compared with the pelagic waters of the WPA (115,645 km^2; 44,651 mi^2). Therefore, most spills would only contact a very small portion of the *Sargassum* population. Accidental spills would likely be diluted by the Gulf water and, therefore, concentrations of toxic components that could potentially contaminate or kill *Sargassum* tissues would also be reduced in this scenario. The impacts to *Sargassum* that are associated with a WPA proposed action are expected to have only minor effects to a small portion of the *Sargassum* community. In the case of a very large spill, the *Sargassum* algae community could result in the death of a large number of plants across a geographically large area in the northern Gulf. The *Sargassum* community lives in pelagic waters with generally high water quality and is expected to show good resilience to the predicted effects of spills. It has a yearly cycle that promotes quick recovery from impacts. No measurable impacts are expected to the overall population of the *Sargassum* community as a result of accidental events associated with a WPA proposed action.

The cumulative impact from routine oil and gas operations includes effects resulting from a WPA proposed action, as well as those resulting from past and future OCS leasing. The OCS oil- and gas-related impact-producing factors that can affect *Sargassum* include impingement by structures and marine vessels, oil and gas drilling discharges, operational discharges, and accidental spills. Of the possible factors, impingement, routine discharges, and accidental spills are the primary pathway that populations could be effected from OCS oil- and gas-related activities. However, because *Sargassum* communities are scattered, patchy, and mobile with a widespread distribution, many activities associated with a WPA proposed action should only result in localized and short-term effects. A low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected, may also cause mortality to *Sargassum* communities (refer to **Appendix B** for more details).

Potential non-OCS oil- and gas-related factors include impingement or destruction from shipping traffic, hurricanes, and coastal water quality. Shipping traffic would be the largest non-OCS oil- and gas-related activity to impact *Sargassum.* However, given the ephemeral nature of *Sargassum* at any given location, it is expected that habitat changes from ships is limited because patches break up and reform naturally and regularly. Destruction by ships is also not expected to result in death as *Sargassum* plants do not rely on root systems and can exist as fragments. The incremental contribution of a WPA proposed action to the overall cumulative impacts on *Sargassum* communities that would result from the OCS Program, environmental factors, and non-OCS oil- and gas-related activities is expected to be minimal.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search of Internet information sources (e.g., the NOAA Gulf Spill Restoration Publications website, the Environmental Response Management Application [ERMA] Gulf Response website, NOAA's *Deepwater Horizon* Archive Publications and Factsheets, the Gulf of Mexico Sea Grant *Deepwater Horizon* Oil Spill Research and Monitoring Activities Database, RestoreTheGulf.gov website, and the *Deepwater Horizon* Oil Spill Portal) and public search engines to search published journal articles, Federal documents, and research reports was conducted to determine the availability of recent information on topographic features. The search revealed new information on nursery areas for *Sargassum*, *Sargassum*'s suitability as habitat for other organisms, and impacts related to oil and dispersant exposure.

One of the primary publications relevant to this Supplemental EIS is the identification of the northwest Gulf of Mexico and the area near the mouth of the Amazon River as "nursery areas" for *Sargassum* in the Sargasso Sea. Estimates suggest that between 0.6 and 6 million metric tons of *Sargassum* are present annually in the Gulf of Mexico, with an additional 100 million metric tons exported to the Atlantic basin (Gower and King, 2008; Gower and King, 2011; Gower et al., 2013). This highlights the importance of the Gulf of Mexico in the global transport of *Sargassum* and that, even if there is a catastrophic spill in the GOM at the right place and time to severely retard *Sargassum* populations, the GOM is not the only source for the Sargasso Sea.

In addition, Rooker et al. (2012) quantified the use of *Sargassum* by billfishes in the Gulf of Mexico and concluded that the *Sargassum* biomass was not a suitable habitat for most juvenile billfishes because it can concentrate predators. As such, small-scale losses of *Sargassum* may not negatively impact billfish populations because billfish that settle in *Sargassum* may have a naturally low survival rate due to the fact that *Sargassum* also concentrates animals that prey on billfish of this size.

Powers et al. (2013) suggests that exposure to oil and/or dispersants can result in direct, sublethal, and indirect effects to *Sargassum*, resulting in death or a decrease in *Sargassum*-related ecosystem services. Therefore, if *Sargassum* is exposed to oil at the surface, it is expected to experience sublethal impacts, such as some of the plant material dying back or no longer providing a suitable habitat for other organisms. The Power et al. results were variable with respect to the amount of time or the rate it took for the plant to die back or succumb. Under normal conditions in the GOM, both species of *Sargassum* co-exist and conditions would never be identical as the static conditions found in mesocosms. Ultimately, damage may occur to *Sargassum* if exposed to oil or dispersant; however, effects would be localized and variable.

The NMFS recently designated *Sargassum* as a critical habitat for loggerhead turtles (*Caretta caretta*) in the Gulf of Mexico and the northwest Atlantic (*Federal Register*, 2014c). In the GOM, this includes all *Sargassum* between the 10-m (33-ft) depth contour and the outer boundary of the Exclusive Economic Zone. This designation could impact the commercial harvest of *Sargassum*; however, to our knowledge the commercial harvest of *Sargassum* does not occur in the GOM. Additionally, NMFS does not expect that this designation would add any risk factors or any conservation measures by BOEM because sea turtles and their required habitats are already adequately protected through the ESA Section 7 process.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231

Supplemental EIS, WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS and in Chapter 4.1.1.7 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified unavailable information regarding *Sargassum* in the WPA. This incomplete or unavailable information includes information on the effects of *in situ* oil exposure and the movement patterns of *Sargassum.* BOEM used existing information and reasonably accepted scientific methodologies to extrapolate in completing this analysis. BOEM determined there are few foreseeable significant adverse impacts to the *Sargassum* population associated with routine or accidental OCS events using publications such as Gower and King (2011), Gower et al. (2013), and Powers et al. (2013). Gower and King (2011) and Gower et al. (2013) suggest that *Sargassum* is continually present in the west-central GOM and that it moves in a general west to east pattern during the growing season; however, movements at a finer temporal or spatial scale are more difficult to predict. Liu et al. (2014) noted that the toxicity or the presence of oil across the surface waters of the GOM was also variable at any given time, suggesting that it is difficult to predict the effects of coming in contact with surface oil. Additionally, Lindo-Atichati (2012) suggested that patterns of larval fish in the surface currents in the northern GOM were not consistent spatially or temporally and that they were highly dependent on mesoscale current structures like the Loop Current and associated eddies. Combined, these studies suggest that, as *Sargassum* is passively moved in the surface waters, its presence at any given location or at given any time is difficult to predict, especially as the population grows exponentially during the growing season. Powers et al. (2013) also suggest that there were adverse effects to *Sargassum* under the proper conditions, but the spatial or temporal extent of those effects remain unknown. It is expected that, for routine or accidental events, the probability of enough *Sargassum* coming in contact with oil and dying as a result of this contact are low, given that oil and *Sargassum* are each controlled by surface currents in differential manners. Ultimately, the cosmopolitan nature across the northern GOM and the reproductive capabilities of *Sargassum* provide a life history that is resilient towards localized or short-term deleterious effects, like those expected associated with routine OCS events and noncatastrophic spills. Therefore, BOEM has determined that the incomplete information on *Sargassum* is not essential to a reasoned choice among alternatives and the information used in lieu of the missing information is acceptable for this analysis.

BOEM recognizes that the incomplete information with respect to possible impacts to *Sargassum* in the WPA as a result of the *Deepwater Horizon* explosion, oil spill, and response may be relevant to the evaluation of impacts. Because of this, BOEM's subject-matter experts have used available scientifically credible evidence in this analysis and applied it using accepted scientific methods and approaches to extrapolate in completing this analysis. *Sargassum* communities within the WPA were likely not significantly affected by the *Deepwater Horizon* explosion, oil spill, and response, based on the best available information and the WPA's distance from the *Macondo* well. However, information related to the possible adverse impacts to *Sargassum* in the WPA as a result of the *Deepwater Horizon* explosion, oil spill, and response cannot be obtained during the timeline contemplated in the NEPA analysis of this Supplemental EIS because data related to research and monitoring related to the *Deepwater Horizon* oil spill has yet to be completed and made publicly available. During the *Deepwater Horizon* oil spill and response, Powers et al. (2013) documented a four-fold increase in *Sargassum* in the north-central GOM in the years following the spill; however, it is unknown if this was due to natural or anthropogenic causes. It is expected that, although this study was completed outside of the WPA, *Sargassum* in the WPA would respond similarly. Therefore, BOEM has determined that the information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for *Sargassum* communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. The new information does not alter the previous impact conclusion for *Sargassum* communities. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.8. Chemosynthetic Deepwater Benthic Communities

BOEM has reexamined the analysis for chemosynthetic deepwater benthic communities (e.g., tubeworms, mussels, and clams that make their own food through symbiosis with bacteria) presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for chemosynthetic communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246, and 248. A detailed description of chemosynthetic communities, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.8.1, 4.1.1.8.2, and 4.1.1.8.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.8 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.8.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.8 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Considerable mechanical damage could be inflicted upon sensitive chemosynthetic deepwater benthic communities by routine activities associated with a WPA proposed action if mitigations are not applied to permits. Mitigations are based on protective measures described by NTL 2009-G40, "Deepwater Benthic Communities," and include distancing requirements for wells (610 m; 2,000 ft), anchors, chains, and pipelines (76 m; 250 ft) from sensitive habitat. This distancing also helps prevent sedimentation on deepwater benthic communities as a result of an accidental seafloor blowout. BOEM reviews exploration and production plans and pipeline applications and applies mitigations to permits to prevent impacts to sensitive seafloor habitats from routine oil and gas activities. Impacts from bottom-disturbing activities are expected to be rare because of the application of mitigations.

The potential routine impact-producing factors on chemosynthetic deepwater benthic communities of the WPA are bottom-disturbing activities associated with anchoring, structure emplacement, pipelaying, and structure removal, as well as discharges of drill cuttings, muds, and produced water. Discharges of produced waters on the sea surface are regulated, and chemical spills and deck runoff would be diluted in surface waters, having little to no effect on seafloor habitats. If a high-density community is subjected to direct impacts by bottom-disturbing activities, potentially severe or catastrophic impacts could occur due to raking of the sea bottom by anchors and anchor chains, and partial or complete burial by muds and cuttings. The severity of such an impact is such that there would be incremental losses of productivity, reproduction, community relationships, and overall ecological functions of the local community, and incremental damage to ecological relationships with the surrounding benthos. However, impacts from bottom-disturbing activities directly on chemosynthetic communities are expected to be extremely rare because of the application of the required protective measures described by NTL 2009-G40, "Deepwater Benthic Communities," which distances bottom-disturbing activities from sensitive deepwater benthic communities. Because of the avoidance policies described in NTL 2009-G40, the risk of these physical impacts are greatly reduced by requiring the avoidance of potential chemosynthetic communities.

Accidental events that could impact chemosynthetic communities are primarily limited to seafloor blowouts and subsea oil spills. A blowout at the seafloor could create a crater and could resuspend and disperse large quantities of bottom sediments. This could bury organisms located within that distance to some degree, possibly eliminating some communities and preventing recolonization, depending on bottom-current conditions. The application of avoidance criteria for chemosynthetic communities described in NTL 2009-G40 precludes the placement of a well within 610 m (2,000 ft) of any suspected site of a chemosynthetic community, therefore distancing the chemosynthetic community from heavy sedimentation resulting from a possible blowout, with only light sediment components able to reach the communities in small quantities. Accidental impacts associated with a WPA proposed action would likely result in only minimal impacts to chemosynthetic communities. One exception would be in the case of a subsea oil spill combined with the application of dispersant or high-pressure ejection of oil. If dispersants are applied to an oil spill or if oil is ejected under high pressure, oil could mix into the water column, could be carried by underwater currents, and could eventually contact the seafloor in some form, either concentrated (near the source) or decayed (farther from the source), where it may impact patches of chemosynthetic community habitat in its path. The possible impacts, however, will be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. Oil plumes that remain in the water column for longer periods would disperse and decay, having only minimal effect. The farther the dispersed oil travels, the more diluted the oil will become as it mixes with surrounding water. Therefore, accidental impacts associated with a WPA proposed action would likely result in only minimal impacts to chemosynthetic communities with adherence to the proposed biological stipulation and the guidelines described in NTL 2009-G40.

Cumulative factors considered to impact the deepwater benthic communities (>300 m; 984 ft) of the Gulf of Mexico include both OCS oil- and gas-related and non-OCS oil- and gas-related activities. Cumulative OCS oil- and gas-related impacts to deepwater communities in the Gulf of Mexico are considered negligible because of the application of BOEM's avoidance criteria as described in NTL 2009-G40. The most serious, impact-producing factor threatening chemosynthetic communities is physical disturbance of the seafloor, which could destroy the organisms of these communities. Such disturbance would most likely come from those OCS oil- and gas-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Drilling discharges and resuspended sediments have a potential to cause minor, mostly sublethal impacts to chemosynthetic communities, but substantial sediment accumulations could result in more serious impacts. Possible catastrophic oil spills (**Appendix B**) due to seafloor blowouts have the potential to devastate localized deepwater benthic habitats. However, these events are rare and would only affect a small portion of the sensitive benthic habitat in the Gulf of Mexico.

The non-OCS oil- and gas-related impact-producing factors include activities such as commercial fishing, trawling, storm impacts, and climate change. Fishing and trawling could potentially crush, topple, and remove chemosynthetic communities in the path of the gear. Because of the water depths where chemosynthetic communities live (>300 m; 984 ft) and because of the low density of potentially commercially valuable fishery species, these activities are not expected to substantially impact deepwater benthic communities. However, if trawling were to occur over a chemosynthetic community, the community may be devastated. Regionwide and even global impacts from CO_2 build-up and proposed methods to sequester carbon in the deep sea (e.g., ocean fertilization) are not expected to have major impacts to deepwater habitats in the near future. This is because changes to water temperature and pH from the CO_2 would not reach extremes at the water depths where chemosynthetic communities occur. Therefore, non-OCS oil- and gas-related activities are not expected to impact chemosynthetic communities. The incremental contribution of a WPA proposed action to cumulative impacts is expected to be slight and to result from the effects of the possible impacts caused by physical disturbance of the seafloor and minor impacts from sediment resuspension or drill cutting discharges. Adverse impacts will be limited but not completely eliminated by adherence to the guidelines described in NTL 2009-G40.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A broad search for relevant new information and scientific journal articles made available since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS was conducted using a publicly available search engine. The websites for Federal and State agencies, as well as other organizations, were reviewed for newly released information. Sources investigated include the NOAA Ocean Exploration website, the Gulf of Mexico Alliance, USEPA, USGS, and coastal universities. The search did not reveal any new information that is relevant to this Supplemental EIS.

Incomplete or Unavailable Information

After evaluating the information above, BOEM has determined that the previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS are still valid because no new information on chemosynthetic deepwater benthic communities pertinent to the proposed action has been published since the release of the 2012-2017

WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS, as well as in Chapter 4.1.1.8 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, there remains incomplete or unavailable information on the location of chemosynthetic communities in the GOM as well as the effects of the *Deepwater Horizon* explosion, oil spill, and response on chemosynthetic communities that could potentially be relevant to this analysis.

BOEM has identified incomplete or unavailable information regarding the abundance and distribution of chemosynthetic communities in the GOM. To fill that data gap, BOEM's subject-matter experts extrapolated existing data using accepted scientific methodologies. BOEM's subject-matter experts use a database of 3D seismic data used to interpret the relationship between reflectivity of the seafloor (an indicator of hard substrate for attachment) and the occurrence of potential habitat for chemosynthetic communities. Similarly, sidescan-sonar data is also used to determine the presence of likely habitat. These surveys are used when deepwater exploration and development plans are reviewed to ensure that chemosynthetic communities are not impacted by OCS oil- and gas-related activities as required in NTL 2009-G40. This information is sufficient in assisting BOEM in identifying areas that should be avoided for OCS oil- and gas-related activities. The confirmed presence of chemosynthetic communities in areas predicted to have likely habitat via reflectivity or sidescan-sonar data indicates that BOEM is currently able to effectively protect these communities from OCS oil- and gas-related activities. Therefore, BOEM has determined that the information is not essential to a reasoned choice among alternatives because BOEM reviews plans on a case-by-case basis to reduce the possibility of impacting chemosynthetic communities and because existing information has shown that current survey interpretation provides for an appropriate means for protecting these communities.

BOEM has also identified incomplete or unavailable information regarding impacts to chemosynthetic communities from the *Deepwater Horizon* explosion, oil spill, and response. Information on possible impacts to chemosynthetic communities in the WPA may be relevant to the affected environment because recent events such as the *Deepwater Horizon* explosion, oil spill, and response may have caused changes to baseline conditions for such communities in the Gulf of Mexico. Information regarding impacts of the *Deepwater Horizon* explosion, oil spill, and response upon deepwater chemosynthetic communities is being developed through the NRDA process, but this information is not yet available and cannot reasonably be obtained within the timeline contemplated in the NEPA analysis of this Supplemental EIS. In lieu of this incomplete information, BOEM extrapolated existing information using scientifically accepted methodologies. Existing information suggests that chemosynthetic communities did not experience significant adverse impacts from the *Deepwater Horizon* explosion, oil spill, and response. Numerous cruises using research ships, submersibles, and drift cameras investigated the seafloor in the area surrounding the well site (USDOC, NOAA, 2011a and 2011b). Damage to chemosynthetic communities in the vicinity of the *Macondo* well has not been reported to date (Shedd, 2014). Furthermore, due to the distance of chemosynthetic communities within the WPA from the *Macondo* well, they were likely not affected to any discernible degree by the *Deepwater Horizon* explosion, oil spill, and response. Based on available information, it has not been demonstrated that the *Deepwater Horizon* explosion, oil spill, and response impacted or changed the baseline for chemosynthetic communities in the WPA. Therefore, based on the distance of the chemosynthetic communities in the WPA from the *Macondo* well and the data from surveys post-*Macondo* that do not show impacts to chemosynthetic communities, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for chemosynthetic communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for chemosynthetic communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.9. Nonchemosynthetic Deepwater Benthic Communities

BOEM has reexamined the analysis for nonchemosynthetic communities (deep coral reefs and communities) presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for nonchemosynthetic communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of nonchemosynthetic communities, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.9.1, 4.1.1.9.2, and 4.1.1.9.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.9 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.9.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.9 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is also presented below.

Considerable mechanical damage could be inflicted upon sensitive nonchemosynthetic deepwater benthic communities by routine OCS oil- and gas-related activities associated with a WPA proposed action if mitigations are not applied to permits. Mitigations are based on the protective measures described by NTL 2009-G40, "Deepwater Benthic Communities," and include distancing requirements for wells (610 m; 2,000 ft), anchors, chains, and pipelines (76 m; 250 ft) from sensitive habitat. This distancing also helps prevent sedimentation and deposition of oil on deepwater benthic communities as a result of an accidental seafloor blowout. BOEM reviews exploration and production plans and pipeline applications, and applies mitigations to permits to prevent impacts to sensitive seafloor habitats from routine OCS oil- and gas-related activities. Impacts from routine and accidental events are expected to be rare because of the application of mitigations.

Routine bottom-disturbing activities (i.e., anchoring, structure and pipeline emplacement, and drill cuttings discharge) associated with a WPA proposed action could crush or smother deepwater benthic communities. Drilling discharges could bury sessile organisms. Structure and pipeline emplacement could destroy carbonate substrates crucial for the attachment of sessile organisms. However, these activities are expected to cause little to no damage to the ecological function or biological productivity of deepwater live bottom communities (deep coral reefs) due to the consistent application of BOEM's protection policies as described in NTL 2009-G40. Information included in required hazards surveys for oil and gas activities depicts areas that could potentially harbor nonchemosynthetic communities. These data allow BOEM to require avoidance of any areas that are conducive to the growth of sensitive hard bottom communities. The same geophysical conditions associated with the potential presence of chemosynthetic communities (refer to **Chapter 4.1.1.8**) also results in the potential occurrence of hard carbonate substrate and other associated deepwater live bottom communities. Because of the distancing requirements for bottom-disturbing activities (i.e., anchoring, structure and pipeline emplacement, and drill cuttings discharges) published in BOEM's NTL 2009-G40 guidelines, these communities are generally avoided in exploration and development planning. Therefore, impacts on sensitive deepwater communities from routine OCS oil- and gas-related activities associated with a WPA proposed action would be minimal to none.

Accidental events that could impact nonchemosynthetic deepwater benthic communities are primarily limited to seafloor blowouts and resultant subsea oil spills. A blowout at the seafloor could create a crater and could resuspend and disperse large quantities of bottom sediments within a 300-m (984-ft) radius from the blowout site. This could destroy any organisms located within that distance by burial or modification of narrow habitat quality requirements, depending on bottom-current conditions, and possibly prevent reestablishment. Rapid burial in sediment could be lethal for all benthic organisms. Subsea oil spills caused by blowouts could devastate local patches of habitat where a subsea oil plume physically contacts the seafloor. Any possible impacts would be localized due to the directional movement of an oil plume by the water currents and because the sensitive habitats have a scattered, patchy distribution. It is also possible that some corals may have a tolerance to limited oil exposure and may recover after exposure (Quattrini et al., 2013). However, the application of avoidance criteria for deepwater coral communities described in NTL 2009-G40 precludes the placement of a well within 610 m (2,000 ft) of any suspected site of a deepwater coral community, therefore distancing the deepwater coral community from sedimentation and concentrated oil contact resulting from a possible blowout.

Cumulative factors considered to impact the deepwater benthic communities (>300 m; 984 ft) of the Gulf of Mexico include both OCS oil- and gas-related and non-OCS oil- and gas-related activities. The OCS oil- and gas-related activities associated with pipelaying, anchoring, structure emplacement, drilling discharges, and seafloor blowouts have the potential to impact nonchemosynthetic deepwater benthic communities. The most serious, impact-producing factor threatening nonchemosynthetic communities is physical disturbance of the seafloor, which could destroy the organisms of these communities. Such disturbance would most likely come from those OCS oil- and gas-related activities associated with pipelaying, anchoring, and structure emplacement. Anchoring and pipeline and structure emplacement have the potential to crush deepwater benthic communities. Drilling discharges and resuspended sediments have a potential to cause minor, mostly sublethal impacts to nonchemosynthetic communities, but substantial accumulations could result in more serious impacts. Possible effects of an oil spill could be no discernible effect (for well-dispersed oil undergoing biodegradation), lack of growth, interruption of reproductive cycles, loss of gamete viability, tissue damage, death of affected organisms, and a reduction in the areas of distribution of species, depending on the amount and duration of contamination. Major impacts to localized benthic habitat are possible in the event of a low-probability catastrophic blowout on the seafloor (refer to **Appendix B** for more details). However, a low-probability catastrophic oil spill is not part of a WPA proposed action and is not likely expected to occur. Therefore, cumulative impacts to deepwater communities in the Gulf of Mexico are considered negligible because of the application of the avoidance criteria described in NTL 2009-G40, which distances bottom-disturbing activities from sensitive habitats.

Non-OCS oil- and gas-related activities include fishing and trawling at a relatively small scale; large-scale factors include storm impacts and climate change, CO_2 build-up, and proposed methods to sequester carbon in the deep sea. Among the activities unrelated to the OCS Program (non-OCS oil and gas impact-producing factors), fishing and trawling represent the greatest possible threat to nonchemosynthetic communities and associated fish communities as a result of habitat destruction and overfishing (Kaiser, 2004). The impacts on deepwater fisheries in the GOM associated with deepwater coral habitat as a result of trawling activity are unknown, but because of the water depths (>300 m; 984 ft) and the low density of potentially commercially valuable fishery species in areas associated with these communities, fishing and trawling are not expected to severely impact deepwater benthic communities. Regionwide and even global impacts from climate change, CO_2 build-up, and proposed methods to sequester carbon in the deep sea (e.g., ocean fertilization) are not expected to have major impacts to deepwater habitats in the near future. More distant scenarios could include severe impacts. Storms generally cause little to no impacts at the depths (>300 m; 984 ft) that nonchemosynthetic communities occur. A storm could potentially cause some type of accident that could then cause secondary impacts, such as shipwrecks that could crush nonchemosynthetic communities, but such occurrences would be rare. State oil and gas activities are not expected to impact deepwater benthic communities due to the great distance between such activities and water depths of >300 m (984 ft).

The OCS oil- and gas-related cumulative impacts on deepwater coral or other high-density, hard bottom communities are expected to be negligible and to cause little damage to their overall ecological function or biological productivity because of BOEM's biological review process and the policies described in NTL 2009-G40, which physically distances petroleum-producing activities from sensitive deepwater benthic communities. The incremental contribution of a WPA proposed action to cumulative impacts is expected to be slight and to result from the effects of the possible impacts caused by physical disturbance of the seafloor and minor impacts from sediment resuspension or drill cutting discharges. Adverse impacts will be limited but not completely eliminated by adherence to the guidelines described in NTL 2009-G40. Localized impacts of a blowout still may occur.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

Internet websites visited included four Federal agencies (USEPA, USGS, NOAA [including *Deepwater Horizon* Bibliography], and BOEM), five coastal universities or universities with coastal divisions (University of Louisiana at Lafayette, Louisiana State University, Texas A&M University, University of Texas at Austin Marine Science Institute College of Natural Sciences, and Florida State University), several various stakeholders (Sierra Club, National Fish and Wildlife Foundation, Nature Conservancy, Gulf of Mexico Alliance, and Gulf of Mexico Program), and Louisiana Universities Marine Consortium ("Effects of Offshore Oil and Gas Development: A Current Awareness Bibliography"). Where applicable, websites of subdivisions of many of these agencies, universities, and stakeholders were also searched. Environmental journal articles were also located online using four search engines (JSTOR, EBSCO, Google Advanced Scholar Search, and Google Advanced Book Search). Three of the search engines collectively searched all of the ecology journals of six major publishers (John Wiley and Sons, Springer, Elsevier Science, Taylor and Francis Group, Cambridge University Press, and Oxford University Press). New information was found on habitat preferences for deepwater corals, as well as information on impacts from sedimentation and oil exposure.

Cold (deep) water corals generally require high-energy macroenvironments (relatively fast currents) for resuspending sediment food particles; subsequent delivery of food; provision of oxygen; and removal of waste, carbon dioxide, and sediment. Such macroenvironments are more likely to be found at topographic features on the seafloor that provide substrate for attachment. These macroenvironments were modeled by using state-of-the-art analyses of bathymetry data using ecological niche models incorporating the efficacious, well-vetted maximum entropy algorithm at scales that could be relevant (Quattrini et al., 2013). Quattrini et al. (2013) found that broken shells and coral rubble within soft bottom environments can provide sufficient substrate for settlement and growth of *Callogorgia* spp. (common octocorals). Quattrini et al. (2013) suggest that *Callogorgia* spp. attached to such substrates could recruit and grow on flat or even concave surfaces. The presence of topographic features did not appear to be a significant factor positively affecting the presence of the genus (Quattrini et al., 2013). This new information is important because it shows that some deepwater corals may attach to broken shells or rubble scattered within areas preferential for drilling (soft bottom environments) and could be impacted because small patches of substrate do not always show up on surveys conducted to find probable deepwater coral habitat because the substrate is smaller than the detection limits of the survey equipment. For more information on soft bottom benthic communities, refer to **Chapter 4.1.1.10**.

Additional research has indicated that, if a well is located too close to deepwater coral habitat, damage may occur to the corals. Experiments with sediment and cold-water corals affirm possible lethal or sublethal impacts of anthropogenic sedimentation from drill cuttings (Allers et al., 2013). Branching coral varieties (e.g., *Lophelia pertusa*) have a structure that creates low-energy microenvironments inside the thickets, where experiments suggest the occurrence of lethal or sublethal impacts of drill cuttings (Allers et al., 2013). These studies reaffirm the necessity for distancing wells from deepwater coral habitats so that the corals are protected from the accumulation of drill cuttings.

A new study has investigated the association of deepwater corals with oil seeps from the seafloor (Quattrini et al., 2013). An investigation of octocorals of the genus *Callogorgia* (using ecological niche models) documented depth and seep activity as the most significant contributing factors on realized niches of these corals (Quattrini et al., 2013). *Callogorgia gracilis* was documented at the shallowest depths (222-317 m; 728-1,040 ft), followed by *C. americana americana* (361-364 m; 1,184-1,194 ft) and *C. americana delta* (403-914 m; 1,322-2,999 ft). Among these species, *C. americana delta*, the coral found at the deepest depths, was the only octocoral found in association with seep activity, indicating this coral could "possess mechanisms for dealing with natural levels of exposure to hydrocarbons" (Quattrini et al., 2013). This research indicates that such an adaptation could result in resilience after exposure to oil from a blowout.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined the new information does not change previous conclusions from the WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238, 246, and 248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplement EIS, as well as in Chapter 4.1.1.9 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete information for impacts related to the location of deepwater corals in the GOM, toxicity of oil to deepwater corals, impacts on deepwater fish communities due to impacts on nonchemosynthetic deepwater benthic communities, and impacts from the *Deepwater Horizon* explosion, oil spill, and response. At present, the best available information does not provide data for a complete understanding of these four data gaps. BOEM used reasonably accepted scientific methodologies to extrapolate from existing information in completing this analysis and formulating the conclusions presented here.

BOEM's database of known deepwater benthic communities is incomplete. This database is used when deepwater exploration and development plans are reviewed to ensure that deepwater corals are not impacted by OCS oil- and gas-related activities. In order to fill this data gap, BOEM's subject-matter experts identify probable habitat for deepwater corals using a database of 3D seismic data, which provides the locations of 28,000 features that could represent such communities, in conjunction with side-scan SONAR data and site-specific, high-resolution surveys to identify sensitive habitat and communities. BOEM's database of 3D seismic anomalies is well suited to the identification of general areas in which favorable coral habitat may occur and is sufficient in assisting BOEM in identifying areas that should be avoided for OCS oil- and gas-related activities. However, these surveys may not be sufficiently high resolution for the identification of small, scattered hard substrate, as discussed by Quattrini et al. (2013). Small patches of shell and rubble substrate are commonly observed in soft bottom habitat near active and inactive seep sites, which frequently occur in areas targeted for OCS oil- and gas-related activities. If data are sparse or indicate additional detail is warranted, this data gap may be additionally filled by site-specific video or photographic surveys to obtain this information. Despite these procedures, some communities scattered throughout predominantly soft bottom habitat may still be impacted if seafloor surveys do not suggest deepwater coral habitat is present. However, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives because BOEM reviews plans on a case-by-case basis to reduce the possibility of impacting deepwater coral habitat.

Information on the toxic impacts of oil on deepwater corals is unavailable. An investigation of several deepwater octocorals and their association with oil seeps indicated that one species was found in association with oil seeps. The results of this study indicate that this coral could "possess mechanisms for dealing with natural levels of exposure to hydrocarbons" (Quattrini et al., 2013). Such an adaptation could result in resilience after exposure to oil from a blowout. It is possible that, if this coral may be tolerant of oil exposure, there may be others as well; however, that information is not known at this time. BOEM has determined that the tolerance of deepwater corals to oil exposure is not essential to a reasoned choice among alternatives because BOEM requires that OCS oil- and gas-related activities are sufficiently distanced from wells and because exposure from accidental events is unlikely.

Harm to nonchemosynthetic deepwater benthic communities as a result of bottom trawling would have an uncertain impact on deepwater bottom fisheries. In place of unavailable information on commercial fishing impacts on deepwater fisheries in areas of deepwater coral habitat, existing information on commercial fishing activity in the deep GOM shows that, unlike other areas in the Atlantic Ocean and in Europe, bottom-fishing and trawling efforts in the deeper water of the WPA are currently minimal, and areas where royal red shrimp are obtained are in soft bottom communities (CSA, 2002). The primary Gulf grounds are restricted to the upper continental slope off the Mississippi Delta (off Mississippi and Alabama) (CSA, 2002). Grounds there are blue-black terrigenous silt and greenish mud, and any known hard bottom (potential nonchemosynthetic communities) would not be trawled (CSA, 2002). The monetary value of seafood is not worth the expense and trouble of deepwater trawling except to a few fishermen (CSA, 2002). The minimal fishery and minimal areal extent of potential nonchemosynthetic communities that are inside the outer boundaries of the fishery indicate that the footprint of the fishery would not likely overlap with the footprint of an impacted deepwater benthic community. Also, nonchemosynthetic communities are widely distributed in the Gulf, mostly outside the narrowly distributed area of royal red shrimp grounds. Therefore, impacts on such communities as a whole are expected to be negligible. In conclusion, available information consistent with acceptable scientific reasoning shows that commercial fishing impacts on nonchemosynthetic deepwater benthic communities are expected to cause only negligible impacts on deepwater fisheries.

Nonchemosynthetic communities within the WPA were likely not affected to any discernible degree by the *Deepwater Horizon* explosion, oil spill, and response because of the WPA's distance from the

Macondo well. Information on possible impacts to nonchemosynthetic communities in the WPA may be relevant to the affected environment because recent events such as the *Deepwater Horizon* explosion, oil spill, and response may have caused changes to baseline conditions for such communities in the Gulf of Mexico. Studies in the CPA have indicated that deepwater corals 7 mi (11 km) southeast of the spill location were damaged following the *Deepwater Horizon* explosion, oil spill, and response (White et al., 2012). Additional information regarding impacts of the *Deepwater Horizon* explosion, oil spill, and response on deepwater nonchemosynthetic communities is being developed through the NRDA process, but this information is not yet available and cannot reasonably be obtained within the timeline contemplated in the NEPA analysis of this Supplemental EIS, and the overall costs in time and money to collect these data are exorbitant. BOEM recognizes that the incomplete information with respect to long-term effects may be relevant to the evaluation of impacts on nonchemosynthetic deepwater benthic communities. However, the distance of the WPA from the *Deepwater Horizon* explosion, oil spill, and response and the lack of published information from this in the WPA makes it likely that the *Deepwater Horizon* explosion, oil spill, and response had negligible impacts to the WPA. Therefore, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for nonchemosynthetic communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for nonchemosynthetic communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248. Regarding incomplete information and the existing information used in its place, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives.

4.1.1.10. Soft Bottom Benthic Communities

BOEM has reexamined the analysis for soft bottom benthic communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for soft bottom benthic communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

A detailed description of soft bottom benthic communities, along with the full analysis of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.10.1, 4.1.1.10.2, and 4.1.1.10.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.10 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.10.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.10 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

A majority of the oil and gas exploration in the GOM is conducted on soft seafloor sediments, directly impacting soft bottom benthic communities. Routine OCS oil- and gas-related activities result in a number of impact-producing factors, including seafloor disturbances (e.g., anchoring, trenching, infrastructure emplacement, and infrastructure removal), waste discharge (e.g., drilling muds and cuttings from oil and gas operations), and resuspension of sediments (e.g., pipeline burial and decommissioning operations). Disturbances of soft bottom benthic communities cause localized disruptions to benthic community composition and an alteration in food sources for some large invertebrate and finfish species. Analysis of these routine activities has identified only localized and short-term impacts to soft bottom benthic communities. Any activity that may affect the soft bottom communities would only impact a small portion of the overall area of the seafloor of the Gulf of Mexico. Because the soft bottom substrate is ubiquitous throughout the Gulf of Mexico, there are no lease stipulations to avoid these communities; however, other routine practices restrict detrimental activities that could cause undue harm to benthic habitats (e.g., discharge restrictions, debris regulations, and NPDES permits).

Accidental oil spills or blowouts associated with OCS oil- and gas-related activities can disturb infaunal communities. Because of the proportionately small area that OCS oil- and gas-related activities occupy on the seafloor, only a very small portion of Gulf of Mexico's soft bottom benthic communities would experience impacts as a result of blowouts and oil spills. The greatest impacts would likely occur closest to the source of the spill, and impacts would rapidly decrease with increased distance from the source. Contact with spilled oil outside the vicinity of the event would likely cause sublethal to negligible effects to benthic invertebrates and finfishes. Oil deposited on sediment communities could result in changes to local community structure. The organic enrichment of impacted sediments may result in altered sediment communities as bacteria degrade deposited organic matter. This response can lead to hypoxic conditions and a series of altered community structures until the organic matter is depleted and surface sediments return to an oxygenated state (Neff, 2005). Although an oil spill may have some detrimental impacts, especially closest to the occurrence of the spill, the impacts may be no greater than natural fluctuations (Clark, 1982), and impacts would affect a relatively small portion of the seafloor.

The cumulative analysis considers activities that have occurred, are currently occurring, and could occur and adversely affect the soft bottoms of the Gulf of Mexico for the years 2012-2051. Long-term OCS oil- and gas- related activities are not expected to adversely impact the entire soft bottom environment of the GOM because the locally impacted areas are small in comparison with the entire area of the GOM. The OCS impacts from seafloor disturbances, discharge of drilling muds and cuttings, and resuspension of sediments may have locally devastating impacts, but impacted communities are repopulated relatively quickly and the cumulative effect on the overall seafloor and benthic communities would be negligible. Non-OCS oil- and gas-related activities such as storms, sand mining, trawling, State oil and gas activities, and hypoxia are likely to impact the soft bottom communities more frequently than do OCS oil- and gas-related activities. In some areas, soft bottom benthic communities remain in an early successional stage due to the frequency of natural and anthropogenic disturbances. The incremental contribution of a WPA proposed action to the cumulative impact is expected to be minor.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

BOEM has examined newly available information for findings that may impact analyses of routine, accidental, and cumulative OCS activities and potentially alter previous conclusions. A search of Internet information sources and scientific journals was conducted to determine the availability of recent information (including NMFS databases, the NOAA Gulf Spill Restoration Publications website, the Gulf of Mexico Fishery Management Council (GMFMC) website, Science Direct, EBSCO, Elsevier, PLoS ONE, JSTOR, and BioOne). Since preparation of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, new information relevant to an analysis of the potential impacts of OCS oil- and gas-related activities on soft bottom benthic communities has been published.

Several new studies suggest that the community structure of microbial communities can be influenced by the presence of oil, the weathered state of oil, and the chemical composition of oil (Kimes et al., 2013; Liu and Liu, 2013; Mason et al., 2014). These studies also document shifts in community structure as the environment transitions from aerobic to anaerobic, such as may occur as a result of excessive aerobic biodegradation of hydrocarbons. Data also suggest that PAHs are more persistent in deep-sea sediments and that degradation of these molecules may occur at a reduced rate when compared with other hydrocarbons (Kimes et al., 2013; Mason et al., 2014). The consequences of the slow breakdown of PAHs on sediment communities remain unknown; however, these studies suggest that the microbial community exhibits a high degree of community resiliency and may revert to a structure similar to pre-spill conditions once the PAHs are consumed. These findings support previous impact analyses because they indicate that lower-order soft bottom benthic communities' structure may transition rapidly when exposed to changing environmental conditions, demonstrating significant resiliency. Our conclusions, which are based on new research, agree with earlier analyses indicating that only a small portion of the

GOM seafloor and associated benthic organisms would be impacted by oil exposure and that population-level responses are not realistically expected.

An investigation of niche divergence among octocorals of the genus *Callogorgia* documented depth and the presence of hydrocarbon seep activity as the most significant contributing factors on niche preference (Quattrini et al., 2013). The study also noted that "flat or even concave surfaces with broken/dead shells or coral rubble" provided sufficient substrate for settlement and growth of these corals (Quattrini et al., 2013). This new information is important because small patches of shell and rubble substrate are commonly observed in soft bottom habitat near active and inactive seep sites, which frequently occur in areas targeted for OCS oil- and gas-related activities. Shell and coral rubble were not previously considered suitable substrate for coral when analyzing the potential impacts to deepwater coral habitat. In addition, Allers et al. (2013) reported that the coral species *Lophelia pertusa*, if not completely buried by sediment, is capable of surviving episodic sedimentation from suspended sediment loads comparable to those expected from anthropogenic activities, such as intermittent drilling discharges. This information, along with the presence of some deepwater corals in association with cold seeps, indicates that some deepwater corals are may be more tolerant of hydrocarbon and sediment exposure than previously realized. For additional information on deepwater corals, refer to **Chapter 4.1.1.9**. **Chapter 4.1.1.9** also discusses the methodology used to identify habitat capable of supporting deepwater corals and the surveys and reviews conducted to help identify these small patches of deepwater corals that may be found scattered among soft bottom benthic communities.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined the new information does not change previous conclusions from the 2012-2017 Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in Chapter 4.1.1.10 of the 2012-2017 Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete information for impacts related to the distribution and abundance of deepwater corals in areas of predominantly soft bottom habitat; the long-term effects of persistent PAHs (Kimes et al., 2013; Liu and Liu, 2013; Mason et al., 2014), and the long-term effects of episodic sedimentation events (Allers et al., 2013; Kimes et al., 2013; Liu and Liu, 2013; Mason et al., 2014).

Although the distribution and abundance of deepwater corals in areas of predominantly soft bottom habitat is not known, BOEM uses reasonably accepted scientific methodologies to extrapolate from existing information when locating communities and suitable substrates potentially impacted by proposed OCS oil- and gas-related activities. Data produced using several seafloor survey methods are analyzed to identify potential deepwater coral habitat. Refer to **Chapter 4.1.1.9** for more detail on these surveys and reviews. BOEM has determined the incomplete information is not essential to a reasoned choice among alternatives because BOEM reviews plans and surveys on a case-by-case basis to reduce the possibility of impacting deepwater coral habitat.

The cumulative impacts of OCS oil and gas exploration and development may result in locally significant impacts to soft bottom benthic communities. However, soft bottom communities are abundant throughout the GOM and the area of the seafloor impacted by OCS oil- and gas-related activities is very small in comparison with the overall area of soft bottom habitat in the GOM. Analysis of available information did not identify any reasonably foreseeable impacts extending beyond localized responses to persistent PAHs or sedimentation events among soft bottom inhabitants (Kimes et al., 2013; Liu and Liu, 2013; Mason et al., 2014).

Soft bottom benthic communities within the WPA were likely not affected to any discernible degree by the *Deepwater Horizon* explosion, oil spill, and response because of the WPA's distance from the *Macondo* well. Although information on possible impacts to soft bottom benthic communities in the WPA may be relevant to the baseline conditions of the affected environment, incomplete information and other relevant data regarding the status and function of soft bottom benthic communities, including that being developed through the NRDA process, may take years to acquire and analyze and cannot be obtained in the timeline contemplated in the NEPA analysis of this Supplemental EIS. BOEM used reasonably accepted scientific methodologies to extrapolate from existing information in completing the analysis of impacts to soft bottom benthic communities and subsequent recovery. The new information summarized above indicates that microbial communities transition rapidly when exposed to changing environmental conditions and demonstrate significant resiliency (Kimes et al., 2013; Liu and Liu, 2013; Mason et al., 2014). Although the body of available information is incomplete or long-term effects cannot yet be known, the evidence currently available supports past analyses and does not indicate severe adverse impacts to the soft bottom benthic communities of the WPA or entire GOM as a result of OCS oil- and gas-related activities. Therefore, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for soft bottom benthic communities based on the additional information provided above. The accumulated data used in this and previous analyses do not indicate significant population-level impacts to soft bottom benthic communities. No new information was discovered that would alter the impact conclusion for soft bottom benthic communities presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.11. Marine Mammals

BOEM has reexamined the analysis for marine mammals presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for marine mammals presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of marine mammals, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.11.1, 4.1.1.11.2, and 4.1.1.11.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.11 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.11.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.11 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Operators must adhere to certain NTLs while conducting OCS oil- and gas-related activities in order to reduce impacts to marine mammals. The operator's reaffirmed compliance with NTL 2012-JOINT-G01 ("Vessel Strike Avoidance and Injured/Dead Protected Species Reporting") and NTL 2012-BSEE-G01 ("Marine Trash and Debris Awareness and Elimination"), as well as the limited scope, timing, and geographic location of a WPA proposed action, would result in negligible effects from the proposed drilling activities on marine mammals. In addition, NTL 2012-JOINT-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," minimizes the potential of harm from seismic operations to marine mammals. These mitigations include onboard observers, airgun shut-downs for whales in the exclusion zone, ramp-up procedures, and the use of a minimum sound source.

The routine activities associated with proposed WPA Lease Sales 246 and 248 that could potentially affect marine mammals include the following: the degradation of water quality from operational discharges; noise generated by aircraft, vessels, operating platforms, and drillships; vessel traffic; explosive structure removals; seismic surveys; and marine debris from service vessels and OCS structures. Some routine activities related to a WPA proposed action have the potential to have adverse, but not significant, impacts to marine mammal populations in the Gulf of Mexico. Impacts from vessel traffic, structure removals, and seismic activity could negatively impact marine mammals and have the potential to harm or harass marine mammal species by increasing noise levels. These activities, when mitigated as required by BOEM and NMFS (through the requirements of ESA and MMPA consultations), are expected to have long-term impacts on the size and productivity of any marine mammal species or population. Mitigation reduces the risk of harassing or harming marine mammal species. Other routine activities such as aircraft activity, drilling and production noise, discharges, and marine debris are expected to have negligible effects.

Impact-producing factors associated with accidental events that may be associated with a WPA proposed action that could affect marine mammals include blowouts, oil spills, and spill-response activities. Accidental events related to a WPA proposed action have the potential to have adverse, but not significant, impacts to marine mammal populations in the Gulf of Mexico. Characteristics of impacts (i.e., acute vs. chronic impacts) depend on the magnitude, frequency, location, and date of accidents; characteristics of spilled oil; spill-response capabilities and timing; and various meteorological and hydrological factors. Oil spills may cause chronic (long-term lethal or sublethal oil-related injuries) and acute (spill-related deaths occurring during a spill) effects on marine mammals. Long-term effects include decreases in prey availability and abundance because of increased mortality rates, change in age-class population structure because certain year-classes were impacted more by oil, decreased reproductive rate, and increased rate of disease or neurological problems from exposure to oil (Harvey and Dahlheim, 1994). The effects of cleanup activities are unknown, but increased human presence (e.g., vessels) could add to changes in marine mammal behavior and/or distribution, thereby additionally stressing animals and perhaps making them more vulnerable to various physiological and toxic effects.

Even after the spill is stopped, oiling or deaths of marine mammals would still occur due to oil and dispersants persisting in the water, past marine mammal/oil or dispersant interactions, and ingestion of contaminated prey. The animals' exposure to hydrocarbons persisting in the sea may result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) and some soft tissue irritation, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil and/or tar, and temporary displacement from preferred habitats.

The cumulative impact analysis considers the effects of impact-producing factors related to OCS oil- and gas-related impacts, along with non-OCS oil- and gas-related impacts of other commercial, military, recreational, offshore, and coastal activities that may occur and adversely affect marine mammals in the same general area of a WPA proposed action. The major impact-producing factors resulting from cumulative OCS oil- and gas-related activities associated with a WPA proposed action that may affect marine mammals and their habitats include ingestion and entanglement in marine debris; contaminant spills and spill-response activities; vessel strikes; and noise from multiple sources including seismic surveys and explosive structure removals. Noise in the ocean has become a worldwide topic of concern, particularly in the last two decades. Noises originate from a broad range of sources, both natural and anthropogenic (Richardson et al., 1995). Virtually all of the marine mammal species in the GOM have been exposed to OCS industrial noise due to the rapid advance into GOM deep oceanic waters by the oil and gas industry in recent years; whereas, 20 years ago, the confinement of industry to shallower coastal and continental shelf waters generally only exposed two species of marine mammals (the bottlenose dolphin and the Atlantic spotted dolphin) to industry activities and the related sounds. Most marine mammal species in the GOM, and particularly the deepwater mammals, rely on echolocation for basic and vital life processes, including feeding, navigation, and conspecific and mate communication. Noise levels that interfere with these basic marine mammal capabilities could have impacts on individuals as well as marine mammal populations. The OCS oil and gas industry's operations contribute noise to the marine environment from several different operations, including G&G surveys, vessel noise, drilling, and explosive removals.

Cumulative impacts on marine mammals are expected to result in some potentially chronic as well as sublethal effects (i.e., behavioral effects and nonfatal exposure to or intake of OCS oil- and gas-related contaminants or discarded debris) that may stress and/or weaken individuals of a local group or population and that may make them more vulnerable to parasites or diseases (Harvey and Dahlheim, 1994).

The net result of any disturbance will depend upon the size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). As discussed in **Chapter 1.2**, the proposed WPA lease sale area encompasses virtually all of the WPA's approximately 28.58 million acres (ac). This area begins 3 marine leagues (9 nmi; 10.36 mi; 16.67 km) offshore Texas and extends seaward to the limits of the United States' jurisdiction over the continental shelf (often the Exclusive Economic Zone) in water depths up to approximately 3,346 m (10,978 ft). The disturbance would be dependent on the size of the area that is leased, surveyed, and developed, and the number of animals there at the time. A description of the species expected to be present are discussed in Chapters 4.1.1.11.1, 4.1.1.11.2, and 4.1.1.11.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.11 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. Further, as discussed in **Appendix B**, a low-probability, large-scale catastrophic event could also have population-level effects on marine mammals.

The effects of a WPA proposed action, when viewed in light of the effects associated with other past, present, and reasonably foreseeable future activities may result in more significant impacts to marine mammals, as compared with effects before the *Deepwater Horizon* explosion, oil spill, and response; however, the magnitude of those effects cannot yet be determined. Nonetheless, operators are required to follow all applicable lease stipulations and regulations, as clarified by NTLs (i.e., NTL 2012-JOINT-G01, NTL 2012-BSEE-G01, and NTL 2012-JOINT-G02), to minimize these potential interactions and impacts. Even when taking into consideration the potential effects of the *Deepwater Horizon* explosion, oil spill, and response and the minimization of impacts through lease stipulations and regulations, no significant cumulative impacts to marine mammals would be expected as a result of the proposed exploration activities when added to the impacts of past, present, or reasonably foreseeable oil and gas development in the area, as well as other ongoing activities in the area.

Non-OCS oil- and gas-related activities that may affect marine mammal populations include vessel traffic and related noise (including from commercial shipping and research vessels), State oil and gas activities, military operations, commercial fishing, pollution, scientific research, and natural phenomena.

Groups such as the military (i.e., U.S. Navy and USCG) and other Federal agencies (i.e., USEPA, COE, and NMFS), dredging companies, commercial fishermen, and recreational boaters operate vessels and aircraft and contribute to the overall noise level in the GOM. Pollution in the ocean comes from many point and nonpoint sources, including the drainage of the Mississippi River being discharged into the GOM. Tropical storms and hurricanes are normal occurrences in the GOM and along the Gulf Coast. Generally, the impacts from these storms have been localized and infrequent. The actual impacts of these storms on the animals in the GOM, and the listed species and critical habitat in particular, have not yet been determined and, for the most part, may remain difficult to quantify.

An unusual mortality event (UME) is defined under the MMPA as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response." Infections, biotoxins, human interactions, and malnutrition are considered causes of UMEs. A UME for bottlenose dolphins occurred off the coast of Texas in 2011-2012 when 126 dolphins were stranded. While there is no known cause for the strandings, preliminary findings include infected lungs, poor body condition, discoloration of the teeth, and substance in the stomach in four of the animals (USDOC, NMFS, 2014a). Further, a UME for cetaceans that encompasses the entire northern GOM began in February 2010 and has continued. This UME is defined by the Florida panhandle west to the Louisiana-Texas border (USDOC, NMFS, 2014a). The relationship of these UMEs to the *Deepwater Horizon* explosion, oil spill, and response remains unclear, as the 2010 UME began before the *Deepwater Horizon* oil spill (refer to the "Incomplete or Unavailable Information" section below).

The incremental contribution of a WPA proposed action to the cumulative impact is expected to be negligible. There are existing leases in the WPA with either ongoing or the potential for exploration, drilling, and production activities. In addition, non-OCS oil- and gas-related activities discussed herein will continue to occur in the WPA irrespective of a WPA proposed action. The potential for effects from changes to the affected environment (post-*Deepwater Horizon*), routine activities, accidental spills, low-probability catastrophic spills (refer to **Appendix B**), which are not reasonably expected and not part of a WPA proposed action, and cumulative effects remains whether or not the No Action or Action alternative is chosen under this Supplemental EIS. Impacts on marine mammals from either smaller accidental events or low-probability catastrophic events would remain the same.

Within the WPA, there is a long-standing and well-developed OCS Program (more than 50 years); existing available data do not suggest that activities from the preexisting OCS Program are significantly impacting marine mammal populations. Therefore, in light of a WPA proposed action and its impacts, the incremental effect of a WPA proposed action on marine mammal populations is not expected to be significant when compared with non-OCS oil- and gas-related activities.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search of Internet information sources (NOAA's website and the RestoreTheGulf.gov website), as well as recently published journal articles, was conducted to determine the availability of recent information on marine mammals.

On December 13, 2010, NMFS declared an UME for cetaceans (whales and dolphins) in the Gulf of Mexico. A UME is defined under the MMPA as a "stranding that is unexpected, involves a significant die-off of any marine mammal population, and demands immediate response." Evidence of the UME was first noted by NMFS as early as February 2010, before the *Deepwater Horizon* explosion, oil spill, and response occurred. As of December 14, 2014, a total of 1,295 cetaceans (6% stranded alive and 94% stranded dead) have stranded since the start of the UME, with a vast majority of these strandings between Franklin County, Florida, and the Louisiana/Texas border (**Table 4-1**; USDOC, NMFS, 2014b). In addition to investigating all other potential causes, scientists are investigating what role the bacterium *Brucella* plays in the northern Gulf of Mexico UME. As of November 25, 2014, 54 out of 177 dolphins tested were positive or suspected positive for *Brucella* (USDOC, NMFS, 2014c). More detail on the UME can be found on NMFS's website (USDOC, NMFS, 2014a). It is unclear at this time whether the increase in strandings is related partially, wholly, or not at all to the *Deepwater Horizon* explosion, oil spill, and response.

A study published from the NRDA process began evaluating the possible effects of the *Deepwater Horizon* explosion, oil spill, and response on bottlenose dolphins in Barataria Bay, Louisiana, which received some degree of prolonged and heavy oiling, and compared them to bottlenose dolphins located in Sarasota Bay, Florida, where no oil was observed. Bottlenose dolphins in Barataria Bay exhibited an elevated occurrence of overall poor health and prevalence of poor body condition, disease, and abnormalities as compared with Sarasota bottlenose dolphins and dolphins from other U.S. coastal sites (Schwacke et al., 2013).

Incomplete or Unavailable Information

After evaluating the information above, BOEM has determined that the new information does not change the conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS, as well as in Chapter 4.1.1.16 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete information for impacts on marine mammals from the *Deepwater Horizon* explosion, oil spill, and response. The final determinations on damages to marine mammal resources from the *Deepwater Horizon* explosion, oil spill, and response will ultimately be made through the NRDA process. The *Deepwater Horizon* explosion, oil spill, and response will ultimately allow a better understanding of any realized effects from a low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected. However, even with recent publications such as Schwacke et al. (2013), the best available information on impacts to marine mammals does not yet provide a complete understanding of the effects of the oil spill and active response/cleanup activities from the *Deepwater Horizon* explosion, oil spill, and response on marine mammals as a whole in the GOM and whether these impacts reach a population level. As identified above, unavailable information such as the anthropogenic impacts following an oil-spill response and population variation due to naturally occurring events such as hurricanes and UMEs provide challenges in understanding the baseline conditions and changes within marine mammal populations.

Here, BOEM concludes that the unavailable information from these events may be relevant but not necessarily essential to reasonably foreseeable significant adverse impacts to marine mammals from the *Deepwater Horizon* explosion, oil spill, and response. In some specific cases, such as with bottlenose dolphins as noted above, the unavailable information may also be relevant to a reasoned choice among the alternatives based on the discussion below. The cost of obtaining data on the effects from the UME and/or *Deepwater Horizon* explosion, oil spill, and response are exorbitant, are duplicative of efforts already being undertaken as part of the UME and NRDA, and would likewise take years to acquire and analyze through the existing NRDA and UME processes. The NMFS has jurisdiction for the investigation of marine mammal strandings and has only released raw data on stranding numbers to date.

Therefore, it is not possible for BOEM to obtain this information within the timeline contemplated in the NEPA analysis of this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEM's subject-matter experts have used available scientifically credible evidence, such as the scientific research evaluated in the 2012-2017 WPA/CPA Multisale EIS as well as new information such as the Schwacke et al. (2013) paper, in this analysis and applied it using accepted scientific methods and approaches. The majority of oil-spill effect data derived from the *Exxon Valdez* oil spill and limited exposure treatments (i.e., Waring et al., 2011; Geraci and St. Aubin, 1990; St. Aubin and Lounsbury, 1990) suggests that localized populations/species in the WPA are unlikely to have been affected. Wider ranging species may have been exposed to the spill but they are unlikely to have experienced population-level effects due to their wide-ranging distributions and behavior (i.e., Davis et al., 2000; Jochens et al., 2008). Further, impacts from the *Deepwater Horizon* explosion, oil spill, and response may be difficult or impossible to discern from other factors. For example, even 20 years after the *Exxon Valdez* spill, long-term impacts to marine mammal populations were still being investigated (Matkin et al., 2008). Therefore, it is not possible for BOEM to obtain this information within the timeline contemplated in the NEPA analysis of this Supplemental EIS regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEM's subject-matter experts have used available scientifically credible evidence in this analysis and applied it using accepted scientific methods and approaches. Nevertheless, a complete understanding of the missing information is not essential to a reasoned choice among alternatives for this Supplemental EIS (including the No Action and Action alternatives) for the three main reasons listed below.

(1) The WPA is an active oil and gas region with ongoing (or the potential for) exploration, drilling, and production activities. In addition, non-OCS oil- and gas-related activities will continue to occur in the WPA irrespective of a WPA proposed action (i.e., fishing, military activities, and scientific research). The potential for effects from changes to the affected environment (post-*Deepwater Horizon*), routine activities, accidental spills (including low-probability catastrophic spills), and cumulative effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on marine mammals from either smaller accidental events or low-probability catastrophic events will remain the same.

(2) Some marine mammal populations in the WPA do not generally travel throughout areas affected by spilled oil from the *Deepwater Horizon* explosion, and they would not be subject to a changed baseline or cumulative effects from the *Deepwater Horizon* explosion, oil spill, and response (e.g., coastal bottlenose dolphins that are resident in the WPA). Other marine mammals, such as Bryde's whales and manatees, although potentially affected by the *Deepwater Horizon* explosion, oil spill, and response do not typically occur in the WPA. Fertl et al. (2005) stated that a manatee was sighted in Mississippi Canyon in 2001, with a bottom depth greater than 1,524 m (5,000 ft) around operating vessels. Since that time, BSEE has documented an additional four manatee sightings that have occurred in deepwater areas within the GOM. Manatees should be expected anywhere within the WPA, CPA, and EPA when GOM water temperatures are greater than 68ºF.

(3) Other wide-ranging populations of marine mammals (e.g., sperm whales and killer whales) that may occur in the WPA and within areas affected by the spill are unlikely to have experienced population-level effects from the *Deepwater Horizon* explosion, oil spill, and response given their wide-ranging distribution and behaviors.

Summary and Conclusion

BOEM has reexamined the analysis for marine mammals presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for marine mammals presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS because of the available scientifically credible evidence in this analysis and based upon accepted scientific methods and approaches. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.12. Sea Turtles

BOEM has reexamined the analysis for sea turtles presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for sea turtles presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of sea turtles, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.12.1, 4.1.1.12.2, and 4.1.1.12.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.12 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.12.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.12 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

In order to minimize potential interactions and impacts to sea turtles, operators are required to follow all applicable lease stipulations and regulations, as clarified by NTLs. The operator's reaffirmed compliance with NTL 2012-JOINT-G01 ("Vessel-Strike Avoidance and Injured/Dead Protected Species Reporting") and NTL 2012-BSEE-G01 ("Marine Trash and Debris Awareness Elimination"), as well as the limited scope, timing, and geographic location of a WPA proposed action, would result in negligible effects from a WPA proposed action on sea turtles. In addition, NTL 2012-JOINT-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," minimizes the potential of harm from seismic operations to sea turtles and marine mammals; these mitigating measures include onboard observers, airgun shut-downs for whales in the exclusion zone, ramp-up procedures, the use of a minimum sound source, and delayed use of explosives when turtles or marine mammals are observed in the exclusion zone.

The routine activities associated with proposed WPA Lease Sales 246 and 248 that could potentially affect sea turtles include the following: the degradation of water quality resulting from operational discharges; noise generated by helicopter and vessel traffic, platforms, drillships, and seismic exploration; noise and impact from explosive structure removals; vessel strikes; and marine debris generated by service vessels and OCS facilities. Noise disturbance and/or exposure to sublethal levels of toxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them more vulnerable to parasites and diseases that normally would not be fatal during their life cycle. Because of the mitigations (e.g., BOEM- and BSEE-proposed compliance with NTLs) as described in the 2012-2017 WPA/CPA Multisale EIS and summarized above, routine activities (e.g., operational discharges, noise, vessel traffic, and marine debris) related to a WPA proposed action are not expected to have long-term adverse effects on the size and productivity of any sea turtle species or populations in the northern Gulf of Mexico. With the mitigations, few deaths are expected from chance collisions with OCS service vessels, ingestion of plastic material, and pathogens. To minimize impacts to sea turtles and marine mammals from explosive structure removal, the use of explosives is delayed when turtles or marine mammals are observed in the exclusion zone. In addition, while little is known about sea turtle hearing, the best available scientific information indicates that sea turtles do not rely on acoustics; therefore, vessel noise and noise from related activities (i.e., drilling, seismic exploration, and explosive structure removals) would have limited effect. Most routine OCS oil- and gas-related activities are expected to have sublethal effects that are not expected to rise to the level of significance.

Accidental events including marine debris generated by service vessels and OCS facilities, blowouts, oil spills, contaminant spills, and spill-response activities that may be associated with a WPA proposed action have the potential to impact small to large numbers of sea turtles in the GOM, depending on the magnitude and frequency of accidents, the ability to respond to accidents, the location and time of year the accidents occur, and various meteorological and hydrological factors. Impacts from smaller accidental events may affect individual sea turtles in the area, but impacts are unlikely to rise to the level of population effects (or significance) given the size and scope of such spills. Population-level impacts are not anticipated based on the best available information. Further, the potential remains for smaller accidental spills to occur in a WPA proposed action area, regardless of any alternative selected under this Supplemental EIS, given that it is an active oil and gas region with either ongoing or the potential for exploration, drilling, and production activities.

The cumulative analysis considers the effects of impact-producing factors related to OCS oil and gas along with non-OCS oil- and gas-related impacts of other commercial, military, recreational, offshore, and coastal activities that may occur and adversely affect sea turtles in the same general area of a WPA proposed action. The major impact-producing factors resulting from cumulative OCS oil- and gas-related activities associated with a WPA proposed action that may affect loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles and their habitats include marine debris, contaminant spills and spill-response activities, vessel strikes, noise, seismic surveys, and explosive structure removals. Most routine impacts are minimized by the operator's requirement to follow all applicable lease stipulations and regulations, as clarified by NTLs. Lease stipulations and regulations are in place to reduce vessel strike mortalities, as well as impacts from marine trash and debris and seismic surveys. In addition, most OCS oil- and gas-related impacts are expected to be sublethal and occur on an individual level (i.e., behavioral effects and nonfatal exposure to or intake of OCS oil- and gas-related contaminants or discarded debris) and not impact the GOM sea turtle population as a whole. However, as discussed in **Appendix B**, a low-probability, large-scale catastrophic event, which is not reasonably foreseeable and not part of a WPA proposed action, could have population-level effects on sea turtles. The net result of any disturbance depends upon the size and percentage of the population likely to be affected, the ecological importance of the disturbed area, the environmental and biological parameters that influence an animal's sensitivity to disturbance and stress, or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980).

Non-OCS oil- and gas-related activities that may affect sea turtle populations include noise related to vessels (including commercial shipping and research vessels) and State drilling operations, military operations, commercial and recreational fishing, pollution, historic overexploitation (which led to listing of the species), coastal infrastructure and habitat loss, dredging, vessel strikes, pathogens, increased runoff, and natural phenomena. Direct population effects are due to mortality, and indirect effects can be from failed reproduction, inability to nest, or weakened immunity due to stress.

The effects of a WPA proposed action, when viewed in light of the effects associated with other past, present, and reasonably foreseeable future OCS oil- and gas-related activities, may result in more significant impacts to sea turtles than before the *Deepwater Horizon* explosion, oil spill, and response; however, the magnitude of those effects cannot yet be determined. Nonetheless, operators are required to follow all applicable lease stipulations and regulations, as clarified by NTLs, to minimize these potential interactions and impacts. The operator's reaffirmed compliance with NTL 2012-JOINT-G01 ("Vessel-Strike Avoidance and Injured/Dead Protected Species Reporting") and NTL 2012-BSEE-G01 ("Marine Trash and Debris Awareness Elimination"), as well as the limited scope, timing, and geographic location of a WPA proposed action, would result in negligible effects from the proposed drilling activities on sea turtles. In addition, NTL 2012-JOINT-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program," minimizes the potential of harm from seismic operations to sea turtles. These mitigations include onboard observers, airgun shut-downs for whales in the exclusion zone, ramp-up procedures, the use of a minimum sound source, and delayed use of explosives when turtles are observed in the exclusion zone. Even when taking into consideration the potential effects of the *Deepwater Horizon* explosion, oil spill, and response and the minimization of impacts through lease stipulations and regulations, no significant cumulative impacts to sea turtles would be expected as a result of the proposed exploration activities when added to the impacts of past, present, or reasonably foreseeable oil and gas development in the area, as well as other ongoing activities in the area.

No significant cumulative impacts to sea turtles would be expected as a result of a WPA proposed action. The potential for impacts is mainly focused on the individual, and population-level impacts are not anticipated. The incremental contribution of a WPA proposed action would not be likely to result in a significant increase of impacts to sea turtles within the WPA; in comparison, non-OCS oil- and gas-related activities, such as overexploitation, commercial fishing, and pollution, have historically proved to be a greater threat to sea turtles. Even when taking into consideration the potential effects of the *Deepwater Horizon* explosion, oil spill, and response and the minimization of impacts through lease stipulations and regulations, no significant cumulative impacts to sea turtles would be expected as a result of the proposed exploration activities when added to the impacts of past, present, or reasonably foreseeable oil and gas development in the area, as well as other ongoing activities in the area.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search of Internet information sources (NOAA's and FWS's websites, Gulf of Mexico coastal State government websites, and the RestoreTheGulf.gov website), as well as recently published, peer-reviewed journal articles was conducted to determine the availability of recent information on sea turtles. New information for the affected environment was discovered, including information on sea turtle strandings and nests.

On April 17, 2014, NMFS published a proposed rule for Taking of Marine Mammals Incidental to Commercial Fishing Operations; Bottlenose Dolphin Take Reduction Plan; Sea Turtle Conservation; Modification to Fishing Activities (*Federal Register*, 2014d). The NOAA published a final rule for the "Endangered and Threatened Species: Designation of Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead DPS" on July 10, 2014 (*Federal Register*, 2014c). Within the GOM, there is a long-standing and well-developed OCS Program (more than 50 years); there are no data to suggest that activities from the preexisting OCS Program are significantly impacting sea turtle populations within these designated critical habitats. Therefore, in light of a WPA proposed action and its impacts, the incremental effect on sea turtle critical habitat is not expected to be significant when compared with non-OCS oil- and gas-related activities.

Since January 1, 2011, a notable increase in sea turtle strandings has occurred in the northern GOM, primarily in Mississippi. While turtle strandings in this region typically increase in the spring, the recent increase is a cause for concern. The Sea Turtle Stranding and Salvage Network is monitoring and investigating this increase. The network is part of the NOAA/FWS National Marine Mammal Health and Stranding Response Program and encompasses the coastal areas of the 18 states from Maine through Texas. There are many possible reasons for the increase in strandings in the northern GOM, both natural and human caused (USDOC, NMFS, 2014b). These sea turtle species include loggerhead, green, Kemp's ridley, leatherback, hawksbill, and unidentified. As of August 25, 2013, NMFS has identified a total of 203 strandings in Alabama, 473 strandings in Louisiana, 641 strandings in Mississippi and 219 strandings in Texas (upper Texas coast—Zone 18). Total strandings per year were 525 in 2011, 466 in 2012, and 545 in 2013 for the previously identified states (USDOC, NMFS, 2014c).

In 2013, loggerhead sea turtle nest counts on Florida's beaches were close to the average of the previous 5 years, totaling 77,975 nests (9,952 west coast). Green sea turtle nest counts have increased exponentially from 267 nests in 1989 to 25,553 nests (207 west coast) in 2013 on Florida index beaches, peaking in 2013. Leatherback nests in 2013 were recorded on beaches in Florida, totaling 896 nests all on the east coast (State of Florida, Fish and Wildlife Conservation Commission, 2014a). Similar to the nest counts for green turtles, leatherback nest counts have been increasing exponentially on Florida index beaches (State of Florida, Fish and Wildlife Conservation Commission, 2014b). The Alabama Gulf Coast turtle nesting in 2012 was a success with a record-breaking 149 nests and in 2013, there was a total of 82 nests (Share the Beach, 2014a). The 2013 Share the Beach season along the Alabama coastline resulted in a total of 8,265 eggs in the sand with over 4,950 hatchlings entering the Gulf of Mexico. As of August 31, 2014, 80 nests were identified for the 2014 Alabama nesting season; however, there were some late nests found at several locations, so the season was extended until October and those data are not yet available (Share the Beach, 2014b). Texas coastline had a documented 153 Kemp's ridley, 13 loggerhead, and 15 green sea turtle nests in 2013 (Shaver, official communication, 2014), and 2014 data are not yet available.

Popper et al. (2014) published *Sound Exposure Guidelines for Fishes and Sea Turtles*. These guidelines found that sea turtles have the potential for mortality from explosions when the peak sound pressure levels are 229-234 decibel (dB) re:1μPa and when there is a high potential for recoverable injury, temporary threshold shift, and behavioral modification if an individual is near or relatively near to the explosive source. For seismic sources, sea turtles have the potential for mortality or injury at or above 210 dB cumulative sound exposure level and above 207 dB peak pressure level. They have a high potential for recoverable injury, temporary threshold shift, and behavioral modifications only when they are close in proximity to the source. Mortality and injury caused by shipping and continuous noise are expected to have low levels of relative risk even if a sea turtle is relatively near the source. The risk for temporary threshold shift near the source is moderate, while the risk for masking may be high both at near and intermediate distances from the source, and the risk for behavioral modifications near the source are high and moderate at intermediate distances from the source. It is important to note, in Popper et al. (2014), that the Working Group states the following:

> Where insufficient data exist to make a recommendation for guidelines a subjective approach is adopted in which the relative risk of an effect is placed in order of rank at three distances from the source – near (N), intermediate (I), and far (F) (top to bottom within each cell of the table, respectively). While it would not be appropriate to ascribe particular distances to effects because of the many variables in making such decisions, "near" might be considered to be in the tens of meters from the source, "intermediate" in the hundreds of meters, and "far" in the thousands of meters.
>
> The relative risk of an effect is then rated as being "high," "moderate," and "low" with respect to source distance and animal type. No assumptions are made about source or received levels because there are insufficient data to quantify what these distances might be. However, in general the nearer the animal is to the source the higher the likelihood of high energy and a resultant effect. In specifying these distances and the potential effects, regulators and others need to consider actual source and received levels and the sensitivity to the sources by the animals of concern. The rating for effects in these tables is highly subjective, and represents general consensus within the WG. However, these ratings are not hard and fast, and they are presented as the basis for discussion.

The new information presented in this chapter provides additional details on the baseline affected environment for sea turtles and does not change BOEM's conclusions about the potential effects of a WPA proposed action on sea turtles.

Incomplete or Unavailable Information

After evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed above, as well as in Chapter 4.2.1.13 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete information regarding impacts of the *Deepwater Horizon* explosion, oil spill, and response on sea turtles in the WPA. BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis of potential oil exposure impacts to sea turtles using studies investigating evidence of oil and impacts stemming from exposure to oil (Witham, 1978; Vargo et al., 1986; Lutz and Lutcavage, 1989; Lutcavage et al., 1995; Plotkin and Amos, 1988). In addition, BOEM used information published on sea turtle nests and strandings to draw conclusions about sea turtle populations following the *Deepwater Horizon* explosion, oil spill, and response (USDOC, NMFS, 2014d and 2014e; State of Florida, Fish and Wildlife Conservation Commission, 2014b; Share the Beach, 2014a and 2014b). Unavailable information on the effects to sea turtles from the *Deepwater Horizon* explosion, oil spill, and response (and thus changes to the sea turtle baseline in the affected environment) makes an understanding of the cumulative effects less clear. A large body of information is being developed though the NRDA process, but it is not yet available. Relevant data on the status of sea turtle populations after the *Deepwater Horizon* explosion, oil spill, and response and increased sea turtle GOM strandings may take years to acquire and analyze, and impacts from the *Deepwater Horizon* explosion, oil spill, and response may be difficult or impossible to discern from other factors. BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information on sea turtle nests and strandings in completing the relevant analysis of sea turtle populations. None of these sources reveal reasonably foreseeable significant adverse impacts. Therefore, BOEM concludes that the unavailable information from these events may be relevant to foreseeable significant adverse impacts to sea turtles because the full extent of impacts on sea turtles is not known, but BOEM has determined that the information is not essential to a reasoned choice among alternatives for this Supplemental EIS (including the No Action and Action alternatives) for the two main reasons listed below:

(1) The WPA is an active oil and gas region with ongoing (or the potential for) exploration, drilling, and production activities. In addition, non-OCS oil- and gas-related activities will continue to occur in the WPA irrespective of a WPA proposed action (i.e., fishing, military activities, scientific research, and shoreline development). The potential for effects from changes to the affected environment (post-*Deepwater Horizon*), routine activities, accidental spills (including low-probability catastrophic spills), and cumulative effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS. Impacts on sea turtles from either smaller accidental events or low-probability catastrophic events will remain the same.

(2) All wide-ranging populations of sea turtles that may occur in the WPA and within areas affected by the spill are unlikely to have experienced population-level effects from the *Deepwater Horizon* explosion, oil spill, and response given their wide-ranging distribution and behaviors.

Nevertheless, there are existing leases in the WPA with either ongoing or the potential for exploration, drilling, and production activities. In addition, non-OCS oil- and gas-related activities will continue to occur in the WPA irrespective of a WPA proposed action (i.e., fishing, military activities, and scientific research). The potential for effects from changes to the affected environment (post-*Deepwater Horizon* explosion, oil spill, and response), routine activities, accidental spills (including low-probability catastrophic spills), and cumulative effects remains whether or not the No Action or Action alternative is chosen under this Supplemental EIS.

Summary and Conclusion

BOEM has reexamined the analysis for sea turtles presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for sea turtles presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.13. Diamondback Terrapins

BOEM has reexamined the analysis for the Texas diamondback terrapin (*Malaclemys terrapin littoralis*) and Mississippi diamondback terrapin (*Malaclemys terrapin pileata*) (referred to as diamondback terrapins in this Supplemental EIS) presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for diamondback terrapins presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of diamondback terrapins, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.13.1, 4.1.1.13.2, and 4.1.1.13.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.13 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.13.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.13 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

The following routine activities associated with proposed WPA Lease Sales 246 and 248 could potentially affect diamondback terrapins: ingestion of beach trash and debris generated by service vessels and OCS oil- and gas-related facilities; and injury from vessel traffic (boat propellers) with associated loss of habitat (coastal marsh) due to erosion. Adverse impacts due to routine activities resulting from a WPA proposed action are possible but unlikely. Because of the greatly improved handling of waste and trash by industry and because of the annual awareness training required by the marine debris mitigations, the plastics in the ocean are decreasing and the devastating effects on offshore and coastal marine life are minimized. Collisions with OCS oil- and gas-related vessel traffic is minimized by NTL 2012-JOINT-G01, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting," which provides guidelines on monitoring procedures related to vessel strike avoidance measures. Erosion to marshes can be indirectly attributed to OCS oil- and gas-related service traffic and onshore development, but it is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of terrapin habitat. Due to the distance from shore, most impacts are not expected to reach terrapins or their habitat. Impacts that may occur from routine activities of a WPA proposed action are unlikely to have significant adverse effects on the size and recovery of any terrapin species or population in the Gulf of Mexico because most routine, OCS oil- and gas-related activities are expected to have sublethal effects. Sublethal effects such as behavioral effects, nonfatal exposure to or intake of OCS oil- and gas-related contaminants, or discarded debris may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources. These effects are not expected to rise to the level of significance to the populations.

Impact-producing factors associated with accidental events that may be associated with a WPA proposed action that could affect diamondback terrapins include offshore and coastal oil spills and spill-response activities. Behavioral effects and nonfatal exposure to or intake of OCS oil- and gas-related contaminants may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources. Even after the oil is no longer visible, terrapins may still be exposed while they forage in the salt marshes lining the edges of estuaries where oil may have accumulated under the sediments and within the food chain (Burger, 1994; Roosenburg et al., 1999). Reproductive success may be reduced if nests are disturbed or destroyed by cleanup efforts. Hatching success studies at various oiled nesting sites of the Northern diamondback terrapin suggest that spills may result in a reduction in nest size and increased mortality of spring emergers at the oiled sites (Wood and Hales, 2001). However, research on the PAH exposure and toxicology of eggs in the vicinity of a spill site found no correlation to substrate PAHs when compared with egg toxicology. The level of PAHs found in the eggs may be the result of maternal transfer and represent the exposure level of the nesting female rather than environmental exposure to PAHs from oil at the site of the nest (Holliday et al., 2008). Impacts on diamondback terrapins from smaller accidental events are likely to affect individual diamondback terrapins in the spill area, but they are unlikely to rise to the level of population effects (or a level of significance) given the probable size and scope of such spills. Further, the potential remains for smaller accidental spills to occur in a WPA proposed action area, regardless of any alternative selected under this Supplemental EIS, given that it is an active oil and gas region with either ongoing or the potential for exploration, drilling, and production activities.

The national and subnational conservation status rank of diamondback terrapins is vulnerable, at a moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors. "Species of concern" is an informal term that refers to those species that might be in need of concentrated conservation actions. Such conservation actions vary depending on the health of the populations and degree and types of threats. At one extreme, there may only need to be periodic monitoring of populations and threats to the species and its habitat. At the other extreme, a species may need to be listed as a federally threatened or endangered species under the Endangered Species Act. Species of concern receive no legal protection above those already afforded the species under other laws, and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species. At the present time, the diamondback terrapin is neither a listed species nor a candidate for listing under the Endangered Species Act.

The major OCS oil- and gas-related impact-producing factors that may affect the diamondback terrapin include vessel traffic, exposure or intake of OCS oil- and gas-related contaminates or debris, and oil spills and spill response. To mitigate the potential impacts from OCS oil- and gas-related activities, operators are required to follow all applicable lease stipulations and regulations, as clarified by NTLs, to minimize these potential interactions and impacts. The operator's reaffirmed compliance with NTL 2012-BSEE-G01 ("Marine Trash and Debris Awareness and Elimination") and NTL 2012-JOINT-G01 ("Vessel Strike Avoidance and Injured/Dead Protected Species Reporting"), as well as the limited scope, timing, and geographic location of a WPA proposed action, would result in minimal effects from the proposed drilling activities on diamondback terrapins. Most spills related to a WPA proposed action, as well as low-probability catastrophic spills (which are not part of a WPA proposed action and not likely expected [refer to **Appendix B** for more information]) and oil spills stemming from tankering and prior and future lease sales, are not expected to contact terrapins or their habitats. Most routine and accidental, OCS oil- and gas-related activities are expected to have sublethal effects, such as behavioral effects, that are not expected to rise to the level of significance to the populations as a whole. Therefore, the incremental contribution of a WPA proposed action to cumulative impacts on terrapins is expected to be minimal.

Activities posing the greatest potential harm to terrapins are non-OCS oil- and gas-related factors, including habitat destruction, overharvesting and crab pot fishing, vessel traffic and road mortality, nest depredation, State oil- and gas-related activity, and natural processes. Spending most of their lives within their limited home ranges at the aquatic-terrestrial boundary in estuaries, terrapins are susceptible to habitat destruction (i.e., urban development, subsidence/sea-level rise, direct oil contact from non-OCS oil- and gas-related leasing program activities, and associated cleanup efforts). Habitat destruction, road construction, nest depredation, and drowning in crab traps are the most recent threats to diamondback terrapins. In the 1800's, populations declined due to overharvesting for meat (Hogan, 2003). Tropical storms, hurricanes, and beach erosion threaten their preferred nesting habitats. Characteristics of terrapin life history render this species especially vulnerable to overharvesting and habitat loss. These characteristics include low reproductive rates, low survivorship, limited population movements, and nest site fidelity year after year. Inshore oil spills from non-OCS oil- and gas-related sources are potential threats to terrapins in their brackish coastal marshes.

The incremental contribution of a WPA proposed action is expected to be minimal compared with non-OCS oil- and gas-related activities. The major impact-producing factors resulting from the cumulative activities associated with a WPA proposed action that may affect diamondback terrapins include oil spills and spill-response activities, alteration and reduction of habitat, and consumption of trash and debris. Overall, within the WPA, there is a long-standing and well-developed OCS Program (more than 50 years); there are no data to suggest that activities from the preexisting OCS Programs are significantly impacting diamondback terrapin populations. Due to the extended distance from shore, impacts associated with activities occurring in the OCS Program are not expected to impact terrapins or their habitat. Non-OCS oil- and gas-related activities will continue to occur in the WPA irrespective of a proposed WPA lease sale (i.e., crabbing, fishing, military activities, scientific research, and shoreline development). Therefore, in light of the above analysis of a WPA proposed action and its impacts, the incremental effect of a WPA proposed action on diamondback terrapin populations is not expected to be significant when compared with historic and current non-OCS oil- and gas-related activities, such as habitat loss, overharvesting, crabbing, and fishing.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search of Internet information sources (NOAA's and FWS's websites, and the RestoreTheGulf.gov website), as well as recently published journal articles was conducted to determine the availability of recent information on diamondback terrapins. The search revealed no new information pertinent to this Supplemental EIS. No new information was found at this time that would alter the overall conclusions of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS that impacts on diamondback terrapins associated with a WPA proposed action are expected to be minimal.

Incomplete or Unavailable Information

After evaluating the information above, BOEM has determined that the previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS are still valid because no new information on diamondback terrapins pertinent to the proposed action has been published since the publication of the 2012-2017 WPA/CPA Multisale EIS, the WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information on possible impacts to diamondback terrapins as a result of the *Deepwater Horizon* explosion, oil spill, and response.

Diamondback terrapins within the WPA were likely not affected to any discernible degree by the *Deepwater Horizon* explosion, oil spill, and response, based on the best available information and the WPA's distance from the *Macondo* well. However, BOEM has identified incomplete information regarding impacts of the *Deepwater Horizon* explosion, oil spill, and response on diamondback terrapins in the WPA because little information about *Deepwater Horizon* explosion, oil spill, and response has been released as of the publication of this Supplement EIS. Through the NRDA process, ongoing research and analysis of the presence of contaminants in terrapin eggs following the *Deepwater Horizon* oil spill is being conducted (USDOC, NOAA, 2012), but the results are not yet available. Relevant data on the status of diamondback terrapin populations after the *Deepwater Horizon* explosion, oil spill, and response may take years to acquire and analyze, and impacts may be difficult or impossible to discern from other factors. This incomplete information may be relevant to evaluating adverse effects because the full extent of potential impacts on terrapins is not known. In place of the missing information, BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis, such as studies investigating evidence of oil and impacts stemming from exposure to oil (Burger, 1994; Roosenburg et al., 1999; Holliday et al., 2008, Wood and Hales, 2001). The results of these studies indicate that impacts resulting from the *Deepwater Horizon* oil spill have been largely indistinguishable from natural fluctuations or variability due to other anthropogenic activities. Although the body of available information is incomplete and long-term effects cannot yet be known, past analyses are not indicative of significant population-level responses. BOEM has determined that the information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for diamondback terrapins presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for diamondback terrapins presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS because of the available scientifically credible evidence in this analysis and based upon accepted scientific methods and approaches. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.14. Coastal and Marine Birds

BOEM has reexamined the analysis for coastal and marine birds presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for coastal and marine birds presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of coastal and marine birds, along with the full analyses of the potential impacts of routine activities and accidental events that may be associated with a WPA proposed action, are presented in Chapters 4.1.1.14.1, 4.1.1.14.2, and 4.1.1.14.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.14 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.14.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.14 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

The majority of the effects resulting from routine activities of a WPA proposed action (**Tables 3-2 through 3-4**) on threatened or endangered (Table 4-1 of the WPA 233/CPA 231 Supplemental EIS) and nonthreatened and nonendangered coastal and marine birds are expected to be sublethal, primarily disturbance-related effects (Chapter 4.1.1.12.1 of the 2012-2017 WPA/CPA Multisale EIS). Major potential impact-producing factors resulting from routine activities for marine birds in the offshore environment include the following:

- habitat loss and fragmentation from coastal facility construction and development and pipeline landfalls (Fahrig, 1997 and 1998);
- behavioral effects primarily due to disturbance from OCS helicopter and service-vessel traffic and associated noise (Habib et al., 2007; Bayne et al., 2008);
- mortality due to exposure and intake of OCS oil- and gas-related contaminants, e.g., produced waters (Wiese et al., 2001; Fraser et al., 2006);
- impacts from discarded debris (Robards et al., 1995);
- sublethal, chronic effects from air emissions (Newman, 1979; Newman and Schreiber, 1988); and
- mortality and energetic costs associated with structure presence and associated light (Russell, 2005; Montevecchi, 2006).

The major impact-producing factors resulting from the accidental events associated with a WPA proposed action that may affect the coastal and marine birds include oil spills, regardless of size, and oil-spill cleanup activities, including the release of rehabilitated birds. Oil spills (and disturbance impacts associated with cleanup activities) have the greatest impact on coastal and marine birds. Sometimes, the rehabilitation of birds may have benefits beyond wild bird condition because of veterinary care that wild birds do not receive. However, the handling of birds during rehabilitation may sometimes stress birds. Depending on the timing and location of the spill, even small spills can result in major avian mortality events (Piatt et al., 1990a and 1990b; Castège et al., 2007; Wilhelm et al., 2007). Small amounts of oil can affect birds, and mortality from oil spills is often related to numerous symptoms of toxicity (Burger and Gochfeld, 2001; Albers, 2006). Data from actual spills strongly suggest that impacts to a bird species' food supply are typically delayed after initial impacts from direct oiling (e.g., Esler et al., 2002; Velando et al., 2005; Zabala et al., 2010). Sublethal, long-term effects of oil on birds have previously been documented (Esler et al., 2000; Alonso-Alvarez et al., 2007), including changes to sexual signaling (Pérez et al., 2010).

Oil-spill impacts on birds from a WPA proposed action are expected to be adverse, but not significant, given the number and relatively small size of spills expected over the 40-year life of a WPA proposed action (Table 3-12 of the 2012-2017 WPA/CPA Multisale EIS). Impacts of oil-spill cleanup from a WPA proposed action are also expected to be adverse, but not significant, and may be negligible depending on the scope and scale of efforts.

Cumulative impacts to coastal and marine birds include both OCS oil- and gas-related and non-OCS oil- and gas-related activities. The OCS oil- and gas-related cumulative impact-producing factors that could potentially impact coastal and marine birds include the following:

- air pollution;
- pollution of coastal and offshore waters resulting from OCS oil- and gas-related activities, including platform and pipeline oil spills, produced waters, and any spill-response activities;

- structure presence and lighting (e.g., OCS platforms);
- aircraft and vessel traffic and oil-spill cleanup associated noise and disturbance impacts, including OCS helicopter and service-vessels;
- habitat loss, alteration, and fragmentation resulting from coastal facility construction and development;
- OCS pipeline landfalls; and
- trash and debris.

The incremental contribution of a WPA proposed action to the cumulative impact is considered adverse but not significant because the effects of the most probable impacts, such as lease sale-related operational discharges, air pollution, or trash and debris and helicopter and service-vessel noise and traffic, are expected to be sublethal; and some displacement of local individuals or flocks to other habitat may occur, if habitat is available. Overall carrying capacity may be reduced temporarily or permanently in habitats disturbed by OCS oil- and gas-related activities. These activities produce a net effect of habitat loss from oil spills, OCS pipeline landfalls, and maintenance and use of navigation waterways, as well as habitat loss and modification resulting from coastal facility construction and development. Nocturnal circulation events at platforms due to platform lighting have unknown impacts on migrating bird populations. Offshore oil and gas platform-related avian mortality, though representing an additional source of human-induced mortality, represents a small fraction compared with other sources of human-induced mortality (Table 4-7 of the 2012-2017 WPA/CPA Multisale EIS). Impacts may occur to coastal and marine birds from a low-probability catastrophic oil spill; however, this is not part of a WPA proposed action and not likely expected. For additional information on a low-probability catastrophic spill, refer to **Appendix B**.

Non-OCS oil- and gas-related cumulative impact-producing factors that could potentially impact coastal and marine birds include the following:

- air pollution;
- pollution of coastal waters resulting from municipal, industrial, and agricultural runoff and discharge;
- tanker oil spills and spills related to oil and gas activities in State coastal waters and any spill-response activities;
- aircraft and military activities, including jet training overflights and sonic booms;
- nonconsumptive recreation, including bird-watching activities, all-terrain vehicle use, walking and jogging with pets, and other beach use;
- maintenance and use of navigation waterways;
- habitat loss, alteration, and fragmentation associated with commercial and residential development;
- collisions of coastal and marine birds with various anthropogenic structures (e.g., buildings, power lines, cell phone towers, etc.);
- diseases;
- climate change and related impacts, including sea-level rise;
- storms and floods;
- fisheries interactions;
- predation;
- hunting;

- trash and debris;
- renewable energy; and
- alternate use conversion.

Impacts from non-OCS oil- and gas-related resources (including impacts from the State oil and gas program and associated structure collisions and spills, waste and debris, water pollution, and air pollution) on habitat and bird behavior operate in a way similar to the OCS oil- and gas-related impacts on each resource discussed previously in this chapter. Avian habitat loss, alteration, and fragmentation associated with commercial and residential development, and maintenance and use of navigation waterways is almost certainly occurring at a much faster pace and on a spatial scale far exceeding that compared with OCS oil- and gas-related activities, especially when compiled with the associated effects of climate change (including sea-level rise and the frequency and intensity of tropical storms). Overall mortality caused by collision with tall buildings is considerable (Drewitt and Langston, 2008), and window strikes may be the greatest cause of anthropogenic mortality in the United States (Table 4-7 of the 2012-2017 WPA/CPA Multisale EIS), at least an order of magnitude greater than strikes with wind turbines, communication towers, tall buildings, and power lines (excluding distribution lines to residences and businesses) (Klem, 2009; Manville, 2005 and 2009). Mortality as a result of long migrations may also impact coastal and marine bird populations. Various passerine forest birds include a substantial migration (approximately tens of kilometers; Gauthreaux, 1975) over land at the end of their spring nonstop trans-Gulf flight. Such a flight over land may also occur before crossing the Gulf itself. The mortality rates of species during nonstop flight due to exhaustion of energy reserves are unknown. However, the overall greatest mortality to birds (anthropogenic and non-anthropogenic) is considered predation by house cats (Table 4-7 of the 2012-2017 WPA/CPA Multisale EIS). House cat predation is a threat mostly for passerines, which comprise most of the trans-Gulf migrants. Despite the number of waterfowl killed annually under Federal hunting laws, their populations remain strong. Sublethal effects on birds may also include interactions with commercial fisheries and noise disturbance from non-OCS oil- and gas-related air and vessel traffic.

A myriad of different anthropogenic (both OCS oil- and gas-related and non-OCS oil- and gas-related) and natural (e.g., disease, predation, exhaustion, and weather) mortality factors (Table 4-7 of the 2012-2017 WPA/CPA Multisale EIS) can negatively affect individuals of populations comprising the seven avian species groups found in the Gulf of Mexico (Tables 4-9, 4-10, and 4-11 of the 2012-2017 WPA/CPA Multisale EIS). Of the OCS oil- and gas-related activities identified previously (Chapters 4.1.1.14.2 and 4.1.1.14.3 of the 2012-2017 WPA/CPA Multisale EIS), several are relevant to the discussion of their potential cumulative effects: habitat loss, alteration, or fragmentation; disturbance-related effects (e.g., support vessels and helicopters); attraction to and collision with offshore platforms; nocturnal circulation (night flights) around them and the potential associated energetic demands; discharge of produced waters; oil spills; and chronic oil pollution. All but the latter two factors are associated with routine OCS oil- and gas-related activities. However, the incremental contribution of a WPA proposed action to the cumulative impact is considered adverse but not significant because the effects of the most probable impacts, such as lease sale-related operational discharges and helicopters and service-vessel noise and traffic, are expected to be sublethal; and some displacement of local individuals or flocks may occur to other habitat, if habitat is available. Collision mortality has been estimated at 200,000-321,000 bird deaths/year over the entire platform archipelago, but offshore oil and gas platform-related avian mortality, though representing an additional source of human-induced mortality, represents a small fraction compared with other sources of human-induced mortality. Of the various factors to consider for avian resources in the GOM associated with climate change (Møller et al., 2004; North American Bird Conservation Initiative, 2010), the factor with the greatest potential net negative impact, at least for the coastal breeding avian assemblage, would be sea-level rise (Galbraith et al., 2002; Erwin et al., 2006). Saltmarsh obligate species are extremely sensitive to loss of saltmarsh habitat from sea-level rise. Routine impacts, accidental impacts, and the incremental contribution of a WPA proposed action to the cumulative impact (which is considered in comparison with the impacts of non-OCS oil- and gas-related factors) is considered adverse but not significant.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A broad Internet search for relevant new information was performed. These include nonprofit organizations, consortias, and administrators of funds that are penalties resulting from the *Deepwater Horizon* explosion, oil spill, and response. Environmental journal articles were also located online using three search engines and the websites of six major journal publishers. New information was found for the affected environment regarding maximizing wetland coastal habitat.

A search of Internet information sources, including published journal articles, was conducted to determine the availability of recent information on coastal and marine birds. Internet websites visited included 4 Federal agencies (USEPA, USGS, NOAA [including *Deepwater Horizon* Bibliography], and BOEM); 12 State agencies (Texas Commission on Environmental Quality; Texas Parks and Wildlife Department; Louisiana Department of Wildlife and Fisheries; Louisiana Department of Natural Resources; Louisiana Department of Environmental Quality; Mississippi Department of Environmental Quality; Mississippi Department of Wildlife, Fisheries, and Parks; Alabama Department of Conservation and Natural Resources; Alabama Department of Environmental Management; Alabama Wildlife and Freshwater Fisheries Division; Florida Department of Environmental Protection; and Florida Fish and Wildlife Conservation Commission); 5 coastal universities or universities with coastal divisions (University of Louisiana at Lafayette, Louisiana State University, Texas A&M University, University of Texas at Austin Marine Science Institute College of Natural Sciences, and Florida State University); several various stakeholders (Sierra Club, National Fish and Wildlife Foundation, Nature Conservancy, Gulf of Mexico Alliance, Gulf of Mexico Program, Barataria-Terrebonne National Estuary Program, National Audubon Society, Gulf Coast Ecosystem Task Force, and Gulf Coast Ecosystem Restoration Council), and Louisiana Universities Marine Consortium ("Effects of Offshore Oil and Gas Development: A Current Awareness Bibliography"). Where applicable, websites of subdivisions of many of these organizations were also consulted. Environmental journal articles were also located online using four search engines (JSTOR, EBSCO, Google Advanced Scholar Search, and Google Advanced Book Search). Three of the search engines collectively searched all of the ecology journals of six major publishers (John Wiley and Sons, Springer, Elsevier Science, Taylor and Francis Group, Cambridge University Press, and Oxford University Press).

New information on Louisiana's Master Plan, which was partly designed for maximizing coastal wetlands, will likely do so for four selected waterbird species and for neotropical birds over the next 50 years. These predictions are based on Habitat Suitability Index models and were controlled for other, nonhabitat environmental variables (Nyman et al., 2013). Therefore, wetland loss will probably not be an issue that would exacerbate other impacts of a WPA proposed action and other cumulative impacts. Otherwise, without the Master Plan, wetland loss could occur and eliminate coastal and marine bird habitat.

The red knot was added to the list of Federal candidate species in 2006. A final rule to list the rufa subspecies as threatened under the Endangered Species Act was published on December 11, 2014, with an effective date of January 12, 2015. Red knots are federally protected under the Migratory Bird Treaty Act and are State-listed as endangered. BOEM will consult with the FWS under the Endangered Species Act. Wintering areas along the northern Gulf Coast are in Texas, Louisiana, and Florida, with smaller numbers in Mississippi and Alabama (USDOI, FWS, 2014). Several threats are likely contributing to habitat loss, anthropogenic mortality, or both, and contribute to the red knot's threatened status (USDOI, FWS, 2014). These threats include loss of both breeding and nonbreeding habitat; likely disruption of natural predator cycles on the breeding grounds, which are in the Arctic; reduced prey availability, especially horseshoe crab eggs in Delaware Bay; and increasing frequency and severity of mismatches in the timing of the birds' migratory cycle relative to favorable food and weather conditions (USDOI, FWS, 2014). Some of these threats are caused by climate change. Although threats to the horseshoe crab egg food resource remain, Adaptive Resource Management is adequate to address present threats to the red knot's Delaware Bay food supply from direct harvest, but Adaptive Resource Management is performed 1 year at a time so it is not known if the resource will continue to adequately support red knot population growth over the next decade (USDOI, FWS, 2014).

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238, 246, and 248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed above, as well as in Chapter 4.1.1.14 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238, 246, and 248 Supplemental EIS, BOEM has identified incomplete information on avian mortality rates during migration, from both exhaustion and collisions with platforms. Various passerine forest birds include a substantial migration (approximately tens of kilometers; Gauthreaux, 1975) over land at the end of their spring nonstop trans-Gulf flight. Such a flight over land may also occur before crossing the Gulf itself unless substantial forests are located near the shoreline. The mortality rates of species during nonstop flight due to exhaustion of energy reserves are unknown. This information may be relevant to the evaluation of adverse impacts from OCS oil- and gas-related activities because, at the present time, there is no way to discern if annual (>200,000) or long-term mortality from such activities, due mostly to collisions with platforms (over the life of newly installed platforms) for any of the affected trans-Gulf migrant species considered herein results in major population-level impacts (Russell, 2005, Chapters 17 and 18). However, in lieu of this data gap, BOEM extrapolated existing information using accepted scientific methodologies to complete this analysis. Studies indicate that the numbers of birds successfully migrating across the Gulf in spring are so great (on the order of magnitude of hundreds of millions; Russell, 2005) that any mortality associated with exhaustion from migration or collision with platforms would likely not exacerbate any cumulative impacts of other mortality factors. Birds suffering from exhaustion would typically be sick or weak, and their mortality would be a case of natural selection where the populations would be strengthened (made more fit). The potential range of a bird adapted to fatten up enough to cross extensive barriers like the open ocean or Gulf of Mexico may be approximated by data on shorebirds, which may be an accurate proxy for the maximum possible flight range of forest songbirds that may traverse the GOM. The computed maximum nonstop range of a bar-tailed godwit leaving Alaska (based on a model of fuel load) was all the way to the South Pole (Pennycuick and Battley, 2003). Given what we know about the life history characteristics of many of these species (e.g., age at first reproduction, clutch size, and nest success), as well as the estimate of maximum nonstop flight range, the potential for such major population-level impacts as a result of migration mortality seems relatively low (Arnold and Zink, 2011, page 2). Additionally, the focus within this Supplemental EIS is on major (population- and ecosystem-level) impacts to bird management, protection, and conservation, as well as ecoregions and landscapes over the long term rather than impacts to individual birds and small sites over a short time. Therefore, although the body of available information on migratory mortality is incomplete and long-term effects are unknown, the evidence currently available supports past analyses The evidence does not indicate severe adverse impacts to coastal and marine bird populations as a result of migration mortality from collisions with platforms. Therefore, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for coastal and marine birds presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information provided above. No new information was discovered that would alter the impact conclusion for coastal and marine birds presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.15. Fish Resources and Essential Fish Habitat

BOEM has reexamined the analysis for fish resources and essential fish habitat (EFH) presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 2312 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for fish resources and EFH presented in the 2012-2017

WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of fish resources and EFH can be found in Chapter 4.1.1.15.1 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.15 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. Also, EFH is discussed in various chapters of this Supplemental EIS, including water quality (**Chapters 4.1.1.2.1 and 4.1.1.2.2**), wetlands (**Chapter 4.1.1.4**), seagrass communities (**Chapter 4.1.1.5**), topographic features (**Chapter 4.1.1.6**), *Sargassum* communities (**Chapter 4.1.1.7**), chemosynthetic deepwater benthic communities (**Chapter 4.1.1.8**), nonchemosynthetic deepwater benthic communities (**Chapter 4.1.1.9**), and soft bottom benthic communities (**Chapter 4.1.1.10**). The full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action are presented in Chapters 4.1.1.15.2 and 4.1.1.15.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.15 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.15.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.15 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Effects on fish resources and EFH from routine oil and gas activities associated with a WPA proposed action could result in coastal and marine environmental degradation as a result of construction activities (onshore facilities to well-site construction activities, including board roads, ring levees, and impoundments), pipeline trenching, offshore discharges of drilling muds and produced waters, anchor and anchor chain placement, and structure emplacement and removal. The OCS oil- and gas-related activities (e.g., anchoring and using anchor chains) could physically destroy live bottom fish habitat, but alternately the emplacement of structures and of artificial reefs can have a positive effect by providing habitat and/or food for reef fishes. Explosive structure removals can be detrimental to fish because blasts can kill or injure fish in close proximity. The removal of the structures would eliminate habitat in areas where natural hard bottom is rare, except when decommissioned platforms are used as artificial reef material. This practice is expected to increase over time. A more detailed discussion of decommissioning and the impacts of these activities on marine fishes can be found in Chapters 3.1.1.10 and 4.1.1.16 of the 2012-2017 WPA/CPA Multisale EIS, respectively. Environmental degradation may also result from turbidity associated with pipeline emplacement. With the number of pipelines estimated for the OCS Program (0-1), sediment would potentially be resuspended in the localized areas. Discharges from OCS oil- and gas-related activities, such as drill mud and produced water, also have an incremental effect on offshore water quality.

Since the majority of fish species within the WPA are estuary dependent, any modification of the coastal environment resulting from a WPA proposed action has the potential to adversely affect EFH and fish resources through the loss of nursery habitat or functional impairment of existing habitat through decreased water quality by vessel traffic and routine dredging (Chambers, 1992; Stroud, 1992). Although there is potential for coastal and marine environmental degradation from a WPA proposed action, any possible degradation would have little effect on fish resources or EFH because many of the offshore EFHs are protected under stipulations, regulations currently set in place, and case-by-case reviews of permit applications to prevent impacts to sensitive fish habitats. Bottom-disturbing activities (i.e., anchoring and structure emplacement) are mitigated by BOEM to prevent habitat loss, all discharges (drilling muds and produced waters) are regulated by USEPA or State agencies, and regulations enforced for structure removal help to prevent loss of fish habitat. Because of the mitigations, regulations, and permit reviews, a WPA proposed action is expected to result in a minimal decrease in fish resources and/or standing stocks or in EFH.

Accidental events associated with a WPA proposed action that could impact fish resources and EFH include blowouts and oil or chemical spills. If oil or chemical spills due to a WPA proposed action were to occur in open waters of the OCS proximate to mobile adult finfish, the effects would likely be nonfatal and the extent of damage would be reduced because adult fish have the ability to move away from a spill, metabolize hydrocarbons, and excrete both metabolites and parent compounds. Fish and shellfish eggs and larvae would be unable to avoid spills, and early development stages may be at greater risk. Fish populations may be impacted by an oil spill, but they will be primarily affected if the oil reaches the coastal and estuarine areas because these are the most productive areas and because many species reside in estuaries for at least part of their life cycle or are dependent on the nutrients exported from the estuaries to the shelf region. Weathered crude oil has been shown in laboratory experiments and field research to cause a range of sublethal effects, including malformation, genetic damage, and physiological impairment in different life history stages of different fish species (Carls et al., 1999; Whitehead et al., 2011; Incardona, 2014). Oil can be lethal to fish, especially in larval and egg stages, depending on the time of the year that the event happened. The effect of oil spills that may be associated with a WPA proposed action on fish resources is expected to cause a minimal decrease in standing stocks of any population because the most common spill events would be small in scale and localized; therefore, they would affect generally only a small portion of fish populations. Historically, there have been no oil spills of any size in the GOM that have had a long-term impact on fishery populations.

There are widespread anthropogenic and natural factors that impact EFH and fish populations in the GOM. These include OCS oil- and gas-related and non-OCS oil- and gas-related factors. The OCS oil- and gas-related activities that could impact fish resources and EFH include construction, pipeline and structure emplacement, anchor and anchor chain placement, drilling and produced water discharges, structure removal, and oil spills. The routine OCS oil- and gas-related activities have the potential to impact fish and degrade EFH, but the activities would probably only have a minimal effect on fish resources and EFH because of the regulations, mitigations, and permit reviews that are applied for OCS oil- and gas-related activities. Oil spills, although considered rare events, can affect seagrass beds through physical oiling and destruction from oil spill cleanup. Low-probability catastrophic spills, which are not part of a WPA proposed action and not likely expected, are analyzed in **Appendix B**. Overall, the incremental contribution of OCS oil- and gas-related activities to fish populations and EFH is small due to regulations, mitigations, and permit reviews.

Non-OCS oil- and gas-related factors that can impact fisheries and EFH include State oil and gas activity, inshore pollutants, dredging, coastal development, human population expansion, commercial and recreational fishing, overfishing, and natural phenomena. Inshore inputs of pollutants to estuaries from runoff and industry are contributors to wetland loss and degradation of water quality. Fish are known to avoid any area of adverse water quality, such as hypoxia (Wannamaker and Rice, 2000; Craig and Bosman, 2013). Canal dredging primarily accommodates commercial, residential, and recreational development, and increased population and commercial pressures on the Gulf Coast are also causing the expansion of ports and marinas. Resource management agencies, both State and Federal, set restrictions and issue permits in an effort to mitigate the effects of development projects and industry activities. The Federal and State governments are also funding research and coastal restoration projects; however, it may take decades of monitoring to ascertain the feasibility and the long-term effectiveness of these coastal restoration efforts.

Overfishing (including bycatch) has contributed to population effects seen with GOM fishes. The Magnuson-Stevens Fishery Conservation and Management Act and its amendments address sustainable fisheries and set guidelines for protecting marine resources and habitat from fishing- and nonfishing-related activities. Under this Act, fisheries management plans, including limits on catch and fishing seasons, are developed and proposed by the regional fisheries management councils for approval and implementation by NMFS. State agencies regulate inshore fishing seasons and limits.

Some natural phenomena can impact fish resources and EFHs. Nearshore habitat can be affected through events such as severe storms and floods. These events can accelerate wetland loss or damage oyster reef habitat. Offshore resources such as biologically sensitive underwater features may be damaged or buried by events like storms or turbidity flows, potentially affecting fish resources. Additionally, variability in spawning success and juvenile survival directly affect Gulf of Mexico fish populations. These natural phenomena are all continual, integral elements of the ecosystem, and impacts attributed to these events are often exacerbated by anthropogenic activities.

While all of these events and activities cause some sort of effect on the different EFHs and fish resources, many anthropogenic inputs, including a WPA proposed action, are now monitored, regulated, and mitigated by the permitting agency or State. A WPA proposed action would add a minimal amount to the overall cumulative effects.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

Various printed and Internet sources (including NMFS databases, the GMFMC website, EBSCO, Elsevier, PLoS ONE, and BioOne) were examined to assess recent information regarding this resource that may be pertinent to the WPA. New information relevant to an analysis of the potential impacts of OCS activities on fishes has been published. An investigation of the impacts of acute exposure to crude oil and dispersed oil on larval and juvenile spotted seatrout (*Cynoscion nebulosus*) found that short-term growth was reduced during exposure (Brewton et al., 2013). Although the different life stages' growth responses to crude oil and dispersed oil treatments differed, upregulation of cytochrome P-4501A (CYP1A) within life stages was consistent with the observed growth effects. These results, combined with the observation that juveniles recovered to the average total length of their cohort after 4 weeks of depuration, suggest the observed effects of acute exposure may not be long term and could be a result of higher metabolic costs associated with exposure to sublethal concentrations of crude oil and dispersed oil (Brewton et al., 2013). Similarly, Anderson et al. (2014) assessed the effects of acute exposure to crude oil water-accommodated fraction (WAF) treatments and dispersed oil treatments on juvenile Harris mud crabs (*Rhithropanopeus harrisii*). In this study, the majority of juvenile crab mortalities occurred within the initial 24 hours of exposure to chemically enhanced (dispersed) water-accommodated fraction (CEWAF) treatments; only one of the crabs exposed to WAFs died. Surviving subjects of all treatments exhibited no long-term effects and there was no significant difference in post-exposure survival. However, the study results do indicate chemical dispersion of oil significantly increases the toxicity to juvenile Harris mud crabs (Anderson et al., 2014).

Incomplete or Unavailable Information

As discussed in Chapter 4.2.1.18 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete information regarding impacts of the *Deepwater Horizon* explosion, oil spill, and response on fish resources and EFH in the Gulf of Mexico. A large body of information is being developed through the NRDA process and is not yet available. Few studies have been released showing impacts following the *Deepwater Horizon* explosion, oil spill, and response. This information cannot be obtained by BOEM because the overall costs are exorbitant. This incomplete information may be relevant to evaluating adverse effects because the full extent of potential impacts on fish resources and EFH are not known. BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis such as studies investigating evidence of oil and impacts stemming from exposure to oil among pelagic fishes, coastal fishes, and marsh-associated nekton (Atlantic Bluefin Tuna Status Review Team, 2011; Fodrie and Heck, 2011; Soniat et al., 2011; Carmichael et al., 2012; Moody et al., 2013; Rooker et al., 2013). These references discuss the effects of PAHs on different species and life history stages of fishes, as well as population distributions and status. These references found that, following the *Deepwater Horizon* explosion, oil spill, and response, there were no short-term effects on species compositions in marsh fishes; oysters did not contain PAHs that would be passed to higher trophic levels; larvae, eggs, and adults are found throughout the GOM; and the populations status of bluefin tuna is still at a point where they do not need to be listed. Further, BOEM analyzed impacts based on the most conservative outcomes; therefore, while there are detailed studies regarding fish larvae and eggs and nonlethal impacts from PAHs, BOEM assumed lethal results if larvae and eggs contacted oil. The results of these recent studies of fish resources (species and communities) indicate impacts resulting from the *Deepwater Horizon* oil spill have been largely indistinguishable from natural fluctuations or variability due to other anthropogenic activities. Although the body of available information is incomplete and long-term effects cannot yet be known, these early results support past analyses and are not indicative of significant population-level responses.

Summary and Conclusion

BOEM has reexamined the analysis for fish resources and EFH presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information provided above. Various printed and Internet sources (including

NMFS databases, the GMFMC website, EBSCO, Elsevier, PLoS ONE, and BioOne) were examined to assess recent information regarding this resource that may be pertinent to the WPA. No new information was discovered that would alter the impact conclusion for fish resources and EFH presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis, potential impacts, and conclusions described in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.16. Commercial Fisheries

BOEM has reexamined the analysis for commercial fisheries presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for commercial fisheries presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts discussed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of commercial fisheries, along with a full analysis of the potential impacts of routine activities and accidental events associated with a WPA proposed action are presented in Chapters 4.1.1.16.1, 4.1.1.16.2, and 4.1.1.16.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.16 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.16.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.16 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Impact-producing factors with the potential to affect commercial fisheries in the WPA include seafloor-disturbing activities (e.g., pipeline installation, infrastructure emplacement, and dredging); waste discharge (e.g., drilling muds, cuttings, and produced waters); explosive severance operations (e.g., decommissioning and structure removal); and space-use conflicts (e.g., seismic surveys and structure emplacement). Some of these factors have the potential to indirectly impact commercial fisheries through degradation or loss of habitat. Healthy fish stocks depend on EFH, which is defined in the Sustainable Fisheries Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, and/or growth to maturity." Since the majority of commercially harvested species within the WPA are estuary-dependent, coastal environmental degradation resulting from a WPA proposed action has the potential to adversely affect EFH and commercially valuable fishes. However, analysis of routine oil and gas activities, such as pipeline trenching, maintenance dredging, canal construction, and OCS discharge of drilling muds and produced water, has identified only short-term localized disturbances that minimally impact commercially valuable fish species and associated EFH. Resuspended sediments and offshore discharges settle or dissipate rapidly, limiting both the area affected and the duration of the effect. Additionally, regulations, mitigations, and current practices reduce the undesirable effects of construction and operational activities on coastal and offshore habitats. At the expected level of impact, the resultant influence on fish resources would be indistinguishable from natural fluctuations and other anthropogenic influences.

Fish mortality as a result of decommissioning operations is an example of OCS oil- and gas-related activities directly impacting fishes. However, a study of structure removals employing explosive severance methods found that associated mortality for three commercially important fishes did not significantly alter projected stocks (Gitschlag et al., 2000). To account for inherent variations in species composition and abundance among platforms (e.g., Stanley and Wilson, 1997; Gitschlag et al., 2000; Stanley and Wilson, 2000; Wilson et al., 2003), mortality estimates were doubled and stock estimates were recalculated. Although the study was limited and cannot be directly applied to all species or habitats, it is reasonable to assume that other commercially important fishes could respond similarly. At the projected rate of removal, these activities are not expected to have a substantial negative impact on stocks of commercially important fishes or, by extension, the associated fisheries.

Space-use conflicts could result directly from OCS oil- and gas-related activities that restrict or prevent other users from accessing OCS resources. For example, seismic surveys and structure emplacement represent short-term and semi-permanent obstructions, respectively. Although studies have shown air guns can produce behavioral responses in fishes, possibly even resulting in species- or gear-specific effects on catch rate (Popper and Hastings, 2009; Fewtrell and McCauley, 2012; Lokkeborg et al., 2012), there is insufficient data to consistently predict responses and important variables, such as the duration of exposure and repeated exposure have not been fully addressed. The OCS structures present a minor space-use conflict when compared with the area available for commercial fishing. In addition, the current paradigm posits these structures act as both fish-attracting and production-enhancing devices, depending upon the species (Carr and Hixon, 1997; Gallaway et al., 2009; Shipp and Bortone, 2009). The resultant assemblages frequently include commercially valuable fishes, such as tunas (*Thunnus* spp.), red snapper (*Lutjanus campechanus*) and wahoo (*Acanthocybium solanderi*). Therefore, OCS structures may either enhance or obstruct commercial fishing, depending upon gear type (e.g., hydraulic reel, greenstick, trawl and long-line) and target species.

Accidental events that could impact commercial fisheries are very limited. Oil spills on the OCS that are >1 bbl due to a WPA proposed action are highly unlikely (Table 3-12 of the 2012-2017 WPA/CPA Multisale EIS). If oil spills due to a WPA proposed action were to occur in open waters of the OCS proximate to mobile adult finfish, the effects would likely be nonfatal, and the extent of damage would be reduced because adult fish have the ability to avoid adverse water conditions. This behavioral mechanism allows mobile fishes to move away from the source of the hydrocarbons, thereby minimizing exposure. Although larval and juvenile life stages are typically more vulnerable than adults, species-specific response, duration of exposure, and hydrocarbon concentration are critical factors in determining short- and long-term effects. If a spill were to occur in coastal waters, oil could potentially impact critical nursery habitat. However, the great majority of coastal spills would be very small, would require a shorter response time than more remote incidents, and would be expected to affect a highly localized area with low-level impacts. The probability of an offshore spill impacting nearshore environments is low, and spilled oil would generally be volatilized or dispersed by currents in the offshore environment prior to impacting inshore nursery habitat. Overall, the commercial fish and shellfish populations have remained healthy in the Gulf of Mexico despite ongoing anthropogenic and natural disturbances.

The cumulative analysis considers activities that have occurred, are currently occurring, and could occur and adversely affect commercial fisheries by harming fishes and affecting landings, or the value of those landings, for the years 2012-2051. These activities include the effects of the OCS Program (proposed action and prior and future OCS lease sales) resulting from pipeline installation, channel dredging, waste discharge, decommissioning operations, seismic surveys, and structure emplacement. Non-OCS oil- and gas-related factors include State oil and gas activity, coastal development, natural phenomena, and commercial and recreational fishing. Although some OCS oil- and gas-related activities contribute incrementally to the degradation and loss of wetland habitat (**Chapter 4.1.1.4**), the cumulative impact is small in comparison with the combined effect of State oil and gas development, coastal commercial, residential and agricultural development, levees, river channelization, and episodic natural phenomena. The cumulative direct impact to commercial fisheries through a reduction in resources (fishable area and fish stocks) is negligible. In recent years, decommissioning operations have exceeded structure emplacements, resulting in a decrease in the total number of OCS platforms. BOEM expects this trend to continue throughout the OCS Program years, further reducing the potential for impacts to commercial fisheries through space-use conflicts. Although the decommissioning process frequently employs explosive severance methods that result in localized mortality of fishes, the cumulative impact to commercially valuable stocks is expected to be indistinguishable from natural fluctuations and the effects of commercial and recreational fishing activity.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

BOEM has examined newly available information for findings that may impact the analyses of routine, accidental, and cumulative OCS oil- and gas-related activities and potentially alter previous conclusions. A search of Internet information sources and scientific journals was conducted to determine the availability of recent information (including NMFS databases, the NOAA Gulf Spill Restoration Publications website, the GMFMC website, Science Direct, EBSCO, Elsevier, PLoS ONE, JSTOR, and

BioOne). Since preparation of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, new information relevant to an analysis of the potential impacts of OCS oil- and gas-related activities on commercial fisheries has been published. The following studies investigate the impacts of acute hydrocarbon exposure on larval and juvenile life stages of species that may be used to extrapolate the potential effects to similar species of commercial interest. An investigation of the impacts of acute exposure to crude oil and dispersed oil on larval and juvenile spotted seatrout (*Cynoscion nebulosus*) found that short-term growth was reduced during exposure (Brewton et al., 2013). Although the different life stages' growth responses to crude oil and dispersed oil treatments differed, upregulation of CYP1A within life stages was consistent with the observed growth effects. These results, combined with the observation that juveniles recovered to the average total length of their cohort after 4 weeks of depuration, suggest the observed effects of acute exposure may not be long term and could be a result of higher metabolic costs associated with exposure to sublethal concentrations of crude oil and dispersed oil (Brewton et al., 2013). Similarly, Anderson et al. (2014) assessed the effects of acute exposure to crude oil WAF treatments and dispersed oil treatments on juvenile Harris mud crabs (*Rhithropanopeus harrisii*). In this study, the majority of juvenile crab mortalities occurred within the initial 24 hours of exposure to CEWAF treatments; only one of the crabs exposed to WAFs died. Surviving subjects of all treatments exhibited no long-term effects and there was no significant difference in post-exposure survival. However, the study results do indicate chemical dispersion of oil significantly increases the toxicity to juvenile Harris mud crabs (Anderson et al., 2014).

These studies serve to expand our understanding of the potential impacts an oil spill may have on valuable marine species and to reaffirm the conclusions reached in previous analyses. As already noted, adult fish have the ability to avoid adverse water conditions and are expected to experience reduced exposure due to their mobility and avoidance response. Larval and juvenile life stages are generally more vulnerable, but studies such as the ones above suggest some species may be more tolerant of exposure than others. Furthermore, these results suggest that, should unweathered oil impact critical nursery habitat, the effects of sublethal acute exposure for some species and life stages may be short term. The potential impact short-term effects may have on juvenile survival and recruitment is not known. Past research (Myers and Cadigan, 1993; Levin and Stuntz, 2005) suggests larval and juvenile survival rates strongly influence offshore adult populations, and a new model developed by Baker et al. (2014) indicates that the survival of juvenile white shrimp (*Litopenaeus setiferus*) may factor more strongly than fishing pressure into population size.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS, as well as in Chapter 4.1.1.16 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238, 246, and 248 Supplemental EIS, BOEM has identified incomplete information for impacts related to explosive structure removal, seismic surveys, acute oil exposure, and chronic oil exposure. Fish mortality resulting from explosive structure removal has not been fully studied across a wide range of water depths and environmental conditions. However, as stated above, existing information (e.g., Gitschlag et al., 2000) is sufficient for the purpose of analyzing the potential impacts of anticipated decommissioning activities. Specific responses by fishes to seismic survey activities cannot be predicted and are unknowable due to the many possible interactions among variables (e.g., species, environmental conditions, exposure history and duration, spawning status, presence of prey or predators, etc.) that could influence the response to sound. However, available information (Popper and Hastings, 2009; Fewtrell and McCauley, 2012; Lokkeborg et al., 2012) is sufficient, within the context of historical landings and with knowledge of anticipated survey frequency and distribution, to extrapolate an overall expectation of negligible impact to commercial fisheries. Information on the potential for juvenile survival to be impacted by acute exposure to oil remains incomplete (Brewton et al., 2013; Anderson et al., 2014); however, recent studies suggest that fishes recruited near the time of the *Deepwater Horizon* explosion and oil spill may not have suffered catastrophic losses (Fodrie and Heck, 2011; Atlantic Bluefin Tuna Status Review Team, 2011; Rooker et al., 2013). As such, it is reasonable to extrapolate that short-term effects of the oil spill did not severely impact recruitment. In the long term, the effects of acute or chronic exposures to oil remain unknown.

This information cannot reasonably be obtained because the long-term effects may not yet be detectable and the overall costs in time and money to determine this are exorbitant. BOEM recognizes that the incomplete information with respect to long-term effects may be relevant to the evaluation of impacts on commercial fisheries.

BOEM used reasonably accepted scientific methodologies to extrapolate from existing information in completing this analysis and formulating the conclusions presented here. Although the body of available information is incomplete and long-term effects cannot yet be known, the evidence currently available supports past analyses and does not indicate severe adverse impacts to commercial fisheries. Therefore, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for commercial fisheries presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. The new information does not alter previous impact conclusions for commercial fisheries. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.17. Recreational Fishing

BOEM has reexamined the analysis for recreational fishing presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for recreational fishing presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of recreational fishing, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action are presented in Chapters 4.1.1.17.1, 4.1.1.17.2, and 4.1.1.17.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.17 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.17.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.17 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. New information that has become available since publication of those documents is also discussed below.

Routine activities during the initial phases of a WPA proposed action, such as seismic surveying operations and other forms of vessel traffic, may lead to some minor space-use conflicts with recreational fishermen. Vessel traffic during subsequent infrastructure emplacement and production operations could also lead to some space-use conflicts with recreational fishing activities. The OCS oil- and gas-related activities could also affect the aesthetics of fishing in a particular location, which could dissuade anglers from fishing in specific locations. However, according to data provided by the Texas Parks and Wildlife Department, less than 2 percent of the annual recreational fishing effort occurs in waters of the Exclusive Economic Zone and the majority of recreational fishing targets species not closely associated with offshore oil and gas infrastructure (Fisher, official communication, 2014). Therefore, direct impacts from space-use conflicts are expected to be minimal.

Proposed WPA Lease Sales 246 and 248 may also lead to low-level environmental degradation of fish habitat (**Chapter 4.1.1.15**), e.g., construction activities and offshore discharges of drilling muds and produced waters, which could negatively impact recreational fishing activity. However, these minor negative effects would likely be outweighed by the beneficial role that oil platforms serve as artificial reefs for fish populations. The degree to which oil platforms will become a part of a particular State's

Rigs-to-Reefs program will be an important determinant of the degree to which a WPA proposed action may impact recreational fishing activity in the long term. As structures are scheduled for decommissioning, a higher level of a State's participation in the Rigs-to-Reefs program may benefit fishermen through the retention of complex habitat and potentially enhanced production for some recreationally desirable species, as opposed to structure removals (particularly those that use explosives), which can negatively impact the recreational activity that depends on any particular platform. However, the vast majority of recreational fishing activity in the WPA occurs in non-Federal waters and thus would not be impacted by structure removals. In aggregate, the impacts of a WPA proposed action on recreational fishing activity are expected to be minor.

Recreational fishing could also be impacted by accidental events, such as oil spills. Oil spills can arise from accidents with respect to vessels, pipelines, drilling operations, or production operations. An oil spill would likely lead to recreational fishing closures in the vicinity of the oil spill. Small-scale spills should not affect recreational fishing to a large degree due to the likely availability of substitute fishing sites in neighboring regions. The longer-term effects of an oil spill will be determined by its effects on fish populations (**Chapter 4.1.1.15**), as well as by its effects on people and firms that support recreational fishing activity.

The cumulative analysis considers the effects of the impact-producing factors related to OCS oil and gas, along with non-OCS oil- and gas-related impacts, that may occur and adversely affect recreational fishing in the same general area of a WPA proposed action. The impacts of proposed WPA Lease Sales 246 and 248 will contribute to the impacts of the broader OCS Program. This includes the space-use impacts arising from vessel traffic and construction operations, as well as the low-level environmental degradation to fish habitats that could occur. A proposed WPA lease sale will also incrementally add to the probabilities of oil spills, which could affect recreational fishing activity in the short term. Low-probability catastrophic oil spills, which are not part of a WPA proposed action and not reasonably expected, could also impact recreational fishing and are described in **Appendix B**. Proposed WPA Lease Sales 246 and 248 could also have positive impacts to recreational fishing activity since OCS platforms often serve as reefs for fish populations, although removals of these platforms could have negative impacts on recreational fishing activity. However, these negative effects would be partially offset if some platforms are maintained through Rigs-to-Reefs programs.

Recreational fishing activity could also be influenced by a number of non-OCS oil- and gas-related factors, such as commercial, military, recreational, and industrial activities; natural processes; wetlands loss; hypoxia events; fish kills; water quality degradation; fisheries management plans; hurricanes; State oil and gas activities; State artificial reef program; tourism (refer to **Chapter 4.1.1.18**); and other economic factors (refer to **Chapter 4.1.1.20.3**). Many of these impacts will be determined by the cumulative impacts to fish populations, which are discussed in **Chapter 4.1.1.15**. However, recreational fishing activity is driven by unique economic and tourism trends (refer to **Chapters 4.1.1.18 and 4.1.1.20.3**). It can also be influenced by the quality of fishing grounds, such as wetland areas, which can be degraded by hurricanes. However, it is likely that Fisheries Management Plans of the Federal and State governments would serve to keep overall recreational fishing activity reasonably stable through time.

A WPA proposed action and the broader OCS Program have varied effects on recreational fishing activity. The OCS Program has generally enhanced recreational fishing opportunities due to the role of oil platforms as artificial reefs. This effect is influenced by the decommissioning rate and the extent to which decommissioned platforms are redeployed as artificial reefs through participation in the States' Rigs-to-Reefs programs. However, oil spills can have important negative consequences on recreational fishing activity due to the resultant fishing closures and longer-term effects oil spills can have on fish populations. These are discrete and rare events, however, and recreational fishing activity is largely driven by broader economic and tourism trends. Recreational fishing activity is also influenced by a number of non-OCS oil- and gas-related activities, such as economic and tourism trends, the quality of fishing grounds, hurricanes, and Fisheries Management Plans of Federal and State governments. The incremental contribution of a WPA proposed action to these positive and negative cumulative effects would be minimal because of the relatively small amount of activity expected with a WPA proposed action.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

BOEM examined a variety of Internet sources, as well as known data providers, for new information regarding the impacts of a WPA proposed action on recreational fishing. New information was found on the affected environment, including recreational fisheries efforts and catches. The primary new data source is an annual update to recreational fishing data in Texas (Fisher, official communication, 2014). This update provides data on both the species caught and the amount of angler effort in 2013 (the data for prior years are unchanged). **Table 4-2** provides data on the number of recreational fishing trips during each season of 2009-2013. Texas has historically divided its data into two fishing seasons: Season A (November 21-May 14) and Season B (May 15-November 20). **Table 4-2** shows that there were 1,041,027 angler trips in 2009; 987,537 angler trips in 2010; 1,125,400 angler trips in 2011; 1,159,187 angler trips in 2012; and 1,149,597 angler trips in 2013. Thus, the total number of angler trips in 2013 was similar to the number of trips in prior years. The number of trips in the Exclusive Economic Zone and in Texas State waters in 2013 slightly increased from 2012 levels, while the number of trips in bays in 2013 slightly decreased. In 2013, the number of private trips increased while the number of charter trips decreased. Also, in 2013, the number of trips in Season B increased while the number of trips in Season A decreased.

Table 4-3 provides data regarding the individual species caught by anglers in Texas during 2009-2013. Panel A presents overall catch data in Texas, while Panels B, C, and D present catch data for Texas bays, State waters, and the Exclusive Economic Zone. For most species, landings in 2013 fell from 2012 levels. However, landings for some species, such as black drum (*Pogonias cromis*) and sheepshead (*Archosargus probatocephalus*), were unusually high in 2012. Therefore, the decrease in landings for some species in 2013 likely partially reflects returns to more normal levels of landings. Landings in 2013 decreased from 2012 levels for all species that are generally caught in bays. However, landings of red snapper (*Lutjanus campechanus*) and king mackerel (*Scomberomorus cavalla*), which are generally caught in Texas State waters and in the Exclusive Economic Zone, increased in 2013 from 2012 levels.

The NMFS has also released its annual *Fisheries Economics of the U.S.* report (USDOC, NMFS, 2014f). This report presents various data regarding the economic significance of recreational fishing in the Gulf of Mexico in 2012, which clarifies the affected environment for recreational fishing. In 2012, recreational fishing expenditures in Texas supported an estimated 13,944 jobs, $1,719,709 in sales, $1,005,040 in value-added, and $615,713 in labor income.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplement EIS, as well as in Chapter 4.1.1.17 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete or unavailable information related to recreational fishing. This information relates to the ultimate impacts of the *Deepwater Horizon* oil spill on fish populations that support recreational fishing activity. An analysis of this incomplete or unavailable information is presented in **Chapter 4.1.1.18**. As discussed in that chapter, this incomplete or unavailable information is being developed through the NRDA process and is not yet available. There is also uncertainty regarding the extent to which recreational fishing is dependent upon OCS platforms. BOEM is planning to undertake a study project to examine this issue, although the results from this study project will not be released in the timeline contemplated in the NEPA analysis of this Supplemental EIS. In lieu of this incomplete or unavailable information, BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis as described above. For example, BOEM has used data on recreational fishing activity provided by the Texas Parks and Wildlife Department (Fisher, official communication, 2014) to examine trends in recreational fishing activity off Texas over time. BOEM does not expect the incomplete or unavailable information to significantly change its estimates of the impacts of the OCS Program on recreational fishing activity because BOEM still has enough baseline data to reasonably estimate impacts. Therefore, BOEM has determined that the incomplete or unavailable information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for recreational fishing presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for recreational fishing presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS because the new information was consistent with prior expectations. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.18. Recreational Resources

BOEM has reexamined the analysis for recreational resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for recreational resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of recreational resources, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.18.1, 4.1.1.18.2, and 4.1.1.18.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.18 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.18.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.18 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. New information that has become available since publication of those documents is presented below.

Routine OCS oil- and gas-related activities in the WPA have the potential to directly and indirectly impact recreational resources along the coasts of Texas and Louisiana. Marine debris, OCS oil and gas vessel noise, and visible OCS oil- and gas-related infrastructure can noticeably affect the aesthetic value of coastal areas, particularly beaches. Additionally, OCS oil- and gas-related vessel traffic can cause space-use conflicts with recreational activities such as boating, and the presence of OCS oil and gas platforms can enhance some recreational activities such as fishing and diving. Although, the long-term impacts of platforms depend on the nature of the decommissioning of the platform. The OCS oil- and gas-related activities can also change the composition of local economies through changes in employment, land use, and the demand for activities related to recreation and tourism. Despite these potential impacts, the small scale of a WPA proposed action relative to the scale of the existing OCS oil and gas industry suggests that the impacts on recreational resources are likely to be minimal.

Accidental spills most likely to result from a WPA proposed action will be small, of short duration, and not likely to impact Gulf Coast recreational resources. Should an oil spill occur and contact a beach area or other recreational resource, it will cause some disruption due to the physical oiling impact and cleanup phases of the spill. Beaches, nature parks, and wetland areas could be impacted during these phases of an oil spill. These disruptions could also have impacts on businesses and consumers that depend on the use of these resources. Media coverage and public perception regarding the extent of the oil damage can also influence the ultimate economic impacts of a spill (**Chapter 4.1.1.20**). However, all of these effects would likely be small in scale and of short duration.

The cumulative analysis considers the effects of impact-producing factors related to OCS oil and gas along with non-OCS oil- and gas-related impacts of other commercial, military, offshore and coastal activities, and natural processes that may occur and adversely affect recreational resources in the same general area of a WPA proposed action.

A WPA proposed action would contribute to the aesthetic impacts and space-use conflicts that arise due to the broader OCS Program. This includes impacts from vessel traffic, marine debris, and the presence or absence of OCS infrastructure. Vessel traffic can cause space-use conflicts with recreational activities such as boating. Marine debris can degrade the recreational value of resources such as beaches. The presence or absence of OCS oil- and gas-related infrastructure could impact activities such as recreational fishing or diving. Oil spills could also contribute to the overall degradation of beach and wetland-based recreational resources. Most accidental spills are not likely to impact Gulf Coast recreational resources because they are expected to be small and of short duration. If oil resulting from a spill were to contact a beach area or other recreational resource, disruption could occur from oiling and oil cleanup. However, these effects are also likely to be small in scale and of short duration. The impacts of a low-probability catastrophic oil spill, which is not part of a WPA proposed action and not likely expected, on recreational resources are discussed in **Appendix B**.

Recreational resources along the Gulf Coast can also be impacted by similar non-OCS oil- and gas-related aesthetic and space-use conflicts, as well as a variety of non-OCS oil- and gas-related factors, such as coastal erosion, beach disruptions, military activities, and economic factors. Coastal erosion negatively impacts recreational activities that depend on wetland and beach resources. Beach disruptions would arise from degradations of air and water quality, as well as by natural processes such as red tides. Military activities could cause aesthetic impacts and space-use conflicts with recreational activities. Recreational activities will also correlate with regional and national economic trends.

The incremental contribution of a WPA proposed action is expected to be minimal in light of all OCS oil- and gas-related and non-OCS oil- and gas-related activities. This is because of the small scale of a WPA proposed action, as well as the fact that most impacts to recreational resources will be temporary.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

BOEM conducted a search of Internet sources and known data providers for new information regarding the affected environment of recreational resources. The Bureau of Labor Statistics has released preliminary data regarding the scale of employment in various industries in the Gulf Coast States in 2013 (U.S. Dept. of Labor, Bureau of Labor Statistics, 2014). **Table 4-4** presents data on the levels of employment in leisure and hospitality industries in various Economic Impact Areas (EIAs) and coastal areas. Leisure and hospitality employment was higher in 2013 than in any year from 2008 through 2012 in all EIAs and coastal areas. Source Strategies Inc. (2014) has released data regarding the levels of hotel rooms-nights sold and hotel prices in various regions in Texas in 2013. In Texas as a whole, room-nights sold increased 3.3 percent and prices increased by 5.1 percent in 2013 compared with 2012. In the Houston-Baytown-Sugar Land region, room-nights sold increased by 3.9 percent and prices increased by 8.6 percent in 2013 compared with 2012. In the Corpus Christi region, room-nights sold increased by 7.6 percent and prices increased by 4.4 percent in 2013 compared with 2012. The increases in economic activity shown by the Bureau of Labor Statistics' employment data and by the hotel data provided by Source Strategies Inc. likely primarily reflect the gradual improvement in overall economic conditions since the recent economic recession.

Lowe and Stokes (2013) present a variety of information regarding the scale of wildlife tourism in various Gulf Coast areas. For example, this report finds that over 1,100 wildlife guide businesses support over 11,000 dining and lodging businesses. This report also estimates that wildlife tourism along the Gulf Coast supports over $19 billion in spending and generates over $5 billion in Federal, State, and local tax revenues. The three primary forms of wildlife tourism are fishing (which supports $8 billion in spending), wildlife watching (which supports $6.5 billion in spending), and hunting (which supports $5 billion in spending). Wildlife tourism supports the most spending in Florida ($8 billion) and Texas ($5 billion); wildlife tourism supports approximately $2 billion in spending each in Louisiana, Mississippi, and Alabama. Cullinane-Thomas et al. (2014) provide estimates of the number of visitors, amount of spending, number of jobs, and amount of income in 2012 supported by each national park along the Gulf Coast. The number of visitors and the amount of visitor spending supported by parks along the Gulf Coast are as follows: Padre Island National Seashore (Texas) (573,855 visitors; $22,815,000); Jean Lafitte National Historical Park and Preserve (Louisiana) (419,964 visitors;

$22,584,000); Gulf Islands National Seashore (Mississippi and Florida) (4,973,462 visitors; $199,385,000); De Soto National Memorial (Florida) (432,981 visitors; $23,299,000); Big Cypress National Preserve (Florida) (882,570 visitors; $64,229,000); Everglades National Park (Florida) (1,141,906 visitors; $102,765,000); and Dry Tortugas National Park (Florida) (60,550 visitors; $3,211,000). Lowe and Stokes (2013) and Culliane-Thomas et al. (2014) enhance BOEM's understanding of the affected environment.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238, 246, and 248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS, as well as in Chapter 4.1.1.18 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238, 246, and 248 Supplemental EIS, BOEM has identified incomplete or unavailable information regarding recreational resources in the WPA. This information relates to quantifying measures of recreation and tourism along the Gulf Coast, as well as information relating to the impacts of the *Deepwater Horizon* explosion, oil spill, and response on recreational resources. These information sources are related to recreation and tourism along the Gulf Coast and impacts of the *Deepwater Horizon* explosion, oil spill, and response, and assist in assessing the baseline environment for recreational resources. BOEM has funded a study that is attempting to improve its information regarding these issues; however, the study is not yet complete. BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis. For example, BOEM used data from the Bureau of Labor Statistics using broader industry categories to estimate the scale of recreation-related activities in recent years (U.S. Dept. of Labor, Bureau of Labor Statistics, 2013). BOEM also used data from Source Strategies Inc. (2014), Lowe and Stokes (2013), and Culliane-Thomas et al. (2014) to estimate the baseline environment for recreational resources. These sources provide sufficient baseline information from which to estimate the impacts of the OCS Program, particularly since the available data suggest that most recreational areas have recovered from the impacts of the *Deepwater Horizon* explosion, oil spill, and response. Therefore, BOEM has determined that the incomplete or unavailable information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for recreational resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for recreational resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS because the new information was roughly consistent with prior expectations. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.19. Archaeological Resources

4.1.1.19.1. Historic Archaeological Resources

Historic archaeological resources on the OCS consist of historic shipwrecks 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 is embedded in the seafloor. Ships are known to have traversed the waters of the WPA as early as Captain Alonso Alverez 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).

BOEM has reexamined the analysis for historic archaeological resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for historic archaeological resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of historic archaeological resources, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.19.1, 4.1.1.19.1.2, and 4.1.1.19.1.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.19.1 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.19.1.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.19.1 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Damage to archaeological resources as a result of offshore oil and gas activity can be minimized by pre-seabed-disturbance archaeological surveys. Archaeological surveys, where required prior to an operator beginning OCS oil and gas activities on a lease, are expected to be effective at identifying possible archaeological sites. The technical requirements of the archaeological resource reports are detailed in NTL 2005-G07, "Archaeological Resource Surveys and Reports." Under 30 CFR § 550.194(c), lessees are required to immediately notify BOEM's Regional Director of the discovery of any potential archaeological resources. Under 30 CFR § 250.194(c) and 30 CFR § 250.1010(c), lessees are also required to immediately notify BSEE's Regional Director of the discovery of any potential archaeological resources. In addition, archaeological resources in the coastal environment are protected through Federal, State, and local agency permit review as well as Section 106 of the National Historic Preservation Act.

Routine impact-producing factors associated with a WPA proposed action that could affect historic archaeological resources include direct physical contact with a shipwreck site; the placement of drilling rigs and production systems on the seafloor; pile driving associated with platform emplacement; pipeline placement; dredging of new channels, as well as maintenance dredging of existing channels; anchoring activities; pipeline installation; post-decommissioning trawling clearance; and the masking from geophysical sensors of archaeological resources from industry-related debris. The greatest potential impact to an archaeological resource as a result of a WPA proposed action would result from direct contact between an offshore activity (i.e., platform or pipeline installation, drilling rig emplacement, dredging, and post-decommissioning trawling) and a historic site because of incomplete knowledge on the location of these sites in the Gulf of Mexico. The risk of contact to archaeological resources is greater in instances where archaeological survey data are inadequate or unavailable. Such an event could result in the disturbance or destruction of important archaeological information. Archaeological surveys provide the necessary information to develop avoidance strategies that reduce the potential for impacts on archaeological resources. Except for the projected 0-1 new gas processing facilities and 0-1 new pipeline landfalls, a WPA proposed action would require no new oil and gas coastal infrastructure. It is expected that archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities.

Impacts to documented and undocumented historic archaeological resources could occur as a result of an accidental oil spill and the associated cleanup operations. Detailed risk analyses of offshore oil spills ranging from <1,000 bbl to ≥1,000 bbl and coastal spills associated with a WPA proposed action are provided in **Chapters 3.2.1.5, 3.2.1.6, and 3.2.1.7** of this Supplemental EIS and Chapters 3.2.1.5, 3.2.1.6, and 3.2.1.7 of the 2012-2017 WPA/CPA Multisale EIS. When oil is spilled in offshore areas, much of the oil volatilizes or is dispersed by currents, so it has a low probability of contacting coastal areas. However, should a spill contact a historic archaeological site (including submerged sites), damage might include contamination of materials, direct impact from oil-spill cleanup equipment, and/or looting. An additional major effect from an oil spill could be viewshed pollution of a historic coastal site, such as a fort or lighthouse. Although such effects may be temporary and reversible, cleaning oil from historic structures can be a complex, time-consuming, and expensive process, and the use of dispersants may result in long-term chemical contamination of submerged cultural heritage sites (e.g., Chin and Church, 2010). It is expected, however, that any spill cleanup operations would be considered a Federal undertaking for the purposes of Section 106 of the National Historic Preservation Act and would be conducted in such a way as to minimize impacts to historic archaeological resources.

Several OCS oil- and gas-related cumulative impact-producing factors could potentially impact historic archaeological resources, including the following: (1) OCS Program routine and accidental impacts; (2) artificial rigs-to-reefs development; and (3) renewable energy and alternative use conversions. A detailed impact analysis of the cumulative impacts of OCS oil- and gas-related activities associated with proposed WPA Lease Sales 246 and 248 on historic archaeological resources can be found in Chapter 4.1.1.19.1.4 of the 2012-2017 WPA/CPA Multisale EIS and Appendix D of the WPA 238/246/248 Supplemental EIS. Historic archaeological resources on the OCS are vulnerable to the above OCS oil- and gas-related cumulative impact-producing factors due to the associated bottom-disturbing activities. An impact could result from direct physical contact between historic shipwrecks located on the OCS and OCS Program oil and gas activities (i.e., pipeline and platform installations, drilling rig emplacement and operation, site decommissioning, rigs-to-reefs development, dredging, and anchoring activities). Permitting OCS oil- and gas-related development prior to requiring archaeological surveys has been documented to have impacted wrecks containing significant or unique historic information. Impacts may be reduced when preconstruction surveys are required by BOEM or the permitting agency prior to these activities. Impacts to historic resources may still occur in areas where a remote-sensing survey fails to resolve the location of partially or completely buried resources or when no pre-disturbance survey is required. Impacts to documented and undocumented historic archaeological resources could occur as a result of an accidental oil spill and the associated cleanup operations; however, the potential for spills is low, the effects would generally be localized, and the cleanup efforts would be regulated. Low-probability catastrophic spills, which are not part of a WPA proposed action and not likely expected, are discussed in **Appendix B**.

Non-OCS oil- and gas-related cumulative impact-producing factors that could potentially impact historic archaeological resources include the following: (1) State oil and gas activity; (2) offshore LNG projects; (3) new channel dredging and maintenance dredging; (4) State renewable energy and alternative use conversions; (5) State artificial reefs and rigs-to-reefs development; (6) commercial fishing; (7) sport diving and commercial treasure hunting; and (8) natural processes, including wave action and hurricanes. As with the OCS oil- and gas-related cumulative impact-producing factors, risks from the above non-OCS oil- and gas-related cumulative impact-producing factors are related to their associated bottom-disturbing activities. An impact could result from direct physical contact between historic shipwrecks and State-related oil and gas activities, sand borrowing, renewable energy activities, LNG facility construction, artificial reef creation, new channel dredging, and maintenance dredging. With the exception of maintenance dredging, preconstruction surveys may be required for these activities. Impacts to historic resources may still occur in areas where a remote-sensing survey fails to resolve the location of partially or completely buried resources or when no pre-disturbance survey is required.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in the localized loss of significant or unique archaeological information. In the case of factors related to past OCS Program activities within the cumulative activity area, it is reasonable to assume that most impacts would have occurred where development took place prior to any archaeological survey requirements. When surveys are not required, it is impossible to anticipate what might be embedded in or lying directly on the seafloor, and impacts to these sites are likely to be significant. When surveys are required, there is still the possibility of an unanticipated interaction between bottom-disturbing activity (i.e., rig emplacement, pipeline trenching, anchoring, and other ancillary activities) and a historic shipwreck, despite diligence in BOEM's survey review process. However, the incremental contribution of a WPA proposed action is expected to be very small due to the efficacy of the remote-sensing survey and archaeological reporting requirements within the proposed lease sale area. Future OCS Program activity, including the bottom-disturbing activity permitted by BOEM and other agencies, may require preconstruction archaeological surveys that, when completed, are highly effective in identifying bottom anomalies that can be either avoided or investigated before bottom-disturbing activities begin.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/ CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

Various Internet sources were examined to assess recent information regarding impacts to archaeological resources or potential new threats to archaeological resources that may be pertinent to the WPA. These Internet sources included various online indexes to periodical literature, such as JSTOR, the National Technical Information Service's National Technical Reports Library, and ScienceDirect. In addition, BOEM has conducted scientific research in the GOM. The research has identified new information on shipwrecks that is pertinent to this Supplemental EIS.

In July 2013 and April 2014, BOEM participated in a multi-agency investigation of three early-19th century shipwrecks located approximately 7-10 nmi (8-12 mi; 13-19 km) east of the WPA/CPA border (USDOI, BOEM, 2014c). Preliminary analysis of the data indicates that these wooden-hulled sailing vessels share similarities in hull construction characteristics and artifact assemblages. Additionally, these shipwrecks are located within 4 nmi (5 mi; 7 km) of each other, suggesting that they may have been sailing together in convoy when they were caught and sunk by a violent storm. Regardless of whether these vessels were sailing together or on separate voyages, their discovery supports BOEM's previous analysis that there is a high probability of historic shipwrecks being located in deepwater areas of the WPA along historic trading routes (Pearson et al., 2003; Lugo-Fernandez et al., 2007).

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238, 246, and 248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS, as well as in Chapter 4.1.1.19 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238, 246, and 248 Supplemental EIS, BOEM has identified incomplete information regarding the location of historic archaeological resources in the WPA. This information cannot be obtained because the overall costs of obtaining it through survey of the entire WPA are exorbitant. This incomplete information may be relevant to adverse effects because the locations and integrity of many historic archaeological resources remain unknown. Nevertheless, this incomplete information is not likely to be available within the timeline contemplated in this NEPA analysis of this Supplemental EIS. It would take several years before data confirming the presence (or lack thereof) of historic archaeological resources, and the status of each could be investigated, analyzed, and compiled. Historic archaeological sites within the WPA region have the potential to be buried, embedded in, or laying on the seafloor. The WPA covers an area of approximately 28.58 million acres and ranges in water depths from an estimated 10 to 3,420 m (33 to 11,220 ft). It includes highly variable bathymetric and geophysical regimes, which differentially affect the ease and ability to identify, ground truth, and evaluate historic archaeological sites. This fact, combined with the scope of the acreage within the WPA, results in the aforementioned exorbitant costs and time factors.

BOEM used existing information and reasonably accepted scientific theories on archaeological site potential in the Gulf of Mexico to extrapolate from available information in completing the relevant analysis. In addition, future site-specific, remote-sensing surveys of the seafloor are required when deemed appropriate to establish the presence of potential resources (NTL 2005-G07). The results of these surveys are reviewed in tandem with credible scientific evidence from previously identified sites, regional sedimentology, and physical oceanography that is relevant to evaluating the adverse impacts on historic resources that are a part of the human environment. The required surveys are analyzed by industry and BOEM archaeologists prior to the authorization of any new or significant bottom-disturbing impacts and, if necessary, avoidance of potential archaeological resources is prescribed. Archaeological surveys are expected to be highly effective in identifying resources to allow for protection of the resource during OCS oil- and gas-related activities. A WPA proposed action is not a reasonably foreseeable significant impact because the BOEM's evaluation of such impacts is based upon pre-disturbance and site-specific surveys, the results of which BOEM uses to require substantial avoidance of any potential historic resource that could be impacted by the proposed activity. Therefore, BOEM has determined that the information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for historic archaeological resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. No new information was discovered that would alter the impact conclusion for historic archaeological resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.19.2. Prehistoric Archaeological Resources

Prehistoric archaeological resources are any material remains of human life or activities associated with the earliest inhabitants of the Gulf Coast, predating European discovery and exploration of the area. Available evidence suggests that the first Americans arrived on the Gulf Coast as much as 12,000 years before present (B.P.) during a time when the continental shelf was exposed above sea level and open to habitation (Pearson et al., 1986).

BOEM has reexamined the analysis for prehistoric archaeological resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for prehistoric archaeological resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of prehistoric archaeological resources, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.19.2.1, 4.1.1.19.2.2 and 4.1.1.19.2.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.19.2 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.19.2.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.19.2 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Prehistoric archaeological sites are thought to be preserved shoreward of the 45-m (148-ft) bathymetric contour, where the Gulf of Mexico continental shelf was subaerially exposed during the Late Pleistocene. Archaeological surveys, where required prior to an operator beginning OCS oil- and gas-related activities on a lease, are expected to be somewhat effective at identifying submerged landforms that could support possible prehistoric archaeological sites. The NTL 2005-G07 recommends a 300-m (984-ft) maximum line spacing for remote-sensing surveys of leases within areas having a high potential for prehistoric sites. While surveys provide a reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric archaeological site, there is still a possibility of an OCS oil- and gas-related activity contacting an archaeological site. Should such impacts occur, there could be damage to or loss of significant and/or unique archaeological information.

Routine impact-producing factors associated with a WPA proposed action that could affect prehistoric archaeological resources include direct physical contact associated with the placement of drilling rigs and production systems on the seafloor; pile driving associated with platform emplacement; pipeline placement; dredging of new channels, as well as maintenance dredging of existing channels; anchoring activities; pipeline installation; and post-decommissioning trawling clearance. This direct physical contact with a site could destroy fragile artifacts or site features and could disturb artifact provenance and site stratigraphy. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contexts for North America, Central America, South America, and the Caribbean. The risk of contact to archaeological resources is greater in instances where archaeological survey data are inadequate or unavailable. Archaeological surveys provide the necessary information to develop avoidance strategies that reduce the potential for impacts on archaeological resources. Except for the projected 0-1 new gas processing facilities and 0-1 new pipeline landfalls, a WPA proposed action would require no new oil and gas coastal infrastructure. It is expected that the protection of archaeological resources would be maximized through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities.

Impacts to documented (onshore) and undocumented (onshore and offshore) prehistoric archaeological resources could occur as a result of an accidental oil spill and the associated cleanup operations. Oil spills resulting from a well blowout in the WPA and related spill-response activities have the potential to impact cultural resources near the spill site and landfall areas. Detailed risk analyses of offshore oil spills ranging from <1,000 bbl to ≥1,000 bbl and of coastal spills that may be associated with a WPA proposed action are provided in **Chapters 3.2.1.5, 3.2.1.6, and 3.2.1.7** of this Supplemental EIS and Chapters 3.2.1.5, 3.2.1.6, and 3.2.1.7 of the 2012-2017 WPA/CPA Multisale EIS. Should a spill contact a prehistoric archaeological site, damage might include loss of radiocarbon-dating potential, direct impact from oil-spill cleanup equipment, and/or looting. However, when oil is spilled in offshore areas, much of the oil volatilizes or is dispersed by currents, so it has a low probability of contacting coastal and barrier island prehistoric sites as a result of a WPA proposed action. A WPA proposed action, therefore, is not expected to result in impacts to prehistoric archaeological sites.

Several OCS oil- and gas-related cumulative impact-producing factors that could potentially impact prehistoric archaeological resources include the following: (1) OCS Program routine and accidental impacts; (2) renewable energy and alternative use conversion; and (3) artificial rigs-to-reefs development. A detailed impact analysis of the cumulative impacts of OCS oil- and gas-related activities associated with proposed WPA Lease Sales 246 and 248 on prehistoric archaeological resources can be found in Chapter 4.1.1.19.2.4 of the 2012-2017 WPA/CPA Multisale EIS and Appendix D of the WPA 238/246/248 Supplemental EIS.

The OCS oil- and gas-related activities that could impact prehistoric archaeological sites located on the OCS through contact include pipeline and platform installations, drilling rig emplacement and operation, site decommissioning, rigs-to-reefs development, dredging, and anchoring activities. Preconstruction surveys may be required by BOEM or the lead permitting agency prior to these activities. Impacts to prehistoric resources may still occur in areas where a remote-sensing survey fails to resolve the location of partially or completely buried resources or when no pre-disturbance survey is required. Development onshore as a result of a WPA proposed action could result in the direct physical contact between a prehistoric site and pipeline trenching. It is assumed that archaeological investigations prior to construction will serve to mitigate these potential impacts. Oil spills have the potential to impact coastal prehistoric sites directly or indirectly by physical impacts caused by oil-spill cleanup operations. The number and most likely spill sizes to occur in coastal waters in the future are expected to resemble the patterns that have occurred in the past, as long as the level of oil- and gas-related commercial and recreational activities remain the same. Low-probability catastrophic spills, which are not part of the proposed action and not likely expected, could also contact coastal prehistoric sites, and the effects of a spill that size would likely result in longer-lasting impacts that take longer to mitigate. Accidental spills as a result of a low-probability catastrophic spill are discussed in **Appendix B**.

Non-OCS oil- and gas-related cumulative impact-producing factors that could potentially impact prehistoric archaeological resources including the following: (1) State oil and gas activity; (2) new channel dredging and maintenance dredging; (3) State renewable energy and alternative use conversions; (4) State artificial reefs and rigs-to-reefs development; (5) OCS sand borrowing; (6) offshore LNG projects; (7) commercial fishing; and (8) natural processes, including wave action and hurricanes.

These impact-producing factors all create associated bottom disturbances that may threaten prehistoric archaeological resources. An impact could result from contact between prehistoric resources and permitted activities such as State oil and gas activities, renewable energy activities, artificial reef creation, new channel dredging, and maintenance dredging. With the exception of maintenance dredging, preconstruction surveys may be required for these activities. Impacts to prehistoric resources may still occur in areas where a remote-sensing survey fails to resolve the location of partially or completely buried resources or when no pre-disturbance survey is required. Oil and gas program wells, structures, and pipelines existing entirely in State waters are not under the jurisdiction of BOEM with respect to the archaeological resource protection requirements of the National Historic Preservation Act and would be the responsibility of the State and the permitting Federal agency. Prehistoric sites in shallow waters and on coastal beaches are exposed to the destructive effects of wave action and scouring currents. Overall, loss of data from prehistoric sites has probably occurred, and will continue to occur, in the northeastern Gulf from the effects of tropical storms.

The effects of the various impact-producing factors discussed in this analysis have likely resulted in localized losses of significant or unique prehistoric archaeological information. In the case of factors related to OCS Program activities in the cumulative activity area, it is reasonable to assume that most impacts would have occurred where development took place prior to any archaeological survey requirements. The incremental contribution of a WPA proposed action is expected to be very small due to the efficacy of the required remote-sensing survey and concomitant archaeological report and clearance.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/ CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental SEIS

Various Internet sources were examined to assess recent information regarding impacts to archaeological resources or potential new threats to archaeological resources that may be pertinent to the WPA. These Internet sources included various online indexes to periodical literature, such as JSTOR, the National Technical Information Service's National Technical Reports Library, and ScienceDirect. This search did not identify any new information that would be pertinent to the analysis of the potential impacts of OCS oil- and gas-related activities on prehistoric archaeological resources.

Incomplete or Unavailable Information

BOEM has determined that previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, the WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS are still valid because no new information on prehistoric archaeological resources pertinent to a WPA proposed action has been published since the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information on the location of prehistoric archaeological resources in the WPA. This information cannot be obtained because the overall costs of obtaining it through survey of the entire WPA are exorbitant. This incomplete information may be relevant to adverse effects because the locations and integrity of many prehistoric archaeological resources remain unknown. Nevertheless, this incomplete information is not likely to be available within the timeline contemplated by the NEPA analysis of this Supplemental EIS. It would take many years before data confirming the presence of prehistoric archaeological resources in a given location, and the status of each could be investigated, analyzed, and compiled. Most prehistoric sites within the WPA region are likely buried and would therefore be difficult to identify, resulting in the largest portion of aforementioned exorbitant costs and time factors.

BOEM used existing information and reasonably accepted scientific theories on prehistoric archaeological site potential in the Gulf of Mexico to extrapolate from available information in completing the relevant analysis. In place of the incomplete or unavailable information, BOEM used archaeological investigations, such as subbottom sonar survey, that are required for all areas shoreward of the 196-ft (60-m) bathymetric contour (NTL 2005-G07), which is understood to represent the Pleistocene shoreline when human beings migrated into the Gulf Coast. These surveys are reviewed in tandem with existing credible scientific evidence of site types, material remains and preservation potential from terrestrial archaeological sites (Rees, 2010, CEI, 1977), geology, and physical oceanography that is relevant to evaluating the adverse impacts on prehistoric resources that are a part of the human environment. The required surveys are analyzed by industry and BOEM archaeologists prior to the authorization of any new or significant bottom-disturbing impacts and, if necessary, avoidance of potential archaeological resources is prescribed. A WPA proposed action is not a reasonably foreseeable significant impact because BOEM's evaluation of such impacts includes analysis of pre-disturbance and site-specific survey, the results of which BOEM uses to require substantial avoidance of any potential prehistoric resource that could be impacted by the proposed activity. Therefore, BOEM has determined that the information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for prehistoric archaeological resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. No new information was discovered that would alter the impact conclusion for prehistoric archaeological resources presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.20. Human Resources and Land Use

4.1.1.20.1. Land Use and Coastal Infrastructure

BOEM has reexamined the analysis for land use and coastal infrastructure presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for land use and coastal infrastructure presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of land use and coastal infrastructure, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.20.1.1, 4.1.1.20.1.2, and 4.1.1.20.1.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.20.1 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.20.1.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.20.1 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Impact-producing factors associated with a WPA proposed action that could affect land use and coastal infrastructure include the addition of gas processing facilities, pipeline landfalls, service bases, offshore supply vessel (OSV) day rates, navigation channels, and waste disposal facilities to the current infrastructure. Activities relating to the OCS Program are expected to minimally affect the current land use of the analysis area because most subareas have strong industrial bases and designated industrial parks to accommodate future growth in oil and gas businesses. There would be only minor infrastructure changes in the Texas, Louisiana, Mississippi, Alabama, and Florida EIAs. This is primarily because the demand would be met with the existing infrastructure and facilities. Since the infrastructure is mature and not subject to rapid fluctuations and because BOEM only projects 0-1 new gas processing facilities and 0-1 new pipeline landfalls for a WPA proposed action, the impacts of routine events associated with a WPA proposed action are expected to remain at historic activity levels. There may be a new increased demand for waste disposal services as a result of a WPA proposed action; however, the effects on land use and infrastructure would be limited, would occur on lands designated for such purposes, and would have minimal impacts to land use and coastal infrastructure. Because the projected addition to infrastructure is near zero, the routine activities associated with a WPA proposed action would have little effect on land use and existing coastal infrastructure, and there would be minimal impacts from any expansion of existing infrastructure.

Accidental events associated with a WPA proposed action that could affect land use and coastal infrastructure include oil spills, vessel collisions, and chemical/drilling-fluid spills. Accidental events associated with a WPA proposed action could occur at differing levels of severity, based in part on the location and size of the event. Spills can occur in coastal waters at shoreline storage, processing, and transport facilities supporting the OCS oil and gas industry. Coastal spills occur in State offshore waters and in navigation channels, rivers, and bays from barges and pipelines carrying OCS-produced oil. Refer to **Chapter 3.2.1** for a detailed discussion of past OCS oil spills, oil-spill risk analysis, oil-spill response, and their impacts. Issues discussed in **Chapter 3.2.1** that are related to spill response include offshore response, containment, and cleanup technology; and onshore response and cleanup. Typically, the impact of small-scale oil spills, vessel collisions, and chemical/drilling fluid spills are not likely to last long enough to adversely affect overall land use or coastal infrastructure in the analysis area.

The cumulative analysis considers both existing land use patterns and the effects of impact-producing factors from OCS oil- and gas-related and non-OCS oil- and gas-related activities. Impact-producing factors associated with OCS oil- and gas-related activities that could affect land use and coastal infrastructure include gas processing facilities, pipeline landfalls, service bases, navigation channels, waste disposal facilities, oil spills, vessel collisions, and chemical/drilling-fluid spills. Any service base expansion in the cumulative case would be limited, would occur on lands designated for such purposes, and would have minimal effects on land use and infrastructure. Impacts resulting from chemical or oil spills and vessel collisions can vary in location and severity, but they are not likely to last long enough to adversely affect overall land use or coastal infrastructure in the analysis area. A low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected, can result in impacts to land use and coastal infrastructure. For more information on a low-probability catastrophic spill event, which is not part of a WPA proposed action and not likely expected, refer to **Appendix B**. Therefore, the incremental contribution of a WPA proposed action to the cumulative impacts on land use and coastal infrastructure is also expected to be minor.

The non-OCS oil- and gas-related factors that can impact coastal infrastructure and land use consist of previous, current, and future State lease sales, as well as housing and other residential developments; macro and microeconomic trends; coastal land loss and subsidence; the establishment of private and publicly owned recreational facilities; the construction and maintenance of industrial facilities and transportation systems; urbanization; city planning and zoning; changes to public facilities such as water, sewer, educational, and health facilities; changes to military bases and reserves; changes in population density; changes in State and Federal land use regulations; changes in non-OCS oil- and gas-related demands for water transportation systems and ports; and natural processes. The Gulf of Mexico OCS leasing program exists within a highly industrialized and economically diverse coastal region, which is itself the aggregate of past and present community, government, and business actions. How land has been traditionally used or will be used in the future is determined irrespective of a WPA proposed action. Coastal infrastructure associated with the OCS oil and gas industry is also utilized by State oil and gas as well as other industries. This short summary of land uses and land use categories is by no means comprehensive, but it should illustrate that OCS coastal land use and infrastructure comprises only a percentage of the total land use and allows us a bird's eye view of the program within context of other impact-producing factors.

Land use categories are tied to existing infrastructure and historic uses and, for the purpose of this analysis, include the Economic Research Service's own land-use inventories categories: State oil and gas activities; agriculture; forest, parks, and special use areas; urban areas; miscellaneous areas; and inland navigable waterways and ports. Land use patterns vary greatly by region, reflecting differences in soils, climate, topography, and patterns of population settlement. Changes in land use will largely depend upon local zoning and economic trends. For example, State oil and gas activities are expected to have similar impacts to OCS oil- and gas-related activities on land use and coastal infrastructure. State oil and gas activities and associated impacts will occur based on State leasing programs, geologic plays, economic trends, and local regulatory regimes. Non-OCS oil- and gas-related vessel collisions and rail car oil spills can contribute substantially to the cumulative impacts to land use and coastal infrastructure (Lipinski, 2014; Tate, 2014). As another example, agricultural land use may result in pesticide and nutrient runoff, competition for water consumption, and changes in hydrology and soil quality. Urbanization can lead to habitat fragmentation, transit choices, and air and water pollution. Urban areas are influenced by economics (**Chapter 4.1.1.20.3**), demographics (**Chapter 4.1.1.20.2**), and local ordinances and zoning. For more details on the cumulative impacts of non-OCS oil- and gas-related impacts on land use and coastal infrastructure, refer to the Chapter 4.1.1.20.1 of the 2012-2017 Multisale EIS and Appendix D of the WPA 238/246/248 Supplemental EIS.

The OCS support activities occur within a context of a well-established populated Texas coastal region, which is home to a diverse and robust economy. Many local and national industries, such as agricultural and industrial, utilize the same transportation systems and ports used by the OCS oil and gas industry. The OCS demands on land use are typically relegated to coastal or inland waterway industrial zones and represent a small fraction of how existing residential, recreational, agricultural, military, and industrial uses utilize and impact land use and coastal infrastructure. Because the vast majority of coastal infrastructure supports OCS and State offshore and land-based oil and gas production, as well as other land-based industrial uses, the coastal infrastructure supporting a WPA proposed action represents only a small portion of the coastal land use and infrastructure throughout the WPA and Gulf of Mexico, and because this is a shared resource, the incremental contribution of a WPA proposed action is expected to have minimal impact overall. With 20 percent of the State's land use devoted to cropland and 61 percent devoted to grassland pasture and range, 15 military bases, more than 10,000 mi (16,093 km) of railroad tracks, an interstate system with 79,696 centerline miles (128,258 km) (miles traveled in a one-way direction regardless of the number of lanes) of road that carries about 74 percent of the State's vehicular traffic, and 4 percent of the State land area used for high population areas, non-OCS oil- and gas-related factors contribute significantly to the cumulative impacts on land use (Lubowski et al., 2006; State of Texas, Dept. of Agriculture, 2013; MilitaryBases.com, 2013a and 2013b; State of Texas, Comptroller of Public Accounts, 2013). Meanwhile, OCS oil- and gas-related coastal infrastructure and land use represent only an incremental contribution to total land use, and the cumulative impacts as a result of a WPA proposed action and the OCS Program as a whole on land use and coastal infrastructure are also expected to be minor.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

Additional research was conducted to investigate the availability of recent information affecting land use and coastal infrastructure since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Various Internet sources were examined, including the websites of numerous Federal and State agencies (USDHS, Federal Emergency Management Agency; USDOC, Bureau of the Census; USDOC, NOAA; USDOE, Energy Information Administration; USDOT, Maritime Administration; USDOI, FWS; RestoreTheGulf.gov website; *Deepwater Horizon* Oil Spill Portal; USEPA; Louisiana Department of Environmental Quality; Texas Commission on Environmental Quality; Louisiana Recovery Authority; and Louisiana Office of Community Development). Further information was sought from other organizations, recently published journal articles, and trade publications such as The Greater Lafourche Port Commission, LA1 Coalition, The Oil Drum, Rigzone, *Oil and Gas Journal*, *Offshore* Magazine, TOLLROAD News, and *The Energy Journal*. New information was found on the status of the affected environment and growing markets related to OCS oil- and gas-related activities, as well as the impacts from non-OCS oil- and gas-related activities. There have been some changes to the spill-response equipment staging locations previously analyzed in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Due to these changes, it is expected that the oil-spill response equipment needed to respond to an offshore spill as a result of a proposed WPA lease sale could be called out from one or more of the following oil-spill equipment base locations: New Iberia, Belle Chasse, Baton Rouge, Sulphur, Morgan City, Port Fourchon, Harvey, Leeville, Fort Jackson, Venice, Grand Isle, or Lake Charles, Louisiana; La Porte, Corpus Christi, Port Arthur, Aransas Pass, Ingleside, Galveston, or Houston, Texas; Kiln and Pascagoula, Mississippi; Mobile or Bayou La Batre, Alabama; and/or Panama City, Pensacola, Tampa, and/or Miami, Florida; and/or Ponce and San Juan, Puerto Rico (Clean Gulf Associates, 2014; Marine Spill Response Corporation, 2014; National Response Corporation, 2014).

The U.S. Federal Gulf of Mexico oil production averaged 1.27 MMbbl of oil per day in 2013, which is unchanged from 2012. The DOE's Energy Information Administration forecasts 1.38 MMbbl of oil per day for GOM production in 2014 and 1.59 MMbbl of oil per day in 2015. Platform fabrication is highly dependent on the structural nature of the oil and gas industry, and projected production growth is anticipated to induce platform fabrication activity. There are 42 platform fabrication yards in the analysis area, with the highest concentration in Louisiana at 37; there are 4 in Mississippi, 1 in Alabama, and 0 in Florida (Dismukes, 2011). New reports have become available regarding supporting industries of offshore oil and gas activities. WorkBoat.com (2014b) provides an analysis of recent trends in day rates for offshore supply boats and crewboats. Because the Merchant Marine Act (Jones Act) requires all water-based commerce between different locations within the U.S. (i.e., U.S. port to OCS rig) be conducted in vessels that are American-owned and built, and crewed by U.S. mariners, most OSVs are built at Gulf Coast shipyards. There are 137 shipyards in the analysis area, with the highest concentration in Louisiana at 64; there are 32 in Texas, 9 in Mississippi, 18 in Alabama, and 14 in Florida (Dismukes, 2011). Day rates for crewboats (particularly the small classes of crewboats) increased between March 2013 and December 2013; day rates for supply boats also increased during this time period. WorkBoat.com conducted a survey that found that lots at newbuild yards for OSVs and crewboats remain tight. Major OSV companies continued to grow their fleets in 2013 through newbuilds and acquisitions. Crewboats under construction have risen from 6 vessels in the 2011 survey to 26 vessels in 2012 and 51 vessels in 2013, and the number of supply boats under construction rose from 54 boats in the 2012 survey to 72 boats in 2013. The Gulf Coast continues to be the busiest region in the U.S. second-tier shipyard market.

The WorkBoat.com (2014b) report has published information on two growing markets related to structure removal and well abandonment. This report found that BSEE's "idle iron" regulations in NTL 2010-G05 (30 CFR §§ 250.1703 and 250.1711) are driving structure-removal activities and growing the platform removal market. According to BSEE's statistics, between 2012 and 2013, 471 offshore structure were removed, scrapped, or reefed (USDOI, BSEE, 2014c). The report speculates that the GOM idle platform removals would generate a dedicated market estimated to be worth $3 billion over the next 5 years. In addition to platform removal, field abandonment requires the removal of surface and subsea well equipment and the sealing of the well bores to ensure continued integrity. Well abandonment, another growing market, generally requires drilling rig-equipped or well intervention vessels capable of controlling the well should well control issues arise during abandonment (WorkBoat.com, 2014c). These activities require the use of ports, scrap, and shipyards, among other coastal infrastructure types.

As described in **Chapter 3.1.2.1** of this Supplemental EIS and in Chapter 3.1.2.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, onshore unconventional natural gas production has increased to the point that existing Gulf Coast LNG facilities are seeking to export natural gas to foreign consumers. New information since the publication of the WPA 238/246/248 Supplemental EIS indicates that 12 additional project sponsors have applied to DOE for authorization to export domestically produced LNG to free trade agreement and non-free trade agreement countries. In 2014, New Orleans-based Harvey Gulf International Marine broke ground on a Port Fourchon-based LNG terminal. The first of its kind in the United States, the LNG facility will provide LNG fuel to the growing supply of LNG-operated vessels servicing the OCS, as well as over-the-road vehicles fueled by LNG (WorkBoat.com, 2014a). BOEM will continue to monitor future development of this new coastal infrastructure category (LNG bunkering facility), but this one proposed plan would not be expected to, on its own, represent a significant development or change in land use.

New information has become available regarding recent accidental events associated with non-OCS onshore activities. In February 2014, the E2MS 303 tank barge pushed by the towboat *Hannah C. Settoon* collided with another towboat near Vacherie, Louisiana (47 mi [76 km] west of New Orleans), by land spilling 31,500 gallons of light crude into the Mississippi River and temporarily closing the river to traffic (Lipinski, 2014). In March 2014, the cargo ship *Genius Star VII* and a barge loaded with 840,000 gallons of #6 fuel collided in the Houston Ship Canal. Recreational boating and fishing remained open, but general mariners were not allowed to operate in the safety zone without permission due to portions of Galveston Bay and offshore areas experiencing floating oil. In total, 18.9 mi (30.4 km) of nonconsecutive shoreline was impacted, requiring 70 response vessels and 940 total personnel in the field (WorkBoat.com, 2014b-d). Both of these events were isolated, with temporary impacts to local coastal infrastructure.

Recent analysis of data from the Pipeline and Hazardous Materials Safety Administration found that more than 1.15 million gallons of crude oil was spilled from rail cars in 2013 (Tate, 2014). By comparison, from 1975 to 2012, U.S. railroads spilled a combined 800 million gallons of crude oil. These spills constitute only a fraction of total shipments but show that many non-OCS oil- and gas-related activities contribute substantially to the cumulative impacts to land use and coastal infrastructure.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS, as well as in Chapter 4.1.1.20.1 of the

2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete information regarding the potential impacts of coastal land loss on land use and coastal infrastructure. It is not completely known how current subsidence and erosion is impacting industry or whether industry is making plans to mitigate current or future impacts. BOEM has proposed a study to evaluate these potential effects by surveying industry on current impacts and potential adaptation strategies, but as of the publication of this Supplemental EIS, it is unfunded and would take several years before data could be available. Therefore, this incomplete information is not likely to be available within the timeline contemplated by the NEPA analysis of this Supplemental EIS. However, this incomplete information may be relevant to adverse effects because a comprehensive understanding of the potential impacts of coastal land loss on coastal infrastructure and land use remains unknown. BOEM used reasonably accepted scientific methodologies to extrapolate from existing information on dredged material use to mitigate for land loss in completing this analysis and formulating the conclusions presented here. For example, in the case of Port Fourchon, dredged material from navigation slips are used to fill in property and mitigation habitat areas for wildlife and to act as a barrier to protect Port Fourchon from storm surges (Volz, 2013). Like any industrial infrastructure improvements, future adaptations will likely occur on an as-needed basis or as new technologies become available. While coastal infrastructure is subject to the impacts of coastal land loss and routine tropical storm activity, there is still considerable investment to expand, improve, and protect existing infrastructure. Although BOEM does not know when industrial infrastructure improvements, such as mitigation for land loss, may occur, the Port Fourchon example shows that industry may mitigate as necessary to protect existing and growing infrastructure. Therefore, while not completely known, current and future industry adaptation plans for coastal land loss are not essential to a reasoned choice among alternatives for this Supplemental EIS (including the No Action and an Action alternative). Therefore, BOEM has determined that the information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for land use and coastal infrastructure presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. BOEM has determined that the additional information regarding OSV day rates, decommissioning activities, or the new LNG bunkering facility do not alter the impact conclusion for land use and coastal infrastructure presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Therefore, the analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.20.2. Demographics

BOEM has reexamined the analysis for demographics presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for demographics presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of demographics, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.20.1, 4.1.1.20.2.2, and 4.1.1.20.2.3 of 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.20.2 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.20.2.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.20.2 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. New information that has become available since publication of those documents is also presented below.

In general, impact-producing factors that cause employment impacts, such as exploration and delineation activities, development and production activities, and coastal infrastructure development, can have some impacts on the demographic characteristics of a particular area. However, routine activities associated with a WPA proposed action are projected to minimally affect the demography of the analysis area. The projected impacts to population arising from a proposed lease sale are calculated by multiplying the employment estimates from the mathematical model MAG-PLAN (MMS Alaska-GOM Model Using IMPLAN) by an estimate of the number of members in a typical family. The projected population increases arising from a proposed lease sale are then divided by the population forecasts in Woods & Poole Economics, Inc. (2014), which yields the percentage impacts to population of a proposed lease sale. Population impacts from a WPA proposed action are projected to be minimal (<1% of the total population) for any EIA in the Gulf of Mexico region. This methodology yields estimates of the percent of the population of each EIA that will be dependent on the OCS Program in low-case and high-case scenarios for OCS oil- and gas-related activities. The baseline population patterns and distributions, as projected and described in Chapter 4.1.1.20.2.1 of the 2012-2017 WPA/CPA Multisale EIS, are unlikely to change as a result of a WPA proposed action. The increase in employment is expected to be met primarily with the existing population and available labor force, with the exception of some in-migration projected to occur in focal areas such as Port Fourchon, Louisiana.

Accidental events associated with a WPA proposed action, such as oil or chemical spills, blowouts, and vessel collisions, would likely have no long-term effects on the demographic characteristics of the Gulf coastal communities. This is because accidental events typically cause only short-term population movements as individuals seek employment related to the event or have their existing employment displaced during the event.

The cumulative analysis considers the effects of impact-producing factors related to OCS oil- and gas-related activities along with non-OCS oil- and gas-related impact-producing factors. The OCS oil- and gas-related factors that could impact the demographics of any area consist of routine activities and accidental events arising from prior, current, and future OCS lease sales, including impact-producing factors that cause employment impacts (exploration and delineation activities, development and production activities, and coastal infrastructure development) as well as oil spills, blowouts, and vessel collisions. The impacts to population arising from a WPA proposed action are projected to be minimal (<1% of the total population) for any EIA in the Gulf of Mexico region based on the employment estimates from the mathematical model MAG-PLAN for low-case and high-case scenarios for OCS oil- and gas-related activities. Accidental events should not have long-term effects on the demographic characteristics of the Gulf coastal communities because population movements are typically short-term. For a detailed discussion on the employment and demographic impacts of a low-probability catastrophic spill, which is not part of a WPA proposed action and not reasonably expected, refer to **Appendix B**.

There are numerous non-OCS oil- and gas-related factors that could impact demographics, including fluctuations in workforce, net migration, relative income, oil and gas activity in State waters, offshore LNG activity, trends in tourism activities (refer to **Chapter 4.1.1.18**), and other economic factors (refer to **Chapter 4.1.1.20.3**). Common approaches in analyzing cumulative effects begin by assembling a list of other projects and actions that will likely be associated with a WPA proposed action. However, no such list of future projects and actions could be assembled that would be sufficiently current and comprehensive to support a cumulative analysis for all 132 of the coastal counties and parishes in the analysis area over a 40-year period. Instead, this analysis uses the economic and demographic projections from Woods & Poole Economics, Inc. (2014) as a reasonable approximation to define the contributions of other likely projects, actions, and trends to the cumulative case.

A WPA proposed action would contribute to the population impacts arising from the overall OCS Program. The Economic Impact Areas TX-3, TX-1, LA-2, and LA-3 are projected to have some increases in the levels of their populations as a result of an increase in demand for OCS labor from both a WPA proposed action and from the overall OCS Program. A WPA proposed action is projected to have an incremental contribution of less than 1 percent to the population level in any of the EIAs, in comparison to other factors influencing population growth, such as the status of the overall economy, fluctuations in workforce, net migration, health trends, and changes in income. Given both the low levels of population growth and industrial expansion associated with a WPA proposed action, it is expected that the baseline age and racial distribution patterns will continue through the analysis period.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

BOEM conducted a search of Internet resources and known data sources related to demographics. New information was found for the affected environment. The primary source of new information is Woods & Poole Economics, Inc. (2014), which is an annual update of the data that were used in the WPA 238/246/248 Supplemental EIS. Woods & Poole Economics, Inc. (2014) provides projections of economic and demographic variables at the county level. **Table 4-5** provides projections of the evolution of the total population in all EIAs in future years, while **Table 4-5** provides projections of the evolution of total employment in the same areas. These projections assume the continuation of existing social, economic, and technological trends at the time of the forecast. In 2013, the total Gulf Coast population was 25.51 million. In 2013, the EIAs with the largest populations were TX-3 (6.54 million), FL-4 (6.43 million), and FL-3 (3.77 million). The EIAs with the smallest populations were LA-1 (353,510), MS-1 (493,860), and LA-2 (603,940). For all EIAs combined, it is expected that the total population will grow at a 1.27 percent rate between 2014 and 2055. The fastest population growth is expected in TX-3 (1.65%), TX-1 (1.46%), and FL-3 (1.28%); the slowest population growth is expected in LA-4 (0.45%) and MS-1 (0.62%). The population growth in TX-3 will primarily be driven by growth in areas around Houston, while the population growth in TX-1 will primarily be driven by the population centers around Corpus Christi (Nueces County) and along the southern border of Texas (Cameron and Hidalgo Counties). **Tables 4-6 through 4-18** provide projections of employment, income, wealth, business patterns, and racial composition for individual EIAs. In general, the projections of these variables have not changed noticeably from the projections in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

Austin et al. (2014a and 2014b) is a recently completed, 2-volume study of the social impacts of the *Deepwater Horizon* explosion, oil spill, and response. This study employed an ethnographic methodology that entailed analyzing data sources, examining various sources of descriptive information, and conducting field interviews with people in Louisiana, Mississippi, and Alabama. This study documents the complex and varied impacts of the *Deepwater Horizon* explosion, oil spill, and response during the 20 months subsequent to the spill. This study found that the impacts of the spill on a particular community depended on a number of factors, such as its proximity to the spill, its economic structure, its social and political dynamics, its organizational structure for dealing with disasters, and its ability to adapt to the structures of the oil cleanup and damage claims processes. This study also provides background information regarding the demographic structures of certain communities.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS, as well as in Chapter 4.1.1.20.2 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete or unavailable information regarding demographics in the WPA. This incomplete or unavailable information relates to translating employment impacts of OCS oil- and gas-related activities into estimated population impacts. This information cannot be obtained at this time due to data limitations and the complexity of methodologies needed to accurately estimate population impacts arising from OCS oil- and gas-related activities. BOEM plans to initiate a study project to analyze population impacts more fully, although this potential study project will not be completed in the timeline contemplated in the NEPA analysis of this Supplemental EIS. BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis as described above. In place of the incomplete or unavailable information, BOEM used the mathematical model MAG-PLAN and population forecasts in Woods & Poole Economics, Inc. (2014) to project the employment impacts to population arising from a proposed lease sale. This incomplete or unavailable information is unlikely to significantly impact

BOEM's estimates of the impacts of OCS lease sales on demographics because MAG-PLAN forecasts fairly limited population impacts and the nature of the employment associated with a WPA proposed action is similar to that of the existing OCS Program. In addition, increases in population arising from lease sales are generally positive, not adverse, impacts. Therefore, BOEM has determined that the incomplete or unavailable information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for demographics presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for demographics presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS because the new Woods & Poole Economic, Inc.'s data did not change much from what was presented in those documents. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.20.3. Economic Factors

BOEM has reexamined the analysis for economic factors presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for economic factors presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of economic factors, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.20.3.1, 4.1.1.20.3.2, and 4.1.1.20.3.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.20.3 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.20.3.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.20.3 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

Impact-producing factors such as exploration and delineation activities, development and production activities, and coastal infrastructure development can have some impacts on the economic characteristics, such as employment, of a particular area. The expected economic impacts of the OCS oil and gas industry are estimated using the mathematical model MAG-PLAN. The MAG-PLAN estimates the direct, indirect, and induced employment arising from a particular scenario for oil and gas exploration and development activities; these scenarios include estimates of activities such as drilling, platform installations, and structure removals. As a result of proposed WPA Lease Sales 246 and 248, there would be only minor economic changes in the Texas, Louisiana, Mississippi, Alabama, and Florida EIAs. This is partly because the demand would be met primarily with the existing population and labor force. Most of the employment related to proposed WPA Lease Sales 246 and 248 is expected to occur in Texas (primarily in the EIA TX-3) and in the coastal areas of Louisiana. A WPA proposed action, irrespective of whether one analyzes the high-case or low-case production scenario, would not cause employment effects of >0.1 percent in any EIA along the Gulf Coast.

Accidental events associated with a WPA proposed action, such as an oil spill, can cause a number of disruptions to local economies. Many of these effects are due to industries that depend on damaged resources. However, the impacts of an oil spill can be somewhat broader if companies further along industry supply chains are affected. These effects depend on issues such as the duration, methods, and logistics of the cleanup operations and the responses of policymakers to a spill. However, the impacts of small- to medium-sized spills should be localized and temporary.

The cumulative analysis considers the effects of OCS oil- and gas-related impact-producing factors along with non-OCS oil- and gas-related impact-producing factors that may occur and adversely affect economic factors in the same general area of a WPA proposed action. The expected economic impacts of the OCS oil and gas industry were estimated using the mathematical model MAG-PLAN to determine the direct, indirect, and induced employment arising from a particular scenario for oil and gas exploration and development activities (i.e., drilling, platform installations, and structure removals). A WPA proposed action would not cause employment effects of >0.1 percent in any EIA along the Gulf Coast. Oil spills can cause a number of disruptions to local economies; however, small- to medium-sized spills should have localized, temporary impacts. A low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected, would have more noticeable impacts to the economy. However, the likelihood of another spill of this scale is quite low. A detailed analysis of a low-probability catastrophic spill can be found in **Appendix B**.

Non-OCS oil- and gas-related impact-producing factors that can affect economic trends in economic areas in the Gulf of Mexico region include commercial, military, recreation/tourism (refer to **Chapter 4.1.1.18**), and numerous other offshore and coastal activities. To estimate the cumulative impacts to economic factors from non-OCS oil- and gas-related impact-producing factors, BOEM employs the economic and demographic projections from Woods & Poole Economics, Inc. (2014). These projections are based on local, regional, and national trend data, as well as likely changes to local, regional, and national economic and demographic conditions. Therefore, the projections include employment associated with the continuation of current patterns in OCS oil- and gas-related leasing activity, as well as the continuation of trends in other industries important to the region. For example, these forecasts include the contributions of State oil and gas activities, renewable energy activities, coastal land use, and tourism-related activities.

The cumulative impacts of a WPA proposed action would be determined by the expected path of the economy and by the expected progression of the OCS oil and gas industry in upcoming years. The expected path of the overall economy is projected using the data provided by Woods & Poole Economics, Inc. (2014). The expected economic impacts of the OCS oil and gas industry in upcoming years are estimated using the mathematical model MAG-PLAN. The cumulative impacts of a WPA proposed action to the economies along the Gulf Coast are expected to be relatively small.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

BOEM conducted a search of Internet sources and known data sources regarding economic factors. New information was found for the affected environment. **Table 4-19** presents updated data from the Office of Natural Resources Revenue (USDOI, Office of Natural Resources Revenue, 2014) regarding sales volumes, sales values, and government revenues received from Federal offshore energy activities in the Gulf of Mexico. Panel A of **Table 4-19** presents annual data regarding the quantities of royalty-bearing and nonroyalty-bearing sales volumes for natural gas, natural gas liquids (NGL), and oil. In FY 2013, royalty-bearing natural gas sales continued on a long-term downward trend, falling from 1.12 billion Mcf (thousand cubic feet) in FY 2012 to 970 million Mcf in FY 2013. Sales volumes of royalty-bearing NGL also continued on a steady downward trend in FY 2013, although sales volumes of nonroyalty-bearing NGL increased in FY 2013 compared with FY 2012. Sales volumes of royalty-bearing oil increased in FY 2013, while sales volumes of nonroyalty-bearing oil decreased. Panel B of **Table 4-19** presents the sales values of gas, NGL, and oil produced in Federal areas in the Gulf of Mexico. Sales values of oil and natural gas increased, while sales values of NGL decreased. The increase in the sales value of natural gas reflects the higher average price for natural gas in FY 2013 compared with FY 2012. Panel C of **Table 4-19** presents the Federal Government revenues received from offshore energy activities in the Gulf of Mexico. The Federal Government received $8.86 billion in revenue from Gulf of Mexico lease sales that occurred during FY 2013, which was larger than any amount received since 2008. This increased revenue reflects the higher energy prices that prevailed in FY 2013, as well as the large amount of bonus bid revenue received from offshore lease sales.

A report conducted by Smith (2014) provides an overview of the status of the oil and gas industries, with an emphasis on the status of Louisiana’s energy industry. This report describes how the large-scale development of onshore shale oil and gas activities will impact the competitive environment for offshore oil and gas activities. The report forecasts that nearshore natural gas production will continue to decline but that this decline will be partially offset by higher energy production in certain deepwater areas. This report also describes how the low price of natural gas is diverting development and production activities from extracting natural gas to extracting oil and NGL.

New reports have become available regarding certain industries that are involved with offshore oil and gas activities. Workboat.com (2014b) provides an analysis of recent trends in day rates for offshore supply boats and crew boats. Day rates for crew boats (particularly the small classes of crew boats) increased between March 2013 and December 2013; day rates for supply boats also increased during this time period. IHS Petrodata (2014) reports that, in April 2014, 80 of 86 marketed drilling rigs were under contract; 77 of 82 drilling rigs were under contract in April 2013. Kaiser et al. (2013) provide additional information regarding the structures of the various components of the offshore drilling industry in the Gulf of Mexico. For example, this report describes the trends, major firms, and determinants of activity levels in both the drilling service market and the rig newbuild market.

Austin et al. (2014a and 2014b) is a recently completed, 2-volume study of the social impacts of the *Deepwater Horizon* explosion, oil spill, and response. This study employed an ethnographic methodology that entailed analyzing data sources, examining various sources of descriptive information, and conducting field interviews with people in Louisiana, Mississippi, and Alabama. This study documents the complex and varied impacts of the *Deepwater Horizon* explosion, oil spill, and response during the 20 months subsequent to the spill. This study found that the impacts of the spill on a particular community depended on a number of factors, such as its proximity to the spill, its economic structure, its social and political dynamics, its organizational structure for dealing with disasters, and its ability to adapt to the structures of the oil cleanup and damage claims processes. This study also provides background information regarding the economic structures of certain communities.

The impacts of a proposed WPA lease sale and the OCS Program should be viewed in the context of overall economic conditions. In **Table 4-20**, data from Woods and Poole Economics, Inc. (2014) is used to generate forecasts of overall employment in all EIAs during the life of activities that would arise from a proposed WPA lease sale; these employment forecasts assume the continued progression of offshore oil and gas exploration and development activities. From 2014 to 2055, the fastest employment growth is expected in TX 3 (1.89%), TX-1 (1.73%), and FL-4 (1.64%); the slowest employment growth is expected in MS-1 (0.84%) and LA-4 (0.95%). The growth forecasts from Woods and Poole Economics, Inc. (2014) show slight increases in the growth forecasts compared with the 2013 data in all EIAs except FL-2, whose forecasted employment growth slightly decreased compared with the 2013 data. Woods and Poole Economics, Inc. (2014) is also used to forecast various demographic variables; refer to **Chapter 4.1.1.20.2** for more information regarding demographics. In general, the projections of these variables have not changed noticeably from the projections in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS, as well as in Chapter 4.1.1.20.3 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete or unavailable information regarding economic factors in the WPA. This information primarily relates to the onshore geographic distributions of economic impacts arising from the OCS Program. This information is difficult to obtain since most data sources do not adequately differentiate between onshore and offshore oil and gas activities. However, BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis as described above. In particular, BOEM used the most recent version of the MAG-PLAN to estimate the impacts of a WPA proposed action and the OCS Program. BOEM also used the economic and demographic projections from Woods and Poole Economics, Inc. (2014). In addition, BOEM is planning to launch a study project to explore new avenues for improving BOEM's information regarding onshore distributions, although this project will take time to pursue. However, any new information regarding onshore distributions of economic impacts is unlikely to significantly change BOEM's estimates of the impacts of the OCS Program. In addition, the economic impacts arising from the OCS Program are generally positive, not adverse. Therefore, BOEM has determined that the incomplete or unavailable information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for economic factors presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS based on the additional information presented above. No new information was discovered that would alter the impact conclusion for economic factors presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS because the new information was roughly in line with prior expectations. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.20.4. Environmental Justice

BOEM has reexamined the analysis for environmental justice presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. No new information was discovered that would alter the impact conclusion for environmental justice presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of environmental justice, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, are presented in Chapters 4.1.1.20.4.1, 4.1.1.20.4.2, and 4.1.1.20.4.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.20.4 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. A WPA proposed action's incremental contribution to the cumulative impacts is presented in Chapter 4.1.1.20.4.4 of the 2012-2017 WPA/CPA Multisale EIS, Chapter 4.1.1.20.4 of the WPA 233/CPA 231 Supplemental EIS, and Appendix D of the WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. Any new information that has become available since those documents were published is presented below.

The oil and gas industry and its associated support sectors are interlinked and widely distributed along the Gulf Coast. Offshore OCS oil- and gas-related industry operations within the WPA may utilize onshore facilities located within the WPA, CPA, or both. This analysis focuses on the potential impacts to low-income and minority populations living onshore. BOEM conducts a county-level analysis to determine the concentration of minority and low-income populations located in the same counties as oil- and gas- related onshore coastal infrastructure (refer to Chapter 4.2.1.23.4.1 and Figures 4-26 through 4-35 of the 2012-2017 WPA/CPA Multisale EIS).

BOEM provides numerous opportunities for public input during the NEPA process. Minority and low-income populations are provided the same opportunities as other populations to engage in the decisionmaking process. Some of the numerous avenues for public outreach employed by BOEM include specific types of notices that are (1) mailed to public libraries; interest groups; industry; ports and docks; local, State, and Federal agencies; and federally recognized Indian Tribes; (2) published in local newspapers; (3) posted on the Internet; and (4) published in the *Federal Register*. These notices reflect the stages of the NEPA process and include the Notice of Intent to Prepare a Supplemental EIS (NOI) and Notice of Availability (NOA) for the Draft and Final Supplemental EISs. A series of specified time periods after the NOI and NOA allow for public comments, all of which are considered and addressed. The formal scoping process is initiated by the NOI, and public scoping meetings are held in several geographically separate cities to allow the public to submit comments and to identify all stakeholders' concerns. All public comments and responses to comments are published in the Draft and Final

Supplemental EISs. A detailed discussion of the complete scoping process can be found in **Chapter 1.4**. A summary of the scoping comments for this Supplemental EIS can be found in **Chapter 5.3.2**.

The following routine activities associated with proposed WPA Lease Sales 246 and 248 could potentially affect environmental justice: potential infrastructure changes/expansions including fabrication yards, support bases, and onshore disposal sites for offshore waste; increased commuter and truck traffic; and employment changes and immigration. Because of the existing extensive and widespread support system for OCS oil- and gas-related industry and associated labor force, the effects of routine events related to a WPA proposed action are expected to be widely distributed and to have little impact. Routine activities related to a single WPA lease sale are not expected to significantly change the existing conditions, such as traffic or the amount of infrastructure. Impacts related to a WPA proposed action on minority and low-income populations are expected to be primarily economic in nature and to have a limited but positive effect because a WPA proposed action would contribute to the sustainability of current industry, related support services, and associated employment, especially in Louisiana where an extensive concentration of OCS oil- and gas-related infrastructure is located, e.g., Port Fourchon in Lafourche Parish. BOEM's county-level analysis found that, given the existing extensive distribution of the industry, associated widespread support system and the limited concentrations of minority and low-income peoples adjacent to oil and gas infrastructure, a WPA proposed action is not expected to have a disproportionate effect on these populations.

Accidental events with impact-producing factors that may be associated with a WPA proposed action and that could affect environmental justice include, but are not limited to, oil spills, vessel collisions, and chemical/drilling-fluid spills. These factors could negatively affect minority and low-income populations through direct exposure to oil, dispersants, degreasers, and other chemicals that can affect human health; temporary interference with subsistence activities due to temporary waterway closures; decreased access to natural resources due to environmental damages, fisheries closures, or wildlife contamination; and proximity to onshore disposal sites used in support of oil and chemical spill cleanup efforts. Oil, chemical, and drilling fluid spills may be associated with exploration, production, or transportation activities that result from a WPA proposed action. Low-income and minority populations might be more sensitive to spills in coastal waters than is the general population because of their potentially higher dietary reliance on wild coastal resources, reliance on these resources for other subsistence purposes such as sharing and bartering, limited flexibility in substituting wild resources with purchased ones, and likelihood of participating in cleanup efforts and other mitigating activities.

As studies of past oil spills have highlighted, different cultural groups can possess varying capacities to cope with these types of events (Palinkas et al., 1992). Some low-income and/or minority groups may be more reliant on natural resources and/or less equipped to substitute contaminated or inaccessible natural resources with private market offerings than higher income level and/or nonminority groups. Because lower-income and/or minority populations may live near and may be directly involved with spill cleanup efforts, the vectors of exposure can be higher for them than for the general population, increasing the potential risks of long-term health effects. Accidental events that could result from a proposed WPA action may affect low-income and/or minority populations more than the general population, at least in the shorter term. These higher-risk groups may lack financial or social resources and may be more sensitive and less equipped to cope with the disruption that these events pose. However, in the long-term, these smaller events are not likely to significantly affect minority and low-income populations because of their small scale and size. Therefore, the impacts of accidental oil spills, vessel collisions, and chemical/drilling fluid spills are not likely to be of sufficient duration to have adverse and disproportionate long-term effects for low-income and minority communities in the analysis area.

The cumulative analysis considers the effects of impact-producing factors related to OCS oil and gas activities along with non-OCS oil- and gas-related activities that may occur and adversely affect minority and low-income populations in the same general area of a WPA proposed action.

The OCS oil- and gas-related impact-producing factors that could impact environmental justice issues include OCS leasing, exploration, development, and production activities. These impact-producing factors may result in potential infrastructure changes/expansions, including fabrication yards, support bases, and onshore disposal sites for offshore waste; increased commuter and truck traffic; and employment changes and immigration. Accidental events arising from these OCS oil- and gas-related activities (i.e., oil spills, vessel collisions, and chemical/drilling-fluid spills), as well as the resultant cleanup may temporarily impact low-income populations who may experience direct exposure to contaminants through subsistence and cleanup activities. However, this exposure is expected to be small scale and short term and not result in disproportionate long-term effects because of the small scale and size of these events. A low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected, may also impact minority and low-income populations. A detailed analysis of a low-probability catastrophic event can be found in **Appendix B**. In general, the cumulative OCS oil- and gas-related effects are expected to be economic, widely distributed, and to have a limited but positive effect on low-income and minority populations. In Louisiana, these positive economic effects are expected to be greater because of the existence of an extensive and widespread support system for OCS oil- and gas-related activities and the associated labor force, especially in Lafourche Parish where Port Fourchon is located. Given the existing distribution of the OCS oil- and gas-related industry and the limited concentrations of minority and low-income populations near oil and gas infrastructure and based on the county-level analysis, a WPA proposed action and the cumulative OCS Program are not expected to have disproportionate high/adverse environmental or health effects on minority or low-income populations.

Non-OCS oil- and gas-related impact-producing factors cover a wide range of potential impact-producing factors including all human activities, natural events, and processes that are not related to OCS oil- and gas-related activities in Federal waters. Some of the human activities that may disproportionately affect minority and low-income populations include, but are not limited to, the following: State oil and gas activities onshore and in State waters; urbanization; pollution (air, light, noise, garbage dumping, and contaminated runoff); commercial/residential/agricultural development; zoning ordinances; community development strategies (multi-purpose, single-use); expansions to the Federal, State, and local highway systems; expansions to regional port facilities; military activities; demographic shifts (in-migration, out-migration); economic shifts on the national, State and local levels (job creation and job losses); military activities; educational systems (quality, availability, expansions, or contractions); family support systems (availability, proximity and quality of mental health services, foster care, charity hospital systems, addictive disorders rehabilitation centers, family planning services, early-learning programs, etc.); governmental functions (municipal waterworks systems, sewage systems, tax structures, revenue collection, law enforcement, fire protection, traffic control, voting processes, legislative processes, court procedures and processes, real estate property assessments, construction permits, environmental protection services, land-use permits, etc.); contraction or expansion of the tourism industry; financial system (banking and investment services); State renewable energy activities; river channelization; dredging of waterways; State oil and gas activity; and existing infrastructure associated with downstream activities such as petrochemical processing; and public health.

While human activities are extensive and nearly all-encompassing, there are a substantial number of natural events and processes that may be classified as non-OCS oil- and gas-related impact-producing factors that may disproportionally affect low-income and minority populations, including the following: oyster reef degradation; saltwater intrusion; sedimentation of rivers; sediment deprivation; barrier island migration and erosion; fish kills; red tide; beach strandings; coastal erosion/subsidence; sea-level rise; and coastal storms. Both human-induced and natural factors, unrelated to OCS oil- and gas-related activities, could affect minority and low-income populations through exposure to high levels of pollution, job loss, reduced social services, adverse infrastructure siting, decreased tourism, public health issues, coastal erosion, land loss and erosion, reduced opportunities for subsistence activities, and vulnerability of coastal communities to name a few. For a detailed discussion of these non-OCS oil- and gas-related impacts to low income populations, see Appendix D of the WPA 238/246/248 Supplemental EIS.

To summarize, cumulative effects will be concentrated in coastal areas, particularly in Louisiana. Most OCS Program effects are expected to make a positive contribution to minority and low-income populations by helping to maintain current employment levels and contributing to economic stimulation. The contribution of the cumulative OCS Program to the cumulative impacts of all factors affecting environmental justice is expected to be minor; therefore, the incremental contribution of a WPA proposed action to the cumulative impacts would also be minor. State offshore leasing programs have similar, although more limited, effects due to their smaller scale. Cumulative effects from onshore infrastructure, including waste facilities, is also expected to be minor because existing infrastructure is regulated, because little new infrastructure is expected to result in the cumulative case, and because any new infrastructure will be subject to relevant permitting requirements. Other human activities and natural events and processes, as noted above, also may raise environmental justice issues, as described in Appendix D of the WPA 238/246/246 Supplemental EIS. When added to existing State and Federal leasing programs, the associated onshore infrastructure, and all of the non-OCS oil- and gas-related impact-producing factors, a single WPA lease sale will make only minor contributions to the cumulative effects on environmental justice issues.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search of various information sources and trade publications (U.S. Department of Health and Human Services, National Institutes of Health; USEPA; USDOC, Bureau of the Census and Bureau of Labor Statistics; USDHS, Federal Emergency Management Agency; RestoreTheGulf.gov website; *Deepwater Horizon* Claims Center; *Deepwater Horizon* Oil Spill Portal; Louisiana Department of Environmental Quality; Texas Commission on Environmental Quality; Louisiana Recovery Authority; Louisiana Office of Community Development; The Greater Lafourche Port Commission; LA1 Coalition; Rigzone; *Oil and Gas Journal*; and The Oil Drum), as well as recently published journal articles, was conducted to determine the availability of recent information on environmental justice. The search revealed the following new information on claims and human health impacts from the *Deepwater Horizon* explosion, oil spill, and response. This information is important because it expands our knowledge of the baseline environment following the *Deepwater Horizon* explosion, oil spill, and response.

The remaining *Deepwater Horizon* medical claims that were on appeal before the U.S. Court of Appeals for the Fifth Circuit were dismissed on February 11, 2014, and the effective date of the *Deepwater Horizon* Medical Benefits Settlement is February 12, 2014 (*Deepwater Horizon* Court-Supervised Settlement Program 2014). An Advisory regarding the Economics & Property Damages Settlement was issued. Even though the deadline to file claims in the Seafood Compensation Program was January 22, 2013, the Claims Administrator developed a "Procedure for Handling Untimely Seafood Claims," which will allow the submittal of late claims with deadline extension requests. The procedure is located in the "Alerts" section of the *Deepwater Horizon* economic settlement website (*Deepwater Horizon* Claims Center, 2014).

The *Deepwater Horizon* Research Consortia, headed by the National Institute for Environmental Health Sciences, developed university-community partnerships to address health effects resulting from the *Deepwater Horizon* explosion, oil spill, and response. The intent is that the Consortia's research findings will inform community preparedness and disaster response, thereby limiting disaster-related health impacts, e.g., exposure to contaminants, emotional distress, and diet changes (National Institute of Environmental Health Sciences, 2014a). The funding allocation of $25.2 million is being spread across the Gulf region to fund numerous studies through several universities, covering several kinds of research topics. A few examples include the following: oil-spill impacts to the health of women and their children; Gulf resilience and women's health; oil-spill impacts on pregnant women; seafood safety; individual, family, and community resilience along the Gulf Coast; social capital and resilience; and community/individual network building (Louisiana State University Health Sciences Center, School of Public Health, 2014; Tulane University, 2014; Center for Gulf Coast Environmental Health, 2014; University of Florida, 2014; and Weiss, 2014).

The National Institute of Environmental Health Sciences' ongoing GuLF Study (Gulf Long-term Follow-up Study) has completed Phase 1 and has started Phase 2 as of April, 2014. Of the 33,000 participants, preliminary findings from the first health exam indicated that cleanup workers were about 30 percent more likely to report moderate to severe depression, anxiety, and stress than participants who did no cleanup work. Researchers stated that it is unclear whether these mental health impacts were the result of exposure to spilled oil and/or dispersants or some other factor of the oil-spill experience and its aftermath. Cleanup workers also reported more physical symptoms, such as coughing, wheezing, and shortness of breath, than did those who were not cleanup workers. Some of the workers still reported these symptoms 3 years after the spill. However, it is too early to determine if cleanup exposures will lead to chronic diseases such as cancer or lung disease. Researchers stressed the importance of participants continuing in the 10-year study so that any potential long-term health impacts may be discovered (National Institute of Environmental Health Sciences, 2014b).

A new study published in April 2014, *The Coastal Index: The Problem and Possibility of Our Coast*, developed new indicators to measure progress toward sustainability in southeast Louisiana (Hobor et al., 2014). Population shifts in coastal areas were tracked, and the study analyzed whether water management activities may diversify the regional economy toward a more positive trajectory. The study establishes a baseline from which social change may be measured in the future. As many people have been moving farther from the coast to avoid land loss, flooding, and coastal subsidence, low-income populations have not been able to relocate as readily, especially in areas such as Theriot and Dulac, Louisiana, where the poverty rates are over 40 percent. The study suggests that increases in water management activities such as diversions, hydraulic restoration, marsh creation, and barrier island restoration will produce positive economic benefits that will affect everyone, including low-income and minority populations (Hobor et al., 2014).

A recently released BOEM-funded study, *Offshore Oil and* Deepwater Horizon*: Social Effects on Gulf Coast Communities – Volume I: Methodology, Timeline, Context, and Communities; and Volume II: Key Economic Sectors, NGOs, and Ethnic Groups* (Austin et al. 2014a and 2014b) researched the social impacts of the *Deepwater Horizon* from April 2010 through December 2012. The study sought to accurately describe and document how the *Deepwater Horizon* disaster was experienced and understood by the people it affected most directly, as the events surrounding the spill unfolded. As an ethnographic approach with several field workers in Louisiana, Mississippi, and Alabama coastal communities, the study did not attempt to quantify economic losses. The study found that the spill affected many different groups of people and individuals across the Gulf region. The economic effects were felt in the offshore oil and gas industry, and commercial and recreational fishing industries and tourism industries, as well as oil and gas support sector services and other businesses from caterers to retail outlets and restaurants. Local and State governments and nongovernmental and community-based organizations were affected by the loss of revenues and by the need to respond to the economic needs of the people in the region. Programs, such as British Petroleum's Vessels of Opportunity and claims processes, aiming to mitigate negative economic conditions had mixed results, with positive impacts distributed in a seemingly random manner through the communities. Most importantly, the failure to distinguish the *Deepwater Horizon* explosion, oil spill, and response from other regional disasters exacerbated, and in some cases created, some of its effects. The disaster did not generate the sorts of volunteer opportunities that follow hurricanes. The ability of individuals and communities to secure resources depended on their political and legal status. Environmental justice-focused nongovernmental organizations found that funding resources after the spill were scarce because the spill was not designated a Federal disaster. With disasters such as hurricanes, the allocation of funds for social services is outlined explicitly in the Stafford Act, establishing a mechanism to help nonprofit organizations respond as needed, but there is no provision for social services to help people recover under the Oil Pollution Act of 1990 (Austin et al., 2014a and 2014b).

Incomplete or Unavailable Information

Even after evaluating the information above, BOEM has determined that the new information does not change the conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in this Supplemental EIS and in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified unavailable information regarding the impacts of the *Deepwater Horizon* explosion, oil spill, and response to environmental justice. This information cannot be obtained because long-term health impact studies, subsistence studies, and the NRDA process are ongoing, and data from these efforts will be unavailable and unobtainable until the studies and NRDA process are complete. In its place, BOEM's subject-matter experts have used credible existing information and applied it using accepted socioeconomic methodologies. In order to fill this data gap, BOEM used existing information and reasonably accepted scientific methodologies to extrapolate from available information in completing the relevant analysis including limited information that has been released after the *Deepwater Horizon* explosion, oil spill, and response and studies of past oil spills which indicate that a low-probability, catastrophic oil spill, which is not part of a WPA proposed action or likely expected, may have significant adverse impacts on lower-income and minority communities. To date, there has been little concrete evidence that subsistence effects have occurred (Brown et al., 2011; Dickey, 2012; King and Gibbons, 2011; Middlebrook et al., 2011; U.S. Dept. of Labor, OSHA, 2010a and 2010b), although there is some dispute in the scientific community about proper risk assessment standards in seafood contamination research (Rotkin-Ellman et al., 2012; Rotkin-Ellman and Soloman, 2012). In addition, some studies have shown that different cultural groups can possess varying levels of coping capacities (Palinkas, 1992), and impacts to social cohesion, including increased distrust in government and other institutions, contributed to community anxiety (Tuler et al., 2009). Also, because lower-income and/or minority populations may live near and be involved directly with spill cleanup efforts, the vectors of exposure can be higher for them than for the general population, increasing the potential risks of long-term health effects. Therefore, because long-term health impacts to low-income and minority populations is unknown, this information may be relevant to the evaluation of impacts from the *Deepwater Horizon* explosion, oil spill, and response to environmental justice. However, long-term health studies are pending and will not be available within the timeline contemplated in the NEPA analysis of this Supplemental EIS. BOEM will continue to seek additional information as it becomes available and bases the previous analysis on the best information currently available. Although long-term health impacts to low-income and minority populations may be relevant to this analysis, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives based on the information discussed above.

Summary and Conclusion

BOEM has reexamined the analysis for environmental justice presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. BOEM has determined that the additional information does not alter the impact conclusion because the information is currently inconclusive with regard to environmental justice issues and will remain so for an indefinite period of time. Therefore, the analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.1.21. Species Considered due to U.S. Fish and Wildlife Concerns

BOEM has reexamined the analysis for species considered due to FWS concerns presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented below. The species considered are the Gulf Coast jaguarundi, ocelot, South Texas ambrosia, Texas prairie dawn-flower, Texas ayenia, black lace cactus, and slender rush-pea. BOEM has only focused on species within coastal counties because those are the species that could be potentially impacted by oil and gas development activities, including an accidental OCS oil spill. Some species considered due to FWS concerns are discussed in other chapters of this Supplemental EIS. The conclusions for the following species can be found in their respective chapters: West Indian manatee (Chapter 4.1.1.11 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS); green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles (**Chapter 4.1.1.12** of this Supplemental EIS and Chapter 4.1.1.12 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS); and red knot (*Calidris canutus rufa*), Attwater's greater prairie-chicken, northern aplomado falcon, piping plover, whooping crane, and mountain plover (**Chapter 4.1.1.14** of this Supplemental EIS and Chapter 4.1.1.14 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS). No new information was discovered that would alter the impact conclusion for species considered due to FWS concerns presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

A detailed description of species considered due to FWS concerns, along with the full analyses of the potential impacts of routine activities and accidental events associated with a WPA proposed action, can be found in Chapters 4.1.1.21.1, 4.1.1.21.2, and 4.1.1.21.3 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 4.1.1.21 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. The following information is a summary of the resource description and impact analysis incorporated from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. New information that has become available since publication of those documents is also presented below.

Adverse impacts due to routine activities resulting from a WPA proposed action, such as operational discharges, noise, and marine debris, are possible but unlikely. Lethal effects could occur from ingestion of released plastic materials from OCS oil- and gas-related vessels and facilities. However, there have been no reports to date on such incidences. Because of the mitigating measures that may be implemented (**Chapter 2.3.1.3**), routine activities (e.g., operational discharges, noise, and marine debris) related to a WPA proposed action are not expected to have long-term adverse effects on the size and productivity of any of the above-mentioned species or populations (2 mammal species and 5 plant species) in the Gulf of Mexico. Greatly improved handling of waste and trash by industry and annual awareness training required by the marine debris mitigations are reducing the amount of plastics in the ocean, and therefore minimizing the devastating effects on offshore and coastal marine life. The routine activities of a WPA proposed action are unlikely to have significant adverse effects on the size and recovery of any of the above-mentioned species or population in the GOM due to the distance of most activities, the heavy regulation of infrastructure and pipelines, and permitting and siting requirements.

Accidental blowouts, oil spills, and spill-response activities resulting from a WPA proposed action have the potential to impact small to large areas in the Gulf of Mexico with physical oiling and habitat destruction, depending on the magnitude and frequency of accidents, the ability to respond to accidents, the location and date of accidents, and various meteorological and hydrological factors (including tropical storms). Adverse impacts due to accidental events are also likely to be minimal because the habitats for the above-mentioned species are far from OCS oil- and gas-related activities and are inland. Therefore, a WPA proposed action would be expected to have little or no effect on these species of concern.

The cumulative analysis considers activities that have occurred, are currently occurring, and could occur and adversely affect species considered due to FWS concerns. The OCS oil- and gas-related activities that could impact species considered due to FWS concerns include operational discharges, noise, marine debris, blowouts, oil spills, and spill-response activities. Routine activities are not anticipated to impact these species because of the mitigations and regulations implemented by BOEM, and accidental events are expected to be minimal to these species because these habitats are far from OCS oil- and gas-related activities and are inland. A low-probability catastrophic spill, which is not part of a WPA proposed action and not likely expected, could impact species considered due to FWS concerns and is discussed in **Appendix B**.

Non-OCS oil- and gas-related activity that could impact species considered due to FWS concerns include State oil and gas activities, other governmental and private projects and activities, hurricanes, and natural processes and events that may occur that adversely affect wetland habitat. Non-OCS oil- and gas-related activities posing the greatest potential harm to species considered due to FWS concerns are factors such as habitat loss and ecological competition. These factors have historically proved to be of greater threat to these species of concern. Impacts may also occur to these species if a hurricane passes over an oil spill or causes spills itself. However, at this time, there is no known record of a hurricane crossing the path of a large oil spill; the impacts of such have yet to be determined. The experience from Hurricanes Katrina and Rita in 2005 was that the oil released during the storms widely dispersed as far as the surge reached, reducing impacts from concentrated oil exposure (USDOC, NOAA, 2010).

Activities outside of BOEM's oil and gas activity have a greater potential to impact species considered in this chapter than the Bureau of Ocean Energy Management's OCS oil- and gas-related activities, especially those factors that contribute to habitat loss. Because the species considered due to FWS concerns rely on terrestrial habitats to carry out their life-history functions at a considerable distance from the GOM, the activities of a WPA proposed action are unlikely to have significant adverse effects on the size and recovery of any of the above-mentioned mammal and plant species or populations in Texas. Therefore, the incremental contribution of a WPA proposed action would not be likely to result in a significant incremental impact on these mammal and plant species within the WPA.

New Information Available Since Publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS

A search of Internet information sources (FWS's website), as well as recently published journal articles, was conducted to determine the availability of recent information on species considered due to FWS concerns. The search revealed no new information pertinent to this Supplemental EIS.

Incomplete or Unavailable Information

After evaluating the information above, BOEM has determined that the previous conclusions from the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS are still valid because no new information on species considered due to FWS concerns has been published since the publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS; nevertheless, there is still incomplete or unavailable information. As discussed in Chapter 4.1.1.21 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, BOEM has identified incomplete information on the impacts to species considered due to FWS concerns as a result of the *Deepwater Horizon* explosion, oil spill, and response because little data have been released to the public. As data continue to be gathered and impact assessments completed, a better characterization of the full scope of impacts to populations in the GOM from the *Deepwater Horizon* explosion, oil spill, and response will be available. Relevant data on the status of populations after the *Deepwater Horizon* explosion, oil spill, and response may take years to acquire and analyze, and impacts from the *Deepwater Horizon* explosion, oil spill, and response may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEM to obtain this information within the timeline contemplated in the NEPA analysis of this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEM's subject-matter experts have extrapolated available scientifically credible evidence in this analysis. Based on life histories of these species and the fact that they live inland, BOEM has determined that the two mammal species and five plant species within the WPA were not affected to any discernible degree by the *Deepwater Horizon* explosion, oil spill, and response. In addition, given that the boundary of the WPA is more than 300 mi (483 km) from the *Macondo* well and that the westernmost extent of the plume and sheen did not reach the WPA, it appears that these mammal and plant species would not have been impacted by the *Deepwater Horizon* explosion, oil spill, and response. Although the body of available information is incomplete, the information extrapolated from the life history of the species and the distance of the *Macondo* well from their habitats was sufficient to draw reasonable conclusions that they should not have been impacted by the *Deepwater Horizon* explosion, oil spill, and response; therefore, BOEM has determined that the incomplete information is not essential to a reasoned choice among alternatives.

Summary and Conclusion

BOEM has reexamined the analysis for species considered due to FWS concerns presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, based on the additional information presented above. No new information was discovered that would alter the impact conclusion for species considered due to FWS concerns presented in the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. The analysis and potential impacts detailed in the 2012-2017 WPA/CPA Multisale EIS and updated in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS still apply for proposed WPA Lease Sales 246 and 248.

4.1.2. Alternative B—Exclude the Unleased Blocks Near Biologically Sensitive Topographic Features

Description of the Alternative

Alternative B differs from Alternative A (a proposed action) by not offering unleased blocks that are possibly affected by the proposed Topographic Features Stipulation under Alternative A (**Chapter 2.3.1.3.1** of this Supplemental EIS and Chapter 2.3.1.3.1 of the 2012-2017 WPA/CPA Multisale EIS). Blocks subject to the Topographic Features Stipulation include any unleased block in which a No Activity Zone or Shunting Zone surrounding a topographic feature is located. There are 159 blocks (776,653 ac) in the WPA in which the Topographic Features Stipulation may be applied (**Figure 2-2**). These unleased blocks will not be available for lease under Alternative B. The number of unleased blocks that would not be offered under Alternative B represents only a small percentage of the total number of blocks to be offered under Alternative A; therefore, it is assumed that the levels of activity for Alternative B would be essentially the same as those projected for a WPA proposed action (refer to **Chapter 2.3.2** for further details). The estimated amount of resources projected to be developed under Alternative B is within the same scenario range as for Alternative A, i.e., 0.116-0.200 BBO and 0.538-0.938 Tcf of gas.

All of the assumptions, including the four other potential mitigating measures (i.e., the Military Areas Stipulation, Protected Species Stipulation, United Nations Convention on the Law of the Sea Royalty Payment Stipulation, and Transboundary Stipulation, as described in **Chapter 2.2.1.3**), are the same as for a WPA proposed action (Alternative A). A description of Alternative A is presented in **Chapter 2.3.1.1**. The Topographic Features Stipulation would not be applicable with Alternative B because the blocks that could be affected by the Topographic Features Stipulation would not be offered for lease.

Because the incremental contribution of Alternative A (the Proposed Action) to the cumulative impacts on topographic features is expected to be slight and because negative impacts should be restricted by the implementation of the Topographic Features Stipulation and site-specific mitigations, the depths of the features, and water currents in the topographic feature area, Alternative A is not expected to result in adverse impacts greater than Alternative B. Therefore, since both Alternatives A and B minimize the potential for adverse impacts to Topographic Features, but since Alternative A better meets the purpose and need by providing a greater level of flexibility when considering oil and gas exploration, development, and production activities, Alternative A is BOEM's preferred alternative.

Effects of the Alternative

The following analyses are based on the scenario for a WPA proposed action (Alternative A). The scenario provides assumptions and estimates on the amounts, locations, and timing for OCS oil and gas exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what would happen as a result of holding proposed WPA Lease Sales 246 and 248. A detailed discussion of the scenario and related impact-producing factors is presented in **Chapter 3.1** of this Supplemental EIS and Chapter 3.1 of the 2012-2017 WPA/CPA Multisale EIS, and updated information is provided in Chapter 3.1 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS.

The analyses of impacts to the various resources under Alternative B are similar to those for Alternative A. The reader should refer to the appropriate discussions under Alternative A for more detailed information regarding impact-producing factors and their expected effects on the various resources. Impacts under Alternative B are expected to be the same as those under a WPA proposed action (**Chapter 4.1.1**) for the following resources:

— Air Quality
— Water Quality
— Coastal Barrier Beaches and Associated Dunes
— Wetlands
— Seagrass Communities
— *Sargassum* Communities
— Chemosynthetic and Nonchemosynthetic Deepwater Benthic Communities
— Soft Bottom Benthic Communities
— Marine Mammals
— Sea Turtles
— Diamondback Terrapins
— Coastal and Marine Birds
— Fish Resources and Essential Fish Habitat
— Commercial Fisheries
— Recreational Fishing
— Recreational Resources
— Archaeological Resources
— Human Resources and Land Use

The impacts to some Gulf of Mexico resources under Alternative B would be slightly different from the impacts expected under a WPA proposed action (Alternative A). These impacts are described below.

Impacts on Topographic Features

The potential routine impact-producing factors to the topographic features of the WPA are anchoring and structure emplacement or removal, and drilling-effluent and produced-water discharges. Under Alternative A, impacts associated with routine OCS oil- and gas-related activity are minimized by the application of the Topographic Features Stipulation, which distances bottom-disturbing activity (e.g., the drilling of wells, anchor and ground tackle placement, and pipeline emplacement) from topographic features. Distancing bottom-disturbing activity from topographic features also minimizes impacts from discharges by allowing for dilution and because the discharges are restricted by through USEPA permits. The possible accidental impact-producing factors to the topographic features of the WPA are surface and subsurface oil spills and blowouts. The application of the Topographic Features Stipulation under Alternative A distances the topographic features from possible oil spills, allowing for dilution as well as allowing for any oil released below the water's surface to float to the surface, reducing the possibility of physical contact. A more detailed discussion of these potential impact-producing factors and the appropriate mitigating measures that are applied under Alternative A to prevent routine impacts to the topographic features is presented in **Chapters 2.3.1.3.1 and 4.1.1.6** of this Supplemental EIS and in Chapters 2.3.1.3.1 and 4.1.1.6 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

Under Alternative B, the routine impacts associated with OCS oil- and gas-related activity would be farther distanced from topographic features because the blocks to which the Topographic Features Stipulation could be applied would not be offered for lease. There are 159 blocks (776,653 ac) in the WPA in which the Topographic Features Stipulation may be applied (**Figure 2-2**). All bottom-disturbing activity associated with OCS oil- and gas-related activity under Alternative B would occur outside of the blocks in which the Topographic Features Stipulation could be applied under Alternative A. The blocks in which the Topographic Features Stipulation could be applied would be any block in which a topographic feature, a No Activity Zone surrounding a topographic feature, or a shunting zone (i.e., 1,000-Meter, 1-Mile, 3-Mile, and/or 4-Mile Zone) surrounding a topographic feature is located. Routine impacts from OCS oil- and gas-related activities would be eliminated because no activity would occur in blocks in which topographic features are located. Accidental impacts would be minimized by allowing for greater distance for oil to dilute before possibly reaching a topographic feature.

The reduction of impacts to topographic features associated with Alternative B is essentially the same as the reduction of impacts associated with Alternative A. While the unleased blocks subject to the Topographic Features Stipulation would not be leased under Alternative B, and therefore all potential routine impacts would be completely removed and potential accidental impacts would be further distanced from any topographic feature, the application of the Topographic Features Stipulation under Alternative A also sufficiently minimizes the potential impacts of routine OCS oil- and gas-related activities by requiring bottom-disturbing activity to be distanced from topographic features in order to diminish physical impacts to them.

Impacts of Routine and Accidental Events

All 21 protected topographic features of the WPA are located within water depths less than 200 m (656 ft) and occupy a small portion of the WPA. Of the potential impact-producing factors that may affect the topographic features, anchoring and structure emplacement or removal would be eliminated by the adoption of this alternative. Effluent discharge and blowouts would not be a significant threat to the topographic features because blocks near enough to the banks for these events to have an impact on the biota of the banks would have been excluded from leasing under this alternative. Thus, the only impact-producing factors remaining would be blowouts and oil spills that could occur from operations in blocks other than those blocks excluded from leasing under Alternative B. The potential impacts from blowouts and oil spills are summarized below and are discussed further in **Chapters 3.2.1 and 4.1.1.6** of this Supplemental EIS and in Chapters 3.2.1 and 4.1.1.6 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS.

Topographic features should be protected from surface oil because the crests of the features are deeper than the physical mixing ability of surface oil (Lange, 1985; McAuliffe et al., 1975 and 1981; Tkalich and Chan, 2002; Rezak et al., 1983). Topographic features would be unaffected by subsurface spills unless they come into contact with the oil. Oil from a subsurface spill is expected to rise to the sea surface, based on the specific gravity of GOM oil. An exception to this could occur if oil is released at the seafloor under high pressure, having the effect of atomizing the oil into micro-droplets that have very little buoyancy. Under these conditions, a subsea oil plume could form and travel laterally with the prevailing currents. This can also happen if chemical dispersants are used underwater, forming a plume. If a subsea oil plume does form, the oil is expected to be swept clear of the banks because prevailing currents travel around the banks rather than over them (Rezak et al., 1983). As the oil travels in the water column, it will become diluted from its original concentration. Transient concentrations of oil below 20 parts per million are not expected to result in lasting harm to a coral reef (Shigenaka, 2001). In addition, any subsea oil plume that formed in deep water would not be expected to impact topographic features because deepwater currents do not typically transit from deep water up onto the shelf (Pond and Pickard, 1983; Inoue et al., 2008). The fact that the topographic features are widely dispersed in the WPA, combined with the random nature of spill events, would serve to limit the likelihood of a spill occurring near a topographic feature. In addition, the exclusion of blocks adjacent to topographic features (i.e., those blocks in which a topographic feature, No Activity Zone surrounding a topographic feature, or shunting zone [i.e., 1,000-Meter, 1-Mile, 3-Mile, and/or 4-Mile]) surrounding a topographic feature are located) from a proposed WPA lease sale would further distance potential spills from the habitat. Chapter 4.1.1.6.3 of the 2012-2017 WPA/CPA Multisale EIS discusses the risk of spills interacting with topographic features, especially the Flower Garden Banks, in more detail, and updated information is provided in the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS. The currents that move around the banks would likely steer any spilled oil around the banks rather than directly upon them, lessening impact severity. In the unlikely event that oil from a subsurface spill does reach the biota of a topographic feature, the effects should be sublethal for most of the adult sessile biota. Lethal effects would probably be limited to a few coral colonies (CSA, 1992 and 1994). If oil from a subsurface spill contacted a coral-covered area, the areal extent of coral mortality would be limited, but long-lasting sublethal effects may be incurred by organisms surviving the initial effects of a spill (Jackson et al., 1989). Stress resulting from the oiling of reef coral colonies could affect their resilience to natural disturbances (e.g., elevated water temperature and diseases) and may hamper their ability to reproduce. A complete recovery of such an affected area could take in excess of 10 years.

Cumulative Impacts

With the exception of the topographic features, the cumulative impacts of Alternative B on the environmental and socioeconomic resources of the WPA would be identical to Alternative A. The incremental contribution of a WPA proposed action to the cumulative impacts on topographic features is expected to be slight, and negative impacts should be restricted by the implementation of the Topographic Features Stipulation and site-specific mitigations, the depths of the features, and water currents in the topographic feature area.

Summary and Conclusion

Alternative B, if adopted, would prevent any OCS oil- and gas-related activity in blocks containing topographic features or their surrounding protective zones; thus, it would eliminate any potential direct impacts to the biota of those blocks from routine oil and gas activities, which otherwise would be conducted within the blocks according to lease stipulations. In the unlikely event that oil from a subsurface spill contacts the biota of a topographic feature, the effects would be localized and primarily sublethal for most of the adult sessile biota. Some lethal effects could occur upon oil contacting coral colonies, and recovery from such an event is anticipated to take in excess of 10 years.

The environmental impacts of Alternative B would be almost indistinguishable from Alternative A with the Topographic Features Stipulation in place. There would be an economic impact to the extent that economic returns from the excluded lease blocks would not be realized. While the unleased blocks subject to the Topographic Features Stipulation would not be leased under Alternative B, and therefore all potential routine impacts would be completely removed and potential accidental impacts would be further distanced from any topographic feature, the application of the Topographic Features Stipulation under Alternative A also sufficiently minimizes the potential impacts of routine OCS oil- and gas-related activities by requiring bottom-disturbing activity to be distanced from topographic features in order to diminish physical impacts to them.

4.1.3. Alternative C—No Action

Description of the Alternative

Alternative C is the cancellation of a single proposed WPA lease sale. If this alternative is chosen, the opportunity for development of the estimated 0.116-0.200 BBO and 0.538-0.938 Tcf of gas that could have resulted from a proposed WPA lease sale would be precluded during the current 2012-2017 Five-Year Program, but it could again be contemplated as part of another proposed lease sale in the current or future Five-Year Program. The No Action alternative encompasses the same potential impacts as a decision to delay a proposed WPA lease sale to a later scheduled lease sale under the Five-Year Program, when another decision on whether to hold that future lease sale is made. Delay of a proposed WPA lease sale was not considered as a separate alternative from Alternative C because the potential impacts are the same, namely that most impacts related to Alternative A would not occur as described below. Any potential environmental impacts resulting from a proposed WPA lease sale would not occur or would be postponed to a future lease sale decision.

Effects of the Alternative

This Agency published a report that examined previous exploration and development activity scenarios (USDOI, MMS, 2007b). This Agency compared forecasted activity with the actual activity from 14 WPA and 14 CPA lease sales. The report shows that many lease sales contribute to the present level of OCS activity, and any single lease sale accounts for only a small percentage of the total OCS oil- and gas-related activities. In 2006, leases from 92 different lease sales contributed to Gulf of Mexico production, while an average WPA lease sale contributed to 3 percent of oil production and 3 percent of gas production in the WPA. In 2006, leases from 15 different lease sales contributed to the installation of production structures in the Gulf of Mexico, while an average WPA lease sale contributed to 6 percent of the installation of production structures in the WPA. In 2006, leases from 70 different lease sales contributed to wells drilled in the Gulf of Mexico, while an average WPA lease sale contributed to 6 percent of the wells drilled in the WPA.

As in the past, a proposed WPA lease sale would contribute to maintaining the present level of OCS oil- and gas-related activity in the Gulf of Mexico. Exploration and development activity, including service-vessel trips, helicopter trips, and construction, that would result from a proposed WPA lease sale would replace activity resulting from existing leases that have reached, or are near the end of, their economic life.

In the short term, however, it is important to note that activities under previous lease sales would continue in the Gulf of Mexico, including exploration, development, production, and decommissioning activities. As a decision on a proposed WPA lease sale will not affect those preexisting leases and activities related to them, there may still be environmental impacts occurring in the Gulf in the short term, even if a proposed WPA lease sale is cancelled.

Environmental Impacts

If a proposed WPA lease sale would be cancelled, the resulting development of oil and gas would most likely be postponed to a future lease sale; therefore, the overall level of OCS activity in the WPA would only be reduced by a small percentage, if any. Therefore, the cancellation of a proposed WPA lease sale would not significantly change the environmental impacts of overall OCS oil- and gas-related activity in the long term. The environmental impacts expected to result from a WPA proposed action, which are described above, would not occur in the short term, but they would likely be postponed to any future lease sale decision.

Economic Impacts

Although environmental impacts may be reduced or postponed by cancelling a proposed WPA lease sale, the economic impacts of cancelling a scheduled lease sale should be given consideration. **Chapter 4.1.1.20.3** of this Supplemental EIS, Chapter 4.1.1.20.3.2 of the 2012-2017 WPA/CPA Multisale EIS, and Chapter 4.1.1.20.3 of the WPA 233/CPA 231 Supplemental EIS and WPA 238/246/248 Supplemental EIS discuss the potential economic impacts of a WPA proposed action. In the event that a proposed WPA lease sale is cancelled or postponed, there may be impacts to employment along the Gulf Coast, but these impacts are not expected to be significant (e.g., less than 1% of total employment) or long term given the existing OCS infrastructure.

Federal, State, and local governments would have to forgo the revenue that would have been received from a proposed WPA lease sale. There could be minor impacts on global energy prices from cancelling a proposed WPA lease sale, along with minor changes in energy consumption patterns that would result from these price changes.

Other factors may minimize or exacerbate the economic impacts of cancelling a proposed WPA lease sale. For example, the longer-term economic impacts of cancelling a proposed WPA lease sale could be minimized if they were offset by a larger lease sale at a later date. The economic impacts may be exacerbated if additional lease sales are cancelled. The OCS oil and gas industry is dependent on high capital investment costs and there may be long lags between the lease sale and the majority of production activities. Therefore, firms' investment and spending decisions are dependent on their confidence that the OCS Program will be maintained in the future. In addition, while firms in the OCS oil and gas industry are generally likely to be able to weather the cancellation of a single lease sale, the cancellation of multiple lease sales could lead to broader damage to firms and workers in the industry or to decisions to operate in areas other than the Gulf. These economic impacts would be particularly damaging to the coastal counties/parishes in Texas and Louisiana for which the OCS industry as a whole is an important component of their economies.

Summary and Conclusion

Cancelling a proposed WPA lease sale may eliminate the effects described for Alternatives A and B (**Chapter 4.1.1**); however, any single lease sale accounts for only a small percentage of the total OCS oil- and gas-related activities. If a proposed WPA lease sale would be cancelled, the resulting development of oil and gas would most likely be postponed to a future lease sale; therefore, the overall level of OCS oil- and gas-related activity in the WPA would only be reduced by a small percentage, if any. Therefore, the cancellation of a proposed WPA lease sale would not significantly change the environmental impacts of overall OCS oil- and gas-related activity in the long term.

Federal, State, and local governments would have to forgo the revenue that would have been received from a proposed WPA lease sale. There could be minor impacts on global energy prices from cancelling a proposed WPA lease sale, along with minor changes in energy consumption patterns that would result from these price changes. Other factors may minimize or exacerbate the economic impacts of cancelling a proposed WPA lease sale.

4.2. UNAVOIDABLE ADVERSE IMPACTS OF THE PROPOSED ACTIONS

Unavoidable adverse impacts associated with a WPA proposed action are expected to be primarily short term and localized in nature and are summarized below. Adverse impacts from low-probability catastrophic events, which are not part of the proposed action and not likely expected, could be of longer duration and extend beyond the local area. All OCS oil- and gas-related activities involve temporary and exclusive use of relatively small areas of the OCS over the lifetimes of specific projects. Lifetimes for these activities can be days, as in the case of seismic surveys; or decades, as in the case of a production structure or platform. No activities in the OCS Program involve the permanent or temporary use or "taking" of large areas of the OCS on a semicontinuous basis. Cumulatively, however, a multitude of individual projects results in a major use of OCS space.

Air Quality: Unavoidable short-term impacts on air quality could occur after large oil spills and blowouts because of evaporation and volatilization of the lighter components of crude oil, combustion from surface burning, and aerial spraying of dispersant chemicals. Mitigation of long-term effects from offshore engine combustion during routine operations would be accomplished through existing regulations and the development of new control emission technology. Short-term effects from spill events are uncontrollable and are likely to be aggravated or mitigated by the time of year the spills take place.

Water Quality: Routine offshore operations would cause some unavoidable adverse impacts to varying degrees on the quality of the surrounding water. Drilling, construction, overboard discharges of drilling mud and cuttings, and pipelaying activities would cause an increase in the turbidity of the affected waters for the duration of the activity periods. This, however, would only affect water in the immediate vicinity of the construction activity or in the vicinity of offshore structures, rigs, and platforms. Accidental spills from platforms and the discharge of produced waters could result in increases of hydrocarbon levels and trace metal concentrations in the water column in the vicinity of the platforms. Spilled oil from a tanker collision would affect the water surface in combination with dispersant chemicals used during spill response. A subsurface blowout would subject the surface, water column, and near-bottom environment to spilled oil and gas released from solution, dispersant chemicals, or emulsions of dispersed oil droplets and dispersant chemicals.

Unavoidable impacts to onshore water quality would occur as a result of chronic point- and nonpoint-source discharges such as runoff and effluent discharges from existing onshore infrastructure used in support of lease sale activities. Vessel traffic contributes to the degradation of water quality by chronic low-quantity oil leakage, treated sanitary and domestic waste, bilge water, and contaminants known to exist in ship paints. Regulatory requirements of the State and Federal water authorities and some local jurisdictions would be applicable to point-source discharges from support facilities such as refineries and marine terminals.

Sensitive Coastal Habitats: If an oil spill contacts beaches or barrier islands, the removal of beach sand during cleanup activities could result in adverse impacts if the sand is not replaced, and a beach could experience several years of small surface residue balls (also called tarballs) washing ashore over time, causing an aesthetic impact. Sand borrowing on the OCS for coastal restorations involves the taking of a quantity of sand from the OCS and depositing it onshore, essentially moving small products of the deltaic system to another location. If sand is left where it is, it would eventually be lost to the deltaic system by redeposition or burial by younger sediments; if transported onshore, it would be lost to burial and submergence caused by subsidence and sea-level rise.

If an oil spill contacts coastal wetlands, adverse impacts could be high in localized areas. In more heavily oiled areas, wetland vegetation could experience suppressed productivity for several years; in more lightly oiled areas, wetland vegetation could experience die-back for one season. Epibionts on wetland vegetation and grasses in the tidal zone could be killed, and the productivity of tidal marshes for the vertebrates and invertebrates that use them to spawn and develop could be impaired. Much of the wetland vegetation would recover over time, but some wetland areas could be converted to open water. Some unavoidable impacts could occur during pipeline and other related coastal construction, but regulations are in place to avoid and minimize these impacts to the maximum extent practicable. Unavoidable impacts resulting from dredging, wake erosion, and other secondary impacts related to channel use and maintenance would occur as a result of a WPA proposed action.

Sensitive Coastal and Offshore Biological Habitats: Unavoidable adverse impacts would take place if an oil spill occurred and contacted sensitive coastal and offshore biological habitats, such as *Sargassum* at the surface; fish, turtles, and marine mammals in the water column; or benthic habitats on the bottom. There could be some adverse impacts on organisms contacted by oil, dispersant chemicals, or emulsions of dispersed oil droplets and dispersant chemicals that, at this time, are not completely understood, particularly in subsurface environments.

Threatened and Endangered Species: Because the proposed WPA lease sales do not in and of themselves make any irreversible or irretrievable commitment of resources that would foreclose the development or implementation of any reasonable and prudent measures to comply with the Endangered Species Act, BOEM may proceed with publication of this Supplemental EIS and finalize a decision among these alternatives even if consultation is not complete, as described in Section 7(d) of the ESA (also refer to **Chapter 5.7**). Irreversible loss of individuals that are ESA-listed species may occur after a large oil spill from the acute impact of being oiled or the chronic impact of oil having eliminated, reduced, or rendered suboptimal the food species upon which they were dependent.

Nonendangered and Nonthreatened Marine Mammals: Unavoidable adverse impacts to nonendangered and nonthreatened marine mammals would be those that also affect endangered and threatened marine mammal species. Routine operation impacts (such as seismic surveys, water quality and habitat degradation, helicopter disturbance, vessel collision, and discarded trash and debris) would be negligible or minor to a population, but they could be lethal to individuals as in the case of a vessel collision. A large oil spill would temporarily degrade habitat if spilled oil, dispersant chemicals, or emulsions of dispersed oil droplets and dispersant chemicals contact free-ranging pods or spawning grounds.

Coastal and Marine Birds: Unavoidable adverse impacts from routine operations on coastal birds could result from helicopter and OCS service-vessel traffic, facility lighting, and floating trash and debris. Marine birds could be affected by noise, platform lighting, aircraft disturbances, and trash and debris associated with offshore activities. Cross-Gulf migrating species could be affected by lighted platforms, helicopter and vessel traffic, and floating trash and debris. If a large oil spill occurs and contacts coastal or marine bird habitats, some birds could experience lethal and sublethal impacts from oiling, and birds feeding or resting in the water could be oiled and die. Coastal birds coming into contact with oil may migrate more deeply into marsh habitats, out of reach from spill responders seeking to count them or collect them for rehabilitation. Oil spills and oil-spill cleanup activities could also affect the food species for coastal, marine, and migratory bird species. Depending on the time of year, large oil spills could decrease the nesting success of species that concentrate nests in coastal environments due to direct effects of the spill and also disruption from oil-spill cleanup activities.

Fish Resources, Essential Fish Habitat, Commercial Fisheries, and Recreational Fishing: Unavoidable adverse impacts from routine operations are loss of open ocean or bottom areas desired for fishing by the presence or construction of OCS oil- and gas-related facilities and pipelines. Loss of gear could occur from bottom obstructions around platforms and subsea production systems. Routine discharges from vessels and platforms are minor given the available area for fish habitat. If a large oil spill occurs, the oil, dispersant chemicals, or emulsions of oil droplets and dispersant chemicals could temporarily displace mobile fish species on a population or local scale. There could also be impacts on prey and sublethal effects on fish. It is unlikely that fishermen would want, or be permitted, to harvest fish in the area of an oil spill, as spilled oil could coat or contaminate commercial fish species, rendering them unmarketable.

Recreational Beaches: Unavoidable adverse impacts from routine operations may result in the accidental loss overboard of some floatable debris that may eventually come ashore on frequented recreational beaches. A large oil spill could make landfall on recreational beaches, leading to local or regional economic losses and stigma effects, causing potential users to avoid the area after acute impacts have been removed. Some recreational beaches become temporarily soiled by weathered crude oil, and small surface residue balls (also called tarballs) may come ashore long after stranded oil has been cleaned from shoreline areas. Impacts on recreational beaches from a large oil spill may, at the time, seem irreversible, but the impacts are generally temporary. Beaches fouled by a large oil spill would be temporarily unavailable to the people who would otherwise frequent them, but only during the period between landfall and cleanup of the oil, followed by an indefinite lag period during which stigma effects recede from public consciousness.

Archaeological Resources: Unavoidable adverse impacts from routine operations could lead to the loss of unique or significant archaeological information if unrecognized at the time an area is disturbed. Required archaeological surveys significantly reduce the potential for this loss by identifying potential archaeological sites prior to an interaction occurring, thereby making avoidance or mitigation of impacts possible. A large oil spill could make landfall on or near protected archaeological landmarks to cause temporary aesthetic or cosmetic impacts until the oil is cleaned or degrades.

Economic Activity: Net economic, political, and social benefits to the U.S. accrue from the production of hydrocarbon resources. Once these benefits become routine, unavoidable adverse impacts from routine operations follow trends in supply and demand based on the commodity prices for oil, gas, and refined hydrocarbon products. Declines in oil and gas prices can lead to activity ramp downs by operators until prices rise. A large oil spill would cause temporary increases in economic activity associated with spill-response activity. An increase in economic activity from the response to a large spill could be offset by temporary work stoppages that are associated with spill-cause investigations and would involve a transfer or displacement of demand to different skill sets. Routine operations affected by new regulations that are incremental would not have much effect on the baseline of economic activity; however, temporary work stoppages or the introduction of several new requirements at one time, which are costly to implement, could cause a drop-off of activity as operators adjust to new expectations or use the opportunity to move resources to other basins where they have interests.

4.3. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible or irretrievable commitment of resources refers to impacts or losses to resources that cannot be reversed or recovered. Examples are when a species becomes extinct or when wetlands are permanently converted to open water. In either case, the loss is permanent.

Wetlands: An irreversible or irretrievable loss of wetlands and associated biological resources could occur if wetlands are permanently lost because of impacts caused by dredging and construction activities that displace existing wetlands or from oil spills severe enough to cause permanent die-back of vegetation and conversion to open water. Construction and emplacement of onshore pipelines in coastal wetlands displace coastal wetlands in disturbed areas that are then subject to indirect impacts like saltwater intrusion or erosion of the marsh soils along navigation channels and canals. Ongoing natural and anthropogenic processes in the coastal zone, only one of which is OCS oil- and gas-related activity, can result in direct and indirect loss of wetlands. Natural losses as a consequence of the coastal area becoming hydrologically isolated from the Mississippi River that built it, sea-level rise, and subsidence of the delta platform in the absence of new sediment added to the delta plain appear to be much more dominant processes impacting coastal wetlands.

Sensitive Nearshore and Offshore Biological Resources: An irreversible loss or degradation of ecological habitat caused by cumulative activity tends to be incremental over the short term. Irretrievable loss may not occur unless or until a critical threshold is reached. It can be difficult or impossible to identify when that threshold is, or would be, reached. Oil spills and chronic low-level pollution can injure and kill organisms at virtually all trophic levels. Mortality of individual organisms can be expected to occur, and possibly a reduction or even elimination of a few small or isolated populations. The proposed biological stipulations, however, are expected to eliminate most of these risks.

Threatened and Endangered Species: Irreversible loss of individuals that are protected species may occur after a large oil spill from the acute impact of being oiled or the chronic impact of oil having eliminated, reduced, or rendered suboptimal the food species upon which they were dependent.

Fish Resources and Commercial Fisheries: Irreversible loss of fish and coral resources, including commercial and recreational species, are caused by structure removal using explosives. Fish in proximity to an underwater explosion can be killed. Without the structure to serve as habitat area, sessile, attached invertebrates and the fish that live among them are absent. Removing structures eliminates these special and local habitats and the organisms living there, including such valuable species as red snapper. Continued structure removal, regardless of the technique used, would reduce the net benefits to commercial fishing due to the presence of these structures.

Archaeological Resources: Irreversible loss of a prehistoric or historic archaeological resource can occur if bottom-disturbing activity takes place without the surveys, where required, to demonstrate its absence before work proceeds. A resource can be completely destroyed, severely damaged, or the scientific context badly impaired by well drilling, subsea completions, and platform and pipeline installation, or sand borrowing.

Oil and Gas Development: Leasing and subsequent development and extraction of hydrocarbons as a result of a WPA proposed action represents an irreversible and irretrievable commitment by the removal and consumption of nonrenewable oil and gas resources. The estimated amount of resources to be recovered as a result of a WPA proposed action is presented in **Table 3-1**.

Loss of Human and Animal Life: The OCS oil and gas exploration, development, production, and transportation are carried out under comprehensive, state-of-the-art, enforced regulatory procedures designed to ensure public and work place safety and environmental protection. Nevertheless, some loss of human and animal life may be inevitable from unpredictable and unexpected acts of man and nature (i.e., unavoidable accidents, accidents caused by human negligence or misinterpretation, human error, willful noncompliance, and adverse weather conditions). Some normal and required operations, such as structure removal, can kill sea life in proximity to explosive charges or by removal of the structure that served as the framework for invertebrates living on it and the fish that lived with it.

4.4. Relationship between the Short-term Use of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

The short-term effects on various components of the environment in the vicinity of a WPA proposed action are related to long-term effects and the maintenance and enhancement of long-term productivity.

Short-Term Use

Short-term refers to the total duration of oil and gas exploration and production activities. Extraction and consumption of offshore oil and natural gas is a short-term benefit. Discovering and producing domestic oil and gas now reduces the Nation's dependency on foreign imports. Depleting a nonrenewable resource now removes these domestic resources from being available for future use. The production of offshore oil and natural gas as a result of a WPA proposed action would provide short-term energy, and as it delays the increase in the Nation's dependency on foreign imports, it can also allow additional time for ramp-up and development of long-term renewable energy sources or substitutes for nonrenewable oil and gas. Economic, political, and social benefits would accrue from the availability of these natural resources.

The principle short-term use of the leased areas in the Gulf of Mexico would be for the production of 0.116-0.200 BBO and 0.538-0.938 Tcf of gas from a typical WPA proposed action. The cumulative impacts scenario in this Supplemental EIS extends approximately from 2012 to 2051. The 40-year time period is used because it is the approximate longest life span of activities conducted on an individual lease. The 40 years following a proposed WPA lease sale is the period of time during which the activities and impacting factors that follow as a consequence of a proposed WPA lease sale would be influencing the environment.

The specific impacts of a WPA proposed action vary in kind, intensity, and duration according to the activities occurring at any given time (**Chapter 3**). Initial activities, such as seismic surveying and exploration drilling, result in short-term, localized impacts. Development drilling and well workovers occur sporadically throughout the life of a WPA proposed action but also result in short-term, localized impacts. Activities during the production life of a platform may result in chronic impacts over a longer period of time (over 25 years), potentially punctuated by more severe impacts as a result of accidental events or a spill. Platform removal is also a short-term activity with localized impacts, including removal of the habitat for encrusting invertebrates and fish living among them. Many of the effects on physical, biological, and socioeconomic resources discussed in **Chapter 4.1.1** are considered to be short term (being greatest during the construction, exploration, and early production phases). These impacts would be further reduced by the mitigating measures discussed in **Chapter 2.2.2**.

The OCS development off Texas and Louisiana has enhanced recreational and commercial fishing activities, which in turn has stimulated the manufacture and sale of larger private fishing vessels and specialized recreational fishing equipment. Commercial enterprises such as charter boats have become heavily dependent on offshore structures for satisfying recreational customers. A WPA proposed action could increase these incidental benefits of offshore development. Offshore fishing and diving has gradually increased in the past three decades, with offshore structures and platforms becoming the focus of much of that activity. As mineral resources become depleted, platform removals would occur and may result in a decline in these activities.

The short-term exploitation of hydrocarbons for the OCS Program in the Gulf of Mexico may lead to long-term impacts on biologically sensitive coastal and offshore resources and areas if a large oil spill occurs. A spill and spill-response activity could temporarily interfere with commercial and recreational fishing, beach use, and tourism in the area where the spill makes landfall and in a wider area based on stigma effects. The proposed leasing may also result in onshore development and population increases that could cause very short-term adverse impacts to local community infrastructure, particularly in areas of low population and minimal existing industrial infrastructure (Chapter 4.1.1.20.1 of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS).

Relationship to Long-Term Productivity

Long-term refers to an indefinite period beyond the termination of oil and gas production. Over a period of time after peak oil production has occurred in the Gulf of Mexico, a gradual easing of the specific impacts caused by oil and gas exploration and production would occur as the productive reservoirs in the Gulf have been discovered and produced, and have become depleted. The Oil Drum (2009) showed a graphic demonstrating that peak oil production in the Gulf occurred in June 2002 at 1.73 MMbbl/day. Whether or not this date is correct can only be known in hindsight and only after a period of years while production continues. At this time, however, the trend is fairly convincing (The Oil Drum, 2009). There is disagreement on what future production trends may be in the Gulf of Mexico after several operators, British Petroleum among them, announced discoveries over the last 5 years (*Oil and Gas Journal*, 2009) in the Lower Tertiary in ultra-deepwater (>5,000 ft; 1,524 m) with large projected reserves. These claims are as yet unproven and there are questions as to the difficulties that may be encountered producing these prospects because of their geologic age; burial depth and high-temperature, high-pressure in-situ conditions; lateral continuity of reservoirs; and the challenges of producing from ultra-deepwater water depths.

The Gulf of Mexico's large marine ecosystem is considered a Class II, moderately productive ecosystem (mean phytoplankton primary production 150-300 gChlorophyll a/m^2-yr [The Encyclopedia of

Earth, 2008]) based on Sea-viewing Wide Field-of-view Sensor (SeaWiFS) global primary productivity estimates (USDOC, NASA, 2003). After the completion of oil and gas production, a gradual ramp-down to economic conditions without OCS oil- and gas-related activity would be experienced, while the marine environment is generally expected to remain at or return to its normal long-term productivity levels that, in recent years, has been described as stressed (The Encyclopedia of Earth, 2008). The Gulf of Mexico's large marine ecosystem shows signs of ecosystem stress in bays, estuaries, and coastal regions (Birkett and Rapport, 1999). There is shoreline alteration, pollutant discharge, oil and gas development, and nutrient loading. The overall condition for the U.S. section of this large marine ecosystem, according to USEPA's seven primary indicators (Jackson et al., 2000), is good dissolved oxygen, fair water quality, poor coastal wetlands, poor eutrophic condition, and poor sediment, benthos, and fish tissue (The Encyclopedia of Earth, 2008).

To help sustain the long-term productivity of the Gulf of Mexico ecosystem, the OCS Program provides structures to be used as site-specific artificial reefs and fish-attracting devices for the benefit of commercial and recreational fishermen and for sport divers and spear fishers. Approximately 10 percent of the oil and gas structures removed from the OCS are eventually used for State artificial reef programs. Additionally, the OCS Program continues to improve the knowledge and mitigation practices used in offshore development to enhance the safe and environmentally responsible development of OCS oil and gas resources.

CHAPTER 5

CONSULTATION AND COORDINATION

5. CONSULTATION AND COORDINATION

5.1. DEVELOPMENT OF THE PROPOSED ACTIONS

This Supplemental EIS addresses two proposed Federal OCS oil and gas lease sales, i.e., Lease Sales 246 and 248 in the WPA of the Gulf of Mexico OCS, as scheduled in the Five-Year Program (USDOI, BOEM, 2012a). BOEM conducted early coordination with appropriate Federal and State agencies and other concerned parties to discuss and coordinate the prelease process for the proposed WPA lease sales and this Supplemental EIS. Key agencies and organizations included the National Oceanic and Atmospheric Administration, NOAA's National Marine Fisheries Service, FWS, U.S. Coast Guard, U.S. Department of Defense, USEPA, State governors' offices, federally recognized Indian Tribes, industry, and nongovernmental organizations.

5.2. CALL FOR INFORMATION AND NOTICE OF INTENT TO PREPARE A SUPPLEMENTAL EIS

On July 9, 2012, the Call for Information (Call) for proposed WPA Lease Sales 233, 238, 246, and 248 was published in the *Federal Register* (2012b). The comment period closed on August 8, 2012. BOEM received two comment letters in response to the Call. These comments are summarized below in **Chapter 5.3.1**.

On April 4, 2014, the Notice of Intent to Prepare a Supplemental EIS (NOI) for the proposed WPA lease sales was published in the *Federal Register* (2014b). Additional public notices were distributed via the U.S. Postal Service, local newspapers, and the Internet. A 30-day comment period was provided; it closed on May 5, 2014. Federal, State, and local governments, federally recognized Indian Tribes, nongovernmental organizations, and other interested parties were invited to send written comments to the Gulf of Mexico OCS Region on the scope of the Supplemental EIS. BOEM received five comment letters in response to the NOI. These comments are summarized below in **Chapter 5.3.2**.

5.3. DEVELOPMENT OF THE DRAFT SUPPLEMENTAL EIS

Scoping for the Draft Supplemental EIS was conducted in accordance with CEQ regulations for implementing NEPA. Scoping provides those with an interest in the OCS Program an opportunity to provide comments on the proposed actions. In addition, scoping provides BOEM an opportunity to update the Gulf of Mexico OCS Region's environmental and socioeconomic information base. Public scoping meetings were held in Texas and Louisiana on the following dates and at the times and locations indicated below:

Tuesday, April 22, 2014
1:00 p.m. CDT
Springhill Suites – Corpus Christi
4331 South Padre Island Drive
Corpus Christi, Texas 78411
0 registered attendees
0 speakers
0 verbal comments received
0 written comments received

Thursday, April 24, 2014
1:00 p.m. CDT
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123
1 registered attendee
0 speakers
0 verbal comments received
0 written comments received

5.3.1. Summary of Comments Received in Response to the Call for Information

In response to the Call, BOEM received two comment letters: one letter from the Louisiana Department of Natural Resources and one letter from the American Petroleum Institute. The Louisiana Department of Natural Resources hopes that BOEM will be more attentive to the State of Louisiana's comments during the prelease planning phase, believes that a better appraisal of coastal effects is necessary, and believes that BOEM must more efficiently revisit reviews of earlier OCS lease sales to determine whether the models and predictive techniques used were accurate. The American Petroleum Institute states that annual, predictable lease sales in these planning areas are needed to help ensure continued offshore exploration and production in the future because production from lease sales will take many years to develop. The American Petroleum Institute further encourages BOEM to pursue legislation that will allow the entry into force of the "Agreement between the United States of America and the United Mexican States Concerning Transboundary Hydrocarbon Reservoirs in the Gulf of Mexico" (Agreement). This Agreement, which was signed after issuance of the Call and entered into force on July 18, 2014, governs the development of reservoirs of petroleum and natural gas straddling the U.S.-Mexico maritime and continental shelf boundary in the Gulf of Mexico.

5.3.2. Summary of Scoping Comments

Five comments were received in response to the NOI from Federal agencies, interest groups, industry, and the general public on the scope of the Supplemental EIS, significant issues that should be addressed, alternatives that should be considered, and mitigating measures. All scoping comments received, which were appropriate for a lease sale NEPA document, were considered in the preparation of the Draft Supplemental EIS. Comments received included the following:

- the Jena Band of Choctaw Indians requested to have Section 106 Consultation once the Draft Supplemental EIS is published;
- support for the 2012-2017 Five-Year Program and its unaltered implementation for proposed WPA Lease Sales 246 and 248 as a means to reduce oil imports, increase energy independence, and reduce environmental risks of transoceanic oil tankering;
- support for the more thorough documentation of methods and sources as seen in recent Supplemental EISs; request that BOEM revisit specific predictions made for earlier lease sales and collect data to evaluate the accuracy of models and predictive techniques; request that BOEM be more proactive in its approach to help conserve Louisiana's coastal wetlands through its assessment of impacts, particularly direct, indirect, and cumulative impacts; and support for the expansion of exploration and development of Gulf energy resources;
- BOEM must focus EIS analyses on currently available, new information, and should not speculate on future results from ongoing studies; BOEM should also take into consideration the new safety and regulatory improvements since the Deepwater Horizon explosion, oil spill, and response as a part of the new information analyzed; suggest that this Supplemental EIS be designed specifically for use as a tiering document for future environmental reviews; and data from the best-available, peer-reviewed scientific literature should be the basis of environmental analyses, and not speculation; and
- opposition to drilling until all studies of the effects of the British Petroleum oil spill are fully addressed and understood.

5.3.3. Additional Scoping Opportunities

Although the scoping process is formally initiated by the publication of the NOI and Call, scoping efforts and other coordination meetings continued throughout this NEPA process. The Gulf of Mexico OCS Region's Information Transfer Meetings provide an opportunity for BOEM's analysts to attend technical presentations related to OCS Program activities and to meet with representatives from Federal, State, and local agencies, industry, BOEM contractors, and academia. Scoping and coordination opportunities were also available during BOEM's requests for information, comments, input, and review of its other NEPA documents, including the following:

- scoping for and draft review of the Five-Year Program EIS;
- scoping for and draft review of the 2012-2017 WPA/CPA Multisale EIS;
- scoping for and draft review of the WPA 233/CPA 231 Supplemental EIS; and
- scoping for and draft review of the WPA 238/246/248 Supplemental EIS.

5.3.4. Cooperating Agency

According to Part 516 of the DOI Departmental Manual, BOEM must invite eligible government entities to participate as cooperating agencies when developing an EIS in accordance with the requirements of NEPA and CEQ regulations. BOEM must also consider any requests by eligible government entities to participate as a cooperating agency with respect to a particular EIS, and then to either accept or deny such requests.

The NOI, which was published on April 4, 2014, included an invitation to other Federal and State agencies, federally recognized Indian Tribes, and local governments to consider becoming cooperating agencies in the preparation of this Supplemental EIS. No Federal, State, or local government agencies or federally recognized Indian Tribes requested to participate as a cooperating agency.

5.4. Distribution of the Draft Supplemental EIS for Review and Comment

BOEM will send copies of the Draft Supplemental EIS to the government, public, and private agencies and groups listed below. Local libraries along the Gulf Coast will be provided copies of this document; a list of these libraries is available on BOEM's website at http://www.boem.gov/nepaprocess/.

Federal Agencies

Congress
- Congressional Budget Office
- House Resources Subcommittee on Energy and Mineral Resources
- Senate Committee on Energy and Natural Resources

Department of Commerce
- National Oceanic and Atmospheric Administration
  - National Marine Fisheries Service

Department of Defense
- Department of the Air Force
- Department of the Army
  - Corps of Engineers
- Department of the Navy
  - Naval Mine and Anti-Submarine Warfare Command

Department of Energy
- Strategic Petroleum Reserve PMD

Department of Homeland Security
- U.S. Coast Guard

Department of State
- Bureau of Oceans and International Environmental and Scientific Affairs

Department of the Interior
- Bureau of Ocean Energy Management
- Fish and Wildlife Service
- Geological Survey
- National Park Service
- Office of Environmental Policy and Compliance
- Office of the Solicitor

Department of Transportation
- Pipeline and Hazardous Materials Safety Administration
  - Office of Pipeline Safety

Environmental Protection Agency
- Region 4
- Region 6

Marine Mammal Commission

State and Local Agencies

Louisiana
- Governor's Office
- City of Grand Isle
- City of Morgan City
- City of New Orleans
- Department of Culture, Recreation, and Tourism
- Department of Environmental Quality
- Department of Natural Resources
- Department of Transportation and Development
- Department of Wildlife and Fisheries
- Houma-Terrebonne Chamber of Commerce
- Jefferson Parish Director

Jefferson Parish President
Lafourche Parish CZM
Lafourche Parish Water District #1
Louisiana Geological Survey
South Lafourche Levee District
St. Bernard Planning Commission
State House of Representatives, Natural Resources Committee
State Legislature, Natural Resources Committee

Texas
Governor's Office
Aransas Pass Public Library
Attorney General of Texas
Chambers County Library System
City of Lake Jackson
General Land Office
Southeast Texas Regional Planning Commission
State Legislature Natural Resources Committee
State Senate Natural Resources Committee
Texas Historical Commission
Texas Legislation Council
Texas Parks and Wildlife Department
Texas Sea Grant
Texas State Library and Archives
Texas Water Development Board

Federally Recognized Indian Tribes

Alabama-Coushatta Tribe of Texas
Caddo Nation
Chitimacha Tribe of Louisiana
Choctaw Nation of Oklahoma
Coushatta Tribe of Louisiana
Jena Band of Choctaw Indians
Miccosukee Tribe of Indians of Florida
Mississippi Band of Choctaw Indians
Poarch Band of Creek Indians
Seminole Tribe of Florida
Seminole Nation of Oklahoma
Tunica-Biloxi Indian Tribe of Louisiana

Industry

American Petroleum Institute
Area Energy LLC
Baker Atlas
Chevron U.S.A. Inc.
Coastal Conservation Association
Coastal Environments, Inc.
Continental Shelf Associates, Inc.
Ecology and Environment
Energy Partners, Ltd.
EOG Resources, Inc.
Exxon Mobil Production Company
Freeport-McMoRan, Inc.
Gulf of Mexico Newsletter
Horizon Marine, Inc.
Industrial Vehicles International, Inc.
J. Connor Consultants
John Chance Land Surveys, Inc.
Marine Safety Office
Newfield Exploration Company
Seneca Resources Corporation
Shell Exploration & Production Company
Stone Energy Corporation
Strategic Management Services-USA
T. Baker Smith, Inc.
Texas Geophysical Company, Inc.
The Washington Post
W & T Offshore, Inc.
WEAR-TV

Special Interest Groups

American Cetacean Society
Audubon Louisiana Nature Center
Capital Region Planning Commission
Center for Marine Conservation
Clean Gulf Associates
Coalition to Restore Coastal Louisiana
Coastal Conservation Association
Concerned Shrimpers of America
Earthjustice
Gulf and South Atlantic Fisheries Foundation, Inc.
Gulf Restoration Network
Houma-Terrebonne Chamber of Commerce
LA 1 Coalition, Inc.
Louisiana Wildlife Federation
Marine Mammal Commission
Natural Resources Defense Council
Nature Conservancy
Offshore Operators Committee
Restore or Retreat
Roffers Ocean Fishing Forecast Service

Ports/Docks

Louisiana
Abbeville Harbor and Terminal District
Grand Isle Port Commission
Greater Baton Rouge Port Commission
Greater Lafourche Port Commission

Lake Charles Harbor and Terminal District
Plaquemines Port, Harbor and Terminal District
Port of Baton Rouge
Port of Iberia District
Port of New Orleans
Twin Parish Port Commission
St. Bernard Port, Harbor and Terminal District
West Cameron Port Commission

Texas
Brownsville Navigation District—Port of Brownsville
Port Freeport
Port Mansfield/Willacy County Navigation District
Port of Beaumont
Port of Corpus Christi Authority
Port of Galveston
Port of Houston Authority
Port of Isabel—San Benito Navigation District
Port of Port Arthur Navigation District

Educational Institutions/Research Laboratories

Abilene Christian University
Louisiana Sea Grant College Program
Louisiana State University
Louisiana Tech University
Louisiana Universities Marine Consortium
Loyola University
McNeese State University
Nicholls State University
Tulane University
University of New Orleans
University of Texas at Arlington
University of Texas at Austin
University of Texas Law School
University of Texas Libraries

5.5. PUBLIC MEETINGS

In accordance with 30 CFR § 556.26, BOEM scheduled public meetings soliciting comments on the Draft Supplemental EIS. The meetings were conducted to solicit information from interested parties in order to provide the Secretary of the Interior with information to help in the evaluation of the potential effects of a proposed WPA lease sale. An announcement of the dates, times, and locations of the public meetings was included in the Notice of Availability of the Draft Supplemental EIS. A copy of the public meeting notices was included with the Draft Supplemental EIS that was mailed to the parties indicated above, was published in local newspapers, and was posted on BOEM's website at http://www.boem.gov/nepaprocess/.

The public meetings were held on the following dates and at the times and locations indicated below:

Tuesday, October 21, 2014
1:00 p.m. CDT
Houston Airport Marriott at George Bush Intercontinental
18700 John F. Kennedy Boulevard
Houston, Texas 77032
1 registered attendee
0 speakers
0 verbal comments received
0 written comments received

Thursday, October 23, 2014
1:00 p.m. CDT
Bureau of Ocean Energy Management
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123
0 registered attendees
0 speakers
0 verbal comments received
0 written comments received

Houston, Texas, October 21, 2014

One person attended the meeting at the public meeting held in Houston, Texas, on October 21, 2014. However, the individual did not speak or submit written or oral comments to the record.

New Orleans, Louisiana, October 23, 2014

There were no attendees at the public meeting held in New Orleans, Louisiana, on October 23, 2014.

5.6. COASTAL ZONE MANAGEMENT ACT

If a Federal agency's activities or development projects within or outside of the coastal zone will have reasonably foreseeable coastal effects in the coastal zone, then the activity is subject to a Federal Consistency Determination (CD). A consistency review will be performed pursuant to the Coastal Zone Management Act (CZMA) and CDs will be prepared for each CZMA State prior to each of the proposed WPA lease sales. To prepare the CDs, BOEM reviews each CZMA State's Coastal Management Plan and analyzes the potential impacts as outlined in this Supplemental EIS, new information, and applicable studies as they pertain to the enforceable policies of each CMP. The CZMA 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).

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 of Louisiana and Texas for proposed WPA lease sales. If a State concurs, BOEM can proceed with the proposed lease sale. A State's concurrence may be presumed when a State does not provide a response within the 60-day review period. A State may request an extension of time to review the CD within the 60-day period, which the Federal agency shall approve for an extension of 15 days or less. If a State objects, it must do the following under the CZMA: (1) indicate how BOEM's prelease proposal is inconsistent with their CMP and suggest alternative measures to bring BOEM's proposal into consistency with their CMP; or (2) describe the need for additional information that would allow a determination of consistency. In the event of an objection, the Federal and State agencies should use the remaining portion of the 90-day review period to attempt to resolve their differences (15 CFR § 930.43(b)). At the end of the 90-day review period, the Federal agency shall not proceed with the activity over a State agency's objection unless the Federal agency concludes that, under the "consistent to the maximum extent practicable" standard described in 15 CFR § 930.32, consistency with the enforceable policies of the CMP is prohibited by existing law applicable to the Federal agency and the Federal agency has clearly described, in writing, to the State agency the legal impediments to full consistency; or, the Federal agency has concluded that its proposed action is fully consistent with the enforceable policies of the CMP, though the State agency objects. Unlike the consistency process for specific OCS plans and permits, there is no procedure for administrative appeal to the Secretary of Commerce for a Federal CD for prelease activities. In the event that there is a serious disagreement between BOEM and a State, either agency may request mediation. Mediation is voluntary, and the Secretary of Commerce would serve as the mediator. Whether there is mediation or not, the final CD is made by DOI, and it is the final administrative action for the prelease consistency process. Each Gulf State's CMP is described in Appendix F of the 2012-2017 WPA/CPA Multisale EIS.

5.7. ENDANGERED SPECIES ACT

The Endangered Species Act of 1973 (16 U.S.C. §§ 1531 *et seq.*) establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend. BOEM and BSEE are currently in consultation with NMFS and FWS regarding the OCS oil and gas program in the Gulf of Mexico, including as it relates to a WPA proposed action. BOEM is acting as the lead agency in the ongoing consultation, with BSEE's assistance and involvement. The programmatic consultation, which was reinitiated in 2010, was expanded in scope after the reinitiation of consultation by BOEM following the *Deepwater Horizon* explosion and oil spill, and it will include both existing and future OCS oil and gas leases in the Gulf of Mexico over a 10-year period. This consultation also considers any changes in baseline environmental conditions following the *Deepwater Horizon* explosion, oil spill, and response. The programmatic consultation will also include postlease activities associated with OCS oil- and gas-related activities in the Gulf of Mexico, including G&G and decommissioning activities. While the programmatic Biological Opinion is in development, BOEM and NMFS have agreed to interim consultations on postlease approvals.

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

5.8. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Pursuant to Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, Federal agencies are required to consult with NMFS on any action that may result in adverse effects to EFH. The NMFS published the final rule implementing the EFH provisions of the Magnuson-Stevens Fisheries Conservation and Management Act (50 CFR part 600) on January 17, 2002. Certain OCS oil- and gas-related activities authorized by BOEM may result in adverse effects to EFH, and therefore, require EFH consultation.

Following the *Deepwater Horizon* explosion, oil spill, and response, NMFS requested a comprehensive review of the existing EFH consultation in a response letter dated September 24, 2010. In light of this request, Regional staff of BOEM and NMFS agreed on procedures that would incorporate a new programmatic EFH consultation into each prepared Five-Year Program EIS and that began with the 2012-2017 Five-Year Program. BOEM has an EFH Assessment (Appendix D of the 2012-2017 WPA/CPA Multisale EIS) that describes the OCS proposed activities, analyzes the effects of the proposed activities on EFH, and identifies proposed mitigating measures. The programmatic EFH consultation, which covers proposed WPA Lease Sales 246 and 248, was initiated with the distribution and review of the 2012-2017 WPA/CPA Multisale EIS and with the subsequent written communications between BOEM and NMFS. These documents formalized the conservation recommendations put forth by NMFS and by BOEM's acceptance and response to these recommendations. While the necessary components of the EFH consultation are complete (as per BOEM's June 8, 2012, response letter to NMFS), there is ongoing coordination among NMFS, BOEM, and BSEE. This coordination includes annual reports from BOEM to NMFS, meetings with Regional staff, and discussions of mitigation and relevant topics. All agencies will continue to communicate for the duration of the Five-Year Program.

5.9. NATIONAL HISTORIC PRESERVATION ACT

In accordance with the National Historic Preservation Act (54 U.S.C. § 300101 *et seq.*), Federal agencies are required to consider the effect of their undertakings on historic properties. The implementing regulations for Section 106 of the National Historical Preservation Act, issued by the Advisory Council on Historic Preservation (36 CFR part 800), specify the required review process. Because of the extensive geographic area analyzed in this Supplemental EIS and because there will be no adverse effects to historic properties as a result of a proposed WPA lease sale, BOEM will complete its Section 106 review process once BOEM has performed the necessary site-specific analysis of postlease permitted or approved activities. Additional consultations with the Advisory Council on Historic Places, State historic preservation offices, federally recognized Indian tribes, and other consulting parties may take place at that time, if appropriate. Refer to **Chapter 4.1.1.19** for more information on this review process.

As an early planning effort, BOEM initiated a request for comment on the NOI for proposed WPA Lease Sales 246 and 248 via a formal letter on April 3, 2014. That letter was addressed to each of the affected Gulf Coast States (Texas and Louisiana) and federally recognized Indian Tribes, including the Alabama-Coushatta Tribe of Texas, Caddo Nation, Chitimacha Tribe of Louisiana, Choctaw Nation of Oklahoma, Coushatta Tribe of Louisiana, Jena Band of Choctaw Indians, Miccosukee Tribe of Indians of Florida, Mississippi Band of Choctaw Indians, Poarch Band of Creek Indians, Seminole Tribe of Florida, Seminole Nation of Oklahoma, and Tunica-Biloxi Indian Tribe of Louisiana. A 30-day comment period was provided, and one Tribal response was received from the Jena Band of Choctaw Indians. Their response to the NOI, in a letter dated April 28, 2014, expressed interest in initiating Section 106 Consultations and offered to host a meeting with BOEM representatives about the project's details once the Draft Supplemental EIS was published.

A letter dated August 22, 2014, was sent to each of the above-listed affected Gulf Coast States and federally recognized Indian Tribes, along with a copy of the Draft Supplemental EIS, announcing that the 45-day comment period on the Draft Supplemental EIS would begin on September 5, 2014.

Upon the release of the Draft Supplemental EIS, the Gulf of Mexico OCS Region's Tribal Liaison contacted the Jena Band of Choctaw Indians to schedule the requested consultation meeting; however, at the time, the Tribal representative had not yet had the opportunity to review the Draft Supplemental EIS and was not prepared to meet. The Gulf of Mexico OCS Region's Tribal Liaison sent additional BOEM correspondence during the 45-day comment period but did not receive a response, and as of the publication of this Final Supplemental EIS, the Jena Band of Choctaw Indians has not indicated any further interest in consultations on this proposed action (i.e., proposed WPA Lease Sale 246).

One Tribal response was received on the Draft Supplemental EIS from the Choctaw Nation of Oklahoma, indicating that the WPA lies outside of their Tribe's area of historic interest and respectfully deferred comment to the other Tribes that had been contacted.

No further responses were received beyond the 45-day public comment period timeline for the Draft Supplemental EIS, and no additional requests for consultation were received. BOEM will continue to impose mitigating measures and monitoring and reporting requirements to ensure that historic properties are not affected by the proposed undertakings. BOEM will reinitiate the consultation process with the affected parties should such circumstances warrant further consultation.

5.10. Government-to-Government

In accordance with Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments," Federal agencies are required to establish regular and meaningful consultation and collaboration with Tribal officials in the development of Federal policies that have Tribal implications, to strengthen the United States' government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes. BOEM initiated a request for comment on the NOI for proposed WPA Lease Sales 246 and 248 via a formal letter on April 3, 2014. That letter was addressed to each of the affected Gulf Coast States (Texas and Louisiana) and federally recognized Indian Tribes, including the Alabama-Coushatta Tribe of Texas, Caddo Nation, Chitimacha Tribe of Louisiana, Choctaw Nation of Oklahoma, Coushatta Tribe of Louisiana, Jena Band of Choctaw Indians, Miccosukee Tribe of Indians of Florida, Mississippi Band of Choctaw Indians, Poarch Band of Creek Indians, Seminole Tribe of Florida, Seminole Nation of Oklahoma, and Tunica-Biloxi Indian Tribe of Louisiana. A 30-day comment period was provided. One Tribal response was received in a letter dated April 28, 2014, from the Jena Band of Choctaw Indians, requesting a Section 106 Consultation once the Draft Supplemental EIS was published.

A letter dated August 22, 2014, was sent to each of the above-listed affected Gulf Coast States and federally recognized Indian Tribes, along with a copy of the Draft Supplemental EIS, announcing that the 45-day comment period on the Draft Supplemental EIS would begin on September 5, 2014.

Upon the release of the Draft Supplemental EIS, the Gulf of Mexico OCS Region's Tribal Liaison contacted the Jena Band of Choctaw Indians to schedule the requested consultation meeting; however, at the time, the Tribal representative had not yet had the opportunity to review the Draft Supplemental EIS and was not prepared to meet. The Gulf of Mexico OCS Region's Tribal Liaison sent additional BOEM correspondence during the 45-day comment period but did not receive a response, and as of the publication of this Final Supplemental EIS, the Jena Band of Choctaw Indians has not indicated any further interest in consultations on this proposed action (i.e., proposed WPA Lease Sale 246).

A second federally recognized Indian Tribe, the Choctaw Nation of Oklahoma, indicated that the WPA lies outside of their Tribe's area of historic interest and respectfully deferred comment to the other Tribes that had been contacted. No further Tribal requests for consultation or responses to the NOI or NOA were received; however, BOEM is willing to initiate consultations with Tribes in the future should concerns arise.

5.11. Major Differences Between the Draft and Final Supplemental EISs

Comments on the Draft Supplemental EIS were received via written and electronic correspondence. As a result of these comments, changes have been made between the Draft and Final Supplemental EISs. Where appropriate, the text in this Final Supplemental EIS has been verified or expanded to provide clarification on specific issues, as well as to provide updated information. None of the revisions between the Draft and Final Supplemental EISs changed the impact conclusions for the physical, environmental, and socioeconomic resources analyzed in this Supplemental EIS.

5.12. Comments Received on the Draft Supplemental EIS and BOEM's Responses

The Notice of Availability and the announcement of public meetings were published in the *Federal Register* on September 5, 2014, were posted on BOEM's website, and were mailed to interested parties. The comment period ended on October 22, 2014. BOEM received five distinct comments in response to the Draft Supplemental EIS via letter and email. The commenters are the Louisiana Department of Natural Resources, the American Petroleum Institute, ConocoPhillips, the Choctaw Nation of Oklahoma, and one general public comment.

Copies of the comments are presented on the subsequent pages. Each comment has been marked for identification purposes. BOEM's responses immediately follow the comments.

Bobby Jindal
Governor

Stephen Chustz
Secretary

State of Louisiana

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF COASTAL MANAGEMENT

October 6, 2014

Mr. Gary D. Goeke, Chief
Environmental Assessment Section
Office of Environment (GM 623E)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

RE: Draft Supplemental Environmental Impact Statement (SEIS) for 2015 and 2016 Western Planning Area (WPA) Lease Sales 246 and 248

Dear Mr. Goeke:

The Department of Natural Resources has received the draft SEIS, which updates the analyses performed for the Gulf of Mexico Outer Continental Shelf Oil and Gas Lease Sales: 2012 – 2017 Environmental Impact Statement (EIS); the SEIS for WPA 233 and CPA 231; and the SEIS for WPA sales 238, 246, and 248.

LADNR-1

The Louisiana Department of Natural Resources, Office of Coastal Management (OCM) endorses oil and gas activity in federal waters off our coast, however we do not believe that the Draft SEIS, nor the EIS from which it tiers, sufficiently covers the material necessary to protect our burdened coastal resources. The Draft Supplemental EIS does not adequately address the indirect and cumulative effects of offshore oil and gas activity in substantially more detail than is provided in the previous and also inadequate environmental impact statements.

LADNR-2

BOEM has made improvements in its National Environmental Policy Act (NEPA) process, with better modeling methods and documentation of source material. However, OCM believes that a more comprehensive appraisal of coastal effects is necessary and that increased focus should be placed on confirming the accuracy of past OCS lease sale predictions, so that future lease sales can better account for both economic and environmental concerns.

LADNR-3

The serious damage that the coastline of Louisiana has suffered from OCS exploration and development is not the result of one particular oil and gas related activity or incident, but is the result of the secondary and cumulative impacts resulting from the entirety of the oil and gas leasing program. The Coastal Zone Management Act and NEPA obligate BOEM to identify, quantify, and provide compensation for all impacts of OCS leasing activities.

Post Office Box 44487 • Baton Rouge, Louisiana 70804-4487
617 North Third Street • 10th Floor • Suite 1078 • Baton Rouge, Louisiana 70802
(225) 342-7591 • Fax (225) 342-9439 • http://www.dnr.louisiana.gov
An Equal Opportunity Employer

We appreciate our cooperative relationship with BOEM and the interest we share in offshore resource development, energy production, and the associated economic benefits. OCM will continue to favor the future growth in offshore energy as long as all impacts, immediate and cumulative, to our coastal resources are given full consideration. If you have any questions concerning this matter, please contact Jeff Harris of the Consistency Section at (225) 342-7949.

Sincerely,

Don Haydel
Acting Administrator
Interagency Affairs/Field Services Division

DH/JDH/jab

cc: Tershara Matthews, BOEM MS 5412
Brian Cameron, BOEM MS 5412
Project file C20140192

LADNR-1 **Chapters 4.1.1.3 and 4.1.1.4** of this Supplemental EIS, Chapters 4.1.1.3 and 4.1.1.4 and Appendix D of the WPA 238/246/248 Supplemental EIS, and Chapters 4.1.1.3 and 4.1.1.4 of the 2012-2017 WPA/CPA Multisale EIS and WPA 233/CPA 231 Supplemental EIS describe the environmental impacts of proposed lease sales on coastal areas, including coastal barrier beaches and wetland resources. Cumulative analyses are also included in order to put the incremental contribution of proposed EPA, CPA, and WPA lease sales in context considering all of the other types of activities (past, present, and reasonably foreseeable) that have the potential to cause impacts, including impacts from other lease sales that are part of the overall OCS Program. BOEM has included in this Supplemental EIS and the aforementioned EISs the relevant information related to its cumulative effects analysis, including both the proposed actions and all OCS oil and gas program activities in its consideration. As noted in **Chapter 4.1.1**, the incremental contribution of an individual lease sale to these impacts is very small. Many of the impacts to environmental and socioeconomic resources that are identified in the cumulative analysis have occurred over many years, much of it prior to the enactment of important laws to protect the environment and prior to the bulk of OCS oil- and gas-related activities.

In particular, BOEM-supported studies by Johnston et al. (2009) and Thatcher et al. (2011), which are used in **Chapters 4.1.1.4, 4.1.1.14, 4.1.1.20.1, and 4.1.1.20.4** (respectively wetlands, coastal and marine birds, land use and coastal infrastructure, and environmental justice), examined secondary impacts associated with OCS oil- and gas-related activity. In addition, the OSRA program at BOEM provides a thorough characterization of the risk to coastal resources from large oil spills.

LADNR-2 **Chapters 4.1.1.3, 4.1.1.4, and 4.1.1.20.3** of this Supplemental EIS; Chapters 4.1.1.3, 4.1.1.4, and 4.1.1.20.3, and Appendix D of the WPA 238/246/248 Supplemental EIS; and Chapters 4.1.1.3, 4.1.1.4, and 4.1.1.20.3 of the 2012-2017 WPA/CPA Multisale EIS and WPA 233/CPA 231 Supplemental EIS describe the environmental impacts of proposed lease sales on coastal areas, including coastal barrier beaches and wetland resources, as well as impacts on economic factors.

The 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS analyzed the potential impacts of a WPA proposed action on the marine, coastal, and human environments. It is important to note that the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS were prepared using the best information that was publicly available at the time the documents were prepared. This Supplemental EIS is deemed appropriate to supplement the documents cited above for proposed WPA Lease Sales 246 and 248 in order to consider new circumstances and information arising from, among other things, the *Deepwater Horizon* explosion, oil spill, and response. This Supplemental EIS's analysis focuses on updating the baseline conditions and potential environmental effects of oil and natural gas leasing, exploration, development, and production in the WPA since publication of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS. This Supplemental EIS will also assist decisionmakers in making informed, future decisions regarding the approval of operations, as well as leasing. This Supplemental EIS is the final NEPA review conducted for proposed WPA Lease Sale 246. A separate NEPA review will be conducted prior to proposed WPA Lease Sale 248 to address any newly available significant information relevant to that proposed action.

In addition, BOEM has completed comprehensive appraisals on the accuracy of past OCS lease sale predictions. BOEM has found that, more than often, oil and gas activities forecasted for a lease sale in the GOM fall below the levels of activity expected from an average lease sale (USDOI MMS, 2007b and 2007c). This results in the use of environmental and socioeconomic impact levels that will generally prevent the underestimation of these impacts in the Bureau of Ocean Energy Management's NEPA analyses.

LADNR-3 BOEM includes a robust consideration of potential mitigation in its analysis. Please note, however, that BOEM's authority to require certain types of mitigation is limited to its statutory authority and that BOEM has no or limited authority to provide or mandate compensatory mitigation for possible activities outside the OCS Federal waters with indirect coastal impacts. These activities are regulated by other Federal and State agencies, such as the U.S. Army Corps of Engineers through the Rivers and Harbors Act Section 10 and Clean Water Act Section 404 permits, and the Louisiana Department of Natural Resources through the Louisiana Coastal Use permits. A decision on what BOEM mitigations may be imposed as part of a proposed WPA lease sale, if the decision is to move forward with a proposed WPA lease sale, will be announced in the Final Notice of Sale and Record of Decision.

October 20, 2014

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
Office of Environment (GM 623E)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Submitted via E-mail to wpa246@boem.gov

Re: Comments on the WPA 246 and 248 Draft Supplemental SEIS

Dear Mr. Goeke:

The American Petroleum Institute (API) offers the following comments on the U.S. Department of Interior Bureau of Ocean Energy Management's (BOEM's) Draft Supplemental Environmental Impact Statement (DSEIS) for the Western Planning Area (WPA) Gulf of Mexico (GOM) lease sales scheduled for 2015 and 2016 (also referred to as the '*WPA Lease Sales 246 and 248 DSEIS*'). The API is a national trade association that represents over 600 members involved in all aspects of the oil and natural gas industry, including exploring for and developing oil and natural gas resources in the GOM – a vital part of our nation's economy. The industry supports millions of American jobs and delivers billions of dollars in annual revenue to our government.

This *WPA Lease Sales 246 and 248 DSEIS* uses information contained in three previous environmental impact statements. This DSEIS tiers from the Proposed Final Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017, *Final Programmatic Environmental Impact Statement (Five-Year Program EIS)*. It incorporates by reference all of the relevant material published in the EIS's that were prepared for the Western and Central Planning Areas (WPA and CPA). *Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247, Final Environmental Impact Statement (2012-2017 WPA/CPA Multisale EIS) and Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231, Final Supplemental Environmental Impact Statement (WPA 233/CPA 231 Supplemental EIS)*.

API-1

BOEM's *CPA Lease Sales 246 and 248 DSEIS* addresses three proposed Federal actions that offer areas for lease on the Gulf of Mexico (GOM) Outer Continental Shelf (OCS) that may contain substantial reserves of economically recoverable oil and gas resources. The Gulf of Mexico constitutes one of the world's major oil and gas producing areas, and has proved a steady and reliable source of U.S. crude oil and natural gas for more than 50 years.

The WPA is a critically important hydrocarbon energy producing area where existing infrastructure and expertise can be used to increase our nation's oil and natural gas resources. Predictable lease sales in this Planning Area are needed to help ensure continued offshore exploration and production in the future since leases sold today will take many years to fully develop. Predictability and certainty in the leasing program helps companies make the long-term decisions required for offshore development and avoids the potential of having years wasted in bringing vital oil and natural gas production to the market.

BOEM's NEPA Analysis

API-2

API strongly supports the analysis made by BOEM in the Gulf of Mexico OCS Oil and Gas Lease Sales: 2015 and 2016 Western Planning Area Lease Sales 246 and 248 Draft Supplemental Environmental Impact Statement (OCS EIS/EA BOEM 2014-619). API believes that the detailed analysis provided in the DSEIS, along with the other supporting environmental documents and additional assessments being conducted by BOEM provide a thorough analysis upon which to make decisions related to the three proposed lease sales, new or revised exploration and development plans in the WPA, and future permit applications, without delay. API notes that the DSEIS contains (by reference) updated information and analyses regarding the 2010 Macondo oil spill. This new information supports the NEPA process by describing the current environmental baseline conditions in the WPA (as appropriate) including the results of numerous new scientific studies regarding the spill. We encourage BOEM to continue reviewing and evaluating the sound, peer-reviewed science in this area and to avoid the use of unsubstantiated or anecdotal information.

API-3

API also acknowledges that BOEM has conducted a detailed Catastrophic Spill Event Analysis at Appendix B of the DSEIS to consider the environmental impacts associated with a low probability high-volume oil spill resulting from loss of well control on the Gulf of Mexico OCS. API believes that this analysis fully meets the agency's obligations under NEPA to provide decision makers with a robust analysis of reasonably foreseeable impacts associated with a low probability oil spill on the OCS.

Tiering Under the National Environmental Policy Act (NEPA)

API-4

API supports BOEM's approach of evaluating multiple similar federal actions (i.e. holding multiple lease sales) in a single EIS as provided in the Council on Environmental Quality's (CEQ's) regulations (see 40 CFR 1502.4). API is aware that at the completion of this EIS process, agency decisions will be made only for proposed Lease Sale 246 in the WPA. We understand that a NEPA review will be conducted before each subsequent lease sale following Lease Sale 248. API believes that this approach will allow the NEPA reviews of the subsequent lease sales to proceed efficiently by focusing on any new issues or information and avoiding the repetitive issuance of cumbersome draft and final EISs for each sale area. In short, API fully supports BOEM's continued practice of tiering EISs and Environmental Assessments (EISs/EAs) under NEPA.

Alternatives Considered in the SEIS

The *WPA Lease Sales 246 and 248 DSEIS* considers three alternatives for the proposed lease sales. API strongly supports Alternative A (the *Proposed Action*) for the proposed WPA lease sales as described below:

Alternative A—The Proposed Action (Preferred Alternative): This alternative would offer for lease all unleased blocks within the proposed WPA lease sale area for oil and gas operations, with the following exception:

(1) whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary (i.e., the boundary as of the publication of this Supplemental EIS).

The proposed WPA lease sale area encompasses about 28.58 million acres (ac). As of July 2014, approximately 21.6 million ac of the proposed WPA lease sale area are currently unleased. The estimated amount of natural resources projected to be developed as a result of a proposed WPA lease sale is 0.116-0.200 billion barrels of oil (BBO) and 0.538-0.938 trillion cubic feet (Tcf) of gas.

Alternative B—Exclude the Unleased Blocks Near Biologically Sensitive Topographic Features: This alternative would offer for lease all unleased blocks within the proposed WPA lease sale area, as described for a proposed action (Alternative A), but it would exclude from leasing any unleased blocks subject to the Topographic Features Stipulation. The estimated amount of resources projected to be developed is 0.116-0.200 BBO and 0.538-0.938 Tcf of gas.

Alternative C—No Action: This alternative is the cancellation of a proposed WPA lease sale. If this alternative is chosen, the opportunity for development of the estimated 0.116-0.200 BBO and 0.538-0.938 Tcf of gas that could have resulted from a proposed WPA lease sale would be precluded during the current Five-Year Program, but it could again be contemplated as part of a future Five-Year Program. Any potential environmental impacts arising out of a proposed WPA lease sale would not occur, but activities associated with existing leases in the WPA would continue.

API-5

API is strongly opposed to *Alternatives B and C* for the WPA lease sales. The analysis in the DEIS does not support the adoption of such restrictive alternatives. API urges BOEM to adopt *Alternative A* for the *WPA Lease Sales 246 and 248 DSEIS*. Adoption of *Alternative A* is fully consistent with the agency's analysis.

Discussion of "Incomplete and Unavailable" Information

API-6

On several occasions throughout the document, the DEIS discusses the instances in which the information available to BOEM is "incomplete or unavailable" within the meaning of 40 C.F.R. § 1502.22. Although "numerous" instances are cited, BOEM has determined, after careful analysis, that the currently unavailable information is not essential to a reasoned choice among alternatives. This conclusion is an important one, since both CEQ regulations and case law spell out how an agency must proceed when confronted by information that is not currently available.

API-7

The resources of the GOM remain a vital source of jobs, revenue, energy and economic growth for the nation. API and its member companies are committed to the safe and responsible development of these vital oil and natural gas resources. As such, we ask that the department finalize the *WPA Lease Sales 246 and 248 DSEIS* as quickly as possible so that leasing can continue in accordance with *Alternative A* as proposed in the DSEIS. Should you have any questions on these comments please contact me at (202) 682-8584 or by email at radforda@api.org.

Sincerely,

Andy Radford

API-1 Comment noted. The WPA 246/248 Draft Supplemental EIS addresses two proposed Federal actions.

API-2 Comment noted.

API-3 Comment noted.

API-4 Comment noted.

API-5 Comment noted. This Supplemental EIS is not a decision document; BOEM will make a decision on a WPA proposed action. If the Assistant Secretary for Land and Minerals Management's decision is to proceed with Alternative A, it will be reflected in the Final Notice of Sale and Record of Decision.

API-6 Comment noted.

API-7 Comment noted.

ConocoPhillips

ConocoPhillips Company
P. O. Box 2197
Houston, Texas 77252-2197

VIA E-MAIL: wpa246@BOEM.gov

October 21, 2014

Attention: Gary D. Goeke
Office of Environment (GM 623E)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394.

Subject: Comments on the Draft SEIS for Western Planning Area Sales 246 and 248

ConocoPhillips Company (ConocoPhillips) is pleased to provide comments on the Draft Supplemental Environmental Impact Statement (DSEIS) for the proposed Western Planning Area (WPA) Lease Sales 246 and 248 as scheduled under the proposed 2012-2017 OCS Oil and Gas Leasing Program on which the Bureau of Ocean Energy Management (BOEM) issued a Notice of Availability on September 3, 2014.

As one of North America's leading energy producers, our primary strategic objectives include producing even more oil and gas in the United States. ConocoPhillips is a leading producer of natural gas in the United States, the largest producer of oil in Alaska, and among Canada's largest producers of natural gas (much of which flows to the U.S.). We have major positions in many of the nation's leading producing basins with active exploration and development drilling programs. ConocoPhillips is known worldwide for our technological expertise in deepwater exploration and production, reservoir management and exploitation, and 3-D seismic technology. ConocoPhillips is one of the most active companies acquiring acreage in the Gulf of Mexico, having exposed nearly $1 Billion in Gulf of Mexico OCS Lease Sales since 2008 and is now the second largest leasehold owner in deepwater Gulf of Mexico. These and other OCS activities reflect ConocoPhillips' commitment and continued interest in the BOEM's offshore leasing programs.

CP-1

Relative to the BOEM Regional Director's Note: ConocoPhillips believes that the DSEIS comprehensively addresses the significance, scale, and likelihood for potential impacts to the marine, coastal and human environments of oil and natural gas leasing, exploration, development and production resulting from the proposed WPA Lease Sales 246 and 248. ConocoPhillips agrees that the DSEIS was composed using the best information that was publicly available at the time the document was prepared.

CP-2

ConocoPhillips supports Alternative "A" as set forth in the DSEIS, as it would offer for lease approximately 21.6 million unleased acres not currently subject to the Flower Garden Banks National Marine Sanctuary and has the potential to increase domestic oil and gas resources by 0.116 - .20 billion barrels of oil and 0.538 - .938 trillion cubic feet of gas per each WPA lease sale. ConocoPhillips does not support Alternatives "B" or "C" as set forth in the DSEIS.

CP-3

As stated in the DSEIS: The cancellation of either WPA Lease Sale 246 or 248 would likely only defer any resulting oil and gas development from such sale to a later date. Therefore, cancellation of WPA Lease Sales 246 or 248 would result in a negligible reduction in the WPA's overall activity level and potentially lead to a redundancy of efforts in due diligence and administration and result in direct, adverse economic impacts for industry and government.

CP-4

ConocoPhillips is pleased to hear that no new significant information was discovered in the DSEIS that would alter the impact conclusions for any of the resources analyzed in the 2012 – 2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, or WPA 238/246/248 Supplemental EIS. ConocoPhillips continues to support increased access for the safe and responsible exploration, development, and production of domestic hydrocarbon resources.

Sincerely,

Richard Lunam
Vice President, North America Exploration

CP-1 Comment noted.

CP-2 Comment noted. This Supplemental EIS is not a decision document; BOEM will make a decision on a WPA proposed action. If the Assistant Secretary for Land and Minerals Management's decision is to proceed with Alternative A, it will be reflected in the Final Notice of Sale and Record of Decision.

CP-3 Comment noted. The cancellation of a WPA lease sale is addressed is this Supplemental EIS under the No Action Alternative.

CP-4 Comment noted.

BISON CONNECT

RE: Comments for the WPA 246 and 248 Draft Supplemental EIS

Lindsey Bilyeu <lbilyeu@choctawnation.com> Tue, Sep 23, 2014 at 2:17 PM
To: "wpa246@boem.gov" <wpa246@boem.gov>

Mr. Christopher,

CNO-1 The Choctaw Nation of Oklahoma thanks the BOEM for the correspondence regarding the above referenced project. It appears that the Western Planning Area lies outside of the Choctaw Nation of Oklahoma's area of historic interest. The Choctaw Nation Historic Preservation Department respectfully defers to the other Tribes that have been contacted. If you have any questions, please contact our office at 580-924-8280 ext. 2631.

Thank You,

Lindsey D. Bilyeu

Senior Section 106 Reviewer

Historic Preservation Department

Choctaw Nation of Oklahoma

P.O. Box 1210

Durant, OK 74701

580-924-8280 ext. 2631

CNO-1 Thank you for your review of the Draft Supplemental EIS and recent comment. Your comment is noted. BOEM will continue to inform you about other future proposed lease sales throughout the Gulf of Mexico.

BISON CONNECT

Re: COMMENT

jean public <jeanpublic1@gmail.com> Tue, Sep 9, 2014 at 7:39 PM
To: WPA246@boem.gov, vicepresident@whitehouse.gov, americanvoices <americanvoices@mail.house.gov>, The Pew Charitable Trusts <info@pewtrusts.org>, info@oceana.org, Oceanic Preservation Society <info@opsociety.org>, PETA Info <info@peta.org>, foe@foe.org, info <info@earthjustice.org>, Kieran Suckling <center@biologicaldiversity.org>, INFO@peer.org

PUBLIC COMMETN ON FEDERAL REGISTER ON OIL LEASES 246

JP-1 JP-2 JP-3

I AM VERY MUCH OPPOSED TO THIS GOVT ISSUING LEASES TO OIL PROFITEERS TO DEVELOP THIS SITE. IT IS CLEAR THAT THE OIL COMPANY PROFITEERS ARE LAX AND NEGLIGENT IN UTILIZING SITES IN AMERICA AND THEY ARE QUITE CONTENT TO CAUSE HUGE SPILLS AND POLLUTION LIKE DEEPWATER. I DO NOT BELIEVE THAT BOEM HAS TAKEN THE STEPS NECESSARY TO SEE THAT THESE PROFITEESR DEVEOP ENOUGH INNOVATION TO PREVENT THESE MASSIVE POLLUTION SPILLS THAT KILL ENDLESS TRILLIONS OF FISH AND MARINE LIFE AND MAKE IT IMPOSSIBLE FOR THE PEOPLE WHO NEED TO CATCH AND EAT FISH TO MAKE A LIVING. ALL THESE OIL PROFITEERS DO IS POLLUTE AND KILL ALL LIFE. I AM VERY MUCH OPPOSED TO THIS LEASE. I WOULD LIKE TO BE ON THE MAILING LIST SO I CAN CONTINAULLYH OPPOSE THIS LEASE AT EVERY OPPORTUNITY. THIS COMMENT IS FOR THE PUBLIC RECORD. PLEASE RECEIPT. JEANPUBLIC JEANPUBLIC1@YAHOO.COM

On Tue, Sep 9, 2014 at 3:13 PM, jean public <jeanpublic1@gmail.com> wrote:

[Federal Register Volume 79, Number 172 (Friday, September 5, 2014)]
[Notices]
[Pages 53078-53079]
From the Federal Register Online via the Government Printing Office [www.gpo.gov]
[FR Doc No: 2014-21008]

DEPARTMENT OF THE INTERIOR

Bureau of Ocean Energy Management

[MMAA 104000]

Outer Continental Shelf (OCS), Gulf of Mexico (GOM), Oil and Gas Lease Sales, Western Planning Area (WPA) Lease Sales 246 and 248

AGENCY: Bureau of Ocean Energy Management (BOEM), Interior.

ACTION: Notice of Availability (NOA) and Announcement of Public Meetings and Comment Period for the Draft Supplemental Environmental Impact Statement (EIS) for Proposed GOM Oil and Gas WPA Lease Sales 246 and 248.

SUMMARY: Consistent with the regulations implementing the National Environmental Policy Act, as amended (42 U.S.C. 4321 et seq.) (NEPA), BOEM has prepared a Draft Supplemental EIS for proposed WPA oil and gas Lease Sales 246 and 248 in the GOM (WPA 246/248 Draft Supplemental EIS). Proposed Lease Sales 246 and 248 are tentatively scheduled to be held in August 2015 and 2016, respectively, in the WPA offshore the States of Texas and Louisiana. The WPA 246/248 Draft Supplemental EIS updates the environmental and socioeconomic analyses in the Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247, Final Environmental Impact Statement (OCS EIS/EA BOEM 2012-019) (2012-2017 WPA/CPA Multisale EIS), Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231, Final Supplemental Environmental Impact Statement (OCS EIS/EA BOEM 2013-0118) (WPA 233/CPA 231 Supplemental EIS), and Gulf of Mexico OCS Oil and Gas Lease Sales: 2014-2016; Western Planning Area Lease Sales 238, 246, and 248, Final Supplemental Environmental Impact Statement (OCS EIS/EA BOEM 2014-009) (WPA 238/246/248 Supplemental EIS).

FOR FURTHER INFORMATION CONTACT: For more information on the WPA 246/248 Draft Supplemental EIS, you may contact Mr. Gary D. Goeke, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, Office of Environment (GM 623E), 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394 or by email at wpa246@boem.gov. You may also contact Mr. Goeke by telephone at (504) 736-3233.

SUPPLEMENTARY INFORMATION: BOEM developed the WPA 246/248 Draft Supplemental EIS to consider new information made available since completion of the 2012-2017 WPA/CPA Multisale EIS, WPA 233/CPA 231 Supplemental EIS, and WPA 238/246/248 Supplemental EIS, and to consider new information related to the Deepwater Horizon explosion, oil spill, and response. The WPA 246/248 Draft Supplemental EIS provides updates on the baseline conditions and potential environmental effects of oil and natural gas leasing, exploration, development, and production in the WPA. BOEM conducted an extensive search for new information, reviewing scientific journals and available scientific data and information from academic institutions and Federal, State, and local agencies; and interviewing personnel from academic institutions and Federal, State, and local agencies. BOEM examined the potential impacts of routine activities and accidental events and the proposed lease sales' incremental contribution to the cumulative impacts on environmental and socioeconomic resources. The oil and gas resource estimates and scenario information for the WPA 246/248 Draft Supplemental EIS are presented as a range that would encompass the

[[Page 53079]]

resources and activities estimated for a proposed WPA lease sale.

Draft Supplemental EIS Availability: You may download or view the WPA 246/248 Draft Supplemental EIS on BOEM's Web site at http://www.boem.gov/nepaprocess/. In keeping with the Department of the Interior's mission to protect natural resources and to limit costs, while ensuring availability of the document to the public, BOEM will primarily distribute digital copies of the WPA 246/248 Draft Supplemental EIS on compact discs. BOEM has printed and will be distributing a limited number of paper copies. If you require a paper copy, BOEM will provide one upon request if copies are still available. You may obtain a copy of the WPA 246/248 Draft Supplemental EIS from the Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, Public Information Office (GM 335A), 1201 Elmwood Park Boulevard, Room 250, New Orleans, Louisiana 70123-2394 (1-800-200-GULF).

Several libraries along the Gulf Coast have been sent copies of the WPA 246/248 Draft Supplemental EIS. To find out which libraries have copies of the WPA 246/248 Draft Supplemental EIS for review, you may contact BOEM's Public Information Office or visit BOEM's Internet Web site at http://www.boem.gov/nepaprocess/.

Comments: All interested parties, including Federal, State, Tribal, and local governments, and other organizations and members of the public, may submit written comments on the WPA 246/248 Draft Supplemental EIS in one of the following ways:

1. In an envelope labeled ``Comments on the WPA 246 and 248 Draft Supplemental EIS" and mailed (or hand carried) to Mr. Gary D. Goeke, Chief, Environmental Assessment Section, Office of Environment (GM 623E), Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394;

2. Through the regulations.gov web portal: Navigate to http://www.regulations.gov and search for ``Oil and Gas Lease Sales: Gulf of Mexico, Outer Continental Shelf; Western Planning Area Lease Sales 246 and 248" (Note: It is important to include the quotation marks in your search terms.) Click on the ``Comment Now!" button to the right of the document link. Enter your information and comment, then click ``Submit"; or

3. Through BOEM's email address: wpa246@boem.gov.

Comments should be submitted no later than 45 days from the publication of this NOA. Pursuant to the regulations implementing the procedural provisions of NEPA, BOEM will hold public meetings in Texas and Louisiana to solicit comments on the WPA 246/248 Draft Supplemental EIS. These meetings are scheduled as follows:

Houston, Texas: Tuesday, September 23, 2014, Houston Airport Marriott at George Bush Intercontinental, 18700 John F. Kennedy Boulevard, Houston, Texas 77032, one meeting beginning at 1:00 p.m. CDT; and, New Orleans, Louisiana: Thursday, September 25, 2014, Bureau of Ocean Energy Management, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123, one meeting beginning at 1:00 p.m. CDT. Public Disclosure of Names and Addresses As BOEM does not consider anonymous comments, please include your name and address as part of your submittal. BOEM makes all comments, including the names and addresses of respondents, available for public review during regular business hours. Individual respondents may request that BOEM withhold their names and/or addresses from the public record; however, BOEM cannot guarantee that we will be able to do so. If you wish your name and/or address to be withheld, you must state your preference prominently at the beginning of your comment. All submissions from organizations or businesses and from individuals identifying themselves as representatives or officials of organizations or businesses will be made available for public inspection in their entirety. Authority: This NOA is published pursuant to the regulations (40 CFR 1503) implementing the provisions of NEPA. Dated: August 1, 2014. L. Renee Orr, Acting Director, Bureau of Ocean Energy Management. [FR Doc. 2014-21008 Filed 9-4-14; 8:45 am] BILLING CODE 4310-MR-P

JP-1 Comment noted. This Supplemental EIS is not a decision document; BOEM will make a decision on a WPA proposed action. If the decision is to hold a proposed lease sale, it will be announced in the Final Notice of Sale and Record of Decision.

JP-2 Low-probability catastrophic oil spills are not reasonably expected and not part of a WPA proposed action. Potential reasonably foreseeable impacts or reasonably foreseeable oil spills are discussed in **Chapter 3**, and the associated potential environmental effects are discussed in **Chapter 4**. In addition, BOEM and BSEE implement rigorous regulatory requirements that mandate extensive safety measures and risk reduction strategies by industry including, but not limited to, implementing redundancies in safety technologies. At the time that these regulations were adopted, BOEM and BSEE conducted NEPA analyses and solicited and considered extensive public comments. Refer to Chapter 1.3 of the 2012-2017 WPA/CPA Multisale EIS for additional information on regulatory framework, and also refer to Chapter 1.3 of this Supplemental EIS, as well as to Chapter 1.3 of the WPA 233/CPA 231Supplemental EIS and WPA 238/246/248 Supplemental EIS for updates since publication of the 2012-2017 WPA/CPA Multisale EIS.

JP-3 Comment noted. To sign up for our mailing list, please visit BOEM's website at https://www.data.boem.gov/homepg/data_center/other/gmaillist/subscribe.asp.

CHAPTER 6

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6. REFERENCES CITED

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CHAPTER 7

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7. PREPARERS

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CHAPTER 8

GLOSSARY

8. GLOSSARY

Acute—Sudden, short term, severe, critical, crucial, intense, but usually of short duration.

Anaerobic—Capable of growing in the absence of molecular oxygen.

Annular preventer—A component of the pressure control system in the BOP that forms a seal in the annular space around any object in the wellbore or upon itself, enabling well control operations to commence.

Anthropogenic—Coming from human sources, relating to the effect of humankind on nature.

API gravity—A standard adopted by the American Petroleum Institute for expressing the specific weight of oil.

Aromatic—Class of organic compounds containing benzene rings or benzenoid structures.

Attainment area—An area that is shown by monitored data or by air-quality modeling calculations to be in compliance with primary and secondary ambient air quality standards established by USEPA.

Barrel (bbl)—A volumetric unit used in the petroleum industry; equivalent to 42 U.S. gallons or 158.99 liters.

Benthic—On or in the bottom of the sea.

Biological Opinion—The FWS or NMFS evaluation of the impact of a proposed action on endangered and threatened species, in response to formal consultation under Section 7 of the Endangered Species Act.

Block—A geographical area portrayed on official BOEM protraction diagrams or leasing maps that contains approximately 2,331 ha (9 mi^2).

Blowout—An uncontrolled flow of fluids below the mudline from appurtenances on a wellhead or from a wellbore.

Blowout preventer (BOP)—One of several valves installed at the wellhead to prevent the escape of pressure either in the annular space between the casing and drill pipe or in open hole (i.e., hole with no drill pipe) during drilling completion operations. Blowout preventers on jackup or platform rigs are located at the water's surface; on floating offshore rigs, BOP's are located on the seafloor.

Bottom kill—A wild well-control procedure involving the intersection of an uncontrolled well with a relief well for the purpose of pumping heavy mud or cement into the wild well to stanch the flow of oil or gas (the well-control strategy for the *Macondo* spill deployed in mid-July 2010 that resulted in the successful capping of the well).

Cetacean—Aquatic mammal of the order Cetacea, such as whales, dolphins, and porpoises.

Chemosynthetic—Organisms that obtain their energy from the oxidation of various inorganic compounds rather than from light (photosynthetic).

Coastal waters—Waters within the geographical areas defined by each State's Coastal Zone Management Program.

Coastal wetlands—forested and nonforested habitats, mangroves, and marsh islands exposed to tidal activity. These areas directly contribute to the high biological productivity of coastal waters by input of detritus and nutrients, by providing nursery and feeding areas for shellfish and finfish, and by serving as habitat for birds and other animals.

Coastal zone—The coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder) strongly influenced by each other and in proximity to the shorelines of several coastal states; the zone includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches, and it extends seaward to the outer limit of the United States territorial sea. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters. Excluded from the coastal zone are lands the use of which is by law subject to the discretion of or which is held in trust by the Federal Government, its officers, or agents (also refer to State coastal zone boundaries).

Completion—Conversion of a development well or an exploration well into a production well.

Condensate—Liquid hydrocarbons produced with natural gas; they are separated from the gas by cooling and various other means. Condensates generally have an API gravity of 50°-120°.

Continental margin—The ocean floor that lies between the shoreline and the abyssal ocean floor, includes the continental shelf, continental slope, and continental rise.

Continental shelf—General term used by geologists to refer to the continental margin province that lies between the shoreline and the abrupt change in slope called the shelf edge, which generally occurs in the Gulf of Mexico at about the 200-m (656-ft) water depth. The continental shelf is characterized by a gentle slope (about 0.1°). This is different from the juridical term used in Article 76 of the United Nations Convention on the Law of the Sea Royalty Payment (refer to the definition of Outer Continental Shelf).

Continental slope—The continental margin province that lies between the continental shelf and continental rise, characterized by a steep slope (about 3°-6°).

Critical habitat—Specific areas essential to the conservation of a protected species and that may require special management considerations or protection.

Crude oil—Petroleum in its natural state as it emerges from a well or after it passes through a gas-oil separator, but before refining or distillation. An oily, flammable, bituminous liquid that is essentially a complex mixture of hydrocarbons of different types with small amounts of other substances.

Delineation well—A well that is drilled for the purpose of determining the size and/or volume of an oil or gas reservoir.

Demersal—Living at or near the bottom of the sea.

Development—Activities that take place following discovery of economically recoverable mineral resources, including geophysical surveying, drilling, platform construction, operation of onshore support facilities, and other activities that are for the purpose of ultimately producing the resources.

Development and Production Plan (DPP)—A document that must be prepared by the operator and submitted to BOEM for approval before any development and production activities are conducted on a lease or unit in any OCS area other than the western Gulf of Mexico.

Development Operations Coordination Document (DOCD)—A document that must be prepared by the operator and submitted to BOEM for approval before any development or production activities are conducted on a lease in the western Gulf of Mexico.

Development well—A well drilled to a known producing formation to extract oil or gas; a production well; distinguished from a wildcat or exploration well and from an offset well.

Direct employment—Consists of those workers involved the primary industries of oil and gas exploration, development, and production operations (Standard Industrial Classification Code 13—Oil and Gas Extraction).

Discharge—Something that is emitted; flow rate of a fluid at a given instant expressed as volume per unit of time.

Dispersant—A suite of chemicals and solvents used to break up an oil slick into small droplets, which increases the surface area of the oil and hastens the processes of weathering and microbial degradation.

Dispersion—A suspension of finely divided particles in a medium.

Drilling mud—A mixture of clay, water or refined oil, and chemical additives pumped continuously downhole through the drill pipe and drill bit, and back up the annulus between the pipe and the walls of the borehole to a surface pit or tank. The mud lubricates and cools the drill bit, lubricates the drill pipe as it turns in the wellbore, carries rock cuttings to the surface, serves to keep the hole from crumbling or collapsing, and provides the weight or hydrostatic head to prevent extraneous fluids from entering the well bore and to downhole pressures; also called drilling fluid.

Economically recoverable resources—An assessment of hydrocarbon potential that takes into account the physical and technological constraints on production and the influence of costs of exploration and development and market price on industry investment in OCS exploration and production.

Effluent—The liquid waste of sewage and industrial processing.

Effluent limitations—Any restriction established by a State or the USEPA on quantities, rates, and concentrations of chemical, physical, biological, and other constituents discharged from point sources into U.S. waters, including schedules of compliance.

Epifaunal—Animals living on the surface of hard substrate.

Essential habitat—Specific areas crucial to the conservation of a species and that may necessitate special considerations.

Estuary—Coastal semienclosed body of water that has a free connection with the open sea and where freshwater meets and mixes with seawater.

Eutrophication—Enrichment of nutrients in the water column by natural or artificial methods accompanied by an increase of respiration, which may create an oxygen deficiency.

Exclusive Economic Zone—The maritime region extending 200 nmi (230 mi; 370 km) from the baseline of the territorial sea, in which the United States has exclusive rights and jurisdiction over living and nonliving natural resources.

Exploration Plan (EP)—A plan that must be prepared by the operator and submitted to BOEM for approval before any exploration or delineation drilling is conducted on a lease.

Exploration well—A well drilled in unproven or semi-proven territory to determining whether economic quantities of oil or natural gas deposit are present.

False crawls—Refers to when a female sea turtle crawls up on the beach to nest (perhaps) but does not and returns to the sea without laying eggs.

Field—An accumulation, pool, or group of pools of hydrocarbons in the subsurface. A hydrocarbon field consists of a reservoir in a shape that will trap hydrocarbons and that is covered by an impermeable, sealing rock.

Floating production, storage, and offloading (FPSO) system—A tank vessel used as a production and storage base; produced oil is stored in the hull and periodically offloaded to a shuttle tanker for transport to shore.

Gathering lines—A pipeline system used to bring oil or gas production from a number of separate wells or production facilities to a central trunk pipeline, storage facility, or processing terminal.

Geochemical—Of or relating to the science dealing with the chemical composition of and the actual or possible chemical changes in the crust of the earth.

Geophysical survey—A method of exploration in which geophysical properties and relationships are measured remotely by one or more geophysical methods.

Habitat—A specific type of environment that is occupied by an organism, a population, or a community.

Hermatypic coral—Reef-building corals that produce hard, calcium carbonate skeletons and that possess symbiotic, unicellular algae within their tissues.

Harassment—An intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, feeding or sheltering.

Hydrocarbons—Any of a large class of organic compounds containing primarily carbon and hydrogen. Hydrocarbon compounds are divided into two broad classes: aromatic and aliphatics. They occur primarily in petroleum, natural gas, coal, and bitumens.

Hypoxia—Depressed levels of dissolved oxygen in water, usually resulting in decreased metabolism.

Incidental take—Takings that result from, but are not the purpose of, carrying out an otherwise lawful activity (e.g., fishing) conducted by a Federal agency or applicant (refer to Taking).

Indirect employment—Secondary or supporting oil- and gas-related industries, such as the processing of crude oil and gas in refineries, natural gas plants, and petrochemical plants.

Induced employment—Tertiary industries that are created or supported by the expenditures of employees in the primary or secondary industries (direct and indirect employment), including consumer goods and services such as food, clothing, housing, and entertainment.

Infrastructure—The facilities associated with oil and gas development, e.g., refineries, gas processing plants, etc.

Jack-up rig—A barge-like, floating platform with legs at each corner that can be lowered to the sea bottom to raise the platform above the water.

Kick—A deviation or imbalance, typically sudden or unexpected, between the downward pressure exerted by the drilling fluid and the upward pressure of in-situ formation fluids or gases.

Landfall—The site where a marine pipeline comes to shore.

Lease—Authorization that is issued under Section 8 or maintained under Section 6 of the Outer Continental Shelf Lands Act and that authorizes exploration for, and development and production of, minerals.

Lease sale—The competitive auction of leases granting companies or individuals the right to explore for and develop certain minerals under specified conditions and periods of time.

Lease term—The initial period for oil and gas leases, usually a period of 5, 8, or 10 years depending on water depth or potentially adverse conditions.

Lessee—A party authorized by a lease, or an approved assignment thereof, to explore for and develop and produce the leased deposits in accordance with regulations at 30 CFR part 250 and 30 CFR part 550.

Lower marine riser package—The head assembly of a subsurface well at the point where the riser connects to a blowout preventer.

***Macondo*—**Prospect name given by BP to the Mississippi Canyon Block 252 exploration well that the *Deepwater Horizon* rig was drilling when a blowout occurred on April 20, 2010.

***Macondo* spill—**The name given to the oil spill that resulted from the explosion and sinking of the *Deepwater Horizon* rig from the period between April 24, 2010, when search and recovery vessels on site reported oil at the sea surface, and September 19, 2010, when the uncontrolled flow from the *Macondo* well was capped.

Marshes—Persistent, emergent, nonforested wetlands characterized by predominantly cordgrasses, rushes, and cattails.

Military warning area—An area established by the U.S. Department of Defense within which military activities take place.

Minerals—As used in this document, minerals include oil, gas, sulphur, and associated resources, and all other minerals authorized by an Act of Congress to be produced from public lands as defined in Section 103 of the Federal Land Policy and Management Act of 1976.

Naturally occurring radioactive materials (NORM)—naturally occurring material that emits low levels of radioactivity, originating from processes not associated with the recovery of radioactive material. The radionuclides of concern in NORM are Radium-226, Radium-228, and other isotopes in the radioactive decay chains of uranium and thorium.

Nepheloid—A layer of water near the bottom that contains significant amounts of suspended sediment.

Nonattainment area—An area that is shown by monitoring data or by air-quality modeling calculations to exceed primary or secondary ambient air quality standards established by USEPA.

Nonhazardous oil-field wastes (NOW)—Wastes generated by exploration, development, or production of crude oil or natural gas that are exempt from hazardous waste regulation under the Resource Conservation and Recovery Act (*Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes,* dated June 29, 1988, 53 FR 25446; July 6, 1988). These wastes may contain hazardous substances.

Offloading—Unloading liquid cargo, crude oil, or refined petroleum products.

Operational discharge—Any incidental pumping, pouring, emitting, emptying, or dumping of wastes generated during routine offshore drilling and production activities.

Operator—An individual, partnership, firm, or corporation having control or management of operations on a leased area or portion thereof. The operator may be a lessee, designated agent of the lessee, or holder of operating rights under an approved operating agreement.

Organic matter—Material derived from living plants or animals.

Outer Continental Shelf (OCS)—All submerged lands that comprise the continental margin adjacent to the United States and seaward of State offshore lands.

Pelagic—Of or pertaining to the open sea; associated with open water beyond the direct influence of coastal systems.

Plankton—Passively floating or weakly motile aquatic plants (phytoplankton) and animals (zooplankton).

Platform—A steel or concrete structure from which offshore development wells are drilled.

Play—A prospective subsurface area for hydrocarbon accumulation that is characterized by a particular structural style or depositional relationship.

Primary production—Organic material produced by photosynthetic or chemosynthetic organisms.

Produced water—Total water discharged from the oil and gas extraction process; production water or production brine.

Production—Activities that take place after the successful completion of any means for the extraction of resources, including bringing the resource to the surface, transferring the produced resource to shore, monitoring operations, and drilling additional wells or workovers.

Province—A spatial entity with common geologic attributes. A province may include a single dominant structural element such as a basin or a fold belt, or a number of contiguous related elements.

Ram—The main component of a blowout preventer designed to shear casing and tools in a wellbore or to seal an empty wellbore. A blind shear ram accomplishes the former and a blind ram the latter.

Recoverable reserves—The portion of the identified hydrocarbon or mineral resource that can be economically extracted under current technological constraints.

Recoverable resource estimate—An assessment of hydrocarbon or mineral resources that takes into account the fact that physical and technological constraints dictate that only a portion of resources can be brought to the surface.

Recreational beaches—Frequently visited, sandy areas along the Gulf of Mexico shorefront that support multiple recreational activities at the land-water interface. Included are National Seashores, State Park and Recreational Areas, county and local parks, urban beachfronts, and private resorts.

Refining—Fractional distillation of petroleum, usually followed by other processing (e.g., cracking).

Relief—The difference in elevation between the high and low points of a surface.

Reserves—Proved oil or gas resources.

Rig—A structure used for drilling an oil or gas well.

Riser insertion tube tool—A "straw" and gasket assembly improvised during the *Macondo* spill response that was designed to siphon oil and gas from the broken riser of the *Deepwater Horizon* rig lying on the sea bottom (an early recovery strategy for the *Macondo* spill in May 2010).

Royalty—A share of the minerals produced from a lease paid in either money or "in-kind" to the landowner by the lessee.

Saltwater intrusion—Saltwater invading a body of freshwater.

Sciaenids—Fishes belonging to the croaker family (Sciaenidae).

Seagrass beds—More or less continuous mats of submerged, rooted, marine, flowering vascular plants occurring in shallow tropical and temperate waters. Seagrass beds provide habitat, including breeding and feeding grounds, for adults and/or juveniles of many of the economically important shellfish and finfish.

Sediment—Material that has been transported and deposited by water, wind, glacier, precipitation, or gravity; a mass of deposited material.

Seeps (hydrocarbon)—Gas or oil that reaches the surface along bedding planes, fractures, unconformities, or fault planes.

Sensitive area—An area containing species, populations, communities, or assemblages of living resources, that is susceptible to damage from normal OCS oil- and gas-related activities. Damage includes interference with established ecological relationships.

Shear ram—The component in a BOP that cuts, or shears, through the drill pipe and forms a seal against well pressure. Shear rams are used in floating offshore drilling operations to provide a quick method of moving the rig away from the hole when there is no time to trip the drill stem out of the hole.

Shoreline Cleanup and Assessment Team—The on-the-scene responders for post-spill shoreline protection who established priorities, standardized procedures, and terminology.

Spill of National Significance—Designation by the USEPA Administrator under 40 CFR § 300.323 for discharges occurring in the inland zone and the Commandant of the U.S. Coast Guard for discharges occurring in the coastal zone, authorizing the appointment of a National Incident Commander for spill-response activity.

State coastal zone boundary—The State coastal zone boundaries for each CZMA-affected State are defined at http://coastalmanagement.noaa.gov/mystate/docs/StateCZBoundaries.pdf.

Structure—Any OCS facility that extends from the seafloor to above the waterline; in petroleum geology, any arrangement of rocks that may hold an accumulation of oil or gas.

Subarea—A discrete analysis area.

Subsea isolation device—An emergency disconnection and reconnection assembly for the riser at the seafloor.

Supply vessel—A boat that ferries food, water, fuel, and drilling supplies and equipment to an offshore rig or platform and returns to land with refuse that cannot be disposed of at sea.

Taking—To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any endangered or threatened species, or to attempt to engage in any such conduct (including actions that induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts). Harassments are the most common form of taking associated with OCS Program activities.

Tension-leg platform (TLP)—A production structure that consists of a buoyant platform tethered to concrete pilings on the seafloor with flexible cable.

Total dissolved solids—The total amount of solids that are dissolved in water.

Total suspended particulate matter—The total amount of suspended solids in water.

Total suspended solids—The total amount of suspended solids in water.

Trunkline—A large-diameter pipeline receiving oil or gas from many smaller tributary gathering lines that serve a large area; common-carrier line; main line.

Turbidity—Reduced water clarity due to the presence of suspended matter.

Volatile organic compound (VOC)—Any organic compound that is emitted to the atmosphere as a vapor.

Water test areas—Areas within the eastern Gulf where U.S. Department of Defense research, development, and testing of military planes, ships, and weaponry take place.

Weathering (of oil)—The aging of oil due to its exposure to the atmosphere, causing marked alterations in its physical and chemical makeup.

FIGURES

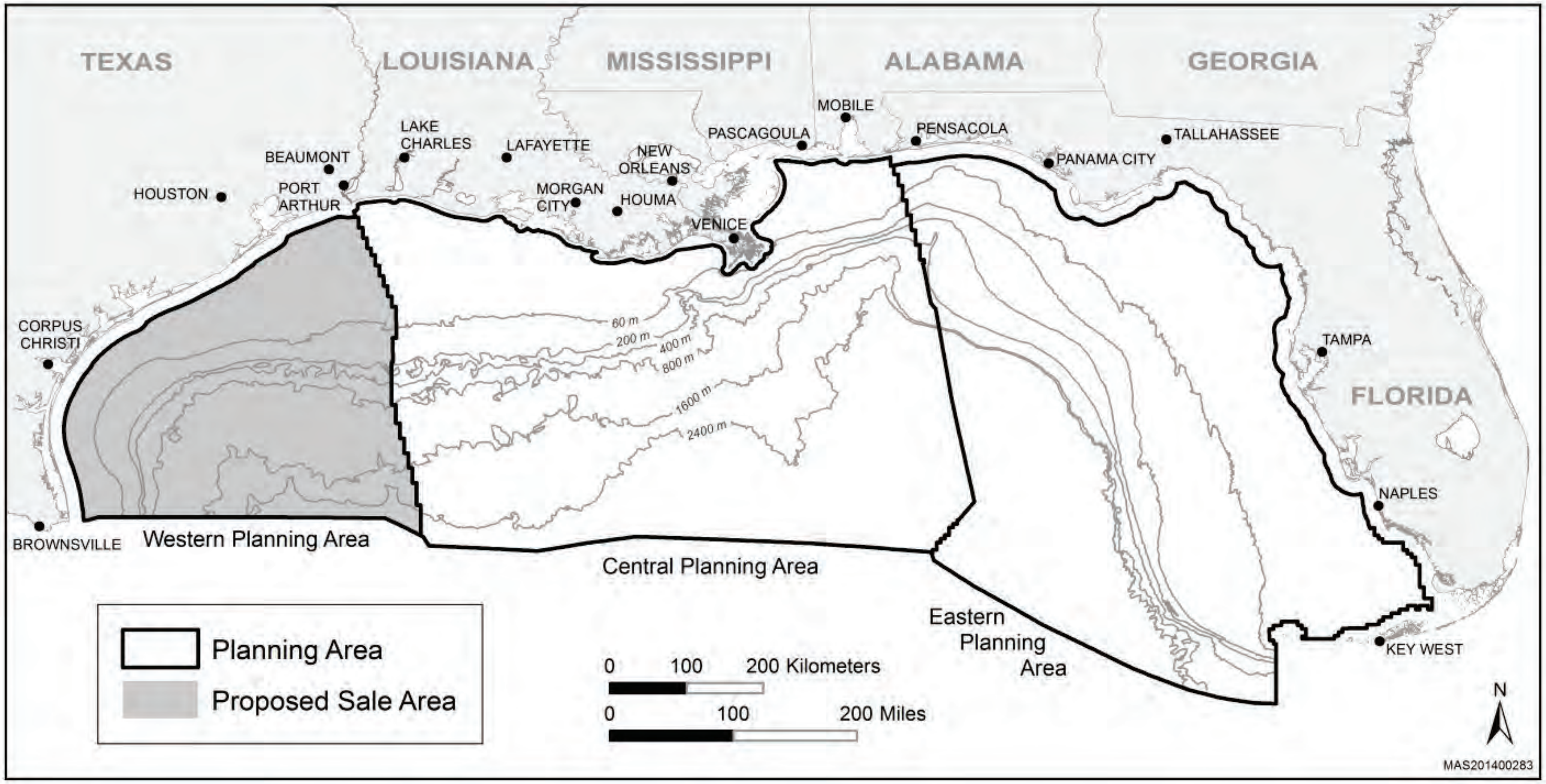

Figure 1-1. Gulf of Mexico Planning Areas, Proposed WPA Lease Sale Area, and Locations of Major Cities.

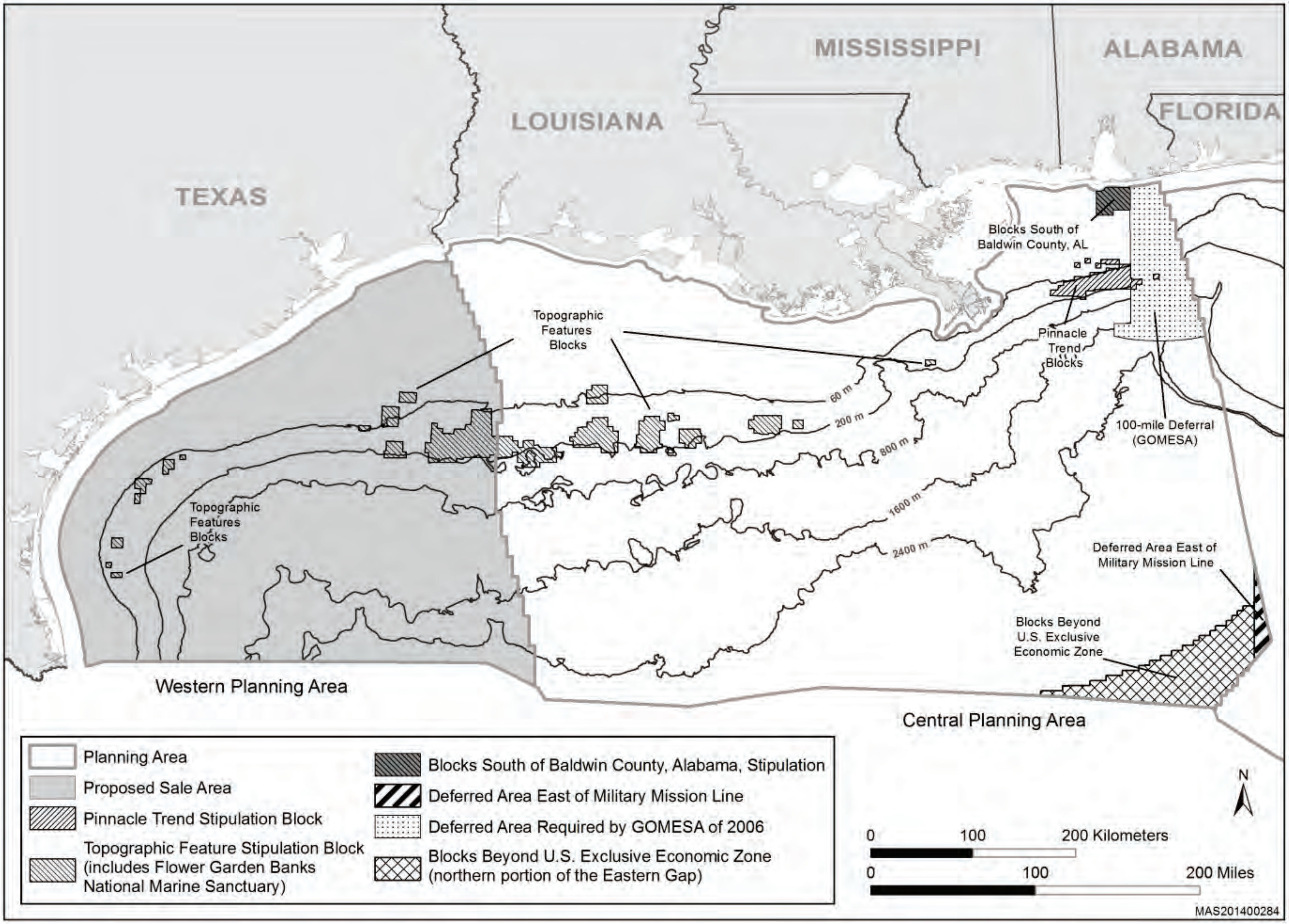

Figure 2-1. Location of Proposed Stipulations and Deferrals.

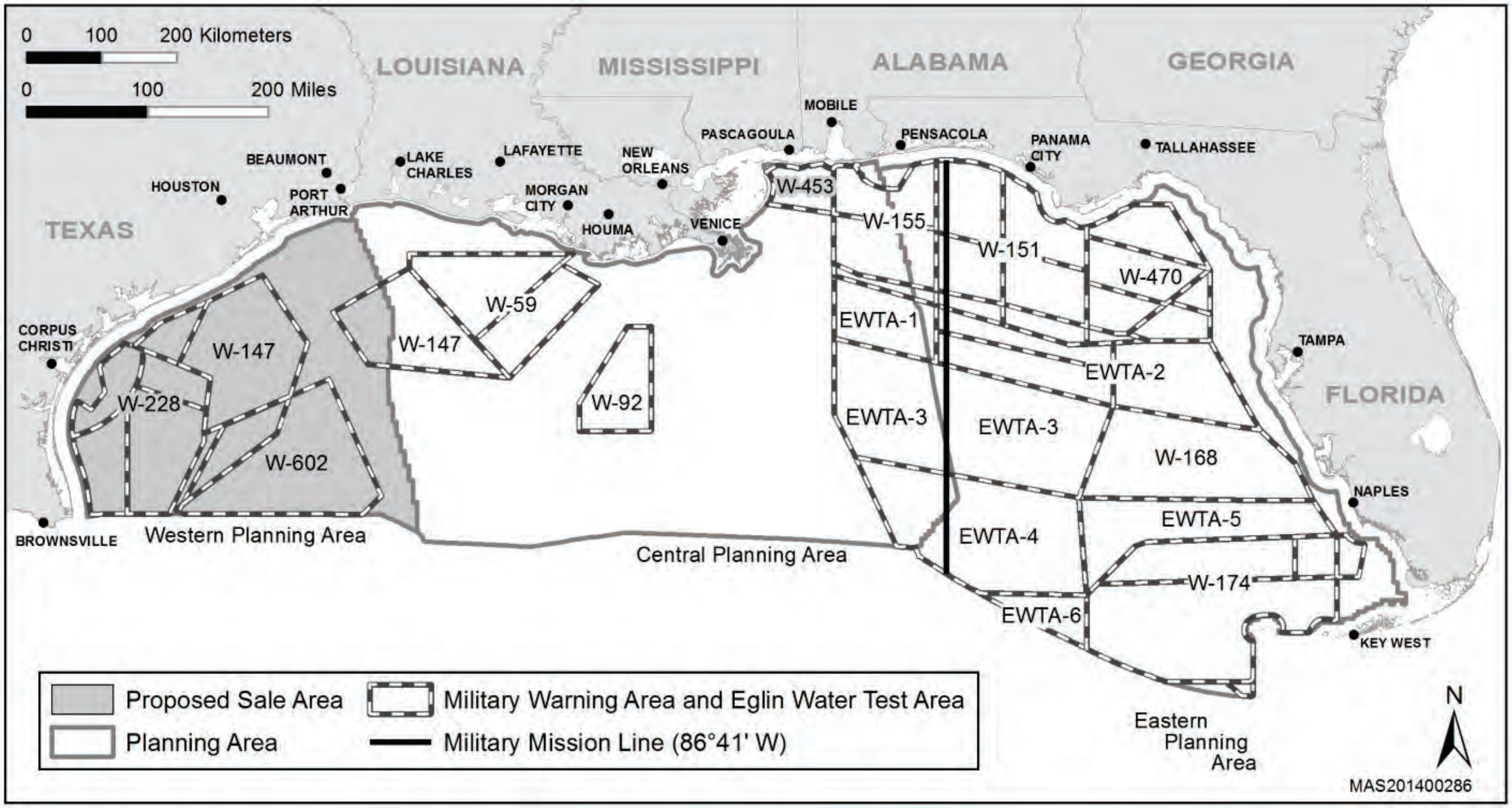

Figure 2-2. Military Warning Areas and Eglin Water Test Areas in the Gulf of Mexico.

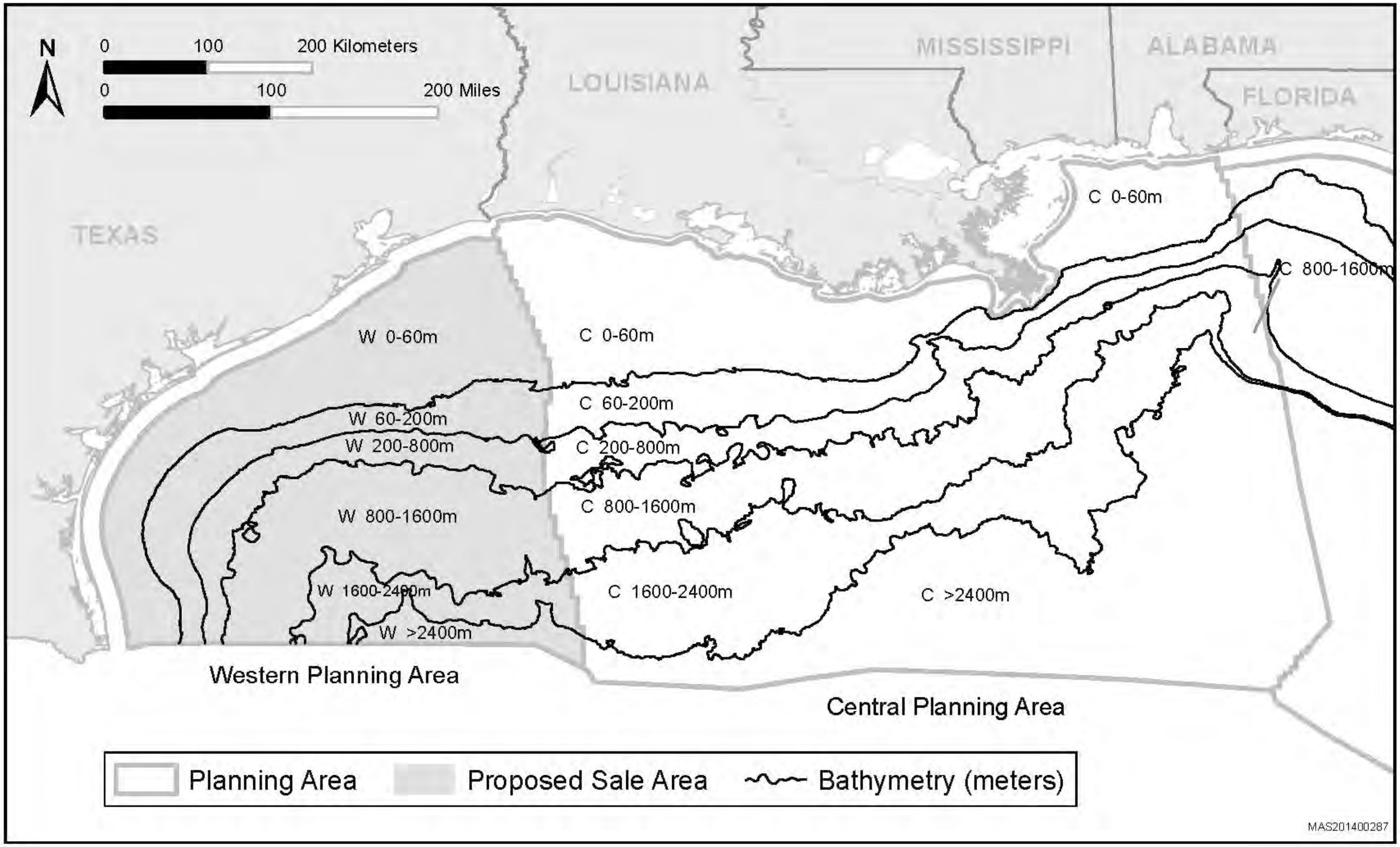

Figure 3-1. Offshore Subareas in the Gulf of Mexico.

TABLES

Table 3-1

Projected Oil and Gas in the Gulf of Mexico OCS

	Typical Lease Sale	OCS Cumulative (2012-2051)
Western Planning Area		
Reserve/Resource Production		
Oil (BBO)	0.116-0.200	2.510-3.696
Gas (Tcf)	0.538-0.938	12.539-18.434
Central Planning Area		
Reserve/Resource Production		
Oil (BBO)	0.460-0.894	15.825-21.733
Gas (Tcf)	1.939-3.903	63.347-92.691
Eastern Planning Area		
Reserve/Resource Production		
Oil (BBO)	0-0.071	0-0.211
Gas (Tcf)	0-0.162	0.0502

BBO = billion barrels of oil.
Tcf = trillion cubic feet.

Table 3-2

Offshore Scenario Information Related to a Typical Lease Sale in the Western Planning Area

	Offshore Subareas[1]						Total WPA[2]
	0-60 m	60-200 m	200-800 m	800-1,600 m	1,600-2,400 m	>2,400 m	
Wells Drilled							
Exploration and Delineation Wells	23-38	7-12	9-16	8-13	3-5	3-5	53-89
Development and Production Wells	30-49	11-17	13-21	11-18	6-8	6-8	77-121
Producing Oil Wells	4-6	2	8-13	7-11	3-4	3-4	27-40
Producing Gas Wells	22-37	7-12	3-5	2-4	1-2	1-2	36-62
Production Structures							
Installed	10-17	1-2	1	1	1	1	15-23
Removed Using Explosives	7-12	1	0	0	0	0	7-13
Total Removed	9-16	1-2	1	1	1	1	14-22
Method of Transportation[3]							
Percent Piped	>99%	>99%	>99%	>99%	83->99%		94->99%
Percent Barged	<1%	0%	0%	0%	0%		<1%
Percent Tankered[4]	0%	0%	0%	0%	0-17%		0-5%
Length of Installed Pipelines (km)[5]	71-182	NA	NA	NA	NA	NA	237-554
Service-Vessel Trips (1,000's round trips)	21-33	2-3	2-3	17	16-17	16-17	64-75
Helicopter Operations (1,000's operations)	194-448	19-54	19-24	19-24	19-24	19-24	290-605

[1] Refer to **Figure 3-1**.

[2] Subareas totals may not add up to the planning area total because of rounding.

[3] 100% of gas is assumed to be piped.

[4] Tankering is forecasted to occur only in water depths >1,600 m.

[5] Projected length of pipelines does not include length in State waters.

NA = not available.

Table 3-3

Offshore Scenario Information Related to OCS Program Activities
in the Gulf of Mexico (WPA, CPA, and EPA) for 2012-2051

	Offshore Subareas[1]						Total OCS[2]
	0-60 m	60-200 m	200-800 m	800-1,600 m	1,600-2,400 m	>2,400 m	
Wells Drilled							
Exploration and Delineation Wells	2,730-3,900	990-1,390	920-1,350	700-960	770-1,030	790-1,170	6,910-9,827
Development and Production Wells	3,380-4,820	1,240-1,730	1,130-1,670	860-1,190	950-1,280	970-1,450	8,530-12,180
Producing Oil Wells	520-701	215-278	704-1,030	574-783	663-873	620-915	3,296-4,605
Producing Gas Wells	2,510-3,629	885-1,272	306-470	196-287	187-267	250-385	4,334-6,320
Production Structures							
Installed	1,210-1,720	110-160	26-40	25-30	32-33	32-38	1,435-2,026
Removed Using Explosives	796-1,139	69-104	3-4	0	0	0	868-1,247
Total Removed	1,090-1,560	100-150	24-34	20-28	23-30	22-33	1,279-1,837
Method of Transportation[3]							
Percent Piped	>99%	>99%	>99%	>99%	87->99%		92->99%
Percent Barged	<1%	0%	0%	0%	0%		<1%
Percent Tankered[4]	0%	0%	0%	0%	0-13%		0-7%
Length of Installed Pipelines (km)[5]	10,482-21,121	NA	NA	NA	NA	NA	30,428-69,749
Service-Vessel Trips (1,000's round trips)	1,366-1,942	196-280	111-162	466-619	584-626	587-719	3,310-4,382
Helicopter Operations (1,000's operations)	24,221-47,322	2,297-4,444	595-1,174	574-1,111	676-1,287	888-1,738	28,710-55,605

[1] Refer to **Figure 3-1**.

[2] Subareas totals may not add up to the planning area total because of rounding.

[3] 100% of gas is assumed to be piped.

[4] Tankering is forecasted to occur only in water depths >1,600 m.

[5] Projected length of pipelines does not include length in State waters.

NA = not available.

Table 3-4

Offshore Scenario Information Related to OCS Program Activities
in the Western Planning Area for 2012-2051

	Offshore Subareas[1]						Total WPA[2]
	0-60 m	60-200 m	200-800 m	800-1,600 m	1,600-2,400 m	>2,400 m	
Wells Drilled							
Exploration and Delineation Wells	500-740	170-230	220-320	160-230	70-90	60-80	1,180-1,690
Development and Production Wells	620-920	220-290	270-400	190-290	80-120	70-100	1,450-2,120
Producing Oil Wells	74-109	27-38	170-255	125-191	54-77	45-67	495-737
Producing Gas Wells	476-711	163-222	70-105	45-69	16-23	15-23	785-1,153
Production Structures							
Installed	220-330	20-30	6-10	5-8	2-3	2-3	255-384
Removed Using Explosives	146-219	14-21	1	0	0	0	160-240
Total Removed	200-300	20-30	6-8	4-7	2-3	1-2	233-350
Method of Transportation[3]							
Percent Piped	>99%	>99%	>99%	>99%	50->99%		84->99%
Percent Barged	<1%	0%	0%	0%	0%		<1%
Percent Tankered[4]	0%	0%	0%	0%	0-50%		0-15%
Length of Installed Pipelines (km)[5]	1,967-4,128	NA	NA	NA	NA	NA	5,224-12,339
Service-Vessel Trips (1,000's round trips)	249-372	35-50	26-36	95-150	38-57	38-56	481-720
Helicopter Operations (1,000's operations)	4,489-8,987	418-836	125-272	104-209	42-84	42-84	5,220-10,450

[1] Refer to **Figure 3-1**.

[2] Subareas totals may not add up to the planning area total because of rounding.

[3] 100% of gas is assumed to be piped.

[4] Tankering is forecasted to occur only in water depths >1,600 m.

[5] Projected length of pipelines does not include length in State waters.

NA = not available.

Table 3-5

Annual Volume of Produced Water Discharged by Depth
(millions of bbl)

Year	Shelf 0-60 m	Shelf 60-200 m	Slope 200-400 m	Deepwater 400-800 m	Deepwater 800-1,600 m	Ultra-Deepwater 1,601-2,400 m	Ultra-Deepwater >2,400 m	Total
2000	370.6	193.1	35.5	25.6	12.2	0.0	0.0	637.0
2001	364.2	185.2	35.0	32.0	16.6	0.0	0.0	633.0
2002	344.6	180.4	32.5	35.2	21.4	0.0	0.0	614.1
2003	359.4	182.9	31.2	39.0	35.5	0.2	0.0	648.2
2004	346.7	160.5	29.3	36.9	39.2	1.9	0.0	614.5
2005	270.1	113.5	23.1	33.5	43.0	5.8	0.0	489.0
2006	260.3	99.7	20.6	35.1	61.5	12.4	0.0	489.6
2007	307.0	139.4	22.2	40.0	70.3	15.5	0.1	594.5
2008	252.7	118.6	15.9	32.7	60.1	16.5	0.1	496.6
2009	263.9	108.3	19.9	39.2	65.3	25.0	0.1	521.7
2010	275.8	115.7	20.9	40.7	56.7	32.5	0.1	542.4
2011	271.3	116.9	20.5	39.7	67.7	32.2	0.1	548.4
2012	237.2	109.0	20.8	35.0	71.3	31.8	0.1	505.2
2013	242.0	103.0	19.9	31.8	75.4	35.3	0.3	507.7

Source: Langley, official communication, 2014.

Table 4-1

Unusual Mortality Event Cetacean Data for the Northern Gulf of Mexico

Cetaceans Stranded	Phase of Oil-Spill Response	Dates
114 cetaceans stranded	Prior to the response phase for the oil spill	February 1, 2010-April 29, 2010
121 cetaceans stranded or were reported dead offshore	During the initial response phase to the oil spill	April 30, 2010-November 2, 2010
1,060 cetaceans stranded*	After the initial response phase ended	November 3, 2010-November 16, 2014**

Note: Numbers are preliminary and may be subject to change. As of December 14, 2014, the unusual mortality event involves 1,295 cetacean “strandings” in the northern Gulf of Mexico (USDOC, NMFS, 2014).

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

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

Table 4-2

Number of Angler Trips in 2009, 2010, 2011, 2012, and 2013

2009									
	Season A			Season B			Annual Total		
Area	Private	Charter	Total	Private	Charter	Total	Private	Charter	Total
Bay	291,400	33,256	324,655	573,978	82,242	656,220	865,377	115,498	980,875
TTS	3,804	431	4,235	29,060	2,394	31,454	32,864	2,825	35,689
EEZ	252	0	252	20,874	3,336	24,211	21,127	3,336	24,463
Total	295,456	33,687	329,143	623,912	87,972	711,885	919,368	121,659	1,041,027
2010									
	Season A			Season B			Annual Total		
Area	Private	Charter	Total	Private	Charter	Total	Private	Charter	Total
Bay	255,995	23,570	279,565	567,522	93,650	661,171	823,517	117,220	940,737
TTS	3,250	2,187	5,437	22,837	2,052	24,888	26,087	4,239	30,326
EEZ	744	0	744	14,129	1,602	15,731	14,873	1,602	16,475
Total	259,989	25,758	285,747	604,487	97,303	701,791	864,476	123,061	987,537
2011									
	Season A			Season B			Annual Total		
Area	Private	Charter	Total	Private	Charter	Total	Private	Charter	Total
Bay	330,461	29,842	360,303	576,735	122,855	699,590	907,196	152,697	1,059,893
TTS	14,830	4,779	19,609	24,372	2,988	27,360	39,202	7,767	46,969
EEZ	1,424	850	2,274	15,138	1,126	16,264	16,562	1,976	18,538
Total	346,715	35,471	382,186	616,245	126,969	743,214	962,960	162,440	1,125,400
2012									
	Season A			Season B			Annual Total		
Area	Private	Charter	Total	Private	Charter	Total	Private	Charter	Total
Bay	331,889	87,696	419,585	563,656	134,502	698,158	895,545	222,198	1,117,743
TTS	7,563	1,172	8,735	15,375	1,622	16,997	22,938	2,794	25,732
EEZ	1,270	0	1,270	12,668	1,774	14,442	13,938	1,774	15,712
Total	340,722	88,868	429,590	591,699	137,898	729,597	932,421	226,766	1,159,187
2013									
	Season A			Season B			Annual Total		
Area	Private	Charter	Total	Private	Charter	Total	Private	Charter	Total
Bay	350,918	39,054	389,972	613,508	101,135	714,643	964,426	140,189	1,104,615
TTS	5,193	111	5,304	18,559	2,269	20,828	23,752	2,380	26,132
EEZ	989	575	1,564	15,695	1,592	17,286	16,684	2,166	18,850
Total	357,100	39,740	396,840	647,761	104,996	752,757	1,004,861	144,735	1,149,597

Notes: (1) Season A is November 21 - May 14 and Season B is May 15 - November 20.
(2) These data are presented in terms of person-trips. This means that, if multiple people go fishing at the same time on the same boat, it is counted as multiple trips.

EEZ = Exclusive Economic Zone.
TTS = Texas Territorial Sea.

Source: Fisher, official communication 2014.

Table 4-3

Top Species Landed by Recreational Fishermen

Panel A: Total Landings						Panel B: Landings in Bays					
Species	2009	2010	2011	2012	2013	Species	2009	2010	2011	2012	2013
Atlantic Croaker	117	124	156	157	152	Atlantic Croaker	117	124	154	156	151
Black Drum	98	165	129	256	150	Black Drum	97	164	127	256	150
King Mackerel	16	6	9	9	10	King Mackerel	--	--	--	--	--
Red Drum	285	264	347	323	269	Red Drum	277	261	344	321	266
Red Snapper	31	33	36	34	47	Red Snapper	--	--	--	--	--
Sand Seatrout	111	127	226	177	151	Sand Seatrout	108	126	220	169	150
Sheepshead	34	49	57	143	84	Sheepshead	34	49	57	143	84
Southern Flounder	47	30	92	96	92	Southern Flounder	47	30	92	96	92
Spotted Seatrout	810	732	1,137	810	795	Spotted Seatrout	789	721	1,119	798	789
Panel C: Landings in State Waters						Panel D: Landings in EEZ					
Species	2009	2010	2011	2012	2013	Species	2009	2010	2011	2012	2013
Atlantic Croaker	--	--	2	1	--	Atlantic Croaker	--	--	--	--	1
Black Drum	1	--	2	--	--	Black Drum	--	1	--	--	--
King Mackerel	7	5	5	4	4	King Mackerel	9	1	4	5	6
Red Drum	8	--	3	2	2	Red Drum	1	3	--	--	1
Red Snapper	13	12	22	21	30	Red Snapper	19	21	14	13	17
Sand Seatrout	2	1	5	8	1	Sand Seatrout	1	1	1	--	--
Sheepshead	--	--	--	--	--	Sheepshead	--	--	--	--	--
Southern Flounder	--	--	--	--	--	Southern Flounder	--	--	--	--	--
Spotted Seatrout	14	--	18	11	6	Spotted Seatrout	8	10	--	1	--

Notes: (1) Fish landings are presented in thousands of fish.
(2) The Texas Parks and Wildlife Department presents data in terms of two seasons: Season A is November 21 - May 14 and Season B is May 15 - November 20. Therefore, the annual data reflect combined catch for Seasons A and B. For example, the catch data for 2013 reflects catch from November 21, 2012, to November 20, 2013.

EEZ = Exclusive Economic Zone.

Source: Fisher, official communication, 2014.

Table 4-4

Employment in the Leisure/Hospitality Industry in Selected Geographic Regions

Region	2008	2009	2010	2011	2012	2013
Panel A: Economic Impact Area (EIA)						
TX-1	54,551	53,772	54,750	56,753	60,670	62,260
TX-2	16,883	16,718	16,934	18,197	19,915	20,384
TX-3	240,231	240,425	244,821	253,071	267,390	280,953
LA-1	14,295	14,214	13,979	14,489	14,635	14,693
LA-2	21,364	20,675	20,618	21,345	22,137	23,054
LA-3	46,037	44,414	44,796	47,121	48,930	50,014
LA-4	68,605	68,161	72,757	76,552	78,978	80,842
MS-1	27,702	26,904	26,981	27,826	28,409	29,064
AL-1	26,516	25,872	26,925	27,300	28,307	29,867
FL-1	40,001	41,002	42,550	45,160	46,720	48,519
FL-2	22,502	21,689	22,111	22,466	23,579	24,424
FL-3	146,368	142,302	145,324	148,103	158,030	166,107
FL-4	283,359	279,839	289,247	304,093	319,912	333,866
TX EIA total	311,665	310,915	316,505	328,021	347,975	363,597
LA EIA total	150,301	147,464	152,150	159,507	164,680	168,603
MS EIA total	27,702	26,904	26,981	27,826	28,409	29,064
AL EIA total	26,516	25,872	26,925	27,300	28,307	29,867
FL EIA total	492,230	484,832	499,232	519,822	548,241	572,916
EIA total	1,008,414	995,987	1,021,793	1,062,476	1,117,612	1,164,047
Panel B: Coastal						
TX	67,087	67,818	68,260	71,041	75,895	77,772
LA	45,545	45,418	49,432	51,742	53,802	55,479
MS	25,575	25,055	25,186	25,900	26,353	27,015
AL	24,319	23,825	24,816	25,145	25,941	27,354
FL	386,892	383,959	396,485	415,379	437,509	454,677
Coastal total	549,418	546,075	564,179	589,207	619,500	1,164,047
Panel C: Statewide						
TX	995,445	982,840	1,006,277	1,039,839	1,094,916	1,137,190
LA	194,905	190,589	194,387	202,704	208,284	213,627
MS	121,033	115,868	116,204	117,874	120,472	123,294
AL	168,413	165,953	165,230	166,671	170,854	176,078
FL	922,534	896,383	929,448	962,616	1,011,874	1,050,263
State total	2,402,330	2,351,633	2,411,546	2,489,704	2,606,400	2,700,452

Notes: (1) The EIAs are defined in Figure 4-20 of the 2012-2017 WPA/CPA Multisale EIS.
(2) The "Coastal" category refers to the counties/parishes within the EIAs that are directly along the coast of the U.S.
(3) The "Statewide" category refers to the number of employees within the borders of the entire state.
(4) The leisure/hospitality industry is defined according to the North American Industrial Classification System (NAICS).
(5) The employment figure for any given year corresponds to the total number of employees in December of that year.
(6) Data for 2013 are preliminary.

Source: U.S. Dept. of Labor, Bureau of Labor Statistics, 2014.

Table 4-5

Baseline Population Projections (in thousands) by Economic Impact Area

Calendar Year	TX-1	TX-2	TX-3	LA-1	LA-2	LA-3	LA-4	MS-1	AL-1	FL-1	FL-2	FL-3	FL-4	Total
2010	1,799.29	626.91	6,202.21	346.02	585.06	1,142.41	1,242.69	482.30	725.87	882.80	659.96	3,626.40	6,170.12	24,492.03
2011	1,827.28	633.41	6,309.03	346.51	588.41	1,147.53	1,260.01	486.36	727.78	889.79	661.80	3,663.94	6,273.04	24,814.88
2012	1,856.04	642.00	6,421.63	349.98	596.10	1,162.47	1,267.26	490.07	734.42	900.02	669.64	3,716.36	6,352.84	25,158.82
2013	1,885.42	650.77	6,536.83	353.51	603.94	1,177.70	1,274.66	493.86	741.19	910.45	677.64	3,769.85	6,434.20	25,510.00
2014	1,915.39	659.71	6,654.44	357.09	611.91	1,193.18	1,282.17	497.70	748.05	921.04	685.77	3,824.28	6,516.92	25,867.66
2015	1,945.76	668.77	6,773.88	360.70	619.95	1,208.79	1,289.69	501.55	754.94	931.71	693.97	3,879.31	6,600.40	26,229.40
2016	1,976.53	677.92	6,895.11	364.32	628.07	1,224.52	1,297.18	505.40	761.85	942.45	702.22	3,934.90	6,684.57	26,595.04
2017	2,007.70	687.19	7,018.20	367.96	636.25	1,240.39	1,304.67	509.25	768.79	953.27	710.54	3,991.09	6,769.48	26,964.77
2018	2,039.30	696.57	7,143.18	371.61	644.52	1,256.39	1,312.15	513.12	775.75	964.17	718.93	4,047.88	6,855.15	27,338.71
2019	2,071.28	706.06	7,269.96	375.28	652.85	1,272.50	1,319.60	516.98	782.72	975.13	727.37	4,105.22	6,941.47	27,716.42
2020	2,103.58	715.61	7,398.25	378.95	661.22	1,288.68	1,326.97	520.81	789.68	986.10	735.84	4,162.92	7,028.15	28,096.76
2021	2,135.87	725.16	7,526.82	382.55	669.51	1,304.66	1,334.05	524.53	796.47	996.93	744.21	4,220.25	7,113.95	28,474.96
2022	2,168.66	734.83	7,657.62	386.18	677.90	1,320.85	1,341.17	528.27	803.33	1,007.88	752.67	4,278.36	7,200.81	28,858.52
2023	2,201.95	744.63	7,790.70	389.85	686.40	1,337.24	1,348.33	532.04	810.24	1,018.94	761.23	4,337.28	7,288.72	29,247.53
2024	2,235.76	754.56	7,926.09	393.55	695.00	1,353.83	1,355.52	535.84	817.21	1,030.13	769.88	4,397.01	7,377.71	29,642.07
2025	2,270.08	764.62	8,063.83	397.29	703.71	1,370.62	1,362.75	539.66	824.24	1,041.44	778.64	4,457.56	7,467.78	30,042.22
2026	2,303.74	774.46	8,199.25	400.82	712.11	1,386.74	1,369.29	543.19	830.83	1,052.24	787.03	4,516.22	7,554.49	30,430.40
2027	2,337.89	784.42	8,336.94	404.39	720.60	1,403.06	1,375.85	546.75	837.47	1,063.16	795.52	4,575.65	7,642.20	30,823.90
2028	2,372.55	794.51	8,476.95	407.99	729.20	1,419.56	1,382.44	550.32	844.17	1,074.19	804.10	4,635.86	7,730.93	31,222.78
2029	2,407.73	804.73	8,619.31	411.62	737.89	1,436.26	1,389.07	553.93	850.92	1,085.34	812.77	4,696.86	7,820.70	31,627.13
2030	2,443.43	815.09	8,764.06	415.28	746.69	1,453.15	1,395.73	557.55	857.73	1,096.60	821.53	4,758.67	7,911.50	32,037.01
2031	2,478.42	825.19	8,906.20	418.73	755.15	1,469.33	1,401.68	560.87	864.08	1,107.33	829.92	4,818.43	7,998.73	32,434.07
2032	2,513.92	835.42	9,050.64	422.21	763.70	1,485.69	1,407.66	564.21	870.48	1,118.16	838.39	4,878.94	8,086.92	32,836.35
2033	2,549.93	845.78	9,197.43	425.72	772.35	1,502.22	1,413.67	567.56	876.92	1,129.10	846.95	4,940.22	8,176.08	33,243.94

Table 4-5. Baseline Population Projections (in thousands) by Economic Impact Area (continued).

Calendar Year	TX-1	TX-2	TX-3	LA-1	LA-2	LA-3	LA-4	MS-1	AL-1	FL-1	FL-2	FL-3	FL-4	Total
2034	2,586.45	856.27	9,346.60	429.26	781.10	1,518.95	1,419.70	570.94	883.42	1,140.15	855.59	5,002.26	8,266.22	33,656.90
2035	2,623.50	866.88	9,498.19	432.83	789.95	1,535.86	1,425.76	574.34	889.96	1,151.30	864.33	5,065.08	8,357.36	34,075.32
2036	2,660.18	877.35	9,648.20	436.24	798.54	1,552.22	1,431.30	577.50	896.15	1,162.06	872.78	5,126.41	8,445.87	34,484.81
2037	2,697.38	887.95	9,800.57	439.68	807.22	1,568.76	1,436.88	580.69	902.39	1,172.92	881.32	5,188.48	8,535.33	34,899.56
2038	2,735.09	898.67	9,955.36	443.14	816.00	1,585.48	1,442.47	583.89	908.67	1,183.87	889.94	5,251.30	8,625.73	35,319.62
2039	2,773.34	909.53	10,112.59	446.63	824.88	1,602.38	1,448.08	587.10	915.00	1,194.93	898.64	5,314.89	8,717.09	35,745.07
2040	2,812.12	920.51	10,272.30	450.15	833.85	1,619.45	1,453.72	590.34	921.37	1,206.10	907.43	5,379.25	8,809.42	36,175.99
2041	2,851.44	931.63	10,434.53	453.69	842.92	1,636.71	1,459.38	593.59	927.78	1,217.36	916.31	5,444.38	8,902.73	36,612.44
2042	2,891.31	942.88	10,599.33	457.27	852.08	1,654.15	1,465.06	596.86	934.24	1,228.74	925.27	5,510.30	8,997.02	37,054.50
2043	2,931.73	954.27	10,766.73	460.87	861.35	1,671.78	1,470.76	600.15	940.74	1,240.22	934.32	5,577.02	9,092.31	37,502.25
2044	2,972.73	965.79	10,936.77	464.50	870.72	1,689.59	1,476.49	603.46	947.29	1,251.80	943.46	5,644.55	9,188.62	37,955.76
2045	3,014.29	977.46	11,109.50	468.16	880.19	1,707.59	1,482.24	606.79	953.88	1,263.50	952.69	5,712.90	9,285.94	38,415.11
2046	3,056.44	989.26	11,284.95	471.84	889.76	1,725.79	1,488.01	610.13	960.52	1,275.30	962.01	5,782.07	9,384.29	38,880.38
2047	3,099.18	1,001.21	11,463.18	475.56	899.44	1,744.18	1,493.80	613.49	967.21	1,287.22	971.41	5,852.09	9,483.69	39,351.64
2048	3,142.51	1,013.30	11,644.22	479.31	909.22	1,762.77	1,499.61	616.87	973.94	1,299.24	980.92	5,922.95	9,584.13	39,828.99
2049	3,186.45	1,025.54	11,828.12	483.08	919.11	1,781.55	1,505.45	620.27	980.72	1,311.38	990.51	5,994.66	9,685.65	40,312.49
2050	3,231.01	1,037.93	12,014.93	486.88	929.10	1,800.54	1,511.31	623.69	987.55	1,323.63	1,000.20	6,067.25	9,788.23	40,802.24
2051	3,276.18	1,050.46	12,204.68	490.72	939.21	1,819.72	1,517.19	627.13	994.42	1,336.00	1,009.98	6,140.71	9,891.91	41,298.32
2052	3,321.99	1,063.15	12,397.44	494.58	949.42	1,839.11	1,523.10	630.58	1,001.34	1,348.48	1,019.86	6,215.07	9,996.68	41,800.81
2053	3,368.44	1,075.99	12,593.23	498.48	959.75	1,858.71	1,529.03	634.06	1,008.31	1,361.07	1,029.84	6,290.32	10,102.56	42,309.80
2054	3,415.54	1,088.98	12,792.12	502.41	970.19	1,878.52	1,534.98	637.55	1,015.33	1,373.79	1,039.91	6,366.49	10,209.56	42,825.37
2055	3,463.30	1,102.13	12,994.15	506.36	980.74	1,898.54	1,540.95	641.06	1,022.40	1,386.62	1,050.08	6,443.58	10,317.70	43,347.62
2014/2055 growth	1.46%	1.26%	1.65%	0.86%	1.16%	1.14%	0.45%	0.62%	0.76%	1.00%	1.04%	1.28%	1.13%	1.27%

Notes: Actual Woods & Poole data for 2010 through 2020, 2025, 2030, 2035, and 2040.
Missing estimates through 2040 calculated using average annual growth rate for the 5-year period; projections after 2040 calculated using the average annual growth rate from 2035 to 2040.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-6

Demographic and Employment Baseline Projections for Economic Impact Area AL-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	692.65	725.87	727.78	734.42	741.19	748.05	754.94	782.72	824.24	857.73	921.37
Age under 19 years	28.1%	27.1%	26.7%	26.6%	26.5%	26.4%	26.3%	26.2%	25.9%	25.5%	24.6%
Age 20 to 34	18.7%	18.6%	18.8%	18.8%	18.7%	18.6%	18.4%	17.5%	16.7%	16.4%	16.9%
Age 35 to 49	21.3%	19.7%	19.3%	19.0%	18.8%	18.6%	18.5%	18.5%	18.6%	18.5%	17.4%
Age 50 to 64	18.3%	20.1%	20.4%	20.5%	20.6%	20.6%	20.7%	20.1%	18.6%	17.8%	18.5%
Age 65 and over	13.5%	14.4%	14.7%	15.1%	15.5%	15.8%	16.2%	17.6%	20.2%	21.8%	22.6%
Median Age of Population (years)	38.2	39.9	40.2	40.5	40.8	41.0	41.2	41.8	43.0	43.8	45.1
White Population (in thousands)	66.2%	65.2%	65.0%	65.0%	64.9%	64.8%	64.7%	64.4%	63.7%	63.2%	62.2%
Black Population (in thousands)	29.6%	29.6%	29.6%	29.6%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.2%
Native American Population (in thousands)	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%
Asian and Pacific Islander Population (in thousands)	1.2%	1.4%	1.4%	1.5%	1.5%	1.5%	1.5%	1.6%	1.8%	1.9%	2.1%
Hispanic or Latino Population (in thousands)	1.9%	2.7%	2.8%	2.9%	3.0%	3.1%	3.1%	3.4%	3.9%	4.3%	5.4%
Male Population (in thousands)	48.3%	48.4%	48.4%	48.4%	48.4%	48.4%	48.4%	48.5%	48.5%	48.5%	48.4%
Total Employment (in thousands of jobs)	363.84	374.37	375.73	381.01	386.35	391.77	397.25	419.86	455.94	488.10	558.68
Farm Employment	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.2%	1.1%	1.0%
Forestry, Fishing, Related Activities	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.8%	0.8%
Mining	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%
Utilities	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%
Construction	8.5%	7.4%	6.3%	6.3%	6.2%	6.2%	6.2%	6.0%	5.8%	5.7%	5.3%
Manufacturing	8.7%	7.2%	7.5%	7.4%	7.2%	7.1%	7.0%	6.5%	5.9%	5.4%	4.5%
Wholesale Trade	3.5%	3.0%	3.2%	3.1%	3.1%	3.1%	3.1%	3.0%	2.9%	2.8%	2.6%
Retail Trade	12.4%	11.8%	11.9%	11.9%	11.8%	11.8%	11.7%	11.6%	11.3%	11.0%	10.5%
Transportation and Warehousing	3.7%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.5%	3.3%	3.2%	3.0%
Information Employment	1.3%	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%
Finance and Insurance	3.4%	3.8%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.2%	4.1%
Real Estate/Rental and Lease	4.4%	5.1%	5.1%	5.1%	5.1%	5.1%	5.1%	5.1%	5.1%	5.0%	5.0%
Professional and Technical Services	4.4%	4.6%	4.6%	4.6%	4.7%	4.7%	4.7%	4.8%	5.0%	5.1%	5.3%

Table 4-6. Demographic and Employment Baseline Projections for Economic Impact Area AL-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Management	0.2%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.6%
Administrative and Waste Services	6.4%	7.2%	7.1%	7.2%	7.2%	7.3%	7.3%	7.6%	7.9%	8.2%	8.8%
Educational Services	1.4%	1.7%	1.8%	1.9%	1.9%	1.9%	1.9%	2.0%	2.2%	2.4%	2.6%
Health Care and Social Assistance	8.5%	9.4%	9.5%	9.6%	9.7%	9.8%	10.0%	10.4%	11.1%	11.7%	12.9%
Arts, Entertainment, and Recreation	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.4%	1.4%	1.4%
Accommodation and Food Services	6.8%	7.3%	7.6%	7.7%	7.8%	7.8%	7.9%	8.2%	8.7%	9.1%	9.8%
Other Services, Except Public Administration	7.7%	8.1%	8.1%	8.2%	8.3%	8.3%	8.4%	8.7%	9.1%	9.4%	10.1%
Federal Civilian Government	0.9%	1.0%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.8%	0.7%	0.6%
Federal Military	1.3%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.0%	0.9%	0.8%
State and Local Government	12.0%	11.6%	11.4%	11.3%	11.2%	11.1%	11.0%	10.6%	10.1%	9.6%	8.7%
Total Earnings (in millions of 2005 dollars)	14,014.96	14,966.90	15,143.01	15,422.61	15,761.05	16,106.59	16,459.36	17,945.78	20,419.98	22,730.96	28,142.17
Farm	0.8%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%
Forestry, Fishing, Related Activities	1.0%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.0%	0.9%
Mining	0.4%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%
Utilities	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.8%
Construction	8.9%	8.6%	6.9%	6.9%	6.8%	6.7%	6.7%	6.4%	6.0%	5.6%	5.0%
Manufacturing	13.6%	12.4%	13.1%	13.0%	12.9%	12.7%	12.6%	12.0%	11.1%	10.4%	9.1%
Wholesale Trade	5.2%	4.7%	4.8%	4.8%	4.8%	4.8%	4.8%	4.7%	4.7%	4.6%	4.4%
Retail Trade	8.9%	8.1%	8.1%	8.1%	8.0%	7.9%	7.8%	7.5%	7.0%	6.5%	5.8%
Transportation and Warehousing	4.8%	5.3%	5.5%	5.4%	5.4%	5.4%	5.3%	5.1%	4.9%	4.7%	4.2%
Information	1.6%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%
Finance and Insurance	4.9%	4.2%	6.0%	6.1%	6.1%	6.1%	6.1%	6.2%	6.3%	6.4%	6.4%
Real Estate/Rental and Lease	2.3%	2.1%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.9%
Professional and Technical Services	5.5%	5.7%	5.7%	5.8%	5.9%	5.9%	6.0%	6.2%	6.6%	6.9%	7.6%
Management	0.3%	0.5%	0.6%	0.5%	0.5%	0.5%	0.5%	0.6%	0.8%	0.9%	1.2%
Administrative and Waste Services	3.7%	4.3%	3.9%	4.0%	4.1%	4.1%	4.2%	4.4%	4.7%	4.9%	5.5%
Educational Services	0.9%	1.0%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.3%	1.4%	1.7%
Health Care and Social Assistance	9.8%	10.9%	10.8%	11.0%	11.2%	11.3%	11.5%	12.1%	13.1%	14.0%	15.8%
Arts, Entertainment, and Recreation	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Accommodation and Food Services	3.2%	3.4%	3.5%	3.6%	3.6%	3.7%	3.7%	3.9%	4.1%	4.3%	4.7%
Other Services, Except Public Administration	4.8%	5.1%	5.1%	5.1%	5.2%	5.2%	5.3%	5.4%	5.7%	5.9%	6.3%

Table 4-6. Demographic and Employment Baseline Projections for Economic Impact Area AL-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Federal Civilian Government	2.2%	2.3%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.1%	2.0%
Federal Military	1.8%	1.7%	1.7%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.5%	1.5%
State and Local Government	13.8%	14.6%	14.1%	14.1%	14.0%	14.0%	13.9%	13.7%	13.3%	13.0%	12.2%
Total Personal Income per Capita (in 2005 dollars)	29,183	31,525	32,073	32,315	32,647	33,020	33,425	35,293	38,730	42,084	50,167
Woods & Poole Economics Wealth Index (U.S. = 100)	68.7	73.2	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.7
Persons per Household (in number of people)	2.5	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.6
Mean Household Total Personal Income (in 2005 dollars)	74,227	80,979	82,094	83,334	83,643	84,101	84,687	88,368	96,803	105,827	128,090
Number of Households (in thousands)	272.33	282.58	284.33	284.79	289.29	293.70	297.97	312.61	329.76	341.10	360.86
Income <$10,000 (thousands of households, 2000$)	11.7%	12.0%	11.7%	11.4%	11.4%	11.2%	11.1%	10.5%	9.2%	8.1%	6.3%
Income $10,000 to $19,999	14.3%	14.4%	14.5%	14.4%	14.3%	14.1%	13.9%	13.2%	11.7%	10.4%	8.2%
Income $20,000 to $29,999	12.7%	12.9%	12.8%	12.9%	12.9%	12.7%	12.6%	12.0%	10.8%	9.6%	7.7%
Income $30,000 to $44,999	16.3%	15.6%	15.7%	15.4%	15.4%	15.3%	15.2%	14.8%	13.6%	12.4%	9.9%
Income $45,000 to $59,999	13.0%	12.9%	12.7%	12.8%	12.9%	13.0%	13.1%	13.5%	14.2%	14.0%	12.0%
Income $60,000 to $74,999	9.0%	9.2%	9.7%	9.8%	9.8%	9.9%	10.0%	10.6%	11.9%	13.2%	14.8%
Income $75,000 to $99,999	10.4%	10.3%	10.3%	10.5%	10.6%	10.7%	10.8%	11.4%	12.9%	14.5%	18.4%
Income $100,000 or more	12.6%	12.7%	12.6%	12.8%	12.9%	13.0%	13.2%	14.0%	15.8%	17.8%	22.7%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-7

Demographic and Employment Baseline Projections for Economic Impact Area FL-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	861.80	882.80	889.79	900.02	910.45	921.04	931.71	975.13	1,041.44	1,096.60	1,206.10
Age Under 19 Years	26.1%	25.0%	24.5%	24.3%	24.2%	24.1%	24.1%	24.3%	24.5%	24.3%	23.6%
Age 20 to 34	20.1%	20.5%	20.9%	21.1%	21.1%	21.1%	20.9%	19.8%	18.0%	17.4%	18.6%
Age 35 to 49	22.3%	20.1%	19.5%	18.9%	18.4%	18.0%	17.8%	17.9%	19.1%	19.7%	17.4%
Age 50 to 64	18.2%	20.1%	20.6%	20.7%	20.8%	20.9%	21.0%	20.4%	18.3%	16.4%	17.9%
Age 65 and over	13.3%	14.3%	14.6%	15.0%	15.5%	15.8%	16.2%	17.5%	20.1%	22.2%	22.6%
Median Age of Population (years)	39.5	40.3	40.5	40.6	40.7	40.8	40.8	41.1	41.7	42.4	42.7
White Population (in thousands)	79.1%	77.2%	76.8%	76.6%	76.4%	76.2%	76.0%	75.1%	73.8%	72.6%	70.1%
Black Population (in thousands)	13.5%	14.0%	14.2%	14.2%	14.2%	14.3%	14.3%	14.5%	14.7%	14.9%	15.1%
Native American Population (in thousands)	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.7%	0.6%	0.5%
Asian and Pacific Islander Population (in thousands)	2.5%	2.8%	2.8%	2.9%	2.9%	2.9%	2.9%	3.0%	3.2%	3.3%	3.4%
Hispanic or Latino Population (in thousands)	4.0%	5.1%	5.4%	5.6%	5.7%	5.9%	6.0%	6.7%	7.7%	8.7%	10.9%
Male Population (in thousands)	50.1%	50.2%	50.2%	50.2%	50.3%	50.3%	50.3%	50.4%	50.7%	50.8%	51.1%
Total Employment (in thousands of jobs)	487.45	474.27	481.21	487.94	494.78	501.71	508.69	537.52	583.42	624.20	713.24
Farm Employment	0.5%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%
Mining	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Utilities	0.3%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%
Construction	9.0%	6.1%	5.8%	5.8%	5.8%	5.7%	5.7%	5.6%	5.4%	5.3%	4.9%
Manufacturing	3.4%	2.9%	2.8%	2.8%	2.7%	2.7%	2.6%	2.4%	2.1%	1.9%	1.5%
Wholesale Trade	2.6%	2.2%	2.1%	2.1%	2.1%	2.1%	2.0%	2.0%	1.9%	1.9%	1.7%
Retail Trade	12.0%	11.2%	11.3%	11.3%	11.3%	11.3%	11.3%	11.2%	11.0%	10.9%	10.5%
Transportation and Warehousing	1.8%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.7%	1.7%
Information Employment	1.9%	1.5%	1.4%	1.4%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.1%
Finance and Insurance	3.6%	4.2%	4.1%	4.1%	4.2%	4.2%	4.2%	4.3%	4.4%	4.4%	4.6%
Real Estate/Rental and Lease	5.5%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.7%	5.7%	5.7%	5.7%

Table 4-7. Demographic and Employment Baseline Projections for Economic Impact Area FL-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Professional and Technical Services	5.2%	5.8%	5.8%	5.9%	6.0%	6.0%	6.1%	6.4%	6.8%	7.2%	8.0%
Management	0.5%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.9%	1.0%	1.1%	1.3%
Administrative and Waste Services	7.0%	6.6%	6.8%	6.9%	6.9%	7.0%	7.0%	7.3%	7.6%	7.9%	8.5%
Educational Services	1.0%	1.3%	1.3%	1.3%	1.3%	1.4%	1.4%	1.4%	1.5%	1.6%	1.8%
Health Care and Social Assistance	8.9%	10.3%	10.1%	10.2%	10.2%	10.3%	10.4%	10.6%	11.0%	11.3%	11.8%
Arts, Entertainment, and Recreation	1.7%	2.0%	2.0%	2.0%	2.1%	2.1%	2.1%	2.2%	2.3%	2.4%	2.6%
Accommodation and Food Services	8.8%	9.4%	10.0%	10.1%	10.1%	10.2%	10.2%	10.4%	10.7%	10.9%	11.3%
Other Services, Except Public Administration	6.2%	6.1%	6.0%	6.0%	6.0%	6.1%	6.1%	6.2%	6.3%	6.3%	6.5%
Federal Civilian Government	3.5%	4.0%	4.0%	3.9%	3.9%	3.8%	3.8%	3.6%	3.4%	3.2%	2.9%
Federal Military	6.9%	7.0%	6.9%	6.8%	6.7%	6.6%	6.5%	6.2%	5.8%	5.4%	4.8%
State and Local Government	9.1%	9.6%	9.4%	9.3%	9.2%	9.2%	9.1%	8.8%	8.3%	7.9%	7.2%
Total Earnings (in millions of 2005 dollars)	20,751.11	20,572.00	20,811.53	21,392.36	21,898.20	22,415.45	22,944.36	25,181.93	28,935.09	32,468.98	40,831.98
Farm	0.1%	0.2%	0.3%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%
Utilities	0.5%	0.9%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%
Construction	8.1%	5.4%	5.3%	5.2%	5.1%	5.0%	5.0%	4.7%	4.4%	4.1%	3.6%
Manufacturing	4.8%	4.2%	4.1%	4.0%	3.9%	3.9%	3.8%	3.5%	3.2%	2.9%	2.4%
Wholesale Trade	3.0%	2.7%	2.7%	2.7%	2.7%	2.7%	2.6%	2.6%	2.5%	2.5%	2.3%
Retail Trade	7.9%	7.0%	7.1%	7.0%	6.9%	6.9%	6.8%	6.5%	6.1%	5.7%	5.0%
Transportation and Warehousing	1.8%	1.7%	2.0%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%
Information	2.4%	1.9%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Finance and Insurance	3.9%	3.9%	3.7%	3.7%	3.7%	3.7%	3.8%	3.8%	4.0%	4.0%	4.2%
Real Estate/Rental and Lease	3.1%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.7%	1.7%
Professional and Technical Services	6.6%	7.4%	7.6%	7.7%	7.8%	7.9%	8.0%	8.5%	9.3%	10.0%	11.4%
Management	0.8%	0.3%	0.5%	1.1%	1.1%	1.2%	1.2%	1.3%	1.6%	1.8%	2.4%
Administrative and Waste Services	4.5%	4.1%	4.1%	4.2%	4.2%	4.3%	4.3%	4.5%	4.8%	5.0%	5.4%
Educational Services	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.1%
Health Care and Social Assistance	10.0%	11.7%	11.6%	11.6%	11.7%	11.8%	11.9%	12.2%	12.7%	13.1%	13.8%
Arts, Entertainment, and Recreation	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%

Table 4-7. Demographic and Employment Baseline Projections for Economic Impact Area FL-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Accommodation and Food Services	4.6%	4.5%	4.9%	4.9%	4.9%	4.9%	5.0%	5.0%	5.2%	5.3%	5.4%
Other Services, Except Public Administration	4.4%	4.1%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	4.0%
Federal Civilian Government	6.8%	8.3%	8.4%	8.3%	8.3%	8.3%	8.2%	8.1%	7.9%	7.7%	7.4%
Federal Military	14.5%	17.1%	17.1%	17.0%	16.9%	16.9%	16.9%	16.7%	16.4%	16.1%	15.6%
State and Local Government	10.5%	11.3%	10.9%	10.8%	10.7%	10.7%	10.6%	10.4%	10.0%	9.6%	8.9%
Total Personal Income per Capita (in 2005 dollars)	33,680	35,157	35,821	36,140	36,444	36,802	37,200	39,089	42,648	46,133	54,499
Woods & Poole Economics Wealth Index (U.S. = 100)	85.9	87.6	87.2	87.3	87.2	87.1	87.0	86.7	86.4	86.3	86.1
Persons per Household (in number of people)	2.5	2.5	2.5	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	85,186	89,563	90,928	92,459	92,646	93,020	93,549	97,201	105,968	115,420	138,697
Number of Households (in thousands)	340.73	346.54	350.54	351.79	358.14	364.40	370.50	392.14	419.13	438.31	473.92
Income < $10,000 (thousands of households, 2000$)	7.3%	7.6%	7.5%	7.5%	7.5%	7.4%	7.3%	6.9%	6.1%	5.4%	4.3%
Income $10,000 to $19,999	11.5%	11.9%	12.0%	12.0%	12.0%	11.8%	11.7%	11.0%	9.8%	8.7%	6.9%
Income $20,000 to $29,999	12.1%	11.6%	11.4%	11.6%	11.6%	11.5%	11.3%	10.7%	9.5%	8.5%	6.8%
Income $30,000 to $44,999	17.4%	16.6%	17.8%	17.5%	17.4%	17.2%	17.1%	16.2%	14.4%	12.9%	10.3%
Income $45,000 to $59,999	14.3%	13.7%	13.7%	13.4%	13.4%	13.5%	13.6%	13.9%	13.7%	12.9%	10.3%
Income $60,000 to $74,999	10.8%	11.1%	11.1%	11.2%	11.3%	11.4%	11.5%	12.2%	13.6%	14.7%	14.9%
Income $75,000 to $99,999	11.9%	12.2%	11.6%	12.0%	12.1%	12.2%	12.4%	13.1%	14.8%	16.5%	20.7%
Income $100,000 or more	14.7%	15.2%	15.0%	14.7%	14.8%	15.0%	15.1%	16.1%	18.2%	20.4%	25.8%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-8

Demographic and Employment Baseline Projections for Economic Impact Area FL-2

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	861.80	882.80	889.79	900.02	910.45	921.04	931.71	975.13	1,041.44	1,096.60	1,206.10
Age Under 19 Years	26.1%	25.0%	24.5%	24.3%	24.2%	24.1%	24.1%	24.3%	24.5%	24.3%	23.6%
Age 20 to 34	20.1%	20.5%	20.9%	21.1%	21.1%	21.1%	20.9%	19.8%	18.0%	17.4%	18.6%
Age 35 to 49	22.3%	20.1%	19.5%	18.9%	18.4%	18.0%	17.8%	17.9%	19.1%	19.7%	17.4%
Age 50 to 64	18.2%	20.1%	20.6%	20.7%	20.8%	20.9%	21.0%	20.4%	18.3%	16.4%	17.9%
Age 65 and over	13.3%	14.3%	14.6%	15.0%	15.5%	15.8%	16.2%	17.5%	20.1%	22.2%	22.6%
Median Age of Population (years)	39.5	40.3	40.5	40.6	40.7	40.8	40.8	41.1	41.7	42.4	42.7
White Population (in thousands)	79.1%	77.2%	76.8%	76.6%	76.4%	76.2%	76.0%	75.1%	73.8%	72.6%	70.1%
Black Population (in thousands)	13.5%	14.0%	14.2%	14.2%	14.2%	14.3%	14.3%	14.5%	14.7%	14.9%	15.1%
Native American Population (in thousands)	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.7%	0.6%	0.5%
Asian and Pacific Islander Population (in thousands)	2.5%	2.8%	2.8%	2.9%	2.9%	2.9%	2.9%	3.0%	3.2%	3.3%	3.4%
Hispanic or Latino Population (in thousands)	4.0%	5.1%	5.4%	5.6%	5.7%	5.9%	6.0%	6.7%	7.7%	8.7%	10.9%
Male Population (in thousands)	50.1%	50.2%	50.2%	50.2%	50.3%	50.3%	50.3%	50.4%	50.7%	50.8%	51.1%
Total Employment (in thousands of jobs)	487.45	474.27	481.21	487.94	494.78	501.71	508.69	537.52	583.42	624.20	713.24
Farm Employment	0.5%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%
Mining	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Utilities	0.3%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%
Construction	9.0%	6.1%	5.8%	5.8%	5.8%	5.7%	5.7%	5.6%	5.4%	5.3%	4.9%
Manufacturing	3.4%	2.9%	2.8%	2.8%	2.7%	2.7%	2.6%	2.4%	2.1%	1.9%	1.5%
Wholesale Trade	2.6%	2.2%	2.1%	2.1%	2.1%	2.1%	2.0%	2.0%	1.9%	1.9%	1.7%
Retail Trade	12.0%	11.2%	11.3%	11.3%	11.3%	11.3%	11.3%	11.2%	11.0%	10.9%	10.5%
Transportation and Warehousing	1.8%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.7%	1.7%
Information Employment	1.9%	1.5%	1.4%	1.4%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.1%
Finance and Insurance	3.6%	4.2%	4.1%	4.1%	4.2%	4.2%	4.2%	4.3%	4.4%	4.4%	4.6%

Table 4-8. Demographic and Employment Baseline Projections for Economic Impact Area FL-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Real Estate/Rental and Lease	5.5%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	5.7%	5.7%	5.7%	5.7%
Professional and Technical Services	5.2%	5.8%	5.8%	5.9%	6.0%	6.0%	6.1%	6.4%	6.8%	7.2%	8.0%
Management	0.5%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.9%	1.0%	1.1%	1.3%
Administrative and Waste Services	7.0%	6.6%	6.8%	6.9%	6.9%	7.0%	7.0%	7.3%	7.6%	7.9%	8.5%
Educational Services	1.0%	1.3%	1.3%	1.3%	1.3%	1.4%	1.4%	1.4%	1.5%	1.6%	1.8%
Health Care and Social Assistance	8.9%	10.3%	10.1%	10.2%	10.2%	10.3%	10.4%	10.6%	11.0%	11.3%	11.8%
Arts, Entertainment, and Recreation	1.7%	2.0%	2.0%	2.0%	2.1%	2.1%	2.1%	2.2%	2.3%	2.4%	2.6%
Accommodation and Food Services	8.8%	9.4%	10.0%	10.1%	10.1%	10.2%	10.2%	10.4%	10.7%	10.9%	11.3%
Other Services, Except Public Administration	6.2%	6.1%	6.0%	6.0%	6.0%	6.1%	6.1%	6.2%	6.3%	6.3%	6.5%
Federal Civilian Government	3.5%	4.0%	4.0%	3.9%	3.9%	3.8%	3.8%	3.6%	3.4%	3.2%	2.9%
Federal Military	6.9%	7.0%	6.9%	6.8%	6.7%	6.6%	6.5%	6.2%	5.8%	5.4%	4.8%
State and Local Government	9.1%	9.6%	9.4%	9.3%	9.2%	9.2%	9.1%	8.8%	8.3%	7.9%	7.2%
Total Earnings (in millions of 2005 dollars)	20,751.11	20,572.00	20,811.53	21,392.36	21,898.20	22,415.45	22,944.36	25,181.93	28,935.09	32,468.98	40,831.98
Farm	0.1%	0.2%	0.3%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%
Utilities	0.5%	0.9%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%
Construction	8.1%	5.4%	5.3%	5.2%	5.1%	5.0%	5.0%	4.7%	4.4%	4.1%	3.6%
Manufacturing	4.8%	4.2%	4.1%	4.0%	3.9%	3.9%	3.8%	3.5%	3.2%	2.9%	2.4%
Wholesale Trade	3.0%	2.7%	2.7%	2.7%	2.7%	2.7%	2.6%	2.6%	2.5%	2.5%	2.3%
Retail Trade	7.9%	7.0%	7.1%	7.0%	6.9%	6.9%	6.8%	6.5%	6.1%	5.7%	5.0%
Transportation and Warehousing	1.8%	1.7%	2.0%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%
Information	2.4%	1.9%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Finance and Insurance	3.9%	3.9%	3.7%	3.7%	3.7%	3.7%	3.8%	3.8%	4.0%	4.0%	4.2%
Real Estate/Rental and Lease	3.1%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.7%	1.7%
Professional and Technical Services	6.6%	7.4%	7.6%	7.7%	7.8%	7.9%	8.0%	8.5%	9.3%	10.0%	11.4%
Management	0.8%	0.3%	0.5%	1.1%	1.1%	1.2%	1.2%	1.3%	1.6%	1.8%	2.4%
Administrative and Waste Services	4.5%	4.1%	4.1%	4.2%	4.2%	4.3%	4.3%	4.5%	4.8%	5.0%	5.4%

Table 4-8. Demographic and Employment Baseline Projections for Economic Impact Area FL-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Educational Services	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.1%
Health Care and Social Assistance	10.0%	11.7%	11.6%	11.6%	11.7%	11.8%	11.9%	12.2%	12.7%	13.1%	13.8%
Arts, Entertainment, and Recreation	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%
Accommodation and Food Services	4.6%	4.5%	4.9%	4.9%	4.9%	4.9%	5.0%	5.0%	5.2%	5.3%	5.4%
Other Services, Except Public Administration	4.4%	4.1%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	4.0%
Federal Civilian Government	6.8%	8.3%	8.4%	8.3%	8.3%	8.3%	8.2%	8.1%	7.9%	7.7%	7.4%
Federal Military	14.5%	17.1%	17.1%	17.0%	16.9%	16.9%	16.9%	16.7%	16.4%	16.1%	15.6%
State and Local Government	10.5%	11.3%	10.9%	10.8%	10.7%	10.7%	10.6%	10.4%	10.0%	9.6%	8.9%
Total Personal Income per Capita (in 2005 dollars)	33,680	35,157	35,821	36,140	36,444	36,802	37,200	39,089	42,648	46,133	54,499
Woods & Poole Economics Wealth Index (U.S. = 100)	85.9	87.6	87.2	87.3	87.2	87.1	87.0	86.7	86.4	86.3	86.1
Persons per Household (in number of people)	2.5	2.5	2.5	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	85,186	89,563	90,928	92,459	92,646	93,020	93,549	97,201	105,968	115,420	138,697
Number of Households (in thousands)	340.73	346.54	350.54	351.79	358.14	364.40	370.50	392.14	419.13	438.31	473.92
Income < $10,000 (thousands of households, 2000$)	7.3%	7.6%	7.5%	7.5%	7.5%	7.4%	7.3%	6.9%	6.1%	5.4%	4.3%
Income $10,000 to $19,999	11.5%	11.9%	12.0%	12.0%	12.0%	11.8%	11.7%	11.0%	9.8%	8.7%	6.9%
Income $20,000 to $29,999	12.1%	11.6%	11.4%	11.6%	11.6%	11.5%	11.3%	10.7%	9.5%	8.5%	6.8%
Income $30,000 to $44,999	17.4%	16.6%	17.8%	17.5%	17.4%	17.2%	17.1%	16.2%	14.4%	12.9%	10.3%
Income $45,000 to $59,999	14.3%	13.7%	13.7%	13.4%	13.4%	13.5%	13.6%	13.9%	13.7%	12.9%	10.3%
Income $60,000 to $74,999	10.8%	11.1%	11.1%	11.2%	11.3%	11.4%	11.5%	12.2%	13.6%	14.7%	14.9%
Income $75,000 to $99,999	11.9%	12.2%	11.6%	12.0%	12.1%	12.2%	12.4%	13.1%	14.8%	16.5%	20.7%
Income $100,000 or more	14.7%	15.2%	15.0%	14.7%	14.8%	15.0%	15.1%	16.1%	18.2%	20.4%	25.8%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-9

Demographic and Employment Baseline Projections for Economic Impact Area FL-3

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	3,435.22	3,626.40	3,663.94	3,716.36	3,769.85	3,824.28	3,879.31	4,105.22	4,457.56	4,758.67	5,379.25
Age Under 19 Years	23.9%	23.2%	22.8%	22.7%	22.7%	22.6%	22.6%	22.5%	22.6%	22.6%	22.9%
Age 20 to 34	18.5%	18.6%	18.9%	19.0%	19.1%	19.2%	19.2%	19.1%	18.4%	18.0%	18.4%
Age 35 to 49	21.3%	19.8%	19.4%	18.9%	18.5%	18.2%	17.9%	17.5%	17.8%	18.3%	17.7%
Age 50 to 64	18.5%	20.2%	20.6%	20.7%	20.7%	20.8%	20.8%	20.3%	18.5%	16.8%	16.8%
Age 65 and over	17.8%	18.2%	18.3%	18.6%	18.9%	19.2%	19.5%	20.6%	22.7%	24.2%	24.1%
Median Age of Population (years)	41.7	42.9	43.3	43.5	43.7	43.8	43.9	44.3	44.7	45.0	45.1
White Population (in thousands)	73.9%	70.0%	69.4%	68.9%	68.3%	67.8%	67.2%	65.0%	61.8%	59.0%	53.3%
Black Population (in thousands)	11.4%	12.0%	12.3%	12.4%	12.4%	12.5%	12.6%	12.8%	13.1%	13.4%	13.8%
Native American Population (in thousands)	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
Asian and Pacific Islander Population (in thousands)	2.6%	3.1%	3.2%	3.3%	3.3%	3.4%	3.5%	3.8%	4.3%	4.7%	5.5%
Hispanic or Latino Population (in thousands)	11.8%	14.5%	14.8%	15.2%	15.6%	16.0%	16.4%	18.1%	20.6%	22.7%	27.2%
Male Population (in thousands)	48.6%	48.6%	48.6%	48.6%	48.7%	48.7%	48.7%	48.8%	48.9%	48.9%	48.9%
Total Employment (in thousands of jobs)	1,944.15	1,832.29	1,846.30	1,875.79	1,905.67	1,935.91	1,966.53	2,092.90	2,294.56	2,474.26	2,867.83
Farm Employment	1.0%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	0.9%	0.9%
Forestry, Fishing, Related Activities	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%
Mining	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Utilities	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Construction	7.3%	5.1%	4.9%	4.9%	4.9%	4.9%	5.0%	5.0%	5.1%	5.2%	5.4%
Manufacturing	5.0%	4.1%	4.2%	4.1%	4.0%	4.0%	3.9%	3.7%	3.4%	3.2%	2.8%
Wholesale Trade	3.4%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%
Retail Trade	11.4%	11.2%	11.3%	11.3%	11.3%	11.4%	11.4%	11.5%	11.7%	11.8%	11.9%
Transportation and Warehousing	2.3%	2.2%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.4%	2.4%
Information Employment	2.2%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.8%	1.7%	1.7%	1.6%
Finance and Insurance	5.8%	6.5%	6.8%	6.8%	6.8%	6.8%	6.7%	6.7%	6.6%	6.6%	6.4%

Table 4-9. Demographic and Employment Baseline Projections for Economic Impact Area FL-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Real Estate/Rental and Lease	4.5%	4.5%	4.6%	4.5%	4.5%	4.5%	4.5%	4.4%	4.3%	4.1%	3.9%
Professional and Technical Services	6.4%	7.2%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.2%	7.2%	7.1%
Management	0.8%	1.2%	1.2%	1.2%	1.3%	1.3%	1.3%	1.3%	1.4%	1.5%	1.6%
Administrative and Waste Services	10.8%	7.9%	7.5%	7.6%	7.7%	7.8%	7.8%	8.1%	8.6%	9.0%	9.8%
Educational Services	1.3%	1.8%	1.9%	1.9%	2.0%	2.0%	2.0%	2.2%	2.5%	2.7%	3.3%
Health Care and Social Assistance	10.3%	12.4%	12.5%	12.6%	12.6%	12.7%	12.8%	13.0%	13.3%	13.5%	14.0%
Arts, Entertainment, and Recreation	2.0%	2.4%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Accommodation and Food Services	6.8%	7.1%	7.2%	7.2%	7.1%	7.1%	7.1%	7.0%	6.8%	6.7%	6.4%
Other Services, Except Public Administration	5.9%	5.9%	6.0%	6.0%	6.0%	6.0%	6.1%	6.1%	6.2%	6.2%	6.3%
Federal Civilian Government	1.3%	1.6%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%	1.3%	1.3%	1.1%
Federal Military	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%	0.6%	0.5%
State and Local Government	9.9%	10.6%	10.4%	10.3%	10.2%	10.1%	10.1%	9.7%	9.2%	8.9%	8.1%
Total Earnings (in millions of 2005 dollars)	85,752.60	82,664.03	83,293.04	85,719.91	87,934.35	90,200.08	92,518.16	102,336.23	118,829.95	134,369.43	171,103.77
Farm	0.5%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
Forestry, Fishing, Related Activities	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	0.3%	0.1%	0.1%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%
Utilities	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
Construction	7.5%	4.8%	4.6%	4.6%	4.5%	4.5%	4.5%	4.4%	4.3%	4.2%	4.1%
Manufacturing	6.8%	5.9%	5.8%	5.8%	5.7%	5.6%	5.6%	5.4%	5.0%	4.7%	4.2%
Wholesale Trade	4.9%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%
Retail Trade	8.3%	7.8%	7.9%	7.8%	7.8%	7.7%	7.7%	7.5%	7.1%	6.9%	6.3%
Transportation and Warehousing	2.2%	2.1%	2.2%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.0%
Information	3.3%	3.0%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.2%
Finance and Insurance	8.0%	8.0%	8.4%	8.4%	8.4%	8.4%	8.4%	8.3%	8.3%	8.3%	8.1%
Real Estate/Rental and Lease	2.3%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%
Professional and Technical Services	8.1%	9.7%	9.7%	9.7%	9.7%	9.8%	9.8%	9.9%	10.1%	10.2%	10.4%
Management	1.6%	2.2%	2.4%	2.4%	2.5%	2.5%	2.6%	2.8%	3.1%	3.4%	4.2%
Administrative and Waste Services	7.1%	5.0%	4.8%	4.8%	4.9%	4.9%	5.0%	5.2%	5.6%	5.9%	6.6%
Educational Services	0.8%	1.2%	1.3%	1.3%	1.3%	1.4%	1.4%	1.5%	1.8%	2.0%	2.5%

Table 4-9. Demographic and Employment Baseline Projections for Economic Impact Area FL-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Health Care and Social Assistance	12.1%	14.8%	14.8%	14.8%	14.9%	15.0%	15.0%	15.3%	15.7%	16.1%	16.7%
Arts, Entertainment, and Recreation	1.5%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.7%
Accommodation and Food Services	3.9%	3.6%	3.6%	3.6%	3.6%	3.6%	3.5%	3.5%	3.4%	3.3%	3.2%
Other Services, Except Public Administration	4.0%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%
Federal Civilian Government	2.7%	3.5%	3.4%	3.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.2%	3.1%
Federal Military	1.2%	1.6%	1.6%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%
State and Local Government	11.8%	13.1%	12.7%	12.6%	12.5%	12.4%	12.4%	12.1%	11.7%	11.4%	10.7%
Total Personal Income per Capita (in 2005 dollars)	35,810	35,952	36,280	36,533	36,788	37,105	37,466	39,232	42,635	45,972	53,929
Woods & Poole Economics Wealth Index (U.S. = 100)	78.9	79.4	78.7	78.7	78.6	78.6	78.5	78.2	77.8	77.5	76.9
Persons per Household (in number of people)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.5
Mean Household Total Personal Income (in 2005 dollars)	84,866	87,077	87,589	88,922	89,017	89,311	89,765	93,124	101,406	110,345	132,237
Number of Households (in thousands)	1,449.50	1,497.25	1,517.61	1,526.86	1,557.98	1,588.81	1,619.14	1,729.47	1,874.15	1,982.57	2,193.76
Income < $10,000 (thousands of households, 2000$)	7.6%	8.1%	8.6%	8.6%	8.5%	8.5%	8.4%	7.9%	7.0%	6.3%	5.1%
Income $10,000 to $19,999	12.6%	13.0%	13.1%	13.2%	13.1%	13.0%	12.8%	12.2%	10.7%	9.6%	7.8%
Income $20,000 to $29,999	13.0%	13.1%	12.9%	13.2%	13.1%	13.0%	12.9%	12.2%	10.8%	9.6%	7.8%
Income $30,000 to $44,999	17.3%	17.5%	17.5%	17.3%	17.2%	17.1%	17.0%	16.3%	14.4%	12.9%	10.4%
Income $45,000 to $59,999	13.5%	13.1%	13.4%	13.5%	13.5%	13.6%	13.8%	14.3%	15.0%	14.6%	12.1%
Income $60,000 to $74,999	9.6%	9.9%	9.8%	9.6%	9.7%	9.8%	9.9%	10.4%	11.9%	13.3%	15.0%
Income $75,000 to $99,999	10.8%	10.6%	10.5%	10.6%	10.6%	10.7%	10.8%	11.4%	13.0%	14.5%	18.1%
Income $100,000 or more	15.6%	14.7%	14.1%	14.1%	14.1%	14.3%	14.5%	15.2%	17.2%	19.2%	23.8%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-10

Demographic and Employment Baseline Projections for Economic Impact Area FL-4

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	5,934.95	6,170.12	6,273.04	6,352.84	6,434.20	6,516.92	6,600.40	6,941.47	7,467.78	7,911.50	8,809.42
Age Under 19 Years	24.4%	23.3%	23.0%	22.8%	22.7%	22.5%	22.4%	22.3%	22.1%	21.9%	21.6%
Age 20 to 34	18.4%	18.3%	18.6%	18.7%	18.7%	18.8%	18.8%	18.5%	17.9%	17.4%	17.3%
Age 35 to 49	22.2%	21.1%	20.7%	20.3%	19.9%	19.5%	19.2%	18.5%	18.2%	18.5%	17.6%
Age 50 to 64	17.8%	19.4%	19.7%	19.8%	19.9%	20.1%	20.2%	20.1%	19.2%	17.6%	16.8%
Age 65 and over	17.1%	17.9%	18.1%	18.4%	18.7%	19.0%	19.3%	20.6%	22.7%	24.6%	26.6%
Median Age of Population (years)	44.0	45.5	45.9	46.0	46.2	46.3	46.4	46.9	46.9	46.8	46.5
White Population (in thousands)	45.8%	42.3%	42.1%	41.5%	41.0%	40.5%	40.0%	38.1%	35.3%	33.1%	29.2%
Black Population (in thousands)	16.7%	16.7%	16.8%	16.8%	16.8%	16.9%	16.9%	16.9%	17.1%	17.1%	17.2%
Native American Population (in thousands)	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Asian and Pacific Islander Population (in thousands)	2.0%	2.2%	2.2%	2.3%	2.3%	2.4%	2.4%	2.5%	2.7%	2.9%	3.2%
Hispanic or Latino Population (in thousands)	35.3%	38.6%	38.7%	39.2%	39.7%	40.1%	40.6%	42.3%	44.7%	46.7%	50.4%
Male Population (in thousands)	48.6%	48.6%	48.7%	48.7%	48.7%	48.7%	48.7%	48.7%	48.7%	48.6%	48.3%
Total Employment (in thousands of jobs)	3,395.35	3,367.36	3,430.32	3,489.82	3,550.17	3,611.37	3,673.45	3,930.55	4,343.66	4,714.39	5,533.20
Farm Employment	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%
Mining	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Utilities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Construction	8.0%	5.0%	4.8%	4.8%	4.8%	4.8%	4.8%	4.9%	4.9%	5.0%	5.0%
Manufacturing	3.6%	2.7%	2.7%	2.7%	2.6%	2.6%	2.5%	2.4%	2.1%	1.9%	1.6%
Wholesale Trade	4.5%	4.3%	4.3%	4.3%	4.3%	4.2%	4.2%	4.1%	4.0%	3.8%	3.6%
Retail Trade	11.2%	11.0%	11.1%	11.2%	11.2%	11.2%	11.2%	11.2%	11.2%	11.1%	11.1%
Transportation and Warehousing	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%	3.8%
Information Employment	2.0%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.5%	1.4%	1.4%	1.3%
Finance and Insurance	5.0%	5.7%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%

Table 4-10. Demographic and Employment Baseline Projections for Economic Impact Area FL-4 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Real Estate/Rental and Lease	6.0%	6.5%	6.5%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%
Professional and Technical Services	6.5%	7.1%	7.1%	7.1%	7.2%	7.2%	7.2%	7.2%	7.3%	7.3%	7.4%
Management	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%
Administrative and Waste Services	9.0%	8.1%	8.1%	8.2%	8.3%	8.3%	8.4%	8.7%	9.0%	9.4%	10.1%
Educational Services	1.8%	2.4%	2.5%	2.5%	2.5%	2.6%	2.6%	2.7%	2.8%	2.9%	3.2%
Health Care and Social Assistance	9.1%	10.7%	10.7%	10.7%	10.8%	10.8%	10.9%	11.0%	11.3%	11.5%	11.9%
Arts, Entertainment, and Recreation	2.2%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Accommodation and Food Services	7.2%	7.7%	7.9%	7.9%	7.9%	7.9%	7.9%	7.9%	7.9%	7.8%	7.8%
Other Services, Except Public Administration	7.7%	8.1%	8.2%	8.2%	8.2%	8.3%	8.3%	8.4%	8.6%	8.8%	9.1%
Federal Civilian Government	1.0%	1.1%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.8%
Federal Military	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.3%
State and Local Government	9.0%	9.0%	8.7%	8.6%	8.5%	8.4%	8.3%	8.0%	7.5%	7.1%	6.3%
Total Earnings (in millions of 2005 dollars)	158,627.01	149,490.08	151,501.99	155,403.01	159,468.65	163,630.35	167,890.18	185,951.93	216,353.63	245,046.34	312,977.23
Farm	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Utilities	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Construction	9.4%	5.5%	5.1%	5.1%	5.1%	5.1%	5.1%	5.0%	4.8%	4.7%	4.5%
Manufacturing	4.4%	3.5%	3.6%	3.5%	3.5%	3.4%	3.4%	3.2%	2.9%	2.7%	2.4%
Wholesale Trade	6.8%	7.0%	7.2%	7.2%	7.2%	7.1%	7.1%	7.0%	6.9%	6.7%	6.5%
Retail Trade	8.5%	8.2%	8.4%	8.3%	8.3%	8.2%	8.1%	7.9%	7.5%	7.2%	6.6%
Transportation and Warehousing	4.0%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.0%	3.9%	3.8%
Information	3.6%	3.0%	3.0%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%
Finance and Insurance	6.9%	7.1%	7.2%	7.1%	7.2%	7.2%	7.2%	7.2%	7.3%	7.4%	7.5%
Real Estate/Rental and Lease	3.7%	3.0%	2.9%	2.9%	2.9%	2.9%	2.9%	2.8%	2.8%	2.8%	2.7%
Professional and Technical Services	8.3%	9.5%	9.7%	9.7%	9.8%	9.8%	9.9%	10.1%	10.5%	10.8%	11.3%
Management	1.3%	1.6%	1.7%	1.7%	1.7%	1.7%	1.8%	1.9%	2.1%	2.2%	2.6%
Administrative and Waste Services	6.2%	4.9%	4.9%	5.0%	5.0%	5.1%	5.1%	5.3%	5.6%	5.8%	6.4%
Educational Services	1.5%	2.0%	2.1%	2.2%	2.2%	2.2%	2.2%	2.3%	2.5%	2.7%	3.0%

Table 4-10. Demographic and Employment Baseline Projections for Economic Impact Area FL-4 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Health Care and Social Assistance	9.5%	12.1%	12.1%	12.2%	12.2%	12.3%	12.4%	12.7%	13.1%	13.4%	14.1%
Arts, Entertainment, and Recreation	1.6%	1.7%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.7%
Accommodation and Food Services	4.3%	4.5%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%	4.7%
Other Services, Except Public Administration	4.2%	4.6%	4.6%	4.6%	4.7%	4.7%	4.7%	4.8%	4.8%	4.9%	5.0%
Federal Civilian Government	2.2%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.4%	2.4%
Federal Military	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%
State and Local Government	11.8%	13.1%	12.6%	12.5%	12.4%	12.3%	12.3%	11.9%	11.4%	11.0%	10.1%
Total Personal Income per Capita (in 2005 dollars)	40,637	40,179	40,450	40,704	41,055	41,486	41,976	44,366	49,014	53,636	64,938
Woods & Poole Economics Wealth Index (U.S. = 100)	118.7	115.8	114.7	114.6	114.5	114.5	114.6	115.1	116.6	118.1	121.3
Persons per Household (in number of people)	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.6	2.6
Mean Household Total Personal Income (in 2005 dollars)	102,546	104,107	104,480	106,007	106,300	106,859	107,629	112,733	124,847	137,930	170,766
Number of Households (in thousands)	2,351.92	2,381.27	2,428.65	2,439.31	2,484.99	2,530.07	2,574.19	2,731.85	2,931.79	3,076.48	3,350.01
Income < $10,000 (thousands of households, 2000$)	7.6%	8.2%	8.6%	8.7%	8.7%	8.6%	8.5%	7.9%	7.1%	6.4%	5.1%
Income $10,000 to $19,999	11.2%	12.2%	12.6%	12.6%	12.5%	12.4%	12.3%	11.5%	10.3%	9.3%	7.4%
Income $20,000 to $29,999	11.3%	11.9%	12.0%	12.2%	12.1%	12.0%	11.9%	11.1%	10.0%	9.0%	7.2%
Income $30,000 to $44,999	15.5%	16.1%	16.3%	16.2%	16.1%	16.0%	15.9%	14.9%	13.3%	12.1%	9.6%
Income $45,000 to $59,999	13.2%	12.8%	12.7%	12.6%	12.7%	12.8%	12.8%	13.2%	13.1%	12.3%	9.8%
Income $60,000 to $74,999	9.8%	9.8%	10.0%	9.8%	9.8%	9.9%	10.0%	10.7%	12.0%	13.0%	13.0%
Income $75,000 to $99,999	11.7%	10.9%	10.6%	10.7%	10.8%	10.9%	11.0%	11.8%	13.2%	14.7%	18.4%
Income $100,000 or more	19.8%	18.1%	17.2%	17.1%	17.2%	17.3%	17.5%	18.7%	21.0%	23.3%	29.4%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-11

Demographic and Employment Baseline Projections for Economic Impact Area LA-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	338.48	346.02	346.51	349.98	353.51	357.09	360.70	375.28	397.29	415.28	450.15
Age Under 19 Years	29.3%	28.5%	28.0%	28.2%	28.3%	28.3%	28.3%	28.7%	28.9%	28.5%	27.5%
Age 20 to 34	21.6%	21.3%	21.5%	21.2%	20.9%	20.7%	20.4%	18.8%	17.8%	18.2%	19.5%
Age 35 to 49	20.9%	19.3%	19.0%	18.8%	18.6%	18.5%	18.5%	19.1%	19.4%	18.5%	16.6%
Age 50 to 64	16.4%	18.5%	18.9%	18.9%	19.1%	19.2%	19.2%	18.7%	17.3%	16.8%	18.0%
Age 65 and over	11.8%	12.4%	12.6%	12.9%	13.1%	13.3%	13.5%	14.7%	16.7%	17.9%	18.3%
Median Age of Population (years)	34.9	36.2	36.3	36.4	36.5	36.6	36.8	37.4	38.0	38.2	38.4
White Population (in thousands)	74.8%	73.4%	73.0%	72.8%	72.7%	72.6%	72.5%	72.0%	71.2%	70.5%	69.1%
Black Population (in thousands)	20.7%	21.4%	21.6%	21.6%	21.6%	21.6%	21.6%	21.6%	21.6%	21.7%	21.7%
Native American Population (in thousands)	0.7%	0.9%	0.8%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
Asian and Pacific Islander Population (in thousands)	1.0%	1.2%	1.2%	1.3%	1.3%	1.3%	1.3%	1.4%	1.6%	1.7%	1.9%
Hispanic or Latino Population (in thousands)	2.7%	3.1%	3.3%	3.4%	3.5%	3.6%	3.7%	4.1%	4.6%	5.2%	6.4%
Male Population (in thousands)	50.0%	50.0%	49.9%	49.9%	50.0%	50.0%	50.0%	50.1%	50.1%	50.1%	50.1%
Total Employment (in thousands of jobs)	171.65	177.97	179.50	181.84	184.23	186.63	189.07	199.12	215.11	229.33	260.40
Farm Employment	1.9%	2.0%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%	1.4%
Forestry, Fishing, Related Activities	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%
Mining	1.1%	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.5%
Utilities	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.2%
Construction	8.7%	8.0%	7.9%	7.9%	7.9%	7.9%	7.9%	8.0%	8.0%	8.0%	7.9%
Manufacturing	6.7%	6.5%	6.4%	6.3%	6.2%	6.1%	5.9%	5.5%	4.9%	4.4%	3.5%
Wholesale Trade	2.2%	2.1%	2.2%	2.2%	2.1%	2.1%	2.1%	2.0%	1.9%	1.8%	1.6%
Retail Trade	11.0%	10.2%	10.1%	10.2%	10.2%	10.2%	10.3%	10.4%	10.6%	10.8%	11.0%
Transportation and Warehousing	3.2%	2.8%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.1%	3.1%	3.1%
Information Employment	1.0%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%
Finance and Insurance	2.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	2.9%	2.8%	2.7%
Real Estate/Rental and Lease	2.4%	3.0%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.3%	3.3%	3.4%
Professional and Technical Services	4.7%	4.3%	4.4%	4.4%	4.5%	4.5%	4.5%	4.7%	4.9%	5.1%	5.4%

Table 4-11. Demographic and Employment Baseline Projections for Economic Impact Area LA-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Management	0.7%	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Administrative and Waste Services	3.8%	4.2%	4.3%	4.3%	4.4%	4.4%	4.4%	4.6%	4.9%	5.1%	5.6%
Educational Services	1.0%	1.1%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Health Care and Social Assistance	9.5%	10.3%	10.3%	10.4%	10.6%	10.7%	10.8%	11.4%	12.2%	12.9%	14.4%
Arts, Entertainment, and Recreation	2.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.2%	1.1%
Accommodation and Food Services	7.9%	7.8%	7.9%	8.0%	8.0%	8.1%	8.1%	8.3%	8.5%	8.7%	9.1%
Other Services, Except Public Administration	6.2%	6.2%	6.2%	6.2%	6.3%	6.4%	6.4%	6.6%	6.9%	7.2%	7.7%
Federal Civilian Government	2.1%	2.2%	2.1%	2.1%	2.1%	2.1%	2.0%	2.0%	1.8%	1.8%	1.6%
Federal Military	5.7%	6.3%	6.4%	6.3%	6.3%	6.2%	6.1%	5.8%	5.4%	5.1%	4.5%
State and Local Government	14.0%	14.2%	13.9%	13.8%	13.7%	13.6%	13.4%	13.0%	12.3%	11.8%	10.7%
Total Earnings (in millions of 2005 dollars)	7,449.88	8,254.72	8,481.64	8,757.57	8,945.94	9,138.23	9,334.50	10,160.97	11,534.46	12,814.51	15,798.99
Farm	0.5%	0.3%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%
Forestry, Fishing, Related Activities	0.7%	0.8%	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%
Mining	1.7%	1.4%	1.5%	1.8%	1.8%	1.8%	1.9%	1.9%	1.9%	2.0%	2.0%
Utilities	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.7%	0.6%
Construction	7.6%	8.6%	8.4%	8.2%	8.2%	8.2%	8.1%	8.0%	7.7%	7.5%	7.0%
Manufacturing	14.6%	14.0%	14.2%	13.8%	13.6%	13.3%	13.1%	12.2%	11.0%	10.1%	8.3%
Wholesale Trade	2.7%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.5%	2.4%	2.3%	2.2%
Retail Trade	6.3%	5.6%	5.5%	5.4%	5.4%	5.4%	5.4%	5.3%	5.1%	5.0%	4.7%
Transportation and Warehousing	3.6%	3.3%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%
Information	2.6%	1.0%	0.9%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%
Finance and Insurance	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.2%	2.2%	2.2%	2.2%
Real Estate/Rental and Lease	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Professional and Technical Services	5.4%	5.0%	5.0%	5.0%	5.1%	5.1%	5.2%	5.5%	5.9%	6.3%	7.0%
Management	1.5%	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.9%	0.9%
Administrative and Waste Services	2.3%	2.3%	2.4%	2.4%	2.4%	2.4%	2.5%	2.6%	2.9%	3.1%	3.5%
Educational Services	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%
Health Care and Social Assistance	8.7%	10.2%	10.3%	10.4%	10.5%	10.7%	10.9%	11.5%	12.6%	13.5%	15.5%
Arts, Entertainment, and Recreation	1.5%	0.6%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%
Accommodation and Food Services	3.7%	3.8%	3.7%	3.7%	3.7%	3.8%	3.8%	3.9%	4.1%	4.2%	4.4%
Other Services, Except Public Administration	3.7%	3.6%	3.5%	3.5%	3.5%	3.6%	3.6%	3.7%	3.9%	4.1%	4.4%

Table 4-11. Demographic and Employment Baseline Projections for Economic Impact Area LA-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Federal Civilian Government	3.8%	3.9%	3.8%	3.8%	3.8%	3.8%	3.7%	3.7%	3.7%	3.6%	3.5%
Federal Military	10.6%	13.2%	14.1%	14.0%	14.0%	14.0%	14.0%	14.1%	14.2%	14.3%	14.4%
State and Local Government	13.8%	14.1%	13.4%	13.2%	13.1%	13.1%	13.0%	12.8%	12.4%	12.1%	11.4%
Total Personal Income per Capita (in 2005 dollars)	29,511	32,958	34,005	34,470	34,772	35,111	35,480	37,175	40,274	43,278	50,426
Woods & Poole Economics Wealth Index (U.S. = 100)	69.2	81.0	81.4	81.8	81.8	81.8	81.8	81.6	81.3	80.9	80.3
Persons per Household (in number of people)	2.6	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.6
Mean Household Total Personal Income (in 2005 dollars)	77,937	88,001	90,444	92,356	92,519	92,834	93,279	96,428	104,035	112,254	132,305
Number of Households (in thousands)	128.17	129.59	130.28	130.62	132.86	135.06	137.19	144.68	153.80	160.11	171.57
Income < $10,000 (thousands of households, 2000$)	10.4%	9.4%	9.6%	9.4%	9.3%	9.2%	9.1%	8.7%	7.9%	7.1%	5.8%
Income $10,000 to $19,999	15.0%	14.3%	14.0%	13.9%	13.9%	13.7%	13.6%	12.9%	11.7%	10.5%	8.6%
Income $20,000 to $29,999	12.8%	12.8%	13.4%	13.3%	13.2%	13.1%	13.0%	12.4%	11.1%	10.1%	8.2%
Income $30,000 to $44,999	17.5%	16.5%	16.3%	15.9%	15.8%	15.7%	15.6%	14.9%	13.5%	12.1%	9.9%
Income $45,000 to $59,999	12.5%	12.7%	12.3%	12.4%	12.4%	12.6%	12.7%	13.2%	13.7%	13.5%	11.3%
Income $60,000 to $74,999	9.1%	9.9%	9.7%	9.7%	9.8%	9.9%	10.0%	10.5%	11.6%	12.7%	14.4%
Income $75,000 to $99,999	10.6%	10.9%	11.1%	11.2%	11.2%	11.4%	11.5%	12.1%	13.5%	15.0%	18.3%
Income $100,000 or more	12.0%	13.5%	13.5%	14.2%	14.3%	14.5%	14.6%	15.4%	17.1%	19.0%	23.3%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-12

Demographic and Employment Baseline Projections for Economic Impact Area LA-2

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	558.42	585.06	588.41	596.10	603.94	611.91	619.95	652.85	703.71	746.69	833.85
Age Under 19 Years	30.0%	29.0%	28.6%	28.5%	28.5%	28.5%	28.5%	28.6%	28.5%	28.1%	26.9%
Age 20 to 34	20.6%	21.1%	21.4%	21.3%	21.2%	21.0%	20.7%	19.4%	17.9%	17.9%	19.0%
Age 35 to 49	21.8%	19.5%	19.1%	18.7%	18.4%	18.2%	18.2%	18.5%	19.7%	19.4%	17.5%
Age 50 to 64	16.1%	18.6%	19.0%	19.3%	19.5%	19.6%	19.6%	19.3%	17.3%	16.4%	18.3%
Age 65 and over	11.5%	11.9%	12.0%	12.2%	12.5%	12.7%	13.0%	14.1%	16.6%	18.1%	18.4%
Median Age of Population (years)	35.0	35.7	35.7	35.8	36.0	36.1	36.2	37.0	38.1	38.9	39.2
White Population (in thousands)	69.3%	67.6%	67.4%	67.2%	67.1%	66.9%	66.8%	66.2%	65.2%	64.4%	62.6%
Black Population (in thousands)	27.1%	27.9%	27.9%	28.0%	28.0%	28.0%	28.0%	28.1%	28.3%	28.4%	28.7%
Native American Population (in thousands)	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Asian and Pacific Islander Population (in thousands)	1.2%	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%	1.7%	1.8%	1.9%
Hispanic or Latino Population (in thousands)	2.1%	2.8%	3.0%	3.1%	3.2%	3.3%	3.4%	3.8%	4.4%	5.1%	6.4%
Male Population (in thousands)	48.7%	48.8%	48.8%	48.8%	48.8%	48.8%	48.9%	49.0%	49.1%	49.1%	49.2%
Total Employment (in thousands of jobs)	297.51	328.88	333.42	339.08	344.80	350.61	356.48	380.77	419.58	454.23	530.17
Farm Employment	1.9%	1.8%	1.7%	1.7%	1.7%	1.7%	1.6%	1.5%	1.4%	1.3%	1.1%
Forestry, Fishing, Related Activities	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Mining	6.9%	7.8%	8.1%	8.0%	7.9%	7.9%	7.8%	7.5%	7.1%	6.8%	6.2%
Utilities	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Construction	6.7%	6.3%	6.1%	6.1%	6.1%	6.1%	6.0%	6.0%	6.0%	5.9%	5.8%
Manufacturing	6.1%	5.8%	6.2%	6.1%	6.0%	6.0%	5.9%	5.6%	5.2%	4.9%	4.3%
Wholesale Trade	3.7%	3.6%	3.6%	3.6%	3.6%	3.5%	3.5%	3.5%	3.4%	3.3%	3.1%
Retail Trade	11.5%	10.8%	10.8%	10.8%	10.8%	10.8%	10.8%	10.9%	10.9%	10.9%	10.9%
Transportation and Warehousing	3.5%	2.9%	2.8%	2.8%	2.9%	2.9%	2.9%	2.9%	2.9%	3.0%	3.1%
Information Employment	1.5%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%
Finance and Insurance	3.4%	3.6%	3.6%	3.6%	3.6%	3.6%	3.5%	3.4%	3.3%	3.2%	2.9%
Real Estate/Rental and Lease	4.0%	4.5%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.7%	4.7%

Table 4-12. Demographic and Employment Baseline Projections for Economic Impact Area LA-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Professional and Technical Services	4.7%	5.2%	5.2%	5.2%	5.3%	5.3%	5.3%	5.3%	5.4%	5.5%	5.6%
Management	1.1%	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Administrative and Waste Services	4.6%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.9%	5.1%	5.2%	5.3%
Educational Services	1.2%	1.3%	1.3%	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%
Health Care and Social Assistance	11.2%	12.0%	12.2%	12.4%	12.5%	12.7%	12.9%	13.5%	14.5%	15.4%	17.1%
Arts, Entertainment, and Recreation	1.5%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.8%	1.9%	2.0%	2.1%
Accommodation and Food Services	6.4%	6.1%	6.1%	6.2%	6.2%	6.2%	6.2%	6.3%	6.4%	6.5%	6.6%
Other Services, Except Public Administration	7.0%	6.7%	6.5%	6.6%	6.6%	6.7%	6.7%	6.9%	7.2%	7.4%	7.9%
Federal Civilian Government	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.3%	0.3%
Federal Military	0.9%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.6%	0.5%
State and Local Government	10.8%	10.4%	9.9%	9.9%	9.8%	9.7%	9.7%	9.4%	9.0%	8.6%	7.9%
Total Earnings (in millions of 2005 dollars)	12,447.44	15,056.94	15,441.31	15,733.44	16,146.69	16,569.39	17,001.76	18,831.45	21,898.55	24,779.07	31,546.99
Farm	0.8%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.0%	0.9%	0.8%
Forestry, Fishing, Related Activities	0.3%	0.3%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
Mining	13.7%	14.1%	14.5%	14.2%	14.1%	14.1%	14.0%	13.7%	13.3%	13.0%	12.2%
Utilities	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Construction	7.1%	7.4%	7.4%	7.3%	7.2%	7.2%	7.1%	6.9%	6.6%	6.3%	5.8%
Manufacturing	7.5%	7.8%	8.6%	8.5%	8.4%	8.4%	8.3%	8.1%	7.8%	7.5%	7.0%
Wholesale Trade	4.7%	4.7%	4.7%	4.8%	4.8%	4.8%	4.8%	4.7%	4.6%	4.6%	4.4%
Retail Trade	7.9%	6.8%	6.9%	6.9%	6.8%	6.8%	6.7%	6.5%	6.2%	5.9%	5.4%
Transportation and Warehousing	4.6%	4.3%	4.1%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.8%	3.8%
Information	1.7%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.3%	1.3%
Finance and Insurance	4.1%	2.9%	2.8%	2.9%	2.8%	2.8%	2.8%	2.7%	2.7%	2.6%	2.4%
Real Estate/Rental and Lease	3.5%	3.6%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.8%	3.8%	3.8%
Professional and Technical Services	6.0%	6.4%	6.7%	6.8%	6.8%	6.9%	6.9%	7.2%	7.5%	7.8%	8.3%
Management	1.6%	1.6%	1.5%	1.5%	1.6%	1.6%	1.6%	1.6%	1.7%	1.8%	1.9%
Administrative and Waste Services	3.1%	3.2%	3.0%	3.1%	3.1%	3.1%	3.1%	3.2%	3.4%	3.5%	3.7%
Educational Services	0.7%	0.8%	0.8%	0.8%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.1%
Health Care and Social Assistance	11.3%	12.6%	12.2%	12.5%	12.7%	12.9%	13.0%	13.8%	14.9%	15.9%	17.9%
Arts, Entertainment, and Recreation	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%

Table 4-12. Demographic and Employment Baseline Projections for Economic Impact Area LA-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Accommodation and Food Services	2.5%	2.5%	2.5%	2.5%	2.5%	2.6%	2.6%	2.6%	2.7%	2.7%	2.8%
Other Services, Except Public Administration	4.5%	4.6%	4.4%	4.4%	4.4%	4.5%	4.5%	4.6%	4.8%	5.0%	5.3%
Federal Civilian Government	1.2%	1.1%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.8%	0.7%
Federal Military	0.9%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
State and Local Government	11.3%	11.2%	10.6%	10.6%	10.6%	10.5%	10.5%	10.3%	10.1%	9.8%	9.3%
Total Personal Income per Capita (in 2005 dollars)	30,899	36,282	37,161	37,038	37,371	37,748	38,158	40,046	43,488	46,795	54,565
Woods & Poole Economics Wealth Index (U.S. = 100)	72.9	84.2	84.3	83.5	83.5	83.5	83.4	83.2	82.8	82.4	81.6
Persons per Household (in number of people)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.6
Mean Household Total Personal Income (in 2005 dollars)	81,039	95,267	97,212	97,581	97,754	98,095	98,577	101,968	110,105	118,808	139,762
Number of Households (in thousands)	212.92	222.81	224.93	226.26	230.88	235.47	239.98	256.40	277.94	294.10	325.54
Income < $10,000 (thousands of households, 2000$)	13.9%	12.3%	12.2%	11.5%	11.4%	11.2%	11.1%	10.7%	9.6%	8.7%	7.1%
Income $10,000 to $19,999	15.5%	15.5%	15.7%	15.6%	15.5%	15.3%	15.2%	14.5%	13.0%	11.8%	9.6%
Income $20,000 to $29,999	12.6%	12.0%	11.4%	11.8%	11.7%	11.6%	11.5%	11.0%	9.9%	9.0%	7.4%
Income $30,000 to $44,999	15.4%	15.0%	15.4%	14.9%	14.8%	14.8%	14.7%	14.4%	13.2%	12.0%	9.9%
Income $45,000 to $59,999	11.7%	11.6%	11.6%	11.8%	11.8%	11.9%	12.0%	12.4%	13.1%	13.0%	11.4%
Income $60,000 to $74,999	8.7%	9.2%	9.2%	8.9%	8.9%	9.0%	9.1%	9.5%	10.5%	11.6%	13.2%
Income $75,000 to $99,999	9.7%	10.2%	10.1%	10.9%	11.0%	11.1%	11.2%	11.7%	12.9%	14.3%	17.4%
Income $100,000 or more	12.6%	14.3%	14.3%	14.7%	14.9%	15.0%	15.2%	15.8%	17.6%	19.6%	24.0%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-13

Demographic and Employment Baseline Projections for Economic Impact Area LA-3

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	1,051.06	1,142.41	1,147.53	1,162.47	1,177.70	1,193.18	1,208.79	1,272.50	1,370.62	1,453.15	1,619.45
Age Under 19 Years	29.6%	28.3%	28.0%	27.9%	27.9%	27.9%	27.9%	27.9%	28.0%	27.6%	26.6%
Age 20 to 34	22.3%	22.8%	22.9%	22.8%	22.7%	22.5%	22.2%	20.7%	18.8%	18.4%	19.1%
Age 35 to 49	21.5%	19.6%	19.2%	18.9%	18.7%	18.5%	18.4%	19.0%	20.1%	20.0%	17.8%
Age 50 to 64	16.4%	18.3%	18.6%	18.7%	18.9%	18.9%	19.0%	18.4%	16.9%	16.3%	18.4%
Age 65 and over	10.3%	11.0%	11.3%	11.6%	11.9%	12.2%	12.6%	13.9%	16.2%	17.6%	18.0%
Median Age of Population (years)	34.6	35.7	35.8	36.0	36.2	36.4	36.5	37.5	38.9	39.9	40.5
White Population (in thousands)	65.3%	62.4%	62.2%	61.9%	61.7%	61.5%	61.2%	60.3%	59.0%	57.9%	55.5%
Black Population (in thousands)	29.4%	31.1%	31.1%	31.2%	31.3%	31.4%	31.4%	31.7%	32.2%	32.5%	33.0%
Native American Population (in thousands)	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%
Asian and Pacific Islander Population (in thousands)	1.5%	1.7%	1.7%	1.7%	1.8%	1.8%	1.8%	2.0%	2.1%	2.2%	2.5%
Hispanic or Latino Population (in thousands)	2.6%	3.7%	3.9%	4.0%	4.1%	4.3%	4.4%	4.9%	5.5%	6.2%	7.9%
Male Population (in thousands)	48.7%	48.9%	48.8%	48.8%	48.8%	48.9%	48.9%	48.9%	49.0%	49.0%	49.1%
Total Employment (in thousands of jobs)	606.81	674.25	681.06	691.34	701.78	712.40	723.17	767.88	840.17	905.55	1,051.77
Farm Employment	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%
Mining	1.5%	2.0%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%	1.5%	1.3%
Utilities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%
Construction	9.8%	8.9%	8.9%	8.8%	8.8%	8.7%	8.6%	8.4%	8.0%	7.6%	7.0%
Manufacturing	6.8%	6.2%	6.4%	6.3%	6.2%	6.1%	6.0%	5.7%	5.2%	4.7%	4.0%
Wholesale Trade	3.2%	2.8%	2.9%	2.9%	2.8%	2.8%	2.8%	2.7%	2.6%	2.5%	2.3%
Retail Trade	10.9%	10.3%	10.2%	10.2%	10.1%	10.1%	10.0%	9.8%	9.5%	9.2%	8.5%
Transportation and Warehousing	4.4%	4.3%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.5%	4.5%	4.5%
Information Employment	1.4%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%
Finance and Insurance	3.5%	3.9%	4.1%	4.1%	4.0%	4.0%	4.0%	4.0%	3.9%	3.8%	3.5%
Real Estate/Rental and Lease	3.6%	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%	4.2%

Table 4-13. Demographic and Employment Baseline Projections for Economic Impact Area LA-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Professional and Technical Services	4.8%	5.2%	5.1%	5.2%	5.2%	5.3%	5.3%	5.5%	5.7%	5.9%	6.3%
Management	1.0%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%
Administrative and Waste Services	5.8%	6.2%	6.3%	6.4%	6.5%	6.7%	6.8%	7.2%	7.9%	8.5%	9.8%
Educational Services	1.1%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.5%	1.7%	1.8%	2.0%
Health Care and Social Assistance	8.8%	9.8%	9.9%	10.0%	10.2%	10.3%	10.4%	11.0%	11.8%	12.5%	13.9%
Arts, Entertainment, and Recreation	1.3%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.7%	1.7%	1.8%	1.9%
Accommodation and Food Services	6.6%	6.3%	6.6%	6.7%	6.7%	6.8%	6.8%	7.0%	7.2%	7.5%	7.9%
Other Services, Except Public Administration	6.7%	6.9%	6.8%	6.9%	7.0%	7.0%	7.1%	7.4%	7.9%	8.3%	9.0%
Federal Civilian Government	0.6%	0.7%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%
Federal Military	0.8%	0.9%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%
State and Local Government	15.6%	14.5%	14.0%	13.8%	13.7%	13.5%	13.4%	12.8%	11.9%	11.2%	9.8%
Total Earnings (in millions of 2005 dollars)	26,073.66	31,814.85	32,091.25	32,704.47	33,455.43	34,223.77	35,009.88	38,340.94	43,948.74	49,252.34	61,885.78
Farm	0.3%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%
Forestry, Fishing, Related Activities	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	2.6%	3.0%	2.7%	2.8%	2.8%	2.7%	2.7%	2.6%	2.5%	2.4%	2.1%
Utilities	0.7%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%
Construction	10.3%	11.0%	11.0%	10.7%	10.5%	10.4%	10.3%	9.8%	9.0%	8.4%	7.3%
Manufacturing	12.4%	11.7%	12.3%	12.4%	12.2%	12.1%	11.9%	11.4%	10.5%	9.9%	8.5%
Wholesale Trade	4.4%	3.9%	4.0%	4.0%	4.0%	4.0%	4.0%	3.9%	3.8%	3.7%	3.5%
Retail Trade	7.2%	6.2%	6.2%	6.2%	6.1%	6.0%	5.9%	5.6%	5.2%	4.8%	4.2%
Transportation and Warehousing	6.0%	7.3%	7.5%	7.7%	7.7%	7.7%	7.7%	7.8%	7.8%	7.8%	7.7%
Information	1.7%	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%
Finance and Insurance	4.3%	4.2%	4.5%	4.2%	4.2%	4.3%	4.3%	4.3%	4.3%	4.3%	4.2%
Real Estate/Rental and Lease	2.1%	2.3%	2.2%	2.1%	2.1%	2.1%	2.1%	2.1%	2.0%	2.0%	1.9%
Professional and Technical Services	6.0%	6.4%	6.3%	6.5%	6.5%	6.6%	6.7%	7.1%	7.7%	8.1%	9.1%
Management	1.4%	1.7%	1.7%	1.8%	1.8%	1.8%	1.9%	2.0%	2.2%	2.4%	2.8%
Administrative and Waste Services	3.5%	3.9%	3.9%	3.9%	4.0%	4.1%	4.2%	4.6%	5.3%	5.8%	7.1%
Educational Services	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.9%	0.9%	1.1%
Health Care and Social Assistance	9.2%	9.6%	9.6%	9.8%	10.0%	10.2%	10.3%	11.0%	12.1%	12.9%	14.7%
Arts, Entertainment, and Recreation	0.7%	0.6%	0.6%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%	0.7%

Table 4-13. Demographic and Employment Baseline Projections for Economic Impact Area LA-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Accommodation and Food Services	2.7%	2.5%	2.6%	2.7%	2.7%	2.7%	2.7%	2.8%	3.0%	3.1%	3.3%
Other Services, Except Public Administration	4.1%	4.0%	4.0%	4.0%	4.1%	4.1%	4.2%	4.3%	4.6%	4.8%	5.2%
Federal Civilian Government	1.2%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%
Federal Military	0.9%	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
State and Local Government	17.5%	16.5%	15.8%	15.7%	15.6%	15.5%	15.4%	15.0%	14.4%	13.8%	12.6%
Total Personal Income per Capita (in 2005 dollars)	32,957	36,886	37,501	37,603	37,902	38,242	38,616	40,361	43,609	46,795	54,473
Woods & Poole Economics Wealth Index (U.S. = 100)	78.2	89.3	89.2	88.6	88.5	88.5	88.4	88.1	87.7	87.4	87.2
Persons per Household (in number of people)	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6
Mean Household Total Personal Income (in 2005 dollars)	87,838	98,809	100,044	101,039	101,133	101,396	101,805	104,964	112,932	121,677	143,312
Number of Households (in thousands)	394.36	426.46	430.14	432.63	441.37	450.02	458.52	489.30	529.27	558.86	615.56
Income < $10,000 (thousands of households, 2000$)	10.7%	9.7%	9.7%	9.2%	9.2%	9.1%	9.0%	8.6%	7.7%	7.0%	5.8%
Income $10,000 to $19,999	13.1%	13.4%	13.4%	13.5%	13.4%	13.3%	13.2%	12.5%	11.3%	10.3%	8.5%
Income $20,000 to $29,999	11.6%	11.3%	11.3%	11.2%	11.2%	11.1%	10.9%	10.4%	9.4%	8.6%	7.1%
Income $30,000 to $44,999	15.6%	14.9%	15.1%	14.6%	14.6%	14.5%	14.4%	13.8%	12.5%	11.4%	9.5%
Income $45,000 to $59,999	12.3%	12.1%	11.9%	11.8%	11.8%	11.9%	11.9%	12.1%	12.1%	11.4%	9.5%
Income $60,000 to $74,999	9.6%	9.7%	9.9%	9.8%	9.8%	9.9%	10.0%	10.5%	11.5%	12.3%	12.5%
Income $75,000 to $99,999	11.6%	11.6%	11.5%	12.2%	12.2%	12.3%	12.5%	13.1%	14.5%	15.9%	19.2%
Income $100,000 or more	15.6%	17.3%	17.2%	17.7%	17.8%	18.0%	18.1%	19.0%	21.0%	23.0%	27.9%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-14

Demographic and Employment Baseline Projections for Economic Impact Area LA-4

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	1,431.31	1,242.69	1,260.01	1,267.26	1,274.66	1,282.17	1,289.69	1,319.60	1,362.75	1,395.73	1,453.72
Age Under 19 Years	28.0%	26.1%	25.8%	25.8%	25.7%	25.7%	25.7%	26.0%	26.0%	25.7%	24.8%
Age 20 to 34	20.6%	21.3%	21.5%	21.4%	21.3%	21.1%	20.8%	19.1%	17.2%	17.3%	18.5%
Age 35 to 49	22.2%	20.1%	19.6%	19.3%	19.1%	19.0%	18.9%	19.6%	20.8%	20.3%	17.3%
Age 50 to 64	17.9%	20.3%	20.6%	20.7%	20.7%	20.8%	20.8%	20.0%	18.1%	17.5%	19.7%
Age 65 and over	11.4%	12.3%	12.5%	12.8%	13.1%	13.4%	13.8%	15.3%	17.8%	19.3%	19.6%
Median Age of Population (years)	36.0	36.7	36.8	37.0	37.1	37.2	37.3	38.1	39.3	39.8	40.0
White Population (in thousands)	53.7%	54.8%	54.5%	54.3%	54.1%	53.8%	53.6%	52.8%	51.5%	50.4%	48.4%
Black Population (in thousands)	38.1%	34.5%	34.6%	34.6%	34.6%	34.5%	34.5%	34.4%	34.1%	33.9%	33.2%
Native American Population (in thousands)	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%
Asian and Pacific Islander Population (in thousands)	2.4%	2.8%	2.8%	2.9%	2.9%	2.9%	3.0%	3.1%	3.4%	3.6%	3.8%
Hispanic or Latino Population (in thousands)	5.4%	7.6%	7.7%	7.9%	8.1%	8.3%	8.5%	9.3%	10.5%	11.6%	14.2%
Male Population (in thousands)	48.1%	48.7%	48.7%	48.7%	48.7%	48.8%	48.8%	48.9%	48.9%	49.0%	49.0%
Total Employment (in thousands of jobs)	740.50	750.90	758.43	766.12	773.87	781.67	789.50	821.31	870.47	912.81	1,001.64
Farm Employment	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
Forestry, Fishing, Related Activities	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Mining	1.3%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%	1.4%	1.3%	1.2%	1.0%
Utilities	0.5%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%
Construction	6.2%	6.6%	6.5%	6.5%	6.5%	6.4%	6.4%	6.3%	6.1%	6.0%	5.7%
Manufacturing	5.6%	5.0%	4.8%	4.7%	4.6%	4.5%	4.4%	4.1%	3.6%	3.3%	2.6%
Wholesale Trade	3.6%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.2%
Retail Trade	10.0%	9.4%	9.5%	9.5%	9.5%	9.5%	9.4%	9.4%	9.3%	9.3%	9.1%
Transportation and Warehousing	4.1%	4.0%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.0%	4.0%	3.9%
Information Employment	1.6%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%
Finance and Insurance	3.9%	4.2%	4.3%	4.3%	4.3%	4.2%	4.2%	4.0%	3.8%	3.6%	3.3%
Real Estate/Rental and Lease	4.0%	4.5%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.7%	4.7%	4.7%
Professional and Technical Services	5.7%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.4%	6.4%	6.4%	6.2%
Management	1.1%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%

Table 4-14. Demographic and Employment Baseline Projections for Economic Impact Area LA-4 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Administrative and Waste Services	6.4%	6.7%	6.6%	6.6%	6.7%	6.7%	6.8%	7.0%	7.3%	7.5%	8.1%
Educational Services	3.1%	3.2%	3.3%	3.3%	3.3%	3.4%	3.4%	3.4%	3.6%	3.6%	3.8%
Health Care and Social Assistance	8.8%	9.3%	9.4%	9.5%	9.6%	9.7%	9.8%	10.2%	10.8%	11.4%	12.6%
Arts, Entertainment, and Recreation	2.5%	2.5%	2.5%	2.5%	2.5%	2.6%	2.6%	2.7%	2.8%	2.9%	3.1%
Accommodation and Food Services	8.8%	9.0%	9.4%	9.4%	9.5%	9.5%	9.6%	9.8%	10.1%	10.3%	10.7%
Other Services, Except Public Administration	6.5%	6.7%	6.8%	6.8%	6.9%	6.9%	7.0%	7.2%	7.5%	7.8%	8.4%
Federal Civilian Government	2.1%	1.8%	1.7%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.5%	1.4%
Federal Military	1.4%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.0%	0.9%
State and Local Government	11.9%	11.0%	10.5%	10.4%	10.3%	10.2%	10.1%	9.8%	9.2%	8.7%	7.9%
Total Earnings (in millions of 2005 dollars)	36,490.43	38,052.69	38,259.52	39,141.19	39,862.24	40,594.91	41,339.39	44,439.04	49,474.55	54,052.90	64,373.74
Farm	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	4.4%	3.4%	3.5%	3.4%	3.4%	3.4%	3.4%	3.2%	3.1%	2.9%	2.6%
Utilities	1.2%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.8%
Construction	6.5%	7.4%	7.5%	7.6%	7.5%	7.4%	7.4%	7.1%	6.6%	6.3%	5.6%
Manufacturing	8.6%	9.2%	9.0%	8.7%	8.6%	8.5%	8.3%	7.8%	7.0%	6.5%	5.4%
Wholesale Trade	5.3%	5.1%	5.2%	5.2%	5.2%	5.2%	5.3%	5.4%	5.5%	5.6%	5.7%
Retail Trade	6.2%	5.7%	5.8%	5.7%	5.7%	5.6%	5.6%	5.4%	5.1%	4.9%	4.4%
Transportation and Warehousing	5.1%	5.3%	5.4%	5.4%	5.3%	5.3%	5.2%	5.1%	4.9%	4.7%	4.3%
Information	1.7%	1.4%	1.3%	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%
Finance and Insurance	5.1%	4.4%	4.6%	4.8%	4.8%	4.8%	4.7%	4.6%	4.4%	4.2%	3.9%
Real Estate/Rental and Lease	2.6%	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Professional and Technical Services	8.0%	9.5%	9.6%	9.7%	9.7%	9.8%	9.8%	10.0%	10.2%	10.4%	10.6%
Management	1.8%	1.8%	1.9%	2.0%	2.0%	2.0%	2.1%	2.2%	2.3%	2.4%	2.7%
Administrative and Waste Services	4.0%	4.3%	4.0%	4.1%	4.1%	4.2%	4.2%	4.4%	4.7%	5.0%	5.6%
Educational Services	2.2%	2.5%	2.5%	2.5%	2.6%	2.6%	2.6%	2.7%	2.9%	3.0%	3.3%
Health Care and Social Assistance	8.7%	9.5%	9.5%	9.6%	9.7%	9.8%	10.0%	10.5%	11.3%	12.0%	13.4%
Arts, Entertainment, and Recreation	2.1%	1.7%	1.7%	1.7%	1.8%	1.8%	1.8%	1.9%	1.9%	2.0%	2.2%
Accommodation and Food Services	4.4%	4.5%	4.7%	4.7%	4.8%	4.8%	4.8%	5.0%	5.1%	5.3%	5.6%
Other Services, Except Public Administration	3.7%	3.9%	3.9%	4.0%	4.0%	4.0%	4.1%	4.2%	4.4%	4.6%	4.9%
Federal Civilian Government	4.2%	3.6%	3.5%	3.5%	3.5%	3.5%	3.5%	3.6%	3.7%	3.7%	3.9%

Table 4-14. Demographic and Employment Baseline Projections for Economic Impact Area LA-4 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Federal Military	1.8%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.7%	1.7%	1.8%
State and Local Government	12.1%	12.3%	11.7%	11.6%	11.6%	11.5%	11.5%	11.3%	10.9%	10.7%	10.1%
Total Personal Income per Capita (in 2005 dollars)	34,100	41,089	41,125	41,603	41,989	42,430	42,914	45,159	49,294	53,302	62,818
Woods & Poole Economics Wealth Index (U.S. = 100)	77.3	93.7	91.3	90.1	89.9	89.8	89.7	89.1	88.4	87.8	86.7
Persons per Household (in number of people)	2.7	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	91,188	105,654	105,247	107,289	107,566	108,042	108,686	112,963	122,998	133,719	159,824
Number of Households (in thousands)	535.25	483.28	492.35	491.40	497.57	503.54	509.23	527.53	546.16	556.36	571.38
Income < $10,000 (thousands of households, 2000$)	10.8%	9.8%	10.7%	10.6%	10.5%	10.4%	10.3%	9.7%	8.6%	7.7%	6.2%
Income $10,000 to $19,999	13.8%	13.2%	13.3%	13.4%	13.4%	13.2%	13.1%	12.4%	11.1%	10.0%	8.2%
Income $20,000 to $29,999	12.3%	11.9%	11.8%	12.0%	12.0%	11.9%	11.7%	11.2%	10.1%	9.1%	7.6%
Income $30,000 to $44,999	16.0%	15.1%	15.4%	14.9%	14.9%	14.8%	14.7%	14.3%	13.1%	12.0%	10.0%
Income $45,000 to $59,999	12.0%	12.0%	11.9%	11.8%	11.8%	11.9%	12.0%	12.2%	12.3%	12.0%	10.5%
Income $60,000 to $74,999	8.8%	9.5%	9.4%	9.2%	9.2%	9.3%	9.4%	9.9%	10.9%	11.6%	11.9%
Income $75,000 to $99,999	10.6%	11.0%	10.8%	11.0%	11.1%	11.2%	11.3%	11.9%	13.3%	14.7%	17.6%
Income $100,000 or more	16.1%	17.5%	16.7%	17.0%	17.1%	17.3%	17.5%	18.5%	20.7%	22.9%	27.9%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-15

Demographic and Employment Baseline Projections for Economic Impact Area MS-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	483.49	482.30	486.36	490.07	493.86	497.70	501.55	516.98	539.66	557.55	590.34
Age Under 19 Years	28.4%	27.7%	27.4%	27.3%	27.2%	27.2%	27.2%	27.6%	27.6%	27.2%	26.4%
Age 20 to 34	19.8%	19.9%	20.1%	20.1%	20.0%	19.8%	19.6%	18.4%	17.6%	17.6%	18.6%
Age 35 to 49	22.0%	20.3%	19.9%	19.6%	19.3%	19.1%	18.9%	19.0%	19.1%	18.9%	17.5%
Age 50 to 64	17.8%	19.4%	19.7%	19.8%	19.9%	20.1%	20.1%	19.7%	18.4%	17.5%	18.1%
Age 65 and over	12.0%	12.7%	12.9%	13.2%	13.6%	13.8%	14.2%	15.3%	17.3%	18.8%	19.3%
Median Age of Population (years)	36.4	37.4	37.5	37.7	37.8	37.9	38.0	38.5	39.0	39.6	39.7
White Population (in thousands)	75.8%	73.9%	73.2%	73.0%	72.8%	72.7%	72.5%	71.8%	70.7%	69.7%	67.9%
Black Population (in thousands)	18.7%	19.3%	19.8%	19.9%	19.9%	20.0%	20.0%	20.3%	20.7%	21.0%	21.5%
Native American Population (in thousands)	0.5%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%
Asian and Pacific Islander Population (in thousands)	2.0%	2.1%	2.1%	2.1%	2.1%	2.2%	2.2%	2.2%	2.3%	2.3%	2.3%
Hispanic or Latino Population (in thousands)	3.0%	4.2%	4.4%	4.5%	4.6%	4.7%	4.8%	5.3%	5.9%	6.6%	7.9%
Male Population (in thousands)	49.7%	49.9%	49.9%	49.9%	49.8%	49.8%	49.8%	49.8%	49.8%	49.8%	49.7%
Total Employment (in thousands of jobs)	238.83	241.07	237.96	240.09	242.26	244.42	246.60	255.42	269.01	280.64	304.84
Farm Employment	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%
Forestry, Fishing, Related Activities	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
Mining	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%
Utilities	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.7%
Construction	7.5%	8.0%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.4%	7.3%	7.2%
Manufacturing	9.5%	9.4%	8.7%	8.6%	8.5%	8.3%	8.2%	7.7%	7.1%	6.5%	5.6%
Wholesale Trade	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%
Retail Trade	10.9%	10.3%	10.5%	10.5%	10.6%	10.6%	10.6%	10.6%	10.7%	10.7%	10.7%
Transportation and Warehousing	2.4%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.2%	2.2%
Information Employment	1.4%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
Finance and Insurance	2.5%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%
Real Estate/Rental and Lease	3.1%	3.4%	3.6%	3.6%	3.6%	3.6%	3.6%	3.7%	3.8%	3.9%	4.0%

Table 4-15. Demographic and Employment Baseline Projections for Economic Impact Area MS-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Professional and Technical Services	3.8%	4.1%	4.1%	4.2%	4.2%	4.2%	4.2%	4.3%	4.5%	4.6%	4.8%
Management	0.5%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Administrative and Waste Services	5.4%	6.7%	6.4%	6.5%	6.5%	6.6%	6.7%	7.1%	7.6%	8.1%	9.1%
Educational Services	0.5%	0.7%	0.8%	0.8%	0.9%	0.9%	0.9%	1.0%	1.2%	1.3%	1.7%
Health Care and Social Assistance	6.3%	6.4%	6.6%	6.7%	6.7%	6.8%	6.9%	7.1%	7.5%	7.8%	8.4%
Arts, Entertainment, and Recreation	2.2%	2.2%	2.2%	2.2%	2.2%	2.3%	2.3%	2.3%	2.4%	2.5%	2.6%
Accommodation and Food Services	12.0%	10.4%	11.0%	10.9%	10.9%	10.8%	10.8%	10.6%	10.4%	10.1%	9.6%
Other Services, Except Public Administration	5.5%	5.0%	5.1%	5.1%	5.2%	5.3%	5.4%	5.7%	6.1%	6.5%	7.4%
Federal Civilian Government	3.9%	3.9%	3.9%	3.9%	3.8%	3.8%	3.8%	3.7%	3.5%	3.4%	3.2%
Federal Military	5.7%	5.5%	5.4%	5.4%	5.3%	5.3%	5.2%	5.1%	4.9%	4.7%	4.3%
State and Local Government	12.3%	12.9%	12.9%	12.8%	12.8%	12.7%	12.7%	12.4%	12.0%	11.7%	11.0%
Total Earnings (in millions of 2005 dollars)	10,100.79	10,982.84	10,749.28	10,953.83	11,146.80	11,342.69	11,541.49	12,366.85	13,699.64	14,902.96	17,585.88
Farm	0.3%	0.0%	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Mining	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%
Utilities	2.1%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	1.9%	1.9%	1.9%	2.0%
Construction	6.0%	8.1%	7.7%	7.7%	7.6%	7.6%	7.5%	7.3%	7.0%	6.7%	6.2%
Manufacturing	15.4%	16.6%	16.0%	15.7%	15.5%	15.3%	15.2%	14.4%	13.4%	12.5%	10.9%
Wholesale Trade	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.5%
Retail Trade	7.0%	6.2%	6.4%	6.3%	6.3%	6.3%	6.2%	6.0%	5.8%	5.5%	5.1%
Transportation and Warehousing	2.3%	2.2%	2.2%	2.2%	2.2%	2.2%	2.1%	2.1%	2.1%	2.0%	1.9%
Information	1.4%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.0%
Finance and Insurance	2.1%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.4%	2.4%	2.4%	2.4%
Real Estate/Rental and Lease	1.0%	0.9%	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%
Professional and Technical Services	4.6%	4.9%	5.0%	5.0%	5.1%	5.1%	5.2%	5.4%	5.7%	6.0%	6.6%
Management	0.6%	0.6%	0.9%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.9%	1.0%
Administrative and Waste Services	3.1%	3.9%	3.5%	3.6%	3.6%	3.7%	3.7%	3.9%	4.3%	4.6%	5.2%
Educational Services	0.3%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.7%	0.8%	1.1%
Health Care and Social Assistance	6.7%	6.7%	6.8%	6.8%	6.9%	7.0%	7.1%	7.4%	7.8%	8.2%	8.9%
Arts, Entertainment, and Recreation	1.5%	1.1%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%	1.3%	1.4%

Table 4-15. Demographic and Employment Baseline Projections for Economic Impact Area MS-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Accommodation and Food Services	7.9%	5.9%	6.1%	6.1%	6.1%	6.0%	6.0%	5.9%	5.8%	5.7%	5.4%
Other Services, Except Public Administration	3.3%	3.2%	3.2%	3.3%	3.3%	3.3%	3.4%	3.6%	3.9%	4.1%	4.6%
Federal Civilian Government	8.4%	7.9%	8.1%	8.1%	8.1%	8.1%	8.1%	8.2%	8.3%	8.3%	8.4%
Federal Military	10.2%	9.9%	9.8%	9.8%	9.8%	9.9%	9.9%	10.0%	10.2%	10.4%	10.7%
State and Local Government	13.2%	14.4%	14.5%	14.5%	14.5%	14.5%	14.4%	14.3%	14.2%	14.0%	13.7%
Total Personal Income per Capita (in 2005 dollars)	29,738	32,644	32,301	32,500	32,751	33,038	33,352	34,810	37,493	40,086	46,208
Woods & Poole Economics Wealth Index (U.S. = 100)	67.8	74.6	71.8	71.8	71.7	71.7	71.6	71.1	70.2	69.5	67.9
Persons per Household (in number of people)	2.6	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.7
Mean Household Total Personal Income (in 2005 dollars)	78,314	87,120	85,836	87,060	87,186	87,453	87,845	90,693	97,647	105,151	123,335
Number of Households (in thousands)	183.59	180.72	183.02	182.95	185.52	188.02	190.43	198.43	207.21	212.55	221.17
Income < $10,000 (thousands of households, 2000$)	9.5%	8.9%	9.3%	9.3%	9.3%	9.2%	9.1%	8.7%	7.8%	7.0%	5.6%
Income $10,000 to $19,999	13.4%	13.5%	13.5%	13.8%	13.8%	13.7%	13.5%	13.0%	11.7%	10.6%	8.5%
Income $20,000 to $29,999	13.0%	12.5%	12.9%	12.7%	12.6%	12.5%	12.4%	11.8%	10.6%	9.5%	7.6%
Income $30,000 to $44,999	17.9%	16.3%	16.2%	16.2%	16.2%	16.0%	15.9%	15.3%	13.6%	12.3%	9.8%
Income $45,000 to $59,999	13.8%	13.4%	13.5%	13.2%	13.2%	13.4%	13.5%	14.0%	14.6%	14.3%	11.9%
Income $60,000 to $74,999	9.5%	10.6%	10.6%	10.4%	10.4%	10.5%	10.6%	11.1%	12.4%	13.8%	15.7%
Income $75,000 to $99,999	10.7%	11.4%	10.9%	11.4%	11.5%	11.6%	11.7%	12.3%	13.7%	15.3%	19.3%
Income $100,000 or more	12.3%	13.3%	13.1%	13.0%	13.0%	13.2%	13.3%	13.9%	15.6%	17.3%	21.6%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-16

Demographic and Employment Baseline Projections for Economic Impact Area TX-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	1,643.97	1,799.29	1,827.28	1,856.04	1,885.42	1,915.39	1,945.76	2,071.28	2,270.08	2,443.43	2,812.12
Age Under 19 Years	35.4%	34.9%	34.7%	34.5%	34.3%	34.2%	34.1%	33.7%	32.6%	32.2%	31.1%
Age 20 to 34	21.4%	20.5%	20.6%	20.5%	20.5%	20.4%	20.3%	20.0%	20.4%	20.2%	20.2%
Age 35 to 49	18.9%	18.7%	18.5%	18.5%	18.4%	18.2%	18.1%	17.9%	17.0%	16.8%	16.9%
Age 50 to 64	13.7%	15.1%	15.1%	15.2%	15.3%	15.4%	15.4%	15.4%	15.4%	15.2%	14.5%
Age 65 and over	10.6%	10.9%	11.1%	11.3%	11.5%	11.8%	12.0%	13.0%	14.6%	15.7%	17.2%
Median Age of Population (years)	33.8	35.7	35.4	35.5	35.6	35.7	35.8	36.2	36.7	37.0	37.4
White Population (in thousands)	18.2%	16.1%	15.8%	15.5%	15.3%	15.0%	14.8%	13.8%	12.5%	11.5%	9.8%
Black Population (in thousands)	1.2%	1.2%	1.3%	1.3%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Native American Population (in thousands)	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Asian and Pacific Islander Population (in thousands)	0.9%	1.0%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%
Hispanic or Latino Population (in thousands)	79.5%	81.6%	81.7%	82.0%	82.3%	82.5%	82.8%	83.7%	85.1%	86.1%	87.9%
Male Population (in thousands)	48.8%	48.8%	48.9%	48.9%	48.9%	48.9%	48.8%	48.8%	48.7%	48.6%	48.3%
Total Employment (in thousands of jobs)	728.91	806.89	820.21	834.82	849.66	864.76	880.09	943.92	1,047.62	1,141.91	1,354.68
Farm Employment	1.7%	1.6%	1.5%	1.5%	1.5%	1.4%	1.4%	1.3%	1.1%	1.0%	0.7%
Forestry, Fishing, Related Activities	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%
Mining	1.8%	2.2%	2.6%	2.6%	2.6%	2.5%	2.5%	2.4%	2.2%	2.0%	1.8%
Utilities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Construction	7.2%	6.3%	6.0%	6.0%	5.9%	5.9%	5.8%	5.6%	5.4%	5.1%	4.7%
Manufacturing	4.0%	3.1%	3.1%	3.0%	3.0%	2.9%	2.9%	2.7%	2.4%	2.1%	1.8%
Wholesale Trade	2.8%	2.6%	2.7%	2.7%	2.6%	2.6%	2.6%	2.5%	2.4%	2.3%	2.0%
Retail Trade	12.0%	11.6%	11.5%	11.5%	11.5%	11.5%	11.5%	11.5%	11.5%	11.5%	11.4%
Transportation and Warehousing	3.3%	3.3%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%
Information Employment	1.2%	1.0%	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%
Finance and Insurance	3.1%	3.7%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	4.0%	4.0%	4.0%
Real Estate/Rental and Lease	3.0%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.0%	3.0%	2.9%

Table 4-16. Demographic and Employment Baseline Projections for Economic Impact Area TX-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Professional and Technical Services	3.3%	3.3%	3.3%	3.3%	3.3%	3.4%	3.4%	3.4%	3.5%	3.5%	3.6%
Management	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Administrative and Waste Services	5.4%	5.6%	5.7%	5.8%	5.8%	5.9%	5.9%	6.1%	6.3%	6.5%	6.8%
Educational Services	0.9%	1.0%	1.0%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.3%
Health Care and Social Assistance	15.6%	17.4%	17.6%	17.8%	18.0%	18.3%	18.5%	19.4%	20.8%	22.0%	24.5%
Arts, Entertainment, and Recreation	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%
Accommodation and Food Services	7.2%	7.4%	7.5%	7.5%	7.5%	7.5%	7.6%	7.6%	7.8%	7.8%	7.9%
Other Services, Except Public Administration	6.5%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.2%	6.2%	6.3%	6.4%
Federal Civilian Government	1.7%	2.0%	1.9%	1.9%	1.8%	1.8%	1.8%	1.7%	1.6%	1.5%	1.3%
Federal Military	1.3%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.8%	0.7%	0.6%
State and Local Government	15.1%	14.9%	14.5%	14.4%	14.3%	14.2%	14.1%	13.7%	13.1%	12.6%	11.5%
Total Earnings (in millions of 2005 dollars)	26,195.82	30,353.80	31,195.76	31,890.93	32,754.54	33,640.93	34,550.73	38,436.40	45,079.92	51,469.18	67,061.12
Farm	1.6%	1.2%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%	0.8%	0.7%	0.5%
Forestry, Fishing, Related Activities	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.5%
Mining	3.6%	4.5%	5.7%	5.5%	5.5%	5.4%	5.4%	5.2%	4.9%	4.6%	4.1%
Utilities	0.6%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%
Construction	7.5%	7.1%	6.9%	6.8%	6.7%	6.6%	6.5%	6.2%	5.6%	5.2%	4.4%
Manufacturing	5.9%	4.9%	5.0%	5.0%	4.9%	4.8%	4.7%	4.4%	4.0%	3.7%	3.1%
Wholesale Trade	4.2%	3.8%	4.1%	4.1%	4.0%	4.0%	4.0%	3.9%	3.8%	3.7%	3.4%
Retail Trade	8.8%	8.0%	8.0%	8.0%	8.0%	7.9%	7.8%	7.6%	7.2%	6.8%	6.1%
Transportation and Warehousing	3.6%	4.3%	4.5%	4.5%	4.5%	4.5%	4.5%	4.4%	4.3%	4.3%	4.1%
Information	1.5%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%
Finance and Insurance	3.4%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.1%	3.2%	3.2%	3.4%
Real Estate/Rental and Lease	1.4%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%	1.1%
Professional and Technical Services	4.6%	3.8%	3.7%	3.8%	3.8%	3.8%	3.9%	4.0%	4.2%	4.3%	4.6%
Management	0.1%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%
Administrative and Waste Services	3.0%	3.2%	3.3%	3.4%	3.4%	3.5%	3.5%	3.7%	3.9%	4.0%	4.4%
Educational Services	0.6%	0.7%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%
Health Care and Social Assistance	14.9%	17.0%	16.6%	17.0%	17.2%	17.5%	17.8%	18.9%	20.7%	22.2%	25.4%
Arts, Entertainment, and Recreation	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%

Table 4-16. Demographic and Employment Baseline Projections for Economic Impact Area TX-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Accommodation and Food Services	3.4%	3.3%	3.4%	3.4%	3.4%	3.4%	3.5%	3.5%	3.6%	3.7%	3.7%
Other Services, Except Public Administration	4.5%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.4%	4.4%	4.4%	4.5%
Federal Civilian Government	4.9%	5.4%	5.4%	5.5%	5.4%	5.4%	5.4%	5.3%	5.1%	4.9%	4.6%
Federal Military	2.8%	2.4%	2.3%	2.2%	2.2%	2.2%	2.2%	2.2%	2.1%	2.1%	2.0%
State and Local Government	17.8%	18.4%	17.6%	17.6%	17.6%	17.6%	17.6%	17.5%	17.2%	17.0%	16.4%
Total Personal Income per Capita (in 2005 dollars)	22,661	25,356	25,749	25,916	26,191	26,491	26,810	28,248	30,827	33,327	39,329
Woods & Poole Economics Wealth Index (U.S. = 100)	67.9	76.7	79.3	78.6	79.0	79.3	79.5	80.5	81.4	82.1	83.1
Persons per Household (in number of people)	3.2	3.3	3.2	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.3
Mean Household Total Personal Income (in 2005 dollars)	72,965	82,534	83,514	84,735	85,117	85,625	86,245	89,976	98,320	107,222	129,227
Number of Households (in thousands)	510.57	552.77	563.40	567.67	580.16	592.58	604.86	650.28	711.76	759.46	855.84
Income < $10,000 (thousands of households, 2000$)	15.0%	14.5%	14.3%	13.7%	13.6%	13.5%	13.3%	12.6%	11.1%	9.9%	8.0%
Income $10,000 to $19,999	18.0%	17.9%	17.7%	17.3%	17.1%	16.9%	16.7%	15.8%	13.9%	12.4%	10.0%
Income $20,000 to $29,999	14.5%	13.6%	13.7%	13.6%	13.5%	13.4%	13.2%	12.6%	11.0%	9.8%	7.8%
Income $30,000 to $44,999	15.4%	16.0%	16.1%	16.1%	16.1%	16.2%	16.3%	16.4%	15.9%	14.5%	11.7%
Income $45,000 to $59,999	11.0%	11.2%	11.1%	11.2%	11.2%	11.4%	11.5%	12.1%	13.6%	14.7%	14.8%
Income $60,000 to $74,999	7.6%	8.0%	8.4%	8.5%	8.6%	8.7%	8.8%	9.2%	10.6%	11.8%	14.4%
Income $75,000 to $99,999	8.2%	8.1%	7.9%	8.5%	8.6%	8.7%	8.8%	9.2%	10.5%	11.8%	14.6%
Income $100,000 or more	10.3%	10.6%	10.7%	11.1%	11.2%	11.3%	11.4%	12.0%	13.6%	15.1%	18.7%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-17

Demographic and Employment Baseline Projections for Economic Impact Area TX-2

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	581.75	626.91	633.41	642.00	650.77	659.71	668.77	706.06	764.62	815.09	920.51
Age Under 19 Years	29.6%	29.1%	29.0%	29.0%	29.0%	29.0%	29.1%	29.3%	29.3%	29.2%	29.1%
Age 20 to 34	18.6%	18.3%	18.5%	18.4%	18.4%	18.3%	18.3%	17.9%	18.5%	18.9%	19.8%
Age 35 to 49	22.3%	20.6%	20.1%	19.8%	19.4%	19.2%	19.0%	18.6%	17.5%	17.2%	17.4%
Age 50 to 64	17.1%	19.2%	19.4%	19.6%	19.6%	19.7%	19.7%	19.0%	17.4%	16.4%	15.3%
Age 65 and over	12.4%	12.8%	13.0%	13.2%	13.5%	13.8%	14.0%	15.2%	17.2%	18.3%	18.5%
Median Age of Population (years)	39.1	40.5	40.5	40.6	40.6	40.5	40.4	40.2	39.2	38.2	36.4
White Population (in thousands)	58.3%	54.0%	53.3%	52.6%	52.0%	51.3%	50.7%	48.2%	44.4%	41.3%	35.2%
Black Population (in thousands)	9.3%	10.2%	10.3%	10.4%	10.4%	10.5%	10.6%	10.8%	11.2%	11.6%	12.5%
Native American Population (in thousands)	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Asian and Pacific Islander Population (in thousands)	2.4%	3.4%	3.4%	3.5%	3.6%	3.6%	3.7%	4.0%	4.3%	4.6%	5.0%
Hispanic or Latino Population (in thousands)	29.6%	32.1%	32.6%	33.2%	33.7%	34.2%	34.7%	36.7%	39.7%	42.2%	47.0%
Male Population (in thousands)	50.2%	50.2%	50.2%	50.2%	50.1%	50.1%	50.1%	50.1%	50.0%	49.9%	49.6%
Total Employment (in thousands of jobs)	287.61	305.43	312.06	316.94	321.93	326.99	332.14	353.64	388.77	420.92	493.98
Farm Employment	7.4%	6.9%	6.6%	6.6%	6.5%	6.5%	6.4%	6.2%	5.8%	5.6%	5.0%
Forestry, Fishing, Related Activities	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%
Mining	2.4%	3.2%	3.6%	3.6%	3.6%	3.6%	3.7%	3.8%	3.9%	4.0%	4.2%
Utilities	1.0%	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.7%
Construction	9.6%	8.9%	9.2%	9.2%	9.3%	9.3%	9.3%	9.5%	9.6%	9.8%	10.1%
Manufacturing	9.8%	8.7%	8.9%	8.8%	8.7%	8.6%	8.5%	8.1%	7.6%	7.2%	6.3%
Wholesale Trade	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.8%	2.8%	2.8%	2.8%	2.8%
Retail Trade	11.3%	11.1%	10.9%	10.9%	10.9%	10.9%	10.9%	11.0%	11.0%	11.1%	11.1%
Transportation and Warehousing	2.8%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.6%	2.6%	2.5%	2.4%
Information Employment	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.5%
Finance and Insurance	3.4%	4.2%	4.2%	4.3%	4.3%	4.3%	4.4%	4.5%	4.7%	4.9%	5.3%
Real Estate/Rental and Lease	3.4%	3.7%	3.8%	3.8%	3.9%	3.9%	3.9%	4.0%	4.1%	4.1%	4.3%
Professional and Technical Services	3.9%	4.1%	4.2%	4.2%	4.2%	4.2%	4.2%	4.3%	4.3%	4.4%	4.5%
Management	0.2%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%

Table 4-17. Demographic and Employment Baseline Projections for Economic Impact Area TX-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Administrative and Waste Services	4.6%	4.2%	4.3%	4.3%	4.3%	4.4%	4.4%	4.5%	4.7%	4.8%	5.1%
Educational Services	0.9%	1.0%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.3%	1.3%	1.4%
Health Care and Social Assistance	7.4%	8.2%	8.0%	8.1%	8.2%	8.3%	8.4%	8.7%	9.2%	9.6%	10.5%
Arts, Entertainment, and Recreation	1.2%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%
Accommodation and Food Services	5.6%	5.9%	6.1%	6.1%	6.2%	6.2%	6.2%	6.4%	6.7%	6.9%	7.4%
Other Services, Except Public Administration	6.5%	6.0%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	5.8%	5.7%
Federal Civilian Government	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.2%
Federal Military	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.3%
State and Local Government	12.9%	13.0%	12.5%	12.4%	12.2%	12.1%	12.0%	11.6%	11.0%	10.4%	9.4%
Total Earnings (in millions of 2005 dollars)	11,144.90	12,256.96	12,903.46	13,073.11	13,410.85	13,757.68	14,113.81	15,636.58	18,246.55	20,763.13	26,920.43
Farm	3.5%	1.7%	2.0%	2.0%	2.0%	1.9%	1.9%	1.8%	1.7%	1.6%	1.4%
Forestry, Fishing, Related Activities	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%
Mining	4.3%	4.6%	5.2%	5.3%	5.4%	5.4%	5.5%	5.7%	6.0%	6.3%	6.9%
Utilities	2.7%	2.8%	2.4%	2.5%	2.5%	2.5%	2.6%	2.6%	2.7%	2.7%	2.8%
Construction	11.7%	11.7%	12.3%	12.2%	12.2%	12.2%	12.1%	12.0%	11.7%	11.5%	11.0%
Manufacturing	20.2%	18.5%	19.0%	19.0%	18.8%	18.6%	18.4%	17.7%	16.6%	15.7%	13.9%
Wholesale Trade	3.5%	4.3%	4.3%	3.8%	3.8%	3.8%	3.9%	4.0%	4.1%	4.3%	4.5%
Retail Trade	8.1%	8.1%	7.8%	7.8%	7.8%	7.7%	7.6%	7.4%	7.0%	6.7%	6.1%
Transportation and Warehousing	3.2%	3.4%	3.5%	3.1%	3.1%	3.0%	3.0%	2.9%	2.8%	2.7%	2.5%
Information	0.8%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Finance and Insurance	3.0%	2.9%	2.9%	3.1%	3.1%	3.1%	3.2%	3.4%	3.6%	3.9%	4.4%
Real Estate/Rental and Lease	1.5%	1.7%	2.0%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	2.0%	2.0%
Professional and Technical Services	3.9%	3.9%	3.9%	3.9%	3.9%	4.0%	4.0%	4.2%	4.4%	4.6%	5.0%
Management	0.1%	0.2%	0.2%	0.4%	0.5%	0.5%	0.5%	0.5%	0.6%	0.7%	0.8%
Administrative and Waste Services	2.5%	2.4%	2.4%	2.5%	2.6%	2.6%	2.6%	2.7%	2.9%	3.1%	3.4%
Educational Services	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.7%
Health Care and Social Assistance	6.8%	8.1%	7.7%	7.8%	8.0%	8.1%	8.2%	8.7%	9.5%	10.1%	11.5%
Arts, Entertainment, and Recreation	0.4%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Accommodation and Food Services	2.2%	2.4%	2.4%	2.5%	2.5%	2.5%	2.5%	2.6%	2.8%	2.9%	3.2%
Other Services, Except Public Administration	5.2%	4.9%	4.7%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.7%

Table 4-17. Demographic and Employment Baseline Projections for Economic Impact Area TX-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Federal Civilian Government	0.9%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%	0.6%
Federal Military	0.6%	0.6%	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%
State and Local Government	13.9%	14.7%	13.8%	13.9%	13.9%	13.8%	13.8%	13.6%	13.3%	13.0%	12.4%
Total Personal Income per Capita (in 2005 dollars)	32,034	35,398	36,450	36,559	36,972	37,417	37,889	40,006	43,822	47,528	56,453
Woods & Poole Economics Wealth Index (U.S. = 100)	78.4	86.3	87.2	87.2	87.5	87.7	88.0	89.0	90.7	92.2	95.5
Persons per Household (in number of people)	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.7	2.7	2.8	2.8
Mean Household Total Personal Income (in 2005 dollars)	88,006	98,664	101,206	102,374	102,941	103,653	104,498	109,413	120,299	131,909	160,791
Number of Households (in thousands)	211.75	224.92	228.13	229.27	233.73	238.15	242.49	258.17	278.53	293.69	323.19
Income < $10,000 (thousands of households, 2000$)	7.6%	7.0%	7.0%	6.9%	6.8%	6.8%	6.7%	6.2%	5.5%	5.0%	4.0%
Income $10,000 to $19,999	12.3%	11.9%	11.8%	12.1%	12.0%	11.8%	11.7%	10.9%	9.6%	8.7%	6.9%
Income $20,000 to $29,999	11.7%	11.2%	11.2%	10.9%	10.8%	10.7%	10.6%	9.9%	8.8%	8.0%	6.3%
Income $30,000 to $44,999	15.2%	14.3%	14.4%	14.1%	14.1%	14.0%	13.8%	13.0%	11.6%	10.6%	8.6%
Income $45,000 to $59,999	12.7%	12.4%	12.8%	13.0%	13.0%	13.0%	13.0%	13.1%	12.7%	11.8%	9.4%
Income $60,000 to $74,999	9.9%	10.1%	10.0%	9.9%	9.9%	10.0%	10.1%	10.5%	11.0%	11.3%	10.6%
Income $75,000 to $99,999	12.4%	12.2%	11.7%	11.9%	12.0%	12.1%	12.2%	13.0%	14.5%	15.8%	18.6%
Income $100,000 or more	18.2%	20.8%	21.0%	21.3%	21.4%	21.7%	21.9%	23.3%	26.2%	28.7%	35.6%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-18

Demographic and Employment Baseline Projections for Economic Impact Area TX-3

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	5,518.20	6,202.21	6,309.03	6,421.63	6,536.83	6,654.44	6,773.88	7,269.96	8,063.83	8,764.06	10,272.30
Age Under 19 Years	30.7%	30.3%	30.1%	30.1%	30.1%	30.1%	30.1%	30.1%	29.7%	29.5%	29.1%
Age 20 to 34	22.2%	21.8%	21.8%	21.7%	21.6%	21.5%	21.4%	20.8%	21.0%	21.1%	21.3%
Age 35 to 49	22.8%	21.3%	21.0%	20.8%	20.5%	20.4%	20.3%	20.1%	19.2%	18.7%	18.4%
Age 50 to 64	15.8%	17.5%	17.7%	17.8%	17.9%	17.9%	17.9%	17.4%	16.4%	15.9%	15.4%
Age 65 and over	8.5%	9.1%	9.3%	9.6%	9.8%	10.1%	10.4%	11.6%	13.6%	14.7%	15.7%
Median Age of Population (years)	37.4	38.2	38.3	38.4	38.5	38.5	38.5	38.6	38.7	38.7	38.3
White Population (in thousands)	45.8%	41.7%	41.3%	40.6%	39.9%	39.3%	38.6%	36.1%	32.5%	29.8%	24.9%
Black Population (in thousands)	17.6%	17.8%	17.6%	17.5%	17.4%	17.3%	17.2%	16.7%	16.0%	15.4%	14.2%
Native American Population (in thousands)	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Asian and Pacific Islander Population (in thousands)	5.7%	6.5%	6.5%	6.7%	6.8%	6.9%	7.1%	7.6%	8.4%	9.0%	10.1%
Hispanic or Latino Population (in thousands)	30.6%	33.8%	34.2%	34.9%	35.5%	36.2%	36.8%	39.3%	42.8%	45.5%	50.5%
Male Population (in thousands)	49.8%	49.8%	49.8%	49.8%	49.8%	49.8%	49.8%	49.7%	49.6%	49.5%	49.2%
Total Employment (in thousands of jobs)	3,218.66	3,598.02	3,682.63	3,752.42	3,823.50	3,895.93	3,969.75	4,279.26	4,789.21	5,260.12	6,344.46
Farm Employment	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	2.8%	3.2%	3.5%	3.5%	3.5%	3.5%	3.5%	3.6%	3.6%	3.6%	3.6%
Utilities	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%
Construction	8.0%	7.5%	7.3%	7.3%	7.3%	7.4%	7.4%	7.4%	7.4%	7.5%	7.5%
Manufacturing	7.4%	6.8%	7.0%	6.9%	6.8%	6.7%	6.6%	6.2%	5.7%	5.3%	4.6%
Wholesale Trade	4.5%	4.4%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Retail Trade	10.2%	9.5%	9.4%	9.4%	9.4%	9.4%	9.3%	9.2%	9.1%	9.0%	8.7%
Transportation and Warehousing	4.3%	4.2%	4.2%	4.1%	4.1%	4.1%	4.1%	4.0%	3.9%	3.8%	3.5%
Information Employment	1.5%	1.2%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	0.9%	0.8%
Finance and Insurance	4.5%	5.1%	5.2%	5.2%	5.2%	5.3%	5.3%	5.3%	5.4%	5.4%	5.4%

Table 4-18. Demographic and Employment Baseline Projections for Economic Impact Area TX-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Real Estate/Rental and Lease	4.1%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.2%	4.2%	4.2%
Professional and Technical Services	7.8%	7.9%	7.9%	8.0%	8.0%	8.0%	8.0%	8.2%	8.3%	8.5%	8.7%
Management	0.6%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
Administrative and Waste Services	7.4%	7.3%	7.6%	7.6%	7.7%	7.7%	7.8%	7.9%	8.2%	8.4%	8.8%
Educational Services	1.6%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.8%	1.8%	1.8%
Health Care and Social Assistance	8.2%	9.2%	9.2%	9.3%	9.4%	9.5%	9.6%	10.1%	10.9%	11.5%	12.7%
Arts, Entertainment, and Recreation	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Accommodation and Food Services	6.5%	6.6%	6.7%	6.8%	6.8%	6.8%	6.9%	7.0%	7.2%	7.3%	7.6%
Other Services, Except Public Administration	6.0%	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%	6.0%	6.1%	6.2%	6.2%
Federal Civilian Government	1.0%	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.6%	0.6%	0.5%
Federal Military	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
State and Local Government	10.3%	9.9%	9.5%	9.4%	9.4%	9.3%	9.2%	8.8%	8.4%	8.0%	7.2%
Total Earnings (in millions of 2005 dollars)	202,185.34	226,898.60	237,509.70	244,420.42	251,920.11	259,653.01	267,626.35	302,075.94	362,333.17	421,701.96	571,319.56
Farm	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
Forestry, Fishing, Related Activities	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Mining	12.3%	9.6%	10.5%	10.3%	10.3%	10.4%	10.4%	10.5%	10.7%	10.8%	10.8%
Utilities	1.6%	1.9%	1.8%	1.9%	1.9%	1.9%	1.9%	1.9%	2.0%	2.0%	2.1%
Construction	8.2%	8.3%	8.0%	8.0%	8.0%	7.9%	7.9%	7.6%	7.3%	7.0%	6.5%
Manufacturing	11.7%	10.8%	11.0%	10.9%	10.7%	10.6%	10.4%	9.8%	8.9%	8.3%	7.0%
Wholesale Trade	6.2%	6.7%	6.9%	7.0%	7.0%	7.1%	7.1%	7.2%	7.3%	7.5%	7.7%
Retail Trade	5.2%	4.8%	4.8%	4.7%	4.7%	4.6%	4.6%	4.3%	4.0%	3.7%	3.2%
Transportation and Warehousing	5.6%	6.1%	6.1%	6.1%	6.1%	6.0%	6.0%	5.7%	5.4%	5.1%	4.6%
Information	1.7%	1.3%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Finance and Insurance	5.5%	5.4%	5.4%	5.4%	5.4%	5.4%	5.5%	5.6%	5.7%	5.8%	6.0%
Real Estate/Rental and Lease	2.4%	1.9%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.7%	1.7%
Professional and Technical Services	10.8%	11.5%	11.4%	11.5%	11.6%	11.7%	11.9%	12.3%	12.9%	13.4%	14.5%
Management	0.6%	1.2%	1.3%	1.3%	1.3%	1.3%	1.4%	1.5%	1.6%	1.7%	2.1%
Administrative and Waste Services	4.4%	4.4%	4.7%	4.7%	4.8%	4.8%	4.8%	5.0%	5.3%	5.5%	5.9%
Educational Services	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%	1.2%	1.2%
Health Care and Social Assistance	6.5%	7.6%	7.4%	7.5%	7.6%	7.8%	7.9%	8.3%	9.0%	9.6%	10.8%

Table 4-18. Demographic and Employment Baseline Projections for Economic Impact Area TX-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Arts, Entertainment, and Recreation	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Accommodation and Food Services	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.4%	2.4%	2.5%	2.6%
Other Services, Except Public Administration	3.1%	3.4%	3.3%	3.3%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%
Federal Civilian Government	1.7%	1.6%	1.5%	1.5%	1.4%	1.4%	1.4%	1.3%	1.2%	1.1%	1.0%
Federal Military	0.3%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
State and Local Government	8.3%	8.9%	8.3%	8.3%	8.2%	8.2%	8.1%	8.0%	7.7%	7.5%	7.0%
Total Personal Income per Capita (in 2005 dollars)	42,471	43,854	45,374	46,029	46,517	47,060	47,647	50,340	55,300	60,188	72,156
Woods & Poole Economics Wealth Index (U.S. = 100)	84.6	93.3	93.5	93.6	93.6	93.7	93.7	93.6	93.5	93.5	93.7
Persons per Household (in number of people)	2.8	2.8	2.8	2.9	2.8	2.8	2.8	2.8	2.8	2.9	2.9
Mean Household Total Personal Income (in 2005 dollars)	116,971	124,887	128,705	131,731	132,446	133,388	134,530	141,237	156,159	172,160	212,416
Number of Households (in thousands)	2,003.61	2,177.90	2,224.21	2,243.83	2,295.85	2,347.73	2,399.14	2,591.20	2,855.59	3,063.95	3,489.41
Income < $10,000 (thousands of households, 2000$)	7.0%	7.3%	7.5%	7.3%	7.3%	7.2%	7.1%	6.7%	6.0%	5.5%	4.3%
Income $10,000 to $19,999	10.4%	11.0%	11.0%	10.8%	10.7%	10.6%	10.5%	9.8%	8.8%	8.1%	6.4%
Income $20,000 to $29,999	10.6%	11.0%	10.7%	10.9%	10.8%	10.7%	10.6%	10.0%	9.0%	8.2%	6.6%
Income $30,000 to $44,999	14.5%	14.9%	15.0%	14.7%	14.7%	14.6%	14.4%	13.5%	12.2%	11.2%	9.0%
Income $45,000 to $59,999	12.4%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	11.8%	11.0%	10.2%	8.2%
Income $60,000 to $74,999	9.5%	9.6%	9.9%	9.7%	9.7%	9.8%	9.9%	10.4%	11.1%	11.3%	9.8%
Income $75,000 to $99,999	12.5%	11.7%	11.7%	12.0%	12.1%	12.2%	12.3%	13.1%	14.4%	15.5%	17.8%
Income $100,000 or more	23.0%	22.6%	22.2%	22.5%	22.6%	22.9%	23.1%	24.7%	27.5%	30.0%	37.9%

Notes: Median Age and The Wealth Index are defined using averages of the original Woods & Poole values for the counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2014.

Table 4-19

Sales Volumes, Sales Values, and Revenues

	Fiscal Year					
	2008	2009	2010	2011	2012	2013
Panel A: Sales Volumes						
Gas (royalty) (Mcf)	2,143,025,840	1,728,872,720	1,685,736,473	1,386,890,198	1,117,174,582	969,558,880
Gas (non-royalty) (Mcf)	319,971,195	462,806,700	359,380,589	274,566,212	228,879,954	197,898,700
NGL (royalty) (gal)	2,045,198,057	1,746,719,986	2,033,407,631	1,794,328,667	1,564,235,458	1,506,799,338
NGL (non-royalty) (gal)	164,425,802	155,790,669	376,697,377	336,415,238	282,395,427	326,089,182
Oil (royalty) (bbl)	274,769,555	393,068,662	413,843,666	358,198,122	336,215,213	357,383,873
Oil (non-royalty) (bbl)	162,507,054	125,837,700	177,500,611	137,919,150	121,710,533	96,283,955
Panel B: Sales Values						
Gas ($)	19,783,276,001	7,895,954,197	7,894,516,113	5,942,396,884	3,252,264,280	3,593,682,083
NGL ($)	3,067,687,538	1,268,806,694	2,069,278,438	2,814,128,996	1,738,915,377	1,302,281,476
Oil ($)	29,407,481,996	21,080,156,402	31,052,123,264	35,322,996,383	36,839,364,707	38,009,687,312
Other Products ($)	423,743	173,955	84,219	60,125	48,228	66,780
Total Sales Value ($)	52,258,869,278	30,245,091,247	41,016,002,033	44,079,582,388	41,830,592,592	42,905,717,650
Panel C: Revenues						
Gas ($)	2,873,950,871	1,110,388,831	1,112,167,319	840,978,575	457,248,784	509,506,758
NGL ($)	287,868,515	120,258,451	243,292,473	280,174,746	216,595,485	157,812,075
Oil ($)	4,057,786,252	2,766,270,473	4,090,113,535	4,795,103,633	5,022,322,667	5,186,978,444
Rents ($)	231,517,822	228,450,250	238,557,438	217,625,912	218,313,871	236,572,594
Bonus ($)	6,817,546,915	1,174,069,762	986,997,466	37,054,282	606,446,360	2,732,922,142
Other Revenues ($)	3,245,974	-30,044,645	46,794,397	4,371,526	5,124,807	34,414,627
Total Revenues ($)	14,271,916,347	5,369,393,121	6,717,922,628	6,175,308,674	6,526,051,974	8,858,206,640

Note: Data in this table refer to the years in which sales occurred (not to the years in which government revenues were received).

bbl = barrel.
gal = gallon.
Mcf = thousand cubic feet.
NGL = natural gas liquids.

Source: USDOI, Office of Natural Resources Revenue, 2014.

Table 4-20

Baseline Employment Projections (in thousands) by Economic Impact Area

Calendar Year	TX-1	TX-2	TX-3	LA-1	LA-2	LA-3	LA-4	MS-1	AL-1	FL-1	FL-2	FL-3	FL-4	Total
2010	806.89	305.43	3,598.02	177.97	328.88	674.25	750.90	241.07	374.37	474.27	320.53	1,832.29	3,367.36	13,252.22
2011	820.21	312.06	3,682.63	179.50	333.42	681.06	758.43	237.96	375.73	481.21	320.83	1,846.30	3,430.32	13,459.65
2012	834.82	316.94	3,752.42	181.84	339.08	691.34	766.12	240.09	381.01	487.94	324.64	1,875.79	3,489.82	13,681.85
2013	849.66	321.93	3,823.50	184.23	344.80	701.78	773.87	242.26	386.35	494.78	328.48	1,905.67	3,550.17	13,907.48
2014	864.76	326.99	3,895.93	186.63	350.61	712.40	781.67	244.42	391.77	501.71	332.38	1,935.91	3,611.37	14,136.55
2015	880.09	332.14	3,969.75	189.07	356.48	723.17	789.50	246.60	397.25	508.69	336.34	1,966.53	3,673.45	14,369.05
2016	895.67	337.37	4,044.98	191.54	362.44	734.10	797.39	248.79	402.81	515.77	340.34	1,997.53	3,736.39	14,605.11
2017	911.50	342.70	4,121.61	194.03	368.47	745.18	805.31	250.99	408.42	522.94	344.38	2,028.94	3,800.21	14,844.68
2018	927.59	348.13	4,199.69	196.56	374.58	756.44	813.30	253.19	414.11	530.18	348.47	2,060.72	3,864.92	15,087.90
2019	943.92	353.64	4,279.26	199.12	380.77	767.88	821.31	255.42	419.86	537.52	352.62	2,092.90	3,930.55	15,334.76
2020	960.54	359.26	4,360.32	201.70	387.03	779.48	829.39	257.66	425.70	544.94	356.83	2,125.50	3,997.07	15,585.39
2021	977.35	364.98	4,442.91	204.31	393.33	791.25	837.44	259.89	431.58	552.43	361.09	2,158.28	4,064.10	15,838.95
2022	994.46	370.78	4,527.06	206.96	399.74	803.21	845.58	262.14	437.55	560.02	365.40	2,191.57	4,132.26	16,096.73
2023	1,011.88	376.69	4,612.81	209.64	406.25	815.34	853.79	264.41	443.59	567.71	369.76	2,225.38	4,201.56	16,358.81
2024	1,029.59	382.68	4,700.18	212.36	412.86	827.66	862.09	266.70	449.73	575.51	374.18	2,259.70	4,272.02	16,625.26
2025	1,047.62	388.77	4,789.21	215.11	419.58	840.17	870.47	269.01	455.94	583.42	378.64	2,294.56	4,343.66	16,896.16
2026	1,065.83	395.00	4,879.89	217.88	426.29	852.86	878.77	271.29	462.20	591.35	383.19	2,329.42	4,415.40	17,169.39
2027	1,084.36	401.33	4,972.29	220.69	433.11	865.74	887.16	273.60	468.54	599.40	387.79	2,364.82	4,488.32	17,447.15
2028	1,103.22	407.75	5,066.44	223.54	440.04	878.81	895.63	275.93	474.98	607.55	392.45	2,400.75	4,562.45	17,729.52
2029	1,122.40	414.28	5,162.37	226.42	447.08	892.08	904.18	278.28	481.50	615.82	397.16	2,437.23	4,637.80	18,016.58
2030	1,141.91	420.92	5,260.12	229.33	454.23	905.55	912.81	280.64	488.10	624.20	401.93	2,474.26	4,714.39	18,308.39
2031	1,161.64	427.70	5,359.67	232.27	461.37	919.22	921.38	282.99	494.76	632.61	406.78	2,511.31	4,791.08	18,602.79
2032	1,181.71	434.58	5,461.10	235.25	468.62	933.09	930.04	285.36	501.51	641.14	411.69	2,548.92	4,869.01	18,902.03
2033	1,202.13	441.58	5,564.46	238.27	475.98	947.17	938.78	287.75	508.35	649.79	416.66	2,587.09	4,948.21	19,206.22

Table 4-20. Baseline Employment Projections (in thousands) by Economic Impact Area (continued).

Calendar Year	TX-1	TX-2	TX-3	LA-1	LA-2	LA-3	LA-4	MS-1	AL-1	FL-1	FL-2	FL-3	FL-4	Total
2034	1,222.90	448.69	5,669.77	241.33	483.46	961.46	947.60	290.16	515.28	658.55	421.69	2,625.83	5,028.70	19,515.43
2035	1,244.03	455.92	5,777.07	244.42	491.06	975.97	956.50	292.59	522.31	667.43	426.78	2,665.15	5,110.50	19,829.74
2036	1,265.41	463.29	5,886.34	247.54	498.64	990.68	965.36	295.00	529.39	676.35	431.97	2,704.51	5,192.38	20,146.85
2037	1,287.16	470.78	5,997.67	250.69	506.34	1,005.61	974.31	297.43	536.57	685.39	437.21	2,744.45	5,275.56	20,469.17
2038	1,309.29	478.39	6,111.11	253.89	514.16	1,020.77	983.33	299.88	543.84	694.55	442.53	2,784.97	5,360.08	20,796.79
2039	1,331.79	486.12	6,226.69	257.13	522.10	1,036.15	992.44	302.35	551.21	703.83	447.90	2,826.10	5,445.95	21,129.78
2040	1,354.68	493.98	6,344.46	260.40	530.17	1,051.77	1,001.64	304.84	558.68	713.24	453.34	2,867.83	5,533.20	21,468.24
2041	1,377.97	501.97	6,464.46	263.72	538.35	1,067.62	1,010.92	307.36	566.25	722.77	458.85	2,910.18	5,621.85	21,812.27
2042	1,401.65	510.09	6,586.73	267.08	546.67	1,083.72	1,020.29	309.89	573.93	732.43	464.42	2,953.15	5,711.91	22,161.95
2043	1,425.74	518.33	6,711.30	270.49	555.11	1,100.05	1,029.74	312.44	581.71	742.22	470.06	2,996.76	5,803.42	22,517.38
2044	1,450.25	526.72	6,838.24	273.94	563.68	1,116.63	1,039.28	315.02	589.59	752.14	475.77	3,041.01	5,896.40	22,878.66
2045	1,475.18	535.23	6,967.58	277.43	572.39	1,133.46	1,048.91	317.61	597.58	762.19	481.55	3,085.92	5,990.86	23,245.89
2046	1,500.53	543.89	7,099.36	280.96	581.23	1,150.55	1,058.63	320.23	605.68	772.38	487.40	3,131.49	6,086.84	23,619.16
2047	1,526.32	552.68	7,233.63	284.55	590.20	1,167.89	1,068.43	322.87	613.89	782.70	493.32	3,177.73	6,184.35	23,998.57
2048	1,552.56	561.62	7,370.45	288.17	599.32	1,185.49	1,078.33	325.53	622.21	793.16	499.32	3,224.65	6,283.43	24,384.24
2049	1,579.24	570.70	7,509.85	291.85	608.58	1,203.36	1,088.32	328.21	630.65	803.76	505.38	3,272.27	6,384.10	24,776.26
2050	1,606.39	579.92	7,651.89	295.57	617.97	1,221.50	1,098.41	330.92	639.19	814.50	511.52	3,320.59	6,486.37	25,174.74
2051	1,634.00	589.30	7,796.62	299.33	627.52	1,239.91	1,108.58	333.64	647.86	825.39	517.73	3,369.62	6,590.29	25,579.79
2052	1,662.08	598.83	7,944.08	303.15	637.21	1,258.59	1,118.86	336.39	656.64	836.42	524.02	3,419.38	6,695.87	25,991.53
2053	1,690.65	608.51	8,094.33	307.01	647.05	1,277.56	1,129.22	339.16	665.54	847.60	530.39	3,469.87	6,803.14	26,410.05
2054	1,719.71	618.35	8,247.43	310.93	657.04	1,296.82	1,139.68	341.96	674.56	858.93	536.83	3,521.11	6,912.14	26,835.48
2055	1,749.27	628.35	8,403.42	314.89	667.19	1,316.37	1,150.24	344.78	683.70	870.41	543.35	3,573.11	7,022.87	27,267.94
2014-2055 growth	1.73%	1.61%	1.89%	1.28%	1.58%	1.51%	0.95%	0.84%	1.37%	1.35%	1.21%	1.51%	1.64%	1.62%

Notes: Actual Woods & Poole data for 2010 through 2020, 2025, 2030, 2035, and 2040.
Missing estimates through 2040 calculated using average annual growth rate for the 5-year period; projections after 2040 calculated using the average annual growth rate from 2035 to 2040.

Source: Woods & Poole Economics, Inc., 2014.

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APPENDIX A

COMMONLY APPLIED MITIGATING MEASURES

A. COMMONLY APPLIED MITIGATING MEASURES

Postlease mitigating measures have been implemented for over 40 years in the Gulf of Mexico region, as they relate to OCS plans and pipeline applications. These mitigating measures have been amended over time to address changes in regulations, new technology, and new methods of operating. Many of these mitigating measures have been adopted and incorporated into regulations and/or guidelines governing OCS exploration, development, and production activities. All plans for OCS oil- and gas-related activities (e.g., exploration and development plans, pipeline applications, geological and geophysical activities, and structure-removal applications) go through rigorous BOEM review and approval to ensure compliance with established laws and regulations. Existing mitigating measures must be incorporated and documented in plans submitted to BOEM. Operational compliance of the mitigating measures is enforced through the Bureau of Safety and Environmental Enforcement's (BSEE's) onsite inspection program.

Mitigating measures are an integral part of BOEM's program to ensure that postlease operations are always conducted in an environmentally sound manner (with an emphasis on minimizing any adverse impact of routine operations on the environment). For example, post-activity surveys are carried out to ensure that a site has been cleared of potential snags to commercial fishing gear, and pre-activity surveys seek to avoid archaeological sites and biologically sensitive areas such as pinnacles, topographic features, and chemosynthetic communities.

Some BOEM-identified mitigating measures are incorporated into OCS operations through cooperative agreements or efforts with industry and State and Federal agencies. These mitigating measures include the National Marine Fisheries Service's (NMFS's) Observer Program to protect marine mammals and sea turtles during explosive removals, labeling operational supplies to track possible sources of debris or equipment loss, development of methods of pipeline landfall to eliminate impacts to beaches or wetlands, and beach cleanup events.

Site-specific mitigating measures are also applied by BOEM during plan and permit reviews. BOEM realized that many of these site-specific mitigations were recurring and developed a list of "standard" or commonly applied mitigations. There are currently over 120 standard mitigations. The wording of a standard mitigation is developed by BOEM in advance and may be applied whenever conditions warrant. Standard mitigation text is revised as often as is necessary (e.g., to reflect changes in regulatory citations, agency/personnel contact numbers, and internal policy). Site-specific mitigation "categories" include the following: air quality; archaeological resources; artificial reef material; chemosynthetic communities; Flower Garden Banks; topographic features; hard bottoms/pinnacles; military warning areas and Eglin Water Test Areas (EWTAs); hydrogen sulfide (H_2S); drilling hazards; remotely operated vehicle surveys; geophysical survey reviews; and general safety concerns. Site-specific mitigation "types" include the following: advisories; conditions of approval; hazard survey reviews; inspection requirements; notifications; post-approval submittals; and safety precautions. In addition to standard mitigations, BOEM may also apply nonrecurring mitigating measures that are developed on a case-by-case basis.

Following a lease sale, an applicant seeks approvals to develop their lease by preparing and submitting OCS plans. The OCS plans are reviewed by BOEM and, depending on what is proposed to take place in a specific place, BOEM may assign conditions of approval (COA). The COAs become part of the approved postlease authorization and include environmental protections, requirements that maintain conformance with law, the requirements of other agencies having jurisdiction, or safety precautions.

Some of BOEM's conditions of approval include the following:

(1) other approvals prerequisite to BOEM's approval (e.g., the Coastal Zone Management Act);

(2) safety precautions (e.g., H_2S present);

(3) post-approval submittals (e.g., surveys and interpretive reports);

(4) inspection requirements (e.g., pipeline pressure testing);

(5) pre-deployment notifications (e.g., U.S. Department of Defense use restrictions and Military Warning Areas); and

(6) reduce or avoid environmental impacts on resources identified in NEPA or other laws (e.g., the National Historic Preservation Act).

BOEM is continually revising applicable mitigations to allow the Gulf of Mexico OCS Region to more easily and routinely track mitigation compliance and effectiveness. A primary focus of this effort is requiring post-approval submittal of information within a specified timeframe or after a triggering event (e.g., end of operations reports for plans, construction reports for pipelines, and removal reports for structure removals).

Table A-1 provides a list and description of standard postlease mitigating measures that may be required by BOEM or BSEE as a result of plan and permit review processes for the Gulf of Mexico OCS Region.

Table A-1

Commonly Applied or "Standard" Mitigating Measures

Mitigation Number	Mitigating Measure Title	Description of Mitigation
0.0	Non-Recurring Mitigation	A non-recurring mitigation is a mitigation measure that is used for a unique, special, one-time-only mitigation that is added to certain plans.
		Boat Traffic Mitigations
1.04	Seismic Vessels (protected species requirements)	The applicant will comply with Notice to Lessees and Operators (NTL) 2012-JOINT-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program." Additionally, the applicant will comply with the guidance under this NTL when operating in all water depths (not just in water depths >200 m [656 ft] or in the Eastern Planning Area), and the NTL's "Shut-Down Conditions" will be applied towards manatees.
1.05	Seismic Vessels (vessel-strike avoidance/reporting)	The applicant will follow the guidance provided under NTL 2012-JOINT-G01, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting." This provides guidance on how a seismic applicant should implement monitoring programs to minimize the risk of vessel strikes to protected species and report observations of injured or dead protected species. In lieu of a formal observer program, NTL 2012-JOINT-G01 provides specific guidelines that should be followed to identify and avoid injury to marine mammals and sea turtles.
1.06	Progressive-Transport/"Hopping" (structure removals)	In accordance with the Outer Continental Shelf Lands Act (OCSLA) requirements (30 CFR § 250.1727(g)), if at any point in the decommissioning schedule progressive-transport/"hopping" activities are required to section the jacket assembly or support material barge loading, a prior written request must be submitted and approval must be obtained from the Bureau of Safety and Environmental Enforcement's (BSEE's) Regional Supervisor, Field Operations. The applicant's request to use progressive-transport must include a detailed procedural narrative and separate location plat for each "set-down" site, showing pipelines, anchor patterns for the derrick barge, and any known archaeological and/or potentially sensitive biological features. The diagram/map of the route to be taken from the initial structure location along the transport path to each site must also be submitted with the request. If the block(s) that the applicant intends to use as "set-down" sites have not been surveyed as per NTL 2009-G39, "Biologically-Sensitive Underwater Features and Areas," and NTL 2005-G07, "Archaeological Resource Surveys and Reports," the applicant may be required to conduct the necessary surveys/reporting prior to mobilizing on site and conducting any seafloor-disturbing activities.
1.07	Seismic Vessels (notification requirements)	In accordance with 30 CFR § 550.208(b)(2), the applicant is hereby required to notify other users of the Outer Continental Shelf (OCS) before conducting the proposed ancillary activities. Prior to commencing the survey(s), the applicant must inform the operators of all leases affected by the proposed activities of when and where the applicant intends to conduct the vessel operations to ensure that proper navigation and safety protocol are observed.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		Air Quality Mitigations
2.05	Fuel Usage or Run Time Documentation	The projected nitrogen oxides (NO_x) emissions amounts in the plan were calculated using historic (insert fuel consumption rates, run times). Maintain monthly records of the total annual (insert fuel consumption, run times) for the (specify the affected vessels or equipment) with a limit of (insert limit in gallons/year, limit in hours/year) and provide the information to the Bureau of Ocean Energy Management's (BOEM's) Regional Supervisor, Office of Leasing and Plans, Plans Section annually by February 1st of each year, beginning in the year (insert year). If no activities were conducted during a calendar year, provide a statement to that effect in lieu of the required records. If at any time during the applicant's activities these records indicate that the NO_x annual emissions may exceed the annual limit approved in your plan or the total annual (insert fuel consumption, run time) limit, the applicant must immediately prepare a revised plan pursuant to 30 CFR § 550.283 to include the recalculated emissions amounts. The applicant will not proceed with the actions that could cause the potential annual increase in emissions until the revised plan has been submitted to and approved by BOEM.
2.08	Potential to Exceed SO_2 Significance Levels (flaring)	Should hydrogen sulfide (H_2S) concentrations greater than (insert number) ppm be encountered, the 3- and 24-hour sulphur oxides (SO_2) onshore ambient air concentration significance levels as prescribed by 30 CFR § 550.303(e) could be exceeded during the proposed well test flaring. Therefore, the applicant is advised that, should H_2S concentrations greater than (insert number) ppm be encountered, they shall use the graph included in their plan to determine the maximum allowable flow rate for the flaring operation. The applicant is responsible for ensuring that their maximum emission concentrations remain below the aforementioned significance levels. In accordance with 30 CFR § 250.1164(c), the applicant is hereby required to submit monthly reports that contain the following: (1) the daily volume and duration (number of hours) of each flaring episode; (2) the H_2S concentration (ppm) in the flared gas; and (3) the calculated amount of SO_2 emitted.
2.11	Using Ultra-Low Sulfur Content Fuel	As proposed, use ultra-low sulfur content diesel fuel (sulfur concentration 0.0015% or less by weight) while conducting these operations. Sulfur content records must be maintained on the platform and made available to authorized BSEE personnel upon request.
2.12	Verification of Emissions Factors (clean burn engines)	The rating, manufacturer, and type of engine(s) proposed in the applicant's plan will be operated and maintained in accordance with the manufacturer's specifications. Using a U.S. Environmental Protection Agency (USEPA)-approved or equivalent method, perform an emissions stack test on the subject engine(s) within 60 days following installation and at least every 3 years thereafter. These tests will be performed at loads representing 25, 50, 75, and 100 percent of the rated capacity or at minimum, average, and highest operational loads to verify that the emission factors are not exceeding those used in calculating the proposed emissions in the plan. Prepare a report of the results of each stack test and submit it to BOEM's Regional Supervisor,

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		Office of Leasing and Plans, Plans Section within 45 days of the test. During engine operation, the applicant will maintain the baseline parameters (such as air-fuel rations) established during the most recent successful stack test. The applicant must monitor and record these parameters daily to ensure consistency with those observed during the most recent successful stack test. Records of these parameters must be maintained on the platform and made available to authorized BSEE personnel upon request. In addition, the applicant must submit this information to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section annually by February 1st of each year, beginning in the year (insert year). If no activities were conducted during a calendar year, provide a statement to that effect in lieu of the required records.
2.13	Monitoring of NO_x Emissions (catalytic converters)	The rating, manufacturer, and type, and catalytic converter(s) proposed in the plan must be operated and maintained in accordance with the manufacturer's specifications. Using a USEPA-approved or equivalent method, perform an emissions stack test on the subject engine(s) and catalytic converter(s) within 60 days following installation and at least every 3 years thereafter. These tests will be performed at loads representing 25, 50, 75, and 100 percent of the rated capacity or at minimum, average, and highest operational loads to verify that the emissions factors are not exceeding those used in calculating the proposed emissions in the plan. The applicant must contact BSEE at least 30 days prior to conducting the test to determine proper protocol for the stack test and also to have the BSEE representative witness the test. Prepare a report of the results of each stack test and submit it to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section within 45 days of the test. During operation, the applicant will maintain the baseline parameters, such as air-fuel ratios for the engine(s) and the pressure drop and temperature increase across the catalytic converter(s) established during the most recent successful stack test. The applicant must monitor and record these parameters daily to ensure they remain consistent with those observed during the most recent successful stack test. The records of these parameters will be maintained on the platform and made available to authorized BSEE personnel upon request. In addition, the applicant must submit this information to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section annually by February 1st of each year, beginning in the year (insert year). If no activities were conducted during a calendar year, the applicant must provide a statement to that effect in lieu of the required records.
2.15	Sulfur Recovery Unit, Flaring Episodes, Production Curtailment	If a shutdown of the sulfur recovery unit necessitates diverting the acid gas stream and if the resulting increased emissions would cause the SO_2 onshore ambient air concentration significance levels as prescribed by 30 CFR § 550.303(e) to be exceeded, begin curtailing production within 6 hours of the onset of the increased emissions. If curtailment is necessary, the appropriate reduced production rate will be reached no later than 8 hours from the onset of the increased emissions and will continue until such time that normal operation of the sulfur recovery unit can resume.
2.16	Monitoring of SO_2 Emissions (sulfur recovery units)	The amine unit and the (specify name of sulfur recovery unit) proposed in the plan must be operated and maintained in accordance with the manufacturer's specifications. Using a USEPA-approved or equivalent method, perform an emissions stack test on the subject sulfur recovery unit

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		within 60 days following installation. This test will be performed at loads representing 25, 50, 75, and 100 percent of the rated capacity of the amine unit or at minimum, average, and highest operational loads of the amine unit to verify that the emission factors are not exceeding those used in calculating the proposed emissions in the plan. Contact BSEE's Environmental Enforcement Division at least 30 days prior to conducting the test to determine proper protocol for the stack test and also to have the BSEE representative witness the test. Prepare a report of the results of each stack test and submit it to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section within 45 days of the test. The applicant must monitor and record these parameters daily to ensure they remain consistent with the approved baseline parameters from the most recent successful stack test. Records of these parameters must be maintained on the platform and made available to authorized BSEE personnel upon request. In addition, the applicant must submit this information to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section annually by February 1st of each year, beginning in the year (insert year). If no activities were conducted during a calendar year, provide a statement to that effect in lieu of the required records.
2.17	Verification of Emissions Factors (general)	The rating, manufacturer, and type of engine(s) proposed in the plan will be operated and maintained in accordance with the manufacturer's specifications. Using a USEPA-approved or equivalent method, perform an emissions stack test on the subject engine(s) within 60 days following installation and at least every 3 years thereafter. These tests will be performed at loads representing 25, 50, 75, and 100 percent of the rated capacity or at minimum, average, and highest operational loads to verify that the emission factors are not exceeding those used in calculating the proposed emissions in the plan. Contact BSEE's Environmental Enforcement Division at least 30 days prior to conducting the test to determine proper protocol for the stack test and also to have the BSEE representative witness the test. Prepare a report of the results of each stack test and submit it to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section within 45 days of the test. During engine operation, the applicant will maintain the baseline parameters (such as air-fuel rations) established during the most recent successful stack test. The applicant must monitor and record these parameters daily to ensure consistency with those observed during the most recent successful stack test. Records of these parameters must be maintained on the platform and made available to authorized BSEE personnel upon request. In addition, the applicant must submit this information to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section annually by February 1st of each year, beginning in the year (insert year). If no activities were conducted during a calendar year, provide a statement to that effect in lieu of the required records.
2.18	Alternative Monitoring of NO_x Emissions (catalytic converters)	Using your established baseline parameters listed below, monitor the performance of the engine(s) and catalytic converter(s) and record daily to ensure that performance remains consistent. Air to fuel ratio for engine: (insert baseline parameters); pressure drop across catalytic converter: (insert baseline parameters); and temperature increase across catalytic converter: (insert baseline parameters).

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		Records of these parameters must be maintained on the platform and made available to authorized BSEE personnel upon request. In addition, the applicant must submit a summary of these data to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section annually by February 1st of each year, beginning in the year (insert year). The summary will report minimum, average, and maximum values for the above-listed parameters, on a monthly basis, for the year. If no activities were conducted during a calendar year, provide a statement to that effect in lieu of the required records. Notify BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section as soon as practical but no later than 24 hours after the event, whenever the engine(s) or catalytic converter(s) exceed these parameters for periods greater than a day. File a detailed report with this office within 5 days of the termination of any such event. At a minimum, this report will include a chronology of the event, NO_x emissions rates in pounds per hour, total NO_x emissions for the duration of the event, and any measures taken to regain operation within these parameters or to prevent a recurrence of similar events. If exceeding the above parameters results in increased emissions that would cause onshore NO_x concentration to exceed BOEM significance levels (30 CFR § 550.303(e)), curtail the use of the (identify equipment associated with catalytic converter) within 2 days of the onset of the increased emissions and continue curtailment until such time that normal operation of the catalytic converter can resume.
Archaeology Mitigations		
3.00	Archaeology Non-Recurring Mitigation	A non-recurring mitigation is a mitigation measure that is used for a unique, special, one-time-only mitigation that is added to certain plans.
3.02	Buried Channels (pipeline applications)	BOEM's review indicates that the proposed activities are in the vicinity of buried channel margin features that may contain significant archaeological resources. In accordance with 30 CFR § 250.1007(a)(5), the applicant must either (1) conduct an underwater archaeological investigation (diver and/or remotely operated vehicle (ROV) investigations) prior to commencing activities to determine whether these features represent archaeological resources or (2) ensure that the depth of the pipeline trench in the vicinity of these features does not exceed 3 ft and that all other seafloor-disturbing actions resulting from the proposed activities avoid the subject channel margins (see the enclosed map depicting the avoidance area in the application). If the applicant conducts an underwater archaeological investigation prior to commencing operations, the applicant should contact BOEM, Gulf of Mexico OCS Region, Office of Environment, and BSEE, Environmental Enforcement Branch at least 2 weeks prior to performing operations to obtain the investigation methodology. If the applicant chooses to avoid the features, then the applicant should submit anchor position plats, at a scale of 1 in = 1,000 ft with differential global positioning system (DGPS) accuracy, with your pipeline construction report required by 30 CFR § 250.1008(b). These plats must depict the "as-placed" location of all anchors, anchor chains, wire ropes, and cables on the seafloor (including sweep) and demonstrate that the features were not physically impacted by the construction activities. If the applicant chooses to avoid the features and no anchoring activities were conducted during pipeline construction, provide a statement to that effect in lieu of the required anchor position plats. This mitigation may be applied by BSEE at the post-approval stage.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
3.03	Buried Channels (plans)	BOEM's review indicates that the proposed activities are in the vicinity of buried channel margin features that may contain significant archaeological resources. In accordance with 30 CFR § 550.194, the applicant must either (1) conduct an underwater archaeological investigation (diver and/or ROV investigations) prior to commencing activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor-disturbing actions resulting from the proposed activities avoid the subject features (see the enclosed map depicting the avoidance area in the application). If the applicant conducts an underwater archaeological investigation prior to commencing operations, contact BOEM's Office of Environment, Gulf of Mexico OCS Region least 2 weeks prior to performing operations to obtain the investigation methodology. If the applicant chooses to avoid the features, then submit an as-built map at a scale of 1 in = 1,000 ft with DGPS accuracy, showing the location of all seafloor disturbances (e.g., the rig or platform, anchors, anchor chains, wire ropes, cables, etc.) relative to these features, to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time that the applicant submits its (specify submittal type).
3.04 and 3.05	Magnetic Anomalies and/or Side-Scan Sonar Targets (pipeline applications - multiple features) Magnetic Anomalies and/or Side-Scan Sonar Targets (pipeline application – singular feature)	BOEM's review indicates that the proposed activities are in the vicinity of the unidentified (insert magnetic anomalies, side-scan sonar targets, magnetic anomalies and side-scan sonar targets) listed in the enclosure, features that may represent significant archaeological resources. In accordance with 30 CFR § 250.1007(a)(5), the applicant must either (1) conduct an underwater archaeological investigation (diver and/or ROV investigations) prior to commencing activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor-disturbing actions resulting from the proposed activities avoid the unidentified features by a distance greater than that listed in the enclosure. If the applicant conducts an underwater archaeological investigation prior to commencing operations, then the applicant must contact BOEM's Office of Environment, Gulf of Mexico OCS Region at least 2 weeks prior to performing operations to obtain the investigation methodology. If the applicant chooses to avoid the features, then submit anchor position plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, with the pipeline construction report required by 30 CFR § 250.1008(b). These plats must depict the "as-placed" location of all anchors, anchor chains, wire ropes, and cables on the seafloor (including sweep) and demonstrate that the features were not physically impacted by the construction activities. If the applicant chooses to avoid the features and no anchoring activities were conducted during pipeline construction, then provide a statement to that effect in lieu of the required anchor position plats. This mitigation may be applied by BSEE at the post-approval stage.
3.06 and 3.07	Magnetic Anomalies and/or Side-Scan Sonar Targets (plans – multiple features) Magnetic Anomalies and/or Side-Scan Sonar Targets (plans – singular feature)	BOEM's review indicates that the proposed activities are in the vicinity of the unidentified (insert magnetic anomalies, side-scan sonar targets, magnetic anomalies and side-scan sonar targets) listed in the enclosure of the application, features that may represent significant archaeological resources. In accordance with 30 CFR § 550.194, the applicant must either (1) conduct an underwater archaeological investigation (diver and/or ROV investigations) prior to commencing the activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor-disturbing actions resulting from the proposed activities avoid the subject features by a

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		distance greater than that listed in the enclosure of the application. If the applicant conducts an underwater archaeological investigation, then the applicant must contact BOEM's Office of Environment, Gulf of Mexico OCS Region at least 2 weeks prior to performing operations to obtain the investigation methodology. If the applicant chooses to avoid the features, submit an as-built map at a scale of 1 in = 1,000 ft with DGPS accuracy, showing the location of all seafloor disturbances (e.g., the rig or platform, anchors, anchor chains, wire ropes, cables, etc.) relative to these features to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time the applicant submits the plan.
3.08	Buried Channels (lease block survey review	BOEM's review of the archaeological assessment indicates that there are buried channel margin features that may contain significant archaeological resources in the lease block(s). The enclosed map in the application identifies the areas to be avoided during any future development within the block(s). In accordance with 30 CFR § 550.194, the applicant must either (1) conduct an underwater archeological investigation (diver and/or ROV investigations) to determine whether these features represent archaeological resources or (2) ensure that all seafloor-disturbing actions required by future exploration or development will avoid the subject features. If the applicant chooses to conduct an underwater archaeological investigation, then the applicant must contact BOEM's Office of Environment, Gulf of Mexico OCS Region at least 2 weeks prior to performing operations to obtain the investigation methodology.
3.09 and 3.10	Magnetic Anomaly and/or Side-Scan Sonar Target (survey review – single feature) Magnetic Anomaly and/or Side-Scan Sonar Target (survey review – multiple features)	BOEM's review of the archaeological assessment indicates the presence of the unidentified magnetic anomaly(ies), side-scan sonar target(s), or magnetic anomaly(ies) and side-scan sonar target(s) listed in the enclosure of the application, features that may represent significant archaeological resources. In accordance with 30 CFR § 550.194, the applicant must either (1) conduct an underwater archaeological investigation (diver and/or ROV investigations) to determine whether these features represent archaeological resources or (2) ensure that all seafloor-disturbing actions required by future exploration and development avoid the unidentified features by a distance greater than that listed in the enclosure of the application. If the applicant conducts an underwater archaeological investigation, then the applicant must contact BOEM's Office of Environment, Gulf of Mexico OCS Region at least 2 weeks prior to performing operations to obtain the investigation methodology.
3.11	Unsurveyed Area (plans)	Avoid impacts to the seafloor in the unsurveyed area approximately (insert number) feet to the (insert direction) of the proposed (specify Well X, Wells X and Y, Platform X, etc.). This area has been identified as requiring a (insert 50-meter or 300-meter) line spacing archaeological resource survey to determine the potential for archaeological resources. BOEM has no archaeological resource assessment on file for this area and, therefore, cannot determine the potential effects to archaeological resources outside of the applicant's survey coverage. Submit an as-built map at a scale of 1 in = 1,000 ft with DGPS accuracy, showing the location of all seafloor disturbances (e.g., the rig or platform, anchors, anchor chains, wire ropes, cables, etc.) relative to the unsurveyed area to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time the applicant submits the plan.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
3.12 and 3.13	Magnetic Anomalies and/or Side-Scan Sonar Targets (structure removals – multiple features) Magnetic Anomalies and/or Side-Scan Sonar Targets (structure removals – single feature)	BOEM's review indicates that the proposed activities are in the vicinity of the unidentified magnetic anomaly(ies), side-scan sonar target(s), or magnetic anomaly(ies) and side-scan sonar target(s) listed in the table in the application, a feature that may represent a significant archaeological resource. In accordance with 30 CFR § 250.194(c), the applicant must either (1) conduct an underwater archaeological investigation (diver and/or ROV investigations) prior to commencing activities to determine whether this feature represents an archaeological resource or (2) ensure that all anchoring operations (e.g., anchors, anchor chains, wire ropes, cables, etc.) avoid the unidentified feature by a distance greater than that listed in the table in the application. If the applicant plans to conduct an underwater archaeological investigation prior to commencing operations, then the applicant must contact BOEM's Office of Environment, Gulf of Mexico OCS Region to obtain the investigation methodology at least 2 weeks prior to performing operations and contact BOEM, Gulf of Mexico OCS Region, Office of Environment, and BSEE, Environmental Enforcement Branch. If the applicant chooses to avoid the feature, then include in the post-removal report as-built plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, the position of anchors, anchor chains, wire ropes, and cables deployed during the structure removal relative to the feature. In addition, supply a copy of ALL vessel logs related to the removal operations (e.g., anchor handling vessels, lift boats, dive vessels, and tug boats). This mitigation may be applied by BSEE at the post-approval stage.
3.16	ROV Surveys (plans)	The proposed operations are in an area designated by BOEM's Regional Director as having a high potential for the location of historic shipwrecks. In accordance with 30 CFR § 550.194(a)(2), prior to commencing the operations, conduct an ROV investigation (using video, sector-scanning sonar, or multibeam bathymetry) of the seafloor areas that could be disturbed by the operations (e.g., the rig or platform, anchors, anchor chains, wire ropes, cables, etc.) to ensure that the applicant will avoid harming potentially significant archaeological sites. The applicant must contact BOEM's Office of Environment, Gulf of Mexico OCS Region at least 2 weeks prior to performing operations to obtain the investigation methodology. The applicant must submit a report of this investigation prepared by a qualified marine archaeologist, along with an "as-placed" anchor plat and copies of the ROV video and acoustic recordings of the investigation to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time the applicant submits the plan. If the applicant discovers any potential archaeological resource (i.e., cannot be definitively identified as modern debris or refuse) while conducting this investigation or future operations, the applicant must immediately halt any seafloor-disturbing activities and report the discovery to BOEM's Regional Supervisor, Office of Environment.
3.17	Conditional Approval for ROV Surveys (plans)	Drilling permits will not be issued for proposed well(s) and well name(s) until the applicant submits an archaeological report to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section and receives approval. This report must be based on an ROV investigation (using video, sector-scanning sonar, or multibeam bathymetry) of the seafloor areas that could be disturbed by the operations. The report must be prepared by a qualified marine archaeologist and must include copies of the ROV video and acoustic recordings of the investigation, along with an "as-placed" anchor plat. If the applicant discovers any potential archaeological resource (i.e., cannot be

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		definitively identified as modern debris or refuse) while conducting this investigation, the applicant must immediately halt any seafloor-disturbing activities and report the discovery to BOEM's Regional Supervisor, Office of Environment. The applicant must contact BOEM's Office of Environment at least 2 weeks prior to performing this survey to obtain the investigation methodology.
3.18	Buried Channels (structure removal)	BOEM's review indicates that the proposed activities are in the vicinity of buried channel margin features that may contain significant archaeological resources. In accordance with 30 CFR § 250.194(c), the applicant must either (1) conduct an underwater archaeological investigation (diver and/or ROV investigations) prior to commencing activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor-disturbing actions resulting from the proposed activities (e.g., site-clearance trawling, anchors, anchor chains, wire ropes, cables, etc.) avoid the subject features (see the enclosed map depicting the avoidance area in the application). If the applicant plans to conduct an underwater archaeological investigation prior to commencing operations, then the applicant must contact BOEM's Office of Environment at least 2 weeks prior to performing operations to obtain the investigation methodology and contact BOEM, Gulf of Mexico OCS Region, Office of Environment, and BSEE, Environmental Enforcement Branch. If the applicant chooses to avoid the features, then include in the Post- removal Report as-built plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, the position of anchors, anchor chains, wire ropes, and cables deployed during the structure removal relative to these features. In addition, supply a copy of ALL vessel logs related to the removal operations (e.g., anchor handling vessels, lift boats, dive vessels, and tug boats). This mitigation may be applied by BSEE at the post-approval stage.
3.20	Avoidance of Potential Archaeological Resources	BOEM's review indicates that the proposed operations have the potential to impact submerged archaeological resources that could be in the area of potential effect, which encompasses all portions of the seafloor where bottom-disturbing activities are to occur. Before conducting any authorized, bottom-disturbing activities, the company will follow the guidance provided at http://www.boem.gov/Environmental-Stewardship/Archaeology/Gulf-of-Mexico-Archaeological-Information.aspx, which includes minimum survey recommendations, requisite certification submittals, and post-activity reporting standards needed to ensure compliance with the regulations under 30 CFR § 550.194. This mitigation may be applied by BSEE at the post-approval stage.
3.21 and 3.22	Side-Scan Sonar Targets (site clearance – single features) Side-Scan Sonar Targets (site clearance – multiple features)	BOEM's review indicates that the proposed activities are in the vicinity of the unidentified side-scan sonar target(s) listed in the table in the application, features that may represent significant archaeological resources. In accordance with 30 CFR § 250.194(c), the applicant must conduct an underwater archaeological investigation (diver and/or ROV investigation) under the supervision of a professional archaeologist to determine whether these features represent archaeological resources potentially eligible to the National Register of Historic Places prior to conducting site-clearance trawling activities. This mitigation may be applied by BSEE at the post-approval stage.
3.23	Protection of Potential Archaeological Resources (all structure removals)	Per 30 CFR § 250.194(c) and clarified in 2005-G07, if, during site clearance operations the applicant discovers any object of potential archaeological significance, the applicant is required to immediately halt operations. In addition, the applicant must immediately report this discovery to

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		BSEE's Environmental Enforcement Branch. Additional guidance will be provided to the applicant as to what steps will be needed to protect any potentially submerged archaeological resources. In order for BSEE to ensure compliance with 30 CFR § 250.194(c) and as specified under 30 CFR § 250.1743, the applicant is required to provide the trawling logs for both heavy-duty nets and verification nets, with descriptions of each item recovered. Should the applicant only pull site-clearance verification nets, the applicant must clearly state this within the body of the Site Clearance Report. The applicant is also requested to provide the following as an appendix in the Site Clearance Report: a CD or DVD of all digital photographs of the items recovered during the use of both the heavy-duty trawl nets and the site-clearance verification trawl nets. This mitigation may be applied by BSEE at the post-approval stage.
Artificial Reef Material Mitigations		
4.01	Louisiana (artificial reef area)	The proposed anchoring operations are located within 500 ft of an artificial reef permit area established by the State of Louisiana. At least 2 weeks prior to conducting anchoring operations (including the use of anchors, anchor chains, and wire ropes) that could disturb the seafloor within 500 ft (152 m) of an artificial reef permit area, the applicant must contact the Louisiana Artificial Reef Coordinator to ensure that the proposed anchoring operations do not damage reefal material. Prior to conducting anchoring operations, the applicant must send an email to BSEE's Environmental Enforcement Branch confirming that the Louisiana Artificial Reef Coordinator has been contacted. If the anchoring operations intersect or cross-over the artificial reef permit area, then submit anchor position plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, depicting the "as-placed" location of all anchors, anchor chains, wire ropes, and cables (including sweep if applicable) on the seafloor relative to the reefal material. For plans, submit the plats to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time the applicant submits the End of Operations Report (Form BSEE-0125) to the appropriate BSEE, Gulf of Mexico OCS Region, District Office and/or notification of platform installation date and final as-built location data as directed in 30 CFR § 250.900(e). For pipelines, submit the plats with the pipeline construction report required by 30 CFR § 250.1008(b). For structure removals, submit the plats with the post-removal report. This mitigation may be applied by BSEE at the post-approval stage.
4.02	Texas (artificial reef general permit area)	The proposed operations are located within an artificial reef General Permit Area established by the State of Texas. At least 2 weeks prior to conducting operations (including the use of anchors, anchor chains, and wire ropes) that could disturb the seafloor within the artificial reef General Permit Area, contact the Texas Artificial Reef Coordinator to ensure that the proposed operations do not damage reefal material. Prior to conducting operations, the applicant must send an email to BSEE's Environmental Enforcement Branch confirming that the Texas Artificial Reef Coordinator has been contacted. This mitigation may be applied by BSEE at the post-approval stage.
4.021	Texas (artificial reef permit area – anchoring)	The proposed anchoring operations are located within 1,000 ft of an artificial reef permit area established by the State of Texas. At least 2 weeks prior to conducting anchoring operations

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		(including the use of anchors, anchor chains, and wire ropes) that could disturb the seafloor within 1,000 ft of the artificial reef permit area, contact the Texas Artificial Reef Coordinator to ensure that the proposed anchoring operations do not damage reefal material. Prior to conducting anchoring operations, the applicant must send an email to BSEE's Environmental Enforcement Branch confirming that the Texas Artificial Reef Coordinator has been contacted. If the anchoring operations intersect or cross-over the artificial reef permit area, submit anchor position plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, depicting the "as-placed" location of all anchors, anchor chains, wire ropes, and cables (including sweep if applicable) on the seafloor relative to the reefal material. For plans, submit the plats to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time the applicant submits the End of Operations Report (Form BSEE-0125) to the appropriate BSEE, Gulf of Mexico OCS Region, District Office and/or notification of platform installation date and final as-built location data as directed in 30 CFR § 250.900(e). For pipelines, submit the plats with the pipeline construction report required by 30 CFR § 250.1008(b). For structure removals, submit the plats with the post-removal report. This mitigation may be applied by BSEE at the post-approval stage.
4.03	Mississippi (artificial reef area)	The proposed anchoring operations are located within 500 ft (152 m) of an artificial reef permit area established by the State of Mississippi. At least 2 weeks prior to conducting anchoring operations (including the use of anchors, anchor chains, and wire ropes) that could disturb the seafloor within 500 ft (152 m) of an artificial reef structure or an artificial reef permit area, contact the Mississippi Artificial Reef Coordinator to ensure that the proposed anchoring operations do not damage reefal material. Prior to conducting anchoring operations, the applicant must send an email to BSEE's Environmental Enforcement Branch confirming that the Mississippi Artificial Reef Coordinator has been contacted. This mitigation may be applied by BSEE at the post-approval stage.
4.04	Alabama (artificial reef general permit area)	The proposed operations are in a General Permit Area established by the State of Alabama for the placement of artificial reef material. At least 2 weeks prior to conducting operations, contact the Alabama Artificial Reef Coordinator to ensure that the proposed operations do not damage reefal material. Prior to conducting operations, the applicant must send an email to BSEE's Environmental Enforcement Branch confirming that the Alabama Artificial Reef Coordinator has been contacted. This mitigation may be applied by BSEE at the post-approval stage.
4.05	Florida (artificial reef general permit area)	The proposed operations are in a General Permit Area established by the State of Florida for the placement of artificial reef material. At least 2 weeks prior to conducting operations, contact the Florida Artificial Reef Coordinator to ensure that the proposed operations do not damage reefal material. Prior to conducting operations, the applicant must send an email to BSEE's Environmental Enforcement Branch confirming that the Florida Artificial Reef Coordinator has been contacted. This mitigation may be applied by BSEE at the post-approval stage.
4.06	Post-Reefing Survey Requirements	BOEM's review indicates that the structure proposed for decommissioning will be abandoned-in-place as an artificial reef under the Rigs-to-Reefs Program. In order to verify compliance with OCSLA reefing (30 CFR § 250.1727(g)) and obstruction clearance requirements (30 CFR § 250.1740(a)(2)), the applicant is required to conduct a high-resolution sonar survey (500 kHz or

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		greater) of the permitted reefal material. The applicant must design the line spacing (for side-scan) or sonar drops (for sector-scanning) and the display range to ensure that 100 percent of the material permitted under this action is covered and that it is demonstrated that the associated seabed is clear of all obstructions apart from the reefal material. The applicant is required to submit the sonar data/survey report to BSEE's Environmental Enforcement Branch at the same time as the post-removal report. This mitigation may be applied by BSEE at the post-approval stage.
Chemosynthetic Communities Mitigations		
5.00	Chemosynthetic Communities Non-Recurring Mitigation	A non-recurring mitigation is a mitigation measure that is used for a unique, special, one-time-only mitigation that is added to certain plans.
5.01	Anchor Positioning (GPS) (plans)	The proposed activities are in the vicinity of areas that could support high-density deepwater benthic communities. Use a state-of-the-art positioning system (e.g., DGPS) on the anchor handling vessel to ensure that any seafloor disturbance resulting from the use of anchors (including that caused by the anchors, anchor chains, and wire ropes) does not occur within 250 ft (76 m) of such areas (see the enclosed map/Map xxx [specify map by name], submitted with the survey report, which depicts the areas). Submit plats for Well(s) (insert number[s] or name[s]), which depict the "as-placed" location of all anchors and any associated anchor chains and wire ropes on the seafloor, at a scale of 1 in = 1,000 ft with DGPS accuracy, to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time the applicant submits the End of Operations Report (Form BSEE-0125) to the appropriate BSEE, Gulf of Mexico OCS Region, District Office to demonstrate that the features were not physically impacted by these anchoring activities. This mitigation may be applied by BSEE at the post-approval stage.
5.02	Conventional Pipeline Laying Vessels (GPS) (pipeline applications)	The proposed pipeline construction activities are in the vicinity of areas that could support high-density deepwater benthic communities. Use a state-of-the-art positioning system (e.g., DGPS) on the pipeline laying vessel and the anchor handling vessels to ensure that any seafloor disturbance (including that caused by anchors, anchor chains, and wire ropes) during pipeline construction activities does not occur within 250 ft of such areas (see the enclosed map/Map xxx [specify map by name], submitted with the pipeline application, which depicts the areas). Additionally, include lay barge anchor position plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, with the pipeline construction report required by 30 CFR § 250.1008(b), which depict the "as-placed" location of all anchors, anchor chains, and wire ropes on the seafloor and which demonstrate that the features were not physically impacted by the construction activities. This mitigation may be applied by BSEE at the post-approval stage.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
5.03	Anchor Positioning (ROV) (plans)	The proposed activities are in the vicinity of areas that could support high-density deepwater benthic communities. Use an ROV to ensure that any seafloor disturbance resulting from the use of anchors (including that caused by the anchors, anchor chains, and wire ropes) does not occur within 250 ft of such areas (see the enclosed map/Map xxx [specify map by name], submitted with your survey report which depicts the areas). Submit plats for Well(s) (insert number[s] or name[s]), which depict the "as-placed" location of all anchors and any associated anchor chains and wire ropes on the seafloor, at a scale of 1 in = 1,000 ft with DGPS accuracy, along with the high-resolution ROV video on disc or removable drive, to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time the applicant submits the End of Operations Report (Form BSEE-0125) to the appropriate BSEE, Gulf of Mexico OCS Region, District Office to demonstrate that the features were not physically impacted by these anchoring activities. The ROV video screen should show time, date, depth, heading, and location coordinates. Observational notes and a corresponding map showing the ROV heading shall also be provided. If still images are collected, include the same information in the images' integrated data. This mitigation may be applied by BSEE at the post-approval stage.
5.04	Conventional Pipeline Laying Vessels (ROV) (pipeline applications)	The proposed pipeline construction activities are in the vicinity of areas that could support high-density deepwater benthic communities. Use an ROV to ensure that any seafloor disturbance (including that caused by the anchors, anchor chains, and wire ropes) during pipeline construction activities does not occur within 250 ft of such areas (see the enclosed map/Map "xxx" [specify map by name], submitted with the pipeline application, which depicts the areas). Submit lay barge anchor position plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, with the pipeline construction report required by 30 CFR § 250.1008(b), which depict the "as-placed" location of all anchors, anchor chains, and wire ropes on the seafloor and which demonstrate that the features were not physically impacted by the construction activities. Additionally, submit the high-resolution ROV video on disc or removable drive. The ROV video screen should show time, date, depth, heading, and location coordinates. Observational notes and a corresponding map showing the ROV heading shall also be provided. If still images are collected, include the same information in the images' integrated data. This mitigation may be applied by BSEE at the post-approval stage.
5.05	Dynamically Positioned Pipeline Laying Vessels (GPS) (pipeline applications)	The proposed pipeline construction activities are in the vicinity of areas that could support high-density deepwater benthic communities. Use a state-of-the-art positioning system (e.g., DGPS) on the dynamically positioned pipeline laying vessel to ensure that any seafloor disturbance resulting from the pipeline construction activities does not occur within 250 ft of such areas (see the enclosed map/Map "xxx" [specify map by name], submitted with the pipeline application, which depicts the areas). Additionally, include "as-built" location plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, with the pipeline construction report required by 30 CFR § 250.1008(b), which depict the location of the pipeline(s) relative to these features to demonstrate that the features were not physically impacted by the construction activities. This mitigation may be applied by BSEE at the post-approval stage.
5.06	Well Positioning (ROV) (plans)	BOEM's review indicates that the applicant has stated in the plan that the proposed activities are in the vicinity of areas that could support high-density chemosynthetic communities. Use an ROV to

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		ensure that any seafloor disturbance resulting from the activities does not occur in such areas that are within 1,500 ft of your proposed location (see the enclosed map/Map "xxx" [specify map by name], submitted with the survey report which depicts these areas). Submit plats for Wells(s) (insert number[s] or name[s]), which depict the "as-drilled" location of the well(s), at a scale of 1 in = 1,000 ft with DGPS accuracy, at the same time the applicant submits the End of Operations report (Form BSEE-0125) to the appropriate BSEE, Gulf of Mexico OCS Region, District Office to demonstrate that the features were not physically impacted. This mitigation may be applied by BSEE at the post-approval stage.
5.07	Anchor Positioning (GPS and ROV)	The proposed activities are in the vicinity of areas that could support high-density deepwater benthic communities. Use a state-of-the-art positioning system (e.g., DGPS) on the anchor handling vessel and use an ROV to ensure that any seafloor disturbance resulting from the use of anchors (including that caused by the anchors, anchor chains, and wire ropes) does not occur within 250 ft of such areas. Submit plats for Well(s) (insert number[s] or name[s]), which depict the "as-placed" location of all anchors and any associated anchor chains and wire ropes on the seafloor, at a scale of 1 in = 1,000 ft with DGPS accuracy, along with the high-resolution ROV video on disc or removable drive, to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time the applicant submits the End of Operations Report (Form BSEE-0125) to the appropriate BSEE, Gulf of Mexico OCS Region, District Office to demonstrate that the features were not physically impacted by these anchoring activities. The ROV video screen should show time, date, depth, heading, and location coordinates. Observational notes and a corresponding map showing the ROV heading shall also be provided. If still images are collected, include the same information in the images' integrated data. This mitigation may be applied by BSEE at the post-approval stage.
5.08	Well Placement Variance (plans)	There is an area capable of supporting high-density deepwater benthic communities within 2,000 ft of the proposed well(s), also known as the chemosynthetic well parameter. The proposed well(s) is/are (insert chemosynthetic distance parameter) from the area capable of supporting high-density deepwater benthic communities, which in this case provides adequate protection from muds and cuttings during operations. The actual well(s) shall not be placed closer than (CHEMO DISTANCE PARAMETER 1) from the potential habitat (see the chemosynthetic map parameter, which depicts the area). Provide a map showing the final as-placed well(s), potential habitat, and distance of the well(s) from the potential habitat to BOEM's Regional Supervisor, Office of Leasing and Plans, Plans Section at the same time the applicant submits the End of Operations Report (Form BSEE-0125) to the appropriate BSEE, Gulf of Mexico OCS Region, District Office to demonstrate that the feature(s) were not physically impacted by the drilling activity. This mitigation may be applied by BSEE at the post-approval stage.
5.09	Well Placement Variance – "Zero Discharge" (plans)	There is an area capable of supporting high-density deepwater benthic communities within 2,000 ft of the proposed well(s) (insert chemosynthetic wells parameter). Since this area is (insert chemosynthetic distance parameter) from your well site(s), chemosynthetic reason parameter, BSEE permits the activity with the following mitigations added.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		1. Do not move the well(s) any closer to the area capable of supporting high-density deepwater benthic communities (see chemosynthetic map parameter, which depicts the area). 2. Follow "zero discharge" practices (i.e., no muds or cuttings shall be discharged near the sea surface in the vicinity of the permitted activity). 3. In this instance, it is understood that the discharge of muds and cuttings will occur on or near the seafloor for the riserless portion of the drilling operations ONLY as part of the "zero discharge" practice. 4. No muds or cuttings shall be discharged near the seafloor or at the sea surface once the blowout preventer and marine riser have been installed. No additional or excess muds or cuttings beyond those necessary to properly accomplish the riserless portion of the drilling activity shall be discharged on or near the seafloor. 5. Perform an assessment survey after the drilling of the well(s) is complete. (a) Conduct an ROV survey to assess sedimentation and its effects on the area capable of supporting high-density deepwater benthic communities (see chemosynthetic map parameter 1, which depicts the area. Transects must be run no more than 50 ft apart). (b) Ensure that the imagery in the ROV survey is high enough quality to adequately assess drilling effects. (This can be accomplished by employing the use of high-resolution still photography, high-resolution video, and/or lower resolution imaging through the use of close-up photography.) (c) The surveyed areas shall be recorded and documented on disc or removable drive for review, and the screen should show time, date, depth, heading, and location coordinates. This mitigation may be applied by BSEE at the post-approval stage.
Coastal Zone Management Mitigations		
6.01	Texas (Coastal Zone Management)	Drilling permits cannot be issued for the proposed wells until concurrence with the coastal zone management consistency certification has been received by BOEM's Office of Environment from the Texas General Land Office or until concurrence with the certification has been conclusively presumed.
6.02	Louisiana (Coastal Zone Management)	Drilling permits cannot be issued for the proposed wells until concurrence with the coastal zone management consistency certification has been received by BOEM's Office of Environment from the Louisiana Department of Natural Resources or until concurrence with the certification has been conclusively presumed.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
6.03	Alabama (Coastal Zone Management)	Drilling permits cannot be issued for the proposed wells until concurrence with the coastal zone management consistency certification has been received by BOEM's Office of Environment from the Alabama Department of Environmental Management or until concurrence with the certification has been conclusively presumed.
6.04	Mississippi (Coastal Zone Management)	Drilling permits cannot be issued for the proposed wells until concurrence with the coastal zone management consistency certification has been received by BOEM's Office of Environment from the Mississippi Department of Marine Resources or until concurrence with the certification has been conclusively presumed.
6.05	Florida (Coastal Zone Management)	Drilling permits cannot be issued for the proposed wells until concurrence with the coastal zone management consistency certification has been received by BOEM's Office of Environment from the Florida Department of Environmental Protection or until concurrence with the certification has been conclusively presumed.
Flower Garden Banks Mitigations		
7.07	Environmental Monitoring Plan	Develop a plan for the early initiation of environmental monitoring of the effects of a hydrocarbon spill that may occur as a result of the proposed activities on the resources of the Flower Garden Banks National Marine Sanctuary, including water quality, pelagic fish, and benthic communities.
7.09	Pressure Sensor Testing	High- and low-pressure sensors protecting the proposed pipeline will be tested at least once bi-weekly with no more than 3 weeks elapsing between each test. The applicant will maintain these records on the platform and will make them available to BSEE personnel upon request.
7.10	Pressure Sensor Setting	The low-pressure sensor protecting the proposed pipeline will be set no lower than 10 percent below the lower limit of the normal operating pressure range.
Hydrogen Sulfide Mitigations		
8.01, 8.02, and 8.03	H_2S Present (plans) H_2S Unknown (plans) H_2S Absent (plans)	In response to the request accompanying your plan for a hydrogen sulfide (H_2S) classification, the area in which the proposed drilling operations are to be conducted is hereby classified, in accordance with 30 CFR § 250.490(c), as "H_2S present," "H_2S unknown," or "H_2S absent." Accordingly, comply with the appropriate requirements of 30 CFR § 250.490 if H_2S is present or unknown.
8.04	H_2S Concentration Deviation	The plan indicates that the applicant anticipates H_2S at a concentration of approximately (specify the ppm). Should the applicant actually encounter H_2S at a concentration greater than 500 ppm, revise the plan in accordance with 30 CFR § 550.285 to include toxic modeling and an analysis of any potential environmental impacts. Contact BOEM's Office of Environment to obtain the methodology for modeling an H_2S plume. The applicant must receive approval of the revised plan before additional permits filed under the plan will be approved.
8.05	Corrosion Inspections (H_2S pipelines)	Inspect the pipeline(s) bi-annually, annually, or biennially for an indication of corrosion or other flaws. Report the results of these inspections to BSEE's Office of Field Operations within 30 days of completion. This mitigation may be applied by BSEE at the post-approval stage.
8.07	National Ocean Service Notification (H_2S pipelines)	When the applicant provides the National Ocean Service, Nautical Data Section with a copy of the pipeline construction report plat, the applicant must also request that the National Ocean Service,

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		Nautical Data Section include the pipeline(s) on their navigation charts and identify it/them as (an) H_2S or toxic sour gas pipeline(s).
8.08	USCG Notification (H_2S pipelines)	Immediately after the applicant begins operation of the pipeline(s), the applicant must notify the U.S. Coast Guard Commander, Eighth Coast Guard District, that the pipeline(s) is/are in operation and request that the USCG publish information about the pipeline(s), including the fact that it is or they are transporting natural gas with a high concentration of H_2S, in the Eighth District Local Notice to Mariners, Gulf of Mexico.
8.09	H_2S Concentration Deviation (pipeline applications)	The application indicated that the applicant anticipates the H_2S concentration of the product to be transported in the proposed pipeline is approximately (specify the ppm). Should the applicant determine at some future date that the H_2S concentration is greater than 500 ppm, immediately submit an application to modify the pipeline in accordance with 30 CFR § 250.1007(b) to include toxic modeling and an analysis of any potential environmental impacts. Contact BOEM's Office of Environment to obtain the methodology for modeling an H_2S plume.
8.10	Notification to Federal Aviation Administration	Prior to initiating operations approved in your plan or pipeline application, the applicant shall update their emergency notification list in their H_2S contingency plan to include the Federal Aviation Administration (FAA: Houston Air Traffic Control/Traffic Management Control Desk). In the event of an above-water or below-water sour gas release greater than 100 standard cubic feet, notify the FAA that air traffic (except evacuation and medical aircraft) should be routed safely away from the site until further notice. For purposes of avoidance recommendations to the FAA, a distance of 10 nautical miles and an altitude of 4000 ft, as minimal, shall be used. In the case of a release of H_2S (that constitutes an emergency), notify all facilities that might be exposed to atmospheric concentrations of 20 ppm or more of H_2S (i.e., all facilities located within [insert number] miles of the H_2S release). The applicant must also assist in the removal of all personnel as well as any other persons observed within the affected area.
8.11	H_2S Absent and H_2S Present or Unknown below Certain Depths (plans)	In response to the request accompanying the plan for a H_2S classification, the area in which the proposed drilling operations are to be conducted above (specify depth) is hereby classified, in accordance with 30 CFR § 250.490(c), as H_2S absent. However, the area in which the proposed drilling operations are to be conducted below (specify depth) is hereby classified, in accordance with 30 CFR § 250.490(c), as H_2S present or unknown. Accordingly, comply with the appropriate requirements of 30 CFR § 250.490.
	Live Bottom Areas	
9.00	Hard Bottoms/Pinnacles/Potentially Sensitive Biological Features Non-Recurring Mitigation	A non-recurring mitigation is a mitigation measure that is used for a unique, special, one-time-only mitigation that is added to certain plans.
9.01	Hard Bottoms/Pinnacles/Potentially Sensitive Biological Features (conventional lay barge) (pipeline applications)	BOEM's analysis indicates that there are hard bottoms/pinnacles/potentially sensitive biological features (PSBFs) that likely provide habitat for biological assemblages located within the scope of the anchor array of the pipeline lay barge. The pipeline construction activities (including the use of anchors, chains, and wire ropes) must avoid these hard bottoms/pinnacles/PSBFs as depicted on the enclosed map(s) in the application by a distance of at least 100 ft. Include lay barge anchor position

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, with the pipeline construction report required by 30 CFR § 250.1008(b), which depict the "as-placed" location of all anchors, anchor chains, and wire ropes on the seafloor and which demonstrate that the features were not physically impacted by the construction activities. This mitigation may be applied by BSEE at the post-approval stage.
9.03	Hard Bottoms/Pinnacles/Potentially Sensitive Biological Features (plans)	BOEM's analysis indicates that there are hard bottoms/pinnacles/PSBFs located in the vicinity of the activities proposed in the plan that likely provide habitat for biological assemblages. Any bottom-disturbing activities associated with the activities proposed in the plan must avoid these hard bottoms/pinnacles/PSBFs as depicted on the enclosed map(s) in the application by a distance of at least 100 ft. Submit to BSEE's Office of Field Operations at the same time you submit your End of Operations report (Form BSEE-0125) to the appropriate BSEE, Gulf of Mexico OCS Region, District Office an as-built map at a scale of 1 in = 1,000 ft with DGPS accuracy, showing the location of any seafloor disturbance (e.g., jack-up rig, barge anchors, etc.) relative to these features. This mitigation may be applied by BSEE at the post-approval stage.
9.04	Hard Bottoms/Pinnacles/Potentially Sensitive Biological Features (DP lay barge) (pipeline applications)	BOEM's analysis indicates that there are hard bottoms/pinnacles/PSBFs that likely provide habitat for biological assemblages located on or near the proposed pipeline route. The pipeline construction activities must avoid these hard bottoms/pinnacles/PSBFs as depicted on the enclosed map(s) in the application by a distance of at least 100 ft. This mitigation may be applied by BSEE at the post-approval stage.
9.05	Hard Bottoms/Pinnacles/Potentially Sensitive Biological Features (structure removal)	BOEM's review of the application indicates that there are hard bottoms/pinnacles/PSBFs located in the vicinity of the activities proposed in the application that likely provide habitat for biological assemblages. Any bottom-disturbing activities associated with the activities proposed in the application must avoid these hard bottoms/pinnacles/PSBFs as depicted on the enclosed map(s) in the application by a distance of at least 100 ft. Include in the post-removal report the as-built plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, which depict the "as-placed" location of all anchors, anchor chains, and wire ropes on the seafloor deployed during the structure removal relative to these features. This mitigation may be applied by BSEE at the post-approval stage.
9.10	ROV Survey Required Non-Recurring Mitigation	A non-recurring mitigation is a mitigation measure that is used for a unique, special, one-time-only mitigation that is added to certain plans.
	Military Mitigations	
10.09	Naval Coastal Systems Center	Please be reminded of the lease stipulation requires the applicant to enter into an agreement with the Coastal Test and Evaluation Division, Coastal System Station/Code E21, Panama City, Florida 32407, concerning the control of your electromagnetic emissions and use of boats and aircraft in the Naval Coastal Systems Center Area.
11.11	Military Warning Area (all)	BOEM's review indicates that the proposed pipeline route and/or the routes to be taken by boats and aircraft in support of the proposed activities are located in or could traverse Military Warning Area W-(insert number) or Eglin Water Test Area EWTA-(insert number) (see BOEM's Internet website at http://www.boem.gov/MWA-Boundaries/ for a map of the areas). Contact the appropriate individual military command headquarters (see BOEM's Internet website at

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		http://www.boem.gov/Military-Contacts-for-Warning-and-Water-Test-Areas/ for a list of the contacts) concerning the control of electromagnetic emissions and the use of boats and aircraft in this area(s) before commencing such traffic.
12.01	Unexploded Ordnance	The proposed operations are located in an area that was used until 1970 by the U.S. Department of Defense as an explosives dumping area. Please be advised that precautions should therefore be taken while conducting operations that involve any disturbance of the seafloor in order to avoid possible unexploded ordnance.
12.02	Naval Mine Warfare Area (MU 732, 733, and 734)	The proposed operations are located within a stipulated area designated by the Naval Mine Warfare Command for mine operations. Therefore, surface structures for exploration activities are subject to approval by BOEM's Gulf of Mexico OCS Region's Regional Director after consultation with the Commander, Mine Warfare Command. No permanent structures or debris of any kind will be allowed in the area during exploration operations. Plans for any above seafloor development operations within the designated area must be coordinated with the Commander, Mine Warfare Command, 325 Fifth Street, SE, Corpus Christi, Texas 78491-5032.
	Shallow Drilling Hazards Mitigations (Plans)	
14.01	Shallow Gas and/or Water Flow	Exercise caution while drilling due to indications of shallow gas (and/or faulting) (and/or possible water flow).
14.02	Seafloor Instability	Exercise caution during drilling rig placement due to indications of seafloor instability.
14.03	Insufficient Information	Exercise caution during drilling rig placement due to insufficient information regarding seafloor foundation integrity.
	Shallow Hazards Mitigations	
15.01 and 15.02	Multiple Hazards (plans) Single Hazard (plans)	BOEM's review indicates that there are pipeline(s), unidentified magnetic anomaly(ies), unidentified side-scan sonar contact(s), or other specified hazard(s) in the vicinity of (insert name of platform(s) or well(s)) that may pose a hazard to the proposed operations. Therefore, take precautions in accordance with NTL 2008-G05, Section VI.B, prior to performing operations.
15.05 and 15.06	Multiple Hazards (plans/pipelines) (anchoring activities) Single Hazard (plans) (anchoring)	BOEM's review indicates that there is a pipeline(s), unidentified magnetic anomaly(ies), unidentified side-scan sonar contact(s), or other specified hazard(s) in the vicinity of (insert name of platform(s) or well(s) that may pose a hazard due to anchoring activities associated with the proposed operations. If any of these activities will take place within 150 m (490 ft) of the potential hazard, take precautions in accordance with NTL 2008-G05, Section VI.B, prior to performing operations.
15.07	Pipeline Spanning	BOEM's review indicates areas of seafloor relief in the vicinity of the proposed pipeline route, which may cause spanning problems for the pipeline. Use an ROV in conjunction with the pipeline construction activities to ensure that these areas are avoided to the extent possible. Additionally, include a report with the pipeline construction report, which is required by 30 CFR § 250.1008(b) and which analyzes the as-laid pipeline with respect to spanning and describes the protective measures taken to ensure pipeline integrity for those portions of the pipeline where the areas of seafloor relief could not be avoided. This mitigation may be applied by BSEE at the post-approval stage.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
15.08	Conflict with Anchors	Please be advised that exploration activities have been approved or are pending approval for (insert lease, block, area), which could potentially interfere with the proposed activities. Therefore, the applicant should contact (insert contact name, company, address, phone number) prior to commencement of the activities in order to avoid any potential conflicts.
	Topographic Features Mitigations	
16.00	Topographic Features Non-Recurring Mitigation	A non-recurring mitigation is a mitigation measure that is used for a unique, special, one-time-only mitigation that is added to certain plans.
16.01	Shunting All Wells (plans)	The proposed activities are within the "4-mile, 3-mile, 1-mile, or 1,000-meter zone" of (insert name of topographic feature). Shunt all drill cuttings and drilling fluids to the seafloor through a downpipe that terminates an appropriate distance, but no more than 10 m, from the bottom.
16.02	Shunting Some Wells (plans)	Some of the proposed activities are within the "4-mile, 3-mile, 1-mile, or 1,000-meter zone" of (insert name of topographic feature). For (insert name of wells to be shunted", shunt all drill cuttings and drilling fluids to the seafloor through a downpipe that terminates an appropriate distance, but no more than 10 m, from the bottom.
16.03	No Activity Zone (right-of-way pipeline applications)	BOEM's analysis indicates that the "no activity zone(s)" of the biologically sensitive feature(s) shown on the enclosed map(s) in the application may be located within the scope of the anchor array of the pipeline lay barge. Anchors, anchor chains, and wire ropes associated with the proposed pipeline construction activities must avoid this/these "no activity zone(s)" by a distance of at least 500 ft. Include lay barge anchor positions plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, with the pipeline construction report required by 30 CFR § 250.1008(b), which depict the "as-placed" location of all anchors, anchor chains, and wire ropes on the seafloor, and which demonstrate that the "no activity zone(s)" was/were not physically impacted by the construction activities. This mitigation may be applied by BSEE at the post-approval stage.
16.04	No Activity Zone (plans)	Bottom-disturbing activities associated with the activities proposed in the plan must avoid the "no activity zone" of the biologically sensitive feature shown on the enclosed map in the application by a distance of at least 500 ft. Submit to BSEE's Office of Field Operations, at the same time the End of Operations report (Form BSEE-0125) is submitted to the appropriate BSEE, Gulf of Mexico OCS Region, District Office, an as-built map at a scale of 1 in = 1,000 ft with DGPS accuracy, showing the location of any seafloor disturbance (e.g., jack-up rig placement, rig anchors, construction barge anchors, etc.) to demonstrate that the "no activity zone(s)" was not physically impacted. This mitigation may be applied by BSEE at the post-approval stage.
16.05	No Activity Zone (structure removal)	Bottom-disturbing activities associated with the activities proposed in the application must avoid the "no activity zone" of the biologically sensitive feature shown on the enclosed map in the application by a distance of at least 500 ft. Include in the post-removal report an as-built plat, at a scale of 1 in = 1,000 ft with DGPS accuracy, depicting the "as-placed" location of all anchors, anchor chains, and wire ropes on the seafloor deployed during the structure-removal activities to show that the "no activity zone" was not physically impacted. This mitigation may be applied by BSEE at the post-approval stage.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
Non-Plan and Pipeline Mitigations		
17.02	Fish (structure removals using explosives)	Under the Magnuson-Stevens Fisheries Conservation and Management Act, 50 CFR § 600.725 prohibits the use of explosives to take reef fish in the Exclusive Economic Zone. Consequently, those involved in explosive structure removals must not take such stunned or killed fish on board their vessels. Should this happen, they could be charged by the National Marine Fisheries Service (NMFS) with violation of the Act.
17.04	Site-Clearance Trawling Reporting	If trawling is used to comply with the site-clearance verification requirements under 30 CFR §§ 250.1740-1743, which mandates that turtle excluder devices (TED) be removed from the trawl nets to facilitate the collection of seabed debris, the applicant must abide by maximum trawl times of 30 minutes, allowing for the removal of any captured sea turtles. If, during trawling activities, the applicant captures a sea turtle in the nets, the applicant must (1) contact BSEE's Environmental Enforcement Branch and the National Marine Fisheries Services' (NMFS's) Southeast Regional Office immediately, (2) resuscitate and release any captured sea turtles as per NMFS's guidelines found online at http://www.sefsc.noaa.gov/turtles/TM_NMFS_SEFSC_580_2010.pdf (refer to page 3-6, Plate 3-1), and (3) photograph the turtle and complete a sea turtle stranding form for each sea turtle caught in the nets. The form can be found at http://www.sefsc.noaa.gov/species/turtles/strandings.htm and submitted to NMFS and BSEE.
Conservation Information Document Mitigations		
18	Self-Burial Approval	BOEM hereby concurs with the determination that the subject pipeline will be installed in an area that is prone to self-burial. However, in the future, should it be determined that the pipeline(s) constitute(s) a hazard to navigation or commercial fishing operations or unduly interferes(s) with other uses of the OCS, the applicant will be required to bury it (them).
18.01	Conservation Information Document – Condition of Approval	Within 15 days after the proposed well is or wells are completed and logged, submit a revision to the plan consisting of the information required for a Conservation Information Document in accordance with NTL 2000-N05.
18.02	Conservation Information Document – Operations Approval	At the applicant's request, we are approving your development operation coordination document (DOCD) prior to the completion of our review of the accompanying Conservation Information Document (CID). However, please be advised that, if the CID review indicates that any of the proposed activities do not conform to sound conservation, engineering, and economic practices as cited in 30 CFR §§ 550.202(a) and 550.1101(a), we will, in accordance with 30 CFR § 550.281(4)(b), require such revisions to the DOCD as are necessary to make the activities conform to such practices.
ROV Survey Mitigations		
19.01	ROV Survey Required – Exploration Plans (EP)	In accordance with NTL 2008-G06, the applicant must conduct the two ROV surveys proposed in the plan. The first survey will be for the first well location approved under this plan which is actually drilled. The post-drilling survey can be conducted at the time the applicant is preparing to leave this location. The applicant must submit both survey reports within 60 days after the rig leaves the well location. This mitigation may be applied by BSEE at the post-approval stage.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
19.02	ROV Survey Required – DOCD	In accordance with NTL 2008-G06, the applicant must conduct the ROV surveys proposed in the plan for the facility location approved under this plan. The applicant must submit the pre- and post-installation survey reports within 60 days after the facility installation is completed. This mitigation may be applied by BSEE at the post-approval stage.
19.03	ROV Survey Not Required	In accordance with NTL 2008-G06, BOEM has determined that the applicant will not need to conduct the two ROV surveys proposed in the plan. This mitigation may be applied by BSEE at the post-approval stage.
		Surveys Mitigations
21.01	Archaeology Assessment Not Acceptable	BOEM's review has determined that the archaeological analysis included in the survey report does not meet current BOEM requirements.
21.02	Archaeology Assessment Acceptable	BOEM's review has determined that the archaeological analysis included in the survey report meets current BOEM requirements.
21.03	Geophysical Review Acceptable	BOEM's review has determined that the subject survey report complies with the provisions of NTL 2008-G05 and, based on available data regarding any man-made hazards that may have been present at the time the survey was conducted, contains sufficient information to prepare an acceptable shallow hazards analysis for specific drilling or platform sites that the applicant may propose in future EPs or DOCDs. However, prior to submitting any such EPs or DOCDs, the applicant should update the accompanying anomaly map, if appropriate, to indicate the location of any man-made hazards, e.g., pipelines, abandoned wells, etc., that did not exist at the time the survey was performed. Additionally, please be reminded that under the guidelines of NTL 2008-G04, the applicant should submit high-resolution survey data from the line closest to any proposed well or platform location, with one copy of each such EP or DOCD.
21.04	Geophysical Survey Report Not Acceptable	BOEM's review has also determined the subject survey report does not comply with the provisions of NTL 2008-G05.
21.05	3D Survey Waiver	Use of three-dimensional (3D) seismic data in lieu of high-resolution survey data as per NTL 2008-G05 is acceptable for the requested locations.
		Pipeline Section Mitigations and Conditions
22	Concrete Mats	The applicant's request to install protective concrete mats over the pipeline crossings in water less than 200 ft deep is hereby approved pursuant to 30 CFR § 250.141.
25	Pipeline High-Pressure (PSH) Higher Than 15%	The applicant's request to set the PSH higher than 15 percent above the normal operating pressure range is hereby approved pursuant to 30 CFR § 250.142. The pipeline PSH shall be set no more than 5 percent above the latest shut-in tubing pressure of the well and will not be set above the maximum allowable operating pressure of the pipeline.
26	Denied Self-Burial	BOEM cannot concur with the applicant's determination that the subject pipeline will be installed in an area that is prone to self-burial. BOEM will only allow self-burial in areas with a soil strength that does not exceed 200 pounds per square foot. Therefore, the portions of the pipeline in water depths less than or equal to 200 ft shall be buried.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
28	Hydrostatic Head to Raise Maximum Allowable Operating Pressure	The applicant's request to determine the internal design pressure of the submerged portion of the pipeline by considering the effects of the external hydrostatic pressure, in lieu of using the standard formula outlined in 30 CFR § 250.1002(a), is hereby approved pursuant to 30 CFR § 250.141(a).
	National Marine Fisheries Service Mitigations	
28.001	Species Protective Measures	The applicant must comply with the following species protective measures in all activities conducted pursuant to the plan: NTL 2012-JOINT-G01, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting"; NTL 2012-JOINT-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program"; and NTL 2012-BSEE-G01, "Marine Trash and Debris Awareness and Elimination." These measures are designed to promote environmental protection, consistent environmental policy, compliance with environmental laws, and safety.
29	Oil Spill Financial Responsibility (OSFR) Coverage	BOEM's review of the application indicates that, per 30 CFR §§ 553.3(1)-(3), the proposed right-of-way pipeline is classified as a covered offshore facility (COF) and requires oil-spill financial responsibility (OSFR) coverage. At this time, BSEE's records do not indicate that the required OSFR coverage is in place. The applicant is advised that they may begin construction of the proposed pipeline immediately. However, in accordance with 30 CFR § 553.15(b), the applicant may not begin operation of the pipeline until they have submitted an application showing evidence of OSFR coverage and that demonstration has been approved by BSEE.
99	Department of Transportation Right-of-Way Pipeline	The applicant shall construct, operate, and maintain the pipeline in accordance with the appropriate U.S. Department of Transportation regulations.
110	Spanning Potential	There are several fault scarps along with the proposed pipeline route. Include with the construction report a listing of the location and length of any pipeline "spanning," resulting from laying the pipeline over these fault scarps. Also include a description of any remedial action necessary to minimize "spanning" and prevent pipeline damage. This mitigation may be applied by BSEE at the post-approval stage.
	Office of Structural Technical Support Mitigations	
120.1	Reminder of NTL 2008-G05	If there are pipelines within the immediate proximity of the proposed platform site, precautions outlined in NTL 2008-G05, "Shallow Hazards Program," shall be taken while conducting operations.
120.15	Notify National Imagery and Mapping	In order to assure publication of onsite activity as it affects marine navigation safety, the applicant must notify the National Imagery and Mapping Agency in advance of commencement of platform installation.
120.2	Send Report to Office of Structural and Technical Support (OSTS)	Written notification shall be submitted to the Office of Structural and Technical Support (OSTS) and the Pipeline Section within 15 calendar days of completion of the platform installation operations, at which time the applicant will be provided with the "Complex Identification Number" (CPXID) that has been assigned to this structure. The CPXID should be included with other pertinent information (i.e., the right-of-way number, area code, block number, platform name, etc.) in all future correspondence related to this structure. Should significant problems occur during

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		structure installation operations, please inform OSTS immediately. If for any reason the applicant decides not to install this structure, they shall submit a written cancellation letter.
120.7	Downhole Well Plugging	In accordance with 30 CFR § 250.1710, the applicant must downhole plug and abandon all wells on (insert area/block platform name) (except [insert well names]), no later than (insert date). However, the applicant will not be required to sever the casings, remove the wellhead, or clear the site until the right-of-use expires.
Geological and Geophysical Mitigations (deep-penetration applications) (no assigned mitigation numbers)		
	Vessel-Strike Avoidance/Reporting	The applicant will follow the guidance provided under NTL 2012-JOINT-G01, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting." The NTL 2012-JOINT-G01 provides guidance on how a seismic operator should implement monitoring programs to minimize the risk of vessel strikes to protected species and should report observations of injured or dead protected species. In lieu of a formal observer program, this NTL provides specific guidelines that should be followed to identify and avoid injury to marine mammals and sea turtles.
	Seismic Survey Operation, Monitoring, and Reporting Guidelines	The applicant will follow the guidance provided under NTL 2012-JOINT-G02, "Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program." Additionally, the applicant will comply with the guidance under this NTL when operating in all water depths (not just in water depths >200 m or in the Eastern Planning Area), and the NTL's "shut-down conditions" will be applied towards manatees.
	Pre-Activity Sound-Source and Array Calibration Verification	Prior to conducting survey activities, the applicant will verify in writing that the proposed airgun arrays to be used are of the lowest sound intensity level that still achieves the survey goals. The written verification must include confirmation that the airgun array has been calibrated/tuned to maximize subsurface illumination and minimize, to the extent practicable, horizontal propagation of noise.
	Mandatory Separation Buffer between Survey Operations	The applicant will be required to maintain, to the extent it can practicably and safely do so, a minimum separation distance of 30 km from any other vessels concurrently conducting deep-penetration seismic surveys and 40 km when operating within an Area of Concern. To assist in implementation of this measure, BOEM will provide the applicant with contact information for all deep-penetration seismic applicants concurrently permitted/authorized to operate within or near the proposed survey area.
	Supplemental Reporting Requirements	In addition to the reporting requirements under NTL 2012-JOINT-G02, the applicant is required to submit bi-weekly reports containing the information listed below. The reporting periods end on the 1st and 15th of each month. These bi-weekly reports are required for the total duration of the permit. When applicable, the reports must be submitted with survey navigation data for the 2-week reporting period. BOEM has a suggested format for the written report. If BOEM's suggested written format is not used, the following information must be submitted along with the navigation data: (1) the dates, locations, and duration of any deep-penetration seismic operations conducted during the reporting period (the navigation data provides this information); (2) any circumstances that caused the total energy output of the airgun source array to exceed that set forth in the permit

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		application; (3) confirmation that the permittee maintained, to the extent they could practicably and safely do so, the minimum separation distance (If applicable, submit a written explanation of why the minimum separation distance was not maintained.); and (4) confirmation that the permittee complied with the other terms of Section V of the Settlement Agreement.
Military Warning Area Coordination		BOEM's review indicates that the routes to be taken by boats in support of the applicant's activities traversed Military Warning Areas W-92, W-147AB, and W-602. The applicant shall contact the appropriate individual military command headquarters concerning the control of electromagnetic emissions and use of boats in each of the areas before commencing the operations.
Marine Trash and Debris Awareness and Elimination		The applicant will follow the guidance provided under NTL 2012-BSEE-G01, "Marine Trash and Debris Awareness and Elimination." The NTL 2012-BSEE-G01 provides information on reducing, if not eliminating, trash intentionally jettisoned into the Gulf of Mexico. The programs described in the NTL to assist in the reduction of marine trash and debris are the marine trash and debris placards, marine trash and debris awareness training, and the marine trash and debris awareness training and certification process.
Geological and Geophysical Mitigation Natural Resource Defense Council Area of Concern (equal to or greater than 20-m water depth) (no assigned mitigation numbers)		
Seismic Survey Restriction Period		BOEM's review indicates that the proposed survey area falls within a portion of an unusual mortality event area declared/established by the National Marine Fisheries Service for cetaceans (whales and dolphins). The applicant shall adhere to a restriction period between March 1 and April 30 (primary bottlenose dolphin calving season) for deep penetration seismic surveys on the Federal Outer Continental Shelf in coastal waters out to the 20-m isobath in the Northern Gulf of Mexico to avoid potential impacts to dolphins in regards to behavioral disruptions to mother/calf bonding or masking of important acoustic cues. No airgun use, including the use of mitigation guns, is permitted during the restriction period.
Geological and Geophysical Mitigation Natural Resource Defense Council Area of Concern (equal to or greater than 100-m water depth) (no assigned mitigation numbers)		
Required Passive Acoustic Monitoring (PAM)		BOEM requires that the applicant use passive acoustic monitoring (PAM) in water depths of 100 m or greater at times of reduced visibility (darkness, rain, fog, etc.) as part of their protected species observer program. The PAM will be monitored at all times of reduced visibility. Applicants will be required to provide BSEE with a description of the passive acoustic system, the software used, and the monitoring plan prior to its use. Additionally, after survey completion, the applicant will provide an assessment of the usefulness, effectiveness, and problems encountered with the use of PAM for marine mammal detection to BSEE for review.
Mitigation for High-Resolution Surveys		
Vessel-Strike Avoidance/Reporting		The applicant will follow the guidance provided under NTL 2012-JOINT-G01, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting." The NTL 2012-JOINT-G01 provides

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		guidance on how a seismic operator should implement monitoring programs to minimize the risk of vessel strikes to protected species and should report observations of injured or dead protected species. In lieu of a formal observer program, this NTL provides specific guidelines that should be followed to identify and avoid injury to marine mammals and sea turtles.
Marine Trash and Debris Awareness and Elimination		The applicant will follow the guidance provided under NTL 2012-BSEE-G01, "Marine Trash and Debris Awareness and Elimination." The NTL 2012-BSEE-G01 provides information on reducing, if not eliminating, trash intentionally jettisoned into the Gulf of Mexico. The programs described in the NTL to assist in the reduction of marine trash and debris are the marine trash and debris placards, marine trash and debris awareness training, and the marine trash and debris awareness training and certification process.
Geological and Geophysical Non-Recurring Mitigations		
Benthic Communities		Review of BOEM's 3D seismic database of water bottom anomalies identified both confirmed deepwater benthic communities and features that could potentially support communities within the area of the proposed activities. Based on BOEM's review of exploration activities proposed in the applicant's application, the following non-recurring mitigations are applied to the area encompassed by the plan: 1. BOEM's 3D seismic database of water bottom anomalies and confirmed communities shall be used to identify features for the purpose of applying this mitigation. 2. The following nine water bottom anomaly categories will be considered as supporting or potentially supporting deepwater benthic communities, unless proved otherwise through high- resolution surveys: anom_conf_coral;, anom_conf_mvol;, anom_conf_orgs,; anom_poss_oil_pos,; wb_anom_lith,; wb_anom_mvol,; wb_anom_neg,; wb_anom_pock,; and wb_anom_pos. 3. These shape files may be downloaded from http://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/Map-Gallery/Seismic-Water-Bottom-Anomalies-Map-Gallery.aspx. 4. Features shall be either avoided or surveyed to confirm the presence or absence of deepwater benthic communities. 5. Per NTL 2009-G40, a minimum separation of 250 ft must be maintained between documented communities or features that could potentially support high-density deepwater benthic communities and bottom-disturbing activities (e.g., sensors deployed on the seafloor).

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
		a. Therefore, a minimum distance of separation for planned sensor deployment sites from any feature or community documented in BOEM's water bottom anomaly database must be at least 250 ft. b. If at any time it is determined that a node has landed within 250 ft of any feature or community documented in BOEM's water bottom anomaly database, an ROV must be used to document the seafloor surrounding the landing location. The seafloor beneath the node and arms must be surveyed visually with an ROV for damages. All images collected during this survey, showing the area within the footprint of the node, must be returned to BOEM's Gulf of Mexico OCS Region, Biological Sciences Unit for evaluation. 6. As required by NTL 2009-G40, for bottom-disturbing activities occurring within 500 ft of a high-density deepwater benthic community, the operator must provide BOEM with an as-placed plat showing the actual location of the disturbance on the seafloor, in relation to documented anomalies and communities. This requirement will apply to sensors placed within 500 ft of a documented anomaly or community, as shown in BOEM's 3D seismic database. For sensor deployments requiring as-placed plats, prepare at a scale of 1 in = 1,000 ft and submit to BOEM's Regional Supervisor, Office of Resource Evaluation, Data Acquisition and Special Projects Unit.
Tethered Ocean Bottom Node Surveys		Acoustic buoy releases, tethered acoustic pingers, and nodal tethering lines pose an entanglement risk to sea turtles and other marine life. Implementing the following measures act to reduce the risk of entanglement and ensure proper reporting of entanglement situations. Reasonable measures are available to applicants using this deployment technique to reduce the risk of entanglement. These measures include the following: (1) shortening the acoustic buoy line and tethered acoustic pinger line to the shortest length practical; and (2) replacing tether rope lines equal to or greater than ¼-in diameter with a thicker, more rigid tether line, modifying the line by tying knots in the line to increase the diameter and rigidness in order to minimize the risk of entanglement. Additional measures include ensuring that a Protected Species Observer (PSO) is onboard each vessel during tethered node retrieval operations. The PSOs will document any entanglement of marine species in the nodal gear, specifically noting the location where entanglement occurred (e.g., pinger tether, acoustic buoy line, etc.). If a marine protected species becomes entangled, specifically a sea turtle, the PSO will immediately begin resuscitation procedures as described in the National Oceanic and Atmospheric Administration's guidelines that can be found at http://www.st.nmfs.noaa.gov/Assets/Observer-Program/pdf/Shrimp_Reef_fish_Manual_9_22_10.pdf. The PSO must also contact the sea turtle stranding network's State coordinator to report the incident, condition of the turtle, and request additional instructions to reduce risk of injury or mortality, including rehabilitation and salvage techniques.

Table A-1. Commonly Applied or "Standard" Mitigating Measures (continued).

Mitigation Number	Mitigating Measure Title	Description of Mitigation
Topographic Features		The applicant must adhere to the provisions of the topographic features lease stipulation and the policy described in NTL 2009-G39, which restrict any bottom-disturbing activities within 152 m of the designated "no activity zone" of a topographic feature, as well as all applicable requirements described in the NTL.
Potential Archaeological Resource Protection		BOEM's review of the application indicates that numerous targets identified by existing remote-sensing data are located in the project area where the ocean bottom cables (OBCs) are proposed to be deployed. Therefore, in order to demonstrate compliance with 30 CFR § 551.6(a)(5), the applicant will either (1) ensure that all seafloor-disturbing actions required for the OBC deployment avoid the features by a distance greater than that listed in the tables or (2) conduct an underwater archaeological investigation prior to cable deployment to determine whether the feature represents an archaeological resource. If the applicant chooses to avoid the feature, they will be required to submit a plat, at a scale of 1 in = 1,000 ft with DGPS accuracy, with their final report as required by 30 CFR § 551.8(c)(2), which demonstrates the feature was not physically impacted by the OBC deployment and retrieval or by any other associated bottom disturbances. If the applicant chooses to conduct an underwater archaeological investigation, they will be required to comply with the investigation methodology and reporting guidelines found on BOEM's website at http://www.boem.gov/gom-archaeology/. This is only a partial list of potential archaeological sites within the project area, based on existing remote-sensing data. There are significant portions of the project area within the OCS that have received either limited or no previous archaeological survey, and these areas are likely to contain additional archaeological materials that may be impacted by the proposed operations. If the applicant discovers additional man-made debris that appears to indicate the presence of a shipwreck (e.g., a sonar image or visual confirmation of an iron, steel, or wooden hull; wooden timbers; anchors; concentrations of man-made objects such as bottles or ceramics; and piles of ballast rock) within or adjacent to the proposed action area during the proposed survey operations, they will be required to immediately halt operations, take steps to ensure that the site is not disturbed in any way, and contact BOEM's Regional Supervisor, Office of Environment within 48 hours of its discovery. They must cease all operations within 1,000 ft (305 m) of the site until BOEM's Regional Director instructs you on what steps you must take to assess the site's potential historic significance and what steps you must take to protect it. If an OBC becomes snagged on any submerged object, divers are required to un-snag and retrieve the OBC, and the applicant must submit a report detailing each instance of this activity. This report should include the coordinates of the snag (to DGPS accuracy), the diver's description of the submerged object creating the snag, any damage that may have resulted from the OBC placement or retrieval operations, and any photographic or video imagery that is collected. The applicant must submit a report of any data collected as a result of these investigations.

APPENDIX B

CATASTROPHIC SPILL EVENT ANALYSIS: HIGH-VOLUME, EXTENDED-DURATION OIL SPILL RESULTING FROM LOSS OF WELL CONTROL ON THE GULF OF MEXICO OUTER CONTINENTAL SHELF

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B. CATASTROPHIC SPILL EVENT ANALYSIS: HIGH-VOLUME, EXTENDED-DURATION OIL SPILL RESULTING FROM LOSS OF WELL CONTROL ON THE GULF OF MEXICO OUTER CONTINENTAL SHELF

B.1. INTRODUCTION

In 1986, the Council on Environmental Quality (CEQ) regulations were amended to rescind the requirement to prepare a "worst-case analysis" for an environmental impact statement (EIS) (refer to 40 CFR § 1502.22(b)(4)). The regulation, as amended, states that catastrophic, low-probability impacts must be analyzed if the analysis is "supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason."

The August 16, 2010, CEQ report, prepared following the *Deepwater Horizon* explosion, oil spill, and response in the Gulf of Mexico, recommended that the Bureau of Ocean Energy Management (BOEM), formerly the Minerals Management Service (MMS) and Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), should "ensure that National Environmental Policy Act (NEPA) documents provide decisionmakers with a robust analysis of reasonably foreseeable impacts, including an analysis of reasonably foreseeable impacts associated with low-probability catastrophic spills for oil and gas activities on the Outer Continental Shelf" (CEQ, 2010). This evaluation is a robust analysis of the impacts from low-probability catastrophic spills and will be made available to all applicable decisionmakers including, but not limited to, the Secretary of the Department of the Interior (USDOI) for the National Five-Year Program, the Assistant Secretary of Land and Minerals Management for an oil and gas lease sale, and the Regional Supervisors of the Gulf of Mexico OCS Region's Office of Environment and Office of Leasing and Plans.

It should be noted that the analysis presented here is intended to be a general overview of the potential effects of a catastrophic spill in the Gulf of Mexico. As such, the *Catastrophic Spill Event Analysis* should be read with the understanding that further detail about accidental oil impacts on a particular resource may be found in the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2014-2016, Western Planning Area Lease Sales 238, 246, and 248, Final Supplemental Environmental Impact Statement (WPA 238, 246, and 248 Supplemental EIS)* analysis or previous relevant NEPA analyses (e.g., the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247, Final Environmental Impact Statement* [2012-2017 WPA/CPA Multisale EIS]; USDOI, BOEM, 2012; the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014; Western Planning Area Lease Sale 233; Central Planning Area Lease Sale 231, Final Supplemental Environmental Impact Statement* [WPA 233/CPA 231 Supplemental EIS]; USDOI, BOEM, 2013a; and the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2014 and 2016, Eastern Planning Area Lease Sales 225 and 226, Final Environmental Impact Statement* [EPA 225/226 EIS]; USDOI, BOEM, 2013b).

B.1.1. What is a Catastrophic Event?

As applicable to NEPA, Eccleston (2008) defines a catastrophic event as "large-scale damage involving destruction of species, ecosystems, infrastructure, or property with long-term effects, and/or major loss of human life." For oil and gas activities on the Outer Continental Shelf (OCS), a catastrophic event is a high-volume, extended-duration oil spill regardless of the cause, whether natural disaster (i.e., hurricane) or manmade (i.e., human error and terrorism). This high-volume, extended-duration oil spill, or catastrophic spill, has been further defined by the National Oil and Hazardous Substances Pollution Contingency Plan as a "spill of national significance" or "a spill which, because of its severity, size, location, actual or potential impact on the public health and welfare or the environment, or the necessary response effort, is so complex that it requires extraordinary coordination of Federal, State, local, and responsible party resources to contain and cleanup the discharge" (40 CFR part 300, Appendix E).

Each oil-spill event is unique; its outcome depends on several factors, including time of year and location of release relative to winds, currents, land, and sensitive resources; specifics of the well (i.e., flow rates, hydrocarbon characteristics, and infrastructure damage); and response effort (i.e., speed and effectiveness). For this reason, the severity of impacts from an oil spill cannot be predicted based on volume alone, although a minimum volume of oil must be spilled to reach catastrophic impacts.

Though large spills may result from a pipeline rupture, such events will not result in a catastrophic spill because the ability to detect leaks and shut off pipelines limits the amount of the spill to the contents of the pipeline. The largest, non-blowout-related spill on the Gulf of Mexico OCS occurred in 1967, a result of internal pipeline corrosion following initial damage by an anchor. In 13 days, 160,638 barrels (bbl) of oil leaked (USDOI, BSEE, 2012); however, no significant environmental impacts were recorded as a result of this spill.

Although loss of well control is defined as the uncontrolled flow of reservoir fluid that may result in the release of gas, condensate, oil, drilling fluids, sand, or water, it is a broad term that includes very minor well control incidents as well as the most severe well control incidents. Historically, loss of well control incidents occurred during development drilling operations, but loss of well control incidents can occur during exploratory drilling, production, well completions, or workover operations. These losses of well control incidents may occur between formations penetrated in the wellbore or at the seafloor.

Prior to the *Deepwater Horizon* explosion, oil spill, and response, the two largest spills resulting from a loss of well control in U.S. waters of the Gulf of Mexico occurred in 1970 and released 30,000 and 53,000 bbl of oil, respectively (USDOI, BSEE, 2012). These incidents resulted in four human fatalities. Although these incidents occurred only 8-14 miles (mi) (13-26 kilometers [km]) from shore, there was minor shoreline contact with oil (USDOC, NOAA, Office of Response and Restoration, 2010a and 2010b). In 1987, a blowout of the Mexican exploratory oil well, YUM II, resulted in a spill of 58,640 bbl and 75 mi (121 km) of impacted shoreline (USDOC, NOAA, Hazardous Materials Response and Assessment Division, 1992). However, none of these spills met the previously described definitions of a catastrophic event or spill.

A blowout is a more severe loss of well control incident that creates a greater risk of a large oil spill and serious human injury. Two blowouts that resulted in catastrophic spills have occurred in U.S. and Mexican waters of the Gulf of Mexico. On June 3, 1979, the *Ixtoc I* well blowout in shallow water (water depth of 164 feet [ft] [50 meters [m]] and 50 mi [80 km] offshore in the Bay of Campeche, Mexico) spilled 3.5 million barrels (MMbbl) of oil in 10 months (USDOC, NOAA, Office of Response and Restoration, 2010c; USDOC, NOAA, Hazardous Materials Response and Assessment Division, 1992; ERCO, 1982). On April 20, 2010, the *Macondo* well blowout (*Deepwater Horizon* explosion, oil spill, and response) in deep water (4,992 ft; 1,522 m) 48 mi (77 km) offshore in Mississippi Canyon Block 252, spilled an estimated 4.9 MMbbl of oil until it was capped approximately 3 months later. Due to being classified as catastrophic, the *Ixtoc I* and *Macondo* well blowouts and spills were utilized to develop the catastrophic spill event scenario in this analysis.

B.1.2. Methodology

Two general approaches are utilized to analyze a catastrophic event under NEPA. The first approach is a bounding analysis for each individual resource category (e.g., marine mammals and sea turtles). A bounding analysis involves selecting and evaluating a different set of factors and scenarios for each resource in the context of a worst-case analysis. The second approach involves the selection of a single set of key circumstances that, when combined, result in catastrophic consequences. The second approach is used for a site-specific analysis and, consequently, its possible application is more limited. Accordingly, this analysis combines the two approaches, relying on a generalized scenario while identifying site-specific severity factors for individual resources. This combined approach allows for the scientific investigation of a range of possible, although not necessarily probable, consequences of a catastrophic blowout and oil spill in the Gulf of Mexico.

B.1.2.1. Geographic Scope

The Gulf of Mexico is a semi-enclosed basin with an extensive history of oil and gas activities and unique environmental conditions and hydrocarbon reservoir properties; consequently, this analysis is only applicable to the Gulf of Mexico OCS and is not intended for other OCS regions.

B.1.2.2. Impact-Producing Factors and Scenario

A hypothetical, yet feasible, scenario (**Chapter B.2**) was developed to provide a framework for identifying the impacts of an extended oil spill from an uncontrolled blowout. Unless noted, this scenario is based on the large magnitude, blowout-related oil spills that have occurred in the Gulf of Mexico, i.e., *Ixtoc I* and *Macondo* well blowouts and spills (discussed in **Chapter B.1.1**). As noted above, because each spill event is unique, its outcome depends on many factors. Therefore, the specific impacts from future spills cannot be predicted based on this scenario.

B.1.2.3. OSRA Catastrophic Run

A special Oil-Spill Risk Analysis (OSRA) model run was conducted to estimate the impacts of a possible future catastrophic or high-volume, extended-duration oil spill. This analysis emphasized modeling a spill that continued for 90 consecutive days by launching spills on each of 90 consecutive days, with each trajectory tracked for up to 60 days. The OSRA was conducted for only the trajectories of oil spills from hypothetical spill locations to various onshore and offshore environmental resources. Data from two hypothetical spill locations located in the Western Planning Area (WPA) (**Figure B-1**) were included and are intended for use as examples of this type of exercise. Information on previous catastrophic OSRA runs for the WPA can be found in Appendix C of the WPA 238/246/248 Supplemental EIS.

The probability of an oil spill contacting a specific resource within a given time of travel from a spill point is termed a conditional probability; the condition being that a spill is assumed to have occurred. Each trajectory was allowed to continue for as long as 60 days. However, once a hypothetical spill contacts land, the spill trajectory is terminated and the contact is recorded. Although, overall OSRA is designed for use as a risk-based assessment, for this analysis, only the conditional probability, the probability of contact to the resource, was calculated. The probability of a catastrophic spill occurring was not calculated; thus, the combination of the probability of a spill and the probability of contact to the resources from the hypothetical spill locations were not calculated. Results from this trajectory analysis provide input to the final product by estimating where spills might travel on the ocean's surface and what environmental resources might be contacted if and when another catastrophic spill occurs, but it does not provide input on the probability of another catastrophic spill occurring. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

B.1.2.4. Environmental and Socioeconomic Impacts

This analysis evaluates the impacts to the Gulf of Mexico's biological, physical, and socioeconomic resources from a catastrophic blowout, oil spill, and associated cleanup activities.

Although the most recent EISs prepared by this Agency for oil and gas lease sales in the Gulf of Mexico analyze the potential impacts from smaller oil spills that are more reasonably foreseeable (USDOI, MMS, 2007 and 2008), this analysis focuses on the most likely and most significant impacts created by a high-volume, extended-duration spill. Because catastrophic consequences may not occur for all resources, factors affecting the severity of impacts are identified by the individual resource.

B.1.3. How to Use This Analysis

The purpose of this technical analysis is to assist BOEM in meeting CEQ requirements that require a discussion of impacts from catastrophic events. This analysis, based on credible scientific evidence, identifies the most likely and most significant impacts from a high-volume blowout and oil spill that continues for an extended period of time. The scenario and impacts discussed in **Chapters B.2 and B.3** should not be confused with the scenario and impacts anticipated to result from routine activities or the more reasonably foreseeable accidental events of a WPA proposed action.

Chapter B.2 is intended to clearly describe the scenario presented for all four phases of a catastrophic blowout event and identify the impact-producing factors associated with each phase. **Chapter B.3** is intended to analyze the impacts of each phase of a catastrophic blowout on various environmental resources. These chapters can be used to differentiate the conditions of a catastrophic spill from the routine activities and accidental events described in this Supplemental EIS.

This technical analysis is designed to be incorporated by reference in future NEPA documents and consultations. Therefore, factors that affect the severity of impacts of a high-volume, extended-duration spill on individual resources are highlighted for use in subsequent site-specific analyses.

To analyze a hypothetical catastrophic event in an area such as the Gulf of Mexico, several assumptions and generalizations were made. However, future project-specific analyses should also consider specific details such as potential flow rates for the specific proposed activity, the properties of the targeted reservoir, and the proximity to environmental resources of the proposed activities.

B.2. IMPACT-PRODUCING FACTORS AND SCENARIO (PHASES 1-4)

For the purposes of this analysis, an event similar to the *Ixtoc I* well blowout and spill that occurred in 1979 in 160-ft (50-m) water depth will be used as the basis for a shallow water spill and an event similar to the *Macondo* well blowout and spill that occurred in 2010 in the Mississippi Canyon area in 5,000-ft (1,524-m) water depth will be used to represent a deepwater spill.

B.2.1. Phase 1—Initial Event

Phase 1 of the scenario is the initiation of a catastrophic blowout incident. While most of the environmental and socioeconomic impacts of a catastrophic blowout would occur during the ensuing high-volume, extended-duration spill (refer to **Chapter B.3**), it is important to acknowledge the deadly events that could occur in the initial phase of a catastrophic blowout. The following scenario was developed to provide a framework for identifying the most likely and most significant impacts during the initial phase.

Impacts, response, and intervention depend on the spatial location of the blowout and release. While there are several points where a blowout could occur, four major distinctions that are important to the analysis of impacts are described in **Table B-1**.

For this analysis, an explosion and subsequent fire are assumed to occur. If a blowout associated with the drilling of a single exploratory well occurs, a fire could result that would burn for 1 or 2 days. If a blowout occurs on a production platform, other wells could feed the fire, allowing it to burn for over a month (USDOC, NOAA, Office of Response and Restoration, 2010b). The drilling rig or platform may sink. If the blowout occurs in shallow water, the sinking rig or platform may land in the immediate vicinity; if the blowout occurs in deep water, the rig or platform could land a great distance away, beyond avoidance zones. For example, when the drilling rig *Deepwater Horizon* sank, it landed 1,500 ft (457 m) away on the seafloor. Regardless of water depth, the immediate response would be from search and rescue vessels and aircraft, such as U.S. Coast Guard (USCG) cutters, helicopters, and rescue planes.

B.2.2. Phase 2—Offshore Spill

Phase 2 of the analysis focuses on the spill and response in Federal and State offshore waters.

B.2.2.1. Duration of Spill

The duration of the offshore spill from a blowout depends on the time needed for intervention and the time the remaining oil persists offshore. If a blowout occurs and the damaged surface facilities preclude well reentry operations, a relief well may be needed to regain control. The time required to drill the relief well depends on the complexity of the intervention, the location of a suitable rig, the type of operation that must be terminated to release the rig (e.g., casing may need to be run before releasing the rig), and the logistics in mobilizing personnel and equipment to the location. A blown-out well may also be successfully capped prior to completion of relief wells, as occurred in the *Macondo* well blowout. In terms of persistence of spilled oil on surface waters, oil from the *Macondo* well blowout did not persist for more than 30 days (OSAT, 2010). However, based on BOEM's weathering modeling (refer to Appendix C of the WPA 238/246/248 Supplemental EIS), it is assumed that oil could persist on surface waters for as long as 1-2 months, depending on the season and year.

B.2.2.1.1. Shallow Water

If a blowout occurs in shallow water, it is estimated that the entire well intervention effort including drilling relief wells, if deemed necessary, could take 2 weeks to 3 months. This estimate would include 1-3 weeks to transport the drilling rig to the well site. Spilled surface oil is not expected to persist more than 1-2 months (depending upon the season and environmental conditions) after the flow is stopped. Spilled oil is more likely to persist in the offshore environment during colder weather and during wind and hydrodynamic conditions that keep the oil offshore. Therefore, the estimated spill duration resulting from a shallow water blowout is 1½-5 months (approximately 2 weeks to 3 months for active spillage and 1-2 months for oil persistence in the environment).

B.2.2.1.2. Deep Water

If a blowout occurs in deep water, it is estimated that it would take 2-4 weeks to remove debris and to install a capping stack or a cap and flow system on a well, if conditions allow this type of intervention. The entire intervention effort, if it required drilling relief wells, could take 3-4 months (USDOI, MMS, 2000; Regg, 2000). This includes 2-4 weeks to transport the drilling rig to the well site. Spilled surface oil is not expected to persist more than 1-2 months (depending upon the season and environmental conditions) after the flow is stopped. Spilled oil is more likely to persist in the offshore environment during colder weather and during wind and hydrodynamic conditions that keep the oil offshore. Therefore, the estimated spill duration from a deepwater blowout is 1½-6 months (approximately 2 weeks to 4 months for active spillage and 1-2 months for oil persistence in the environment).

B.2.2.2. Area of Spill

When oil reaches the sea surface, it spreads. The speed and extent of spreading depends on the type and volume of oil that is spilled. However, a catastrophic spill would likely spread to hundreds of square miles. Also, the oil slick may break into several smaller slicks, depending on local wind patterns that drive the surface currents in the spill area.

Subsurface oil observed during both the *Ixtoc I* and *Macondo* well blowouts and spills could also spread to significant distances depending on environmental conditions (such as hydrodynamics), oil chemistry and weathering, and the application of subsea dispersants or mechanical conditions at the release point that would diffuse the oil.

B.2.2.3. Volume of Spill

After 50 years of oil and gas exploration and development activity on the continental shelf of the Gulf of Mexico, most of the largest oil and natural gas reservoirs thought to exist in shallow-water areas of the GOM at drill depths less than 15,000 ft (4,572 m) subsea have been identified. Large undiscovered hydrocarbon reservoirs are still thought to exist in shallow-water areas. However, results taken from BOEM’s most recent resource assessment study and a review of the more recent shallow-water drilling and leasing activity suggest that future discoveries of large reservoirs in the shallow-water areas of the GOM are likely to exist greater than 15,000 ft (4,572 m) below sea level where geologic conditions are more favorable for natural gas reservoirs to exist than oil reservoirs. In contrast to the shallow-water areas of the GOM where the discovery of a new, large, prolific oil reservoir is considered a low-probability event, the results from BOEM’s resource assessment study pertaining to the deeper water areas of the GOM suggest that there is a high probability that many large oil and gas reservoirs have yet to be discovered in deep water. BOEM’s forecast for deep water has support from other public and private sector resource studies. The forecast is also supported by the results of BOEM’s analysis of deepwater leasing and drilling activity, which indicates that the industry is leasing acreage in deepwater areas of the GOM where large prospects can be identified and where the majority of exploration and development drilling activity targets potentially thick oil reservoirs capable of achieving the high production rates necessary to offset the high costs associated with deep water oil development in the GOM.

B.2.2.3.1. Shallow Water

For this analysis, an uncontrolled flow rate of 30,000 bbl per day is assumed for a catastrophic blowout in shallow water. This assumption is based upon the results of well tests in shallow water and the maximum flow rate from the 1979 *Ixtoc I* well blowout, which occurred in shallow water. Using this flow rate, the total volume of oil spilled from a catastrophic blowout in shallow water is estimated at 900,000 bbl to 3 MMbbl from spillage occurring over 1-3 months. In addition to the flow rate, it is assumed that any remaining diesel fuel from a sunken drilling rig or platform would also leak.

B.2.2.3.2. Deep Water

For the purposes of this analysis, an uncontrolled flow rate of 30,000-60,000 bbl per day is assumed for a catastrophic blowout in deep water. This flow rate is based on the assumption in **Chapter B.2.2.3.1** above, well test results, and the maximum flow rate estimated for the *Macondo* well blowout and spill occurred in deep water. Therefore, the total volume of oil spilled is estimated to be 0.9-7.2 MMbbl over 1-4 months. In addition, deepwater drilling rigs or platforms hold a large amount of diesel fuel (10,000-20,000 bbl). Therefore, it is assumed that any remaining diesel fuel from a sunken structure would also leak and add to the spill.

B.2.2.4. Oil in the Environment: Properties and Persistence

The fate of oil in the environment depends on many factors, such as the source and composition of the oil, as well as its persistence (NRC, 2003). Persistence can be defined and measured in different ways (Davis et al., 2004), but the National Research Council (NRC) generally defines persistence as how long oil remains in the environment (NRC, 2003; page 89). Once oil enters the environment, it begins to change through physical, chemical, and biological weathering processes (NRC, 2003). These processes may interact and affect the properties and persistence of the oil through the following:

- evaporation (volatilization);
- emulsification (the formation of a mousse);
- dissolution;
- oxidation (including respiration); and
- transport processes (NRC, 2003; Scholz et al., 1999).

Horizontal transport takes place via spreading, advection, dispersion, and entrainment while vertical transport takes place via dispersion, entrainment, Langmuir circulation, sinking, overwashing, partitioning, and sedimentation (NRC, 2003). The persistence of an oil slick is influenced by the effectiveness of oil-spill response efforts and affects the resources needed for oil recovery (Davis et al., 2004). The persistence of an oil slick may also affect the severity of environmental impacts as a result of the spilled oil.

Crude oils are not a single chemical, but instead are complex mixtures with varied compositions. Thus, the behavior of the oil and the risk the oil poses to natural resources depends on the composition of the specific oil encountered (Michel, 1992). Generally, oils can be divided into three groups of compounds: (1) light-weight; (2) medium-weight; and (3) heavy-weight components. On average, these groups are characterized as outlined in **Table B-2**.

Of the oil reservoirs sampled in the Gulf of Mexico OCS, the majority fall within the light-weight category, while less than one quarter are considered medium-weight and a small portion are considered heavy-weight. Oil with an American Petroleum Institute (API) gravity of 10.0 or less would sink and has not been encountered in the Gulf of Mexico OCS; therefore, it is not analyzed in this Appendix (USDOI, BOEMRE, 2010a).

Heavy-weight oil may persist in the environment longer than the other two types of oil, but the medium-weight components within oil present the greatest risks to organisms because, with the exception of the alkanes, these medium-weight components are persistent, bioavailable, and toxic (Michel, 1992).

Previous studies (e.g., Johansen et al., 2001) supported the theory that most, if not all, released oil would reach the surface of the water column. However, data and observations from the *Macondo* well blowout and spill challenge that theory. While analyses are in their preliminary stages, it appears that measurable amounts of hydrocarbons (dispersed or otherwise) were detected in the water column as subsurface "plumes" and on the seafloor in the vicinity of the release. While not all of these hydrocarbons have been definitively traced back to releases from the *Macondo* well, these early measurements and results warrant a reassessment of previous theories of the ultimate fate of hydrocarbons from unintended subsurface releases. It is important to note that the North Sea experiment (Johansen et al., 2001) did not include the use of dispersants at or near the source of the subsea oil discharge.

B.2.2.5. Release of Natural Gas

The quality and quantity of components in natural gas vary widely by the field, reservoir, or location from which the natural gas is produced. Although there is not a "typical" makeup of natural gas, it is primarily composed of methane (NaturalGas.org, 2012). Thus, if natural gas were to leak into the environment, methane may be released into the environment. Limited research is available for the biogeochemistry of hydrocarbon gases in the marine environment (Patin, 1999, page 233). Theoretically, methane could stay in the marine environment for long periods of time (Patin, 1999, page 237) as methane is highly soluble in seawater at the high pressures and cold temperatures found in deepwater environments (NRC, 2003, page 108). Methane diffusing through the water column would likely be oxidized in the aerobic zone and would rarely reach the air-water interface (Mechalas, 1974, page 23). Methane is a carbon source and its introduction into the marine environment could result in diminished dissolved oxygen concentrations due to microbial degradation.

The *Macondo* well blowout and spill resulted in the emission of an estimated 9.14×10^{9} to 1.29×10^{10} moles of methane from the wellhead (Kessler et al., 2011; Valentine et al., 2010) with maximum subsurface methane concentrations of 183-315 micromoles measured in May/June 2010 (Valentine et al., 2010; Joye et al., 2011). This methane release corresponded to a measurable decrease in oxygen in the subsurface plume due to respiration by a community of methanotrophic bacteria. During the *Macondo* well blowout and spill, methane and oxygen distributions were measured at 207 stations throughout the affected region (Kessler et al., 2011). Based on these measurements, it was concluded that within ~120 days from the onset of release $\sim 3.0 \times 10^{10}$ to 3.9×10^{10} moles of oxygen were respired, primarily by methanotrophs, and left behind a residual microbial community containing methanotrophic bacteria. The researchers further suggested that a vigorous deepwater bacterial bloom respired nearly all the released methane within this time and that by analogy, large-scale releases of methane from hydrates in the deep ocean are likely to be met by a similarly rapid methanotrophic response. However, hypoxic conditions were never reached (OSAT, 2010). Hypoxic conditions are generally agreed to occur when dissolved oxygen falls below 2 milligrams/liter (1.4 milliliter/liter) (OSAT, 2010). Note that methane released from the *Macondo* well blowout and spill was generally confined to the subsurface, with minimal amounts reaching the atmosphere (Kessler et al., 2011; Ryerson et al., 2011).

B.2.2.6. Deepwater Subsea Containment

To address the new improved containment systems' expectations to rapidly contain a spill as a result of a loss of well control from a subsea well as addressed in Notice to Lessees and Operators (NTL) 2010-BSEE-N10, the Marine Well Containment Company (MWCC) and Helix Well Containment Group (HWCG) initiated the development of new, rapid response systems. These systems are designed to fully contain oil flow in the event of a potential future underwater blowout and to address a variety of scenarios. The systems consist of specially designed equipment constructed, tested, and available for rapid response. Both the MWCC and HWCG systems are anticipated to be fully operational within days to weeks after a spill event occurs. The availability of these systems can significantly reduce the length of time a blowout continues, thereby reducing the amount of oil potentially spilled during a catastrophic spill. However, this assumes that a particular blowout situation lends itself to the use of this subsea containment technology, whereas there are some situations that may delay or make its use improbable, such as the location of debris resulting from the blowout and the condition of the well.

The MWCC system is designed to operate in up to a 10,000-ft (3,048-m) water depth and adds containment capability of 60,000 bbl of oil per day. In November 2013, the MWCC announced that the single ram capping stack, which is part of the company's interim containment system, can now cap a well that has fluids with temperatures up to 350 ºF (177 ºC). The MWCC is the only well containment provider that has this industry-first capping stack capable of handling temperatures of 350 º F (177 ºC) at pressures up to 15,000 pounds per square inch (Marine Well Containment Company, 2014). The HWCG system focuses on the utilization of the *Helix Producer I* and the *Q4000* vessels. Each of these vessels played a role in the *Macondo* well blowout and spill response, and each of these vessels are continually working in the Gulf. The HWCG system has the ability to fully operate in up to 10,000 ft (3,048 m) of water and has intervention equipment to cap and contain a well with the mechanical integrity to be shut-in. The HWCG system also has the ability to capture and process 57,000 bbl of oil per day and 72,000 bbl of liquid per day at 10,000 pounds per square inch (Helix Energy Solutions Group, 2014).

In addition, industry has a multitude of vendors available within the GOM region that can provide the services and supplies necessary for debris removal capability, dispersant injection capability, and top-hat deployment capability. Many of these vendors are already cited for use by MWCC and HWCG.

The BSEE has indicated to BOEM that, it will not allow an operator to begin drilling operations until adequate subsea containment and collection equipment, as well as subsea dispersant capability is determined by BSEE to be available to the operator and is sufficient for use in response to a potential incident from the proposed well(s) (refer to NTL 2010-N10). The BSEE conducted a successful deployment drill of the MWCC's subsea containment capping stack in the summer of 2012. A successful deployment drill of the HWCG's subsea containment capability was conducted in the spring of 2013. The HWCG was required to lower its capping stack through some 5,047 ft (1,538 m) of water to the seafloor by wire and then latch it to a test wellhead and pressurize the system. These types of exercises assist BSEE by spotlighting potential problems before an emergency and by identifying lessons that can be shared with the oil and gas industry to protect the environment and improve the safety of offshore operations. For instance, during the test of the MWCC equipment, it was discovered that a containment response should have "mud mats" on hand to ensure a stable platform for heavy equipment that otherwise might sink into soft seabed.

B.2.2.7. Offshore Cleanup Activities

As demonstrated by the *Ixtoc I* and *Macondo* well blowouts and spills, a large-scale response effort is certain to follow a catastrophic blowout. The number of vessels and responders would steadily increase as the spill continued. In the event of a spill, particularly a loss of well control, there is no single method of containment and removal that would be 100 percent effective. Removal and containment efforts to respond to an ongoing spill offshore would likely require multiple technologies, including source containment, mechanical cleanup, in-situ burning of the slick, and chemical dispersants. Even with the deployment of all of these spill-response technologies, it is likely that, with the operating limitations of today's spill-response technology, not all of the oil could be contained and removed offshore.

B.2.2.7.1. Shallow Water

The following are estimates for the deployment of equipment and personnel during a shallow-water spill response. Within the first week of an oil spill originating in shallow water, 25 vessels are estimated to respond, which would steadily increase to over 3,000 by the end of the spill. This includes about 25 skimmers in the vicinity of the well at any given time. In addition, recovered oil may be barged to shore from recovery vessels. Within the first week, over 500 responders are estimated to be deployed to a spill originating in shallow water, which would steadily increase up to 25,000 before the well is capped or killed within 2-4 months. Up to 25 planes and 50 helicopters are estimated to respond per day by the end of a shallow-water spill. Response to an oil spill in shallow water is expected to involve over 10,000 ft (3,048 m) of boom within the first week and would steadily increase up to 5 million feet (~950 mi; ~1,520 km) for use offshore and nearshore; the amount is dependent upon the location of the potentially impacted shoreline, environmental considerations, and agreed upon protection strategies involving the local potentially impacted communities.

Dispersant use must be in accordance with the Regional Response Team's (RRT) Preapproved Dispersant Use Manual and with any conditions outlined within an RRT's site-specific, dispersant approval given after a spill event. Consequently, dispersant use would be in accordance with the restrictions for specific water depths, distances from shore, and monitoring requirements. At this time, this manual does not give preapproval for the application of dispersant use subsea. Aerial dispersants would likely be applied from airplanes as a mist, which settles on the oil on the water's surface. Along the Gulf Coast, surface dispersants are presently preapproved for use greater than 3 nautical miles (nmi) (3.5 mi; 5.6 km) from shore and in water depths greater than 33 ft (10 m), with the exception of Florida (U.S. Dept. of Homeland Security, CG, 2010). At this time, pursuant to a letter from the Florida Department of Environmental Protection dated May 5, 2011, sent to USCG, preapproval for dispersant use is not approved for any Florida State waters. However, the U.S. Environmental Protection Agency (USEPA) is presently revisiting these RRT preapprovals in light of the dispersant issues, such as subsea application that arose during the *Macondo* well blowout and spill response. In addition, revisions are presently being made to the RRT IV and VI's Preapproved Dispersant Use Manuals. The USEPA issued a letter dated December 2, 2010, that provided interim guidance on the use of dispersants for major spills that are continuous and uncontrollable for periods greater than 7 days and for expedited approval of subsurface applications. This letter outlined the following exceptions to the current preapprovals until they are updated:

- dispersants may not be applied to major spills that are continuous in nature and uncontrollable for a period greater than 7 days;
- additional dispersant monitoring protocols and sampling plans may be developed that meet the unique needs of the incident; and
- subsurface dispersants may be approved on an incident-specific basis as requested by the USCG On-Scene Commander.

More robust documentation of dispersant usage may be required. This documentation would include daily reports that contain the products used, the specific time and locations of application, equipment used for each application, spotter aircraft reports, photographs, vessel data, and analytical data. In addition to dispersants, controlled burns may also occur. It is estimated that 5-10 controlled burns would be conducted per day in suitable weather. About 500 burns in all would remove 5-10 percent of the oil.

B.2.2.7.2. Deep Water

The following are estimates for the deployment of equipment and personnel during a deepwater spill response. Within the first week of an oil spill originating in deep water, 50 vessels are estimated to respond, which would steadily increase to over 7,000 by the end of the spill. This includes about 25 skimmers in the vicinity of the well at a time. In addition, recovered oil may be shuttle tankered to shore from recovery vessels. For an oil spill in deep water, over 1,000 responders are estimated to be deployed within the first week, which would steadily increase up to 50,000 before capping or killing the well within 4-5 months. Over 20,000 ft (6,096 m) of boom is estimated to be deployed within the first week of a deepwater spill, which would steadily increase up to 13.5 million feet (~2,257 mi; ~4,115 km) offshore and nearshore. The amount of boom would be dependent upon the location of the potentially impacted shoreline, environmental considerations, and agreed upon protection strategies involving the local potentially impacted communities. Up to 50 planes and 100 helicopters are estimated to respond per day by the end of a deepwater spill.

With the exception of special Federal management areas or designated exclusion areas, dispersants have been preapproved in the vicinity of a deepwater blowout (U.S. Dept. of Homeland Security, CG, 2010). However, USEPA is presently examining these preapprovals, and restrictions are anticipated regarding the future use of dispersants as a result. No preapproval presently exists for the use of subsea dispersants, and approval must be obtained before each use of this technology. The use of subsea dispersants depends on the location of the blowout, as discussed in **Table B-1**. Aerial dispersants are usually applied from airplanes as a mist, which settles on the oil on the water's surface. Major spills that are continuous and uncontrollable for periods greater than 7 days and the approval of subsurface dispersant application are presently subject to the guidance outlined in USEPA's letter dated December 2, 2010. This letter provides interim guidance on the use of dispersants for major spills and outlines exceptions to the current preapprovals until they are updated, as discussed more fully in **Chapter B.2.2.7.1**. For a deepwater spill, dispersant application may be a preferred response in the open-water environment to prevent oil from reaching a coastal area, in addition to mechanical response. However, the window of opportunity for successful dispersant application may be somewhat narrower for some deepwater locations depending on the physical and chemical properties of the oil, which tend to be somewhat heavier or more likely to emulsify than those found closer to shore. A significant reduction in the window of opportunity for dispersant application may render this response option ineffective.

In addition to dispersants, controlled burns may also occur. It is estimated that 5-10 controlled burns would be conducted per day in suitable weather. About 500 burns in all would remove 5-10 percent of the oil.

B.2.2.7.3. Vessel Decontamination Stations

To avoid contaminating inland waterways, multiple vessel decontamination stations may be established offshore in Federal and State waters. The selected locations to conduct decontamination of oiled vessels will, due to the unique aspects of each spill response, be decided by the Unified Command during the spill response effort. Since the Unified Command includes representatives of the affected state(s), the states will have a prominent voice regarding whether a location in State waters will be acceptable.

Vessels responding to the spill and commercial and recreational vessels passing through the spill would anchor, awaiting inspection. If decontamination is required, work boats would use fire hoses to clean oil from the sides of the vessels. This could result in some oiling of otherwise uncontaminated waters. While these anchorage areas would be surveyed for buried pipelines that could be ruptured by ship anchors, they may not be surveyed adequately for benthic communities or archaeological sites. Therefore, some damage to benthic communities or archaeological sites may occur because of vessel decontamination activities associated with an oil spill (Alabama State Port Authority, 2010; State of Florida, Office of the Governor, 2010; Nodar, 2010; Unified Incident Command, 2010a-c; USDOC, NOAA, 2010a; USEPA, 2012).

B.2.2.8. Severe Weather

A hurricane could accelerate biodegradation, increase the area affected by the spill, and slow or stop the response effort. The movement of oil would depend on the track, wind speed, and size of a hurricane. The official Atlantic hurricane season runs from June 1st through November 30th, with a peak of hurricane probability in September. In an average Atlantic season, there are 11 named storms, 6 hurricanes, and 2 Category 3 or higher storms (USDOC, NOAA, National Weather Service, 2010). As a result of a hurricane, high winds and seas would mix and weather the oil from an oil spill. This can help accelerate the biodegradation process (USDOC, NOAA, National Weather Service, 2012). The high winds may distribute oil over a wider area (USDOC, NOAA, National Weather Service, 2012).

Weather has been recognized as one of the most important factors in predicting oil-spill fate and behavior and in predicting the success of an oil-spill response. During an oil spill, booms, skimmers, oil burn, and the use of dispersants have been used to remove oil from the water surface. Adverse weather conditions will affect the use, performance, and effectiveness of booms and skimmers. Skimmers work best in calm wind; for wave heights greater than 1 m (3 ft), some skimmers will not work effectively. Conventional booms will not work at a current velocity of 0.5 meters per second (m/sec) (1.6 feet per second [ft/sec]) or greater. For oil burn, ignition cannot be carried out at wind speeds greater than 10 m/sec (33 ft/sec). The minimum wind speed for dispersant use is about 5 m/sec (16 ft/sec), and the maximum wind speed for the limit of dispersant applications is about 12-14 m/sec (39-46 ft/sec) (Fingas, 2004).

There are tradeoffs in deciding where and when to place boom because, once deployed, boom is time consuming to tend and to relocate. As previously noted, booming operations are sensitive to wind, wave, and currents, and those sections of boom need to be tethered and secured to keep them from moving. Furthermore, it was discovered during the *Deepwater Horizon* explosion, oil spill, and response that hard boom often did more damage than anticipated in the marsh it was intended to protect after weather conditions ended up stranding the boom back into the marsh. Due to time constraints prior to a hurricane event, it is therefore unlikely that much effort could be expended to move large amounts of deployed boom, particularly given the effort that would be required to move skimming equipment to safer locations inland and to move large numbers of response personnel to safer areas. However, since the conditions for each spill response are unique, these considerations would be examined and a site-specific hurricane response plan developed during the actual spill response effort by the Unified Command at the beginning of the official hurricane season.

In addition, adverse weather would reduce ability to respond to the spill and could result in delayed transport and placement of the capping stack. The action of wind on the water surface will generate waves. Typically, waves greater than 3 ft (1 m) will prevent smaller vessels from skimming in offshore waters; waves greater than 5 ft (1.5 m) will prevent even the larger vessels from getting offshore to skim. The new high-speed skimmers under development are very promising; some skimmers have recovered oil with wave heights of up to 10 ft (3 m) with corresponding winds of up to 15 m/sec (49 ft/sec).

In the event of a hurricane, vessels would evacuate the area, delaying response efforts, including the drilling of relief wells and any well capping or collection efforts. Severe weather, such as a hurricane, would delay the transport and placement of the capping stack. If a cap is applied and oil is flowed to a collection vessel, severe weather would cause the collection vessel to vacate its location and the oil would flow until the collection vessel could return and resume collection. Severe weather could also require that response assets be relocated inland. The response would be delayed because following the severe weather event the assets would need to be transported back to the staging areas. The speed with which the assets could be brought back to the locations would depend upon on the condition of the roads and bridges for traffic resumption and the amount of debris potentially blocking the roads.

B.2.3. Phase 3—Onshore Contact

B.2.3.1. Duration

The duration of shoreline oiling is measured from initial shoreline contact until the well is capped or killed and the remaining oil dissipates offshore. The time needed to cap or kill a well may vary, depending on, among other things, the well's water depth, its location, the well and geologic formation characteristics, and the associated debris. Depending on the spill's location in relation to winds and currents and the well's distance to shore, oil could reach the coast within 1 week to 1 month, based on evidence from previous spills in the Gulf of Mexico OCS (e.g., it was nearly 4 weeks after the *Macondo* well blowout and spill). While it is assumed that the majority of spilled oil would dissipate offshore within 30-60 days of stopping the flow, some oil may remain in coastal areas for some time after a spill, as was observed along the Gulf Coast following the *Macondo* well blowout and spill.

B.2.3.1.1. Shallow Water

Due to the distance from shore, oil spilled as a result of a blowout in shallow water could reach shore within 1-3 weeks and could continue until the well is killed or capped and the oil dissipates offshore. Therefore, it is estimated that initial shoreline oiling would likely occur for 2-5 months following a catastrophic blowout. Some shoreline areas could be re-oiled during this timeframe dependent upon the weather conditions at the time of the spill as well as the persistence of the spilled oil.

B.2.3.1.2. Deep Water

Intervention is more difficult and would take longer in deeper water, in part, because at these water depths these intervention efforts are conducted by remotely operated vehicles. In general, most of the deep water in the Gulf of Mexico is located farther from shore and, therefore, it is assumed that oil would reach shore within 2-4 weeks. However, for the few deepwater areas that are located closer to shore, such as in the Mississippi Canyon Area, the amount of estimated time until shoreline contact could be the same as the shallow-water scenario above (1-3 weeks). The length of shoreline oiled would continue to increase and previously oiled areas could be re-oiled until the well is killed or capped (3-4 months) and the oil dissipates offshore (1-2 months). Therefore, initial shoreline oiling could occur from 3 months up to 6 months following a catastrophic blowout. Persistent shoreline oiling is discussed in **Chapter B.2.4** (Phase 4) below.

B.2.3.2. Volume of Oil Contacting Shore

In the event of a catastrophic spill, not all of the oil spilled would contact shore. The amount of oil recovered and chemically or naturally dispersed would vary. For example, the following are recovery and cleanup rates from previous high-volume, extended spills:

- 10-40 percent of oil recovered or cleaned up (including burned, chemically dispersed, and skimmed);
- 25-40 percent of oil naturally dispersed, evaporated, or dissolved; and
- 20-65 percent of the oil remains available for offshore or inshore contact.

In the case of the *Macondo* well blowout and spill, the "expected" scenario, developed by the Oil Budget Calculator Science and Engineering Team of The Federal Interagency Solutions Group, suggests that more than one quarter (29%) was naturally or chemically dispersed into Gulf waters, while burning, skimming, and direct recovery from the wellhead removed one quarter (25%) of the oil released. Less than one quarter (23%) of the total oil naturally evaporated or dissolved. The residual amount, just under one quarter (23%), remained in the Gulf of Mexico as a light sheen or as tarballs that have washed ashore or are buried in sand and other sediments (The Federal Interagency Solutions Group, 2010).

For planning purposes, USCG estimates that 5-30 percent of oil will reach shore in the event of an offshore spill (33 CFR part 154, Appendix C, Table 2). Using the USCG assumptions, a catastrophic spill could result in a large amount of oil reaching shore.

B.2.3.3. Length of Shoreline Contacted

While larger spill volumes increase the chance of oil reaching the coast, other factors that influence the length and location of shoreline contacted include the duration of the spill and the well's location in relation to winds, currents, and the shoreline. Depending upon winds and currents throughout the spill event, already impacted areas could be re-oiled. As seen with the *Deepwater Horizon* oil spill, as the spill continued, the length of oiled shoreline at any one time increased by orders of magnitude as follows:

Duration of Spill	Length of Shoreline Oiled[1]
30 days	0-50 miles
60 days	50-100 miles
90 days	100-1,000 miles
120 days	>1,000 miles[2]

[1] Not cumulative.
[2] Length was extrapolated.

Source: USDOC, NOAA, 2011a.

B.2.3.3.1. Shallow Water

While a catastrophic spill from a shallow-water blowout is expected to be lower in volume than a deepwater blowout, as explained in **Chapter B.2.2.3**, the site would typically be closer to shore, allowing less time for oil to be weathered, dispersed, and recovered. This could result in a more concentrated and toxic oiling of the shoreline.

B.2.3.3.2. Deep Water

While a catastrophic spill from a deepwater blowout is expected to have a much greater volume than a shallow-water blowout (refer to **Chapter B.2.2.3**), the site would typically be farther from shore, allowing more time for oil to be weathered, dispersed, and recovered. This could result in broader, patchier oiling of the shoreline.

Translocation of the spilled oil via winds and currents is also a factor in the length of shoreline contacted. For example, oil could enter the Loop Current and then the Gulf Stream. However, the longer it takes oil to travel, the more it would degrade, disperse, lose toxicity, and break into streamers and tarballs (USDOC, NOAA, Office of Response and Restoration, 2010d).

B.2.3.4. Severe Weather

The official Atlantic hurricane season runs from June 1st through November 30th, with a peak in hurricane probability in September. In an average Atlantic season, there are 11 named storms, 6 hurricanes, and 2 Category 3 or higher storms (USDOC, NOAA, National Weather Service, 2010). In the event of a hurricane, vessels would evacuate the area, delaying response efforts, including the drilling of relief wells. The storm surge may push oil to the coastline and inland as far as the surge reaches, or the storm surge may remove the majority of oil from shore, as seen in some of the previous spills reviewed.

Movement of oil during a hurricane would depend greatly on the track of the hurricane in relation to the slick. A hurricane's winds rotate counter-clockwise. In general, a hurricane passing to the west of the slick could drive oil to the coast, while a hurricane passing to the east of the slick could drive the oil away from the coast.

Severe weather may distribute spilled oil over a wide area. Storm surge may carry oil into the coastal and inland waters and shore. Debris resulting from severe weather may be contaminated by oil. Thus, the responders need to take proper precautions if weathered oil is present. Weather that results in waves greater than 3 ft (1 m) prevents skimming in coastal waters so there is greater likelihood of contact with the shoreline. Severe weather would also displace or destroy shoreline boom so that oil could come into contact with the shoreline until responders put the boom back in place. Severe weather could require that assets be relocated inland. The response would be delayed because following the severe weather event the assets would need to be transported back to the staging areas. The speed with which the assets could be brought back to the locations would depend upon on the condition of the roads and bridges for traffic resumption and the amount of debris potentially blocking the roads.

The USEPA, USCG, other Federal response agencies, and applicable State agencies would work together to address oil spills reported to the National Response Center or reported by emergency responders before, during, or after a hurricane occurs. Response personnel will cleanup significant spills and take other actions appropriate to protect public health and the environment. This response would cover any OCS spills that may occur as a result of the hurricane or preexisting at the time of the hurricane. Response activities may be interrupted or complicated during a hurricane event. Oil from an ongoing OCS spill event may be washed ashore during a hurricane event; could be weathered, diluted, or washed farther inland; and could be mixed with other contaminants from other sources released during a hurricane event (e.g., heating oil or industrial chemicals). For example, onshore sources account for most of the oil spilled during the past few hurricane seasons that has resulted in oiled property. After Hurricane Sandy, some oil heating tanks flooded and caused oiling of a property owner's own building(s). As such, depending on circumstances, a hurricane event during an OCS spill event could complicate and exacerbate spill impacts and response operations, but could also increase weathering and dilution.

B.2.3.5. Onshore Cleanup Activities

A large-scale response effort would be expected for a catastrophic blowout. The number of vessels and responders would increase steadily as the spill continued. In addition to the response described in **Chapter B.2.2.7**, the following response is also estimated to occur once the spill contacts the shore.

B.2.3.5.1. Shallow Water

- There would be 5-10 staging areas established.
- Weathering permitting, about 200-300 skimmers could be deployed near shore to protect coastlines.

B.2.3.5.2. Deep Water

- There would be 10-20 staging areas established.
- Weather permitting, about 500-600 skimmers could be deployed near shore to protect coastlines. As seen in Louisiana following the *Macondo* well blowout and spill, a few hundred coastal skimmers could still be in operation a few months after the well is capped or killed (State of Louisiana, 2010).

B.2.3.5.3. Response Considerations for Sand Beaches for Both Shallow-Water and Deepwater Spills

- No mechanical techniques allowed in some areas.
- Surface residence balls (SRBs), also commonly known as tarballs, and surface residence patties (SRPs) are subject to smearing during the day; therefore, much of the beach cleanup can be expected to be conducted at night, if the weather is warm.
- There are marked differences in the sediments on the central Louisiana coast as compared with the Gulf beaches of Alabama, Florida, and Mississippi; therefore, no single technique will be universally applicable for cleaning sand beaches.
- Typically, sand sieving, shaking, and sifting beach cleaning machines will be utilized. The depth of cut below the sand surface can be expected to typically range from 0 to 12 inches (in) (0 to 30 centimeters [cm]) when using this equipment.
- It is anticipated that the responders will be instructed that no disturbance will be allowed below 18 in (46 cm). However, oil can be expected down to a depth of 24-26 in (61-66 cm) below the sand surface.
- Repetitive tilling and mixing may be used at beaches such as Grand Isle, using agriculture plows and discs in combination with beach cleaning machines. Sand washing treatment also may take place at beaches such as Grand Isle's beach. Sand washing includes a sand sieve/shaker to remove debris and large oil particles and a heated washing system. Average daily throughput for these systems would be 290 cubic yards per day. Sand treated in this manner is typically treated by sediment relocation, which is where the sand is moved to an active intertidal zone

B.2.3.5.4. Response Considerations for Marshes for Both Shallow-Water and Deepwater Spills

- Lightly oiled marsh may be allowed to recover naturally; the oil may be allowed to degrade in place or to be removed by tidal or wave action.
- Moderately or heavily oiled marsh could be cleaned by vacuuming or skimming from boats in conjunction with flushing to enhance oil recovery rates, low pressure flushing (with water comparable to marsh type), manual removal by hand or mechanized equipment, or vegetation cutting.
- In some heavily oiled areas, in-situ burning may be an option if water covers the sediment surface. This technique is only considered when the source is contained due to potential re-oiling of the area. Surface washing agents are also a technique that might be utilized.
- Bioremediation may be utilized but mostly as a secondary treatment after bulk removal.

B.2.3.5.5. Response Considerations for Nearshore Waters for Both Shallow-Water and Deepwater Spills

- Nearshore submerged oil is difficult to recover and hard to locate; vacuums and snares could be used.
- In the vicinity of marsh areas, skimming techniques with flushing could be utilized where warranted. In areas too shallow to use skimmers, oil removal could be accomplished using vacuum systems, in conjunction with flushing as needed. Booming could also be used to temporarily contain mobile slicks until they are recovered.

B.2.4. Phase 4—Post-Spill, Long-Term Recovery

During the final phase of a catastrophic blowout and spill, it is presumed that the well has been capped or killed and that cleanup activities are concluding. While it is assumed that the majority of spilled oil floating on surface waters would be dissipated within 30-60 days of stopping the flow, oil has the potential to persist in the environment long after a spill event and has been detected in sediment 30 years after a spill dependent upon the impacted environment (USDOI, FWS, 2004). On sandy beaches, oil can sink deep into the sediments. In tidal flats and salt marshes, oil may seep into the muddy bottoms (USDOI, FWS, 2010a).

The multiple-year response required for the *Deepwater Horizon* explosion, oil spill, and response provided one example of a long-term recovery to a catastrophic spill in the Gulf of Mexico. After the *Deepwater Horizon* explosion, oil spill, and response, a multi-agency Operational Science Advisory Team (OSAT), under the direction of the USCG, was convened to provide information to help guide response activities and to provide a better understanding of the potential environmental and health risks after the *Deepwater Horizon* explosion, oil spill, and response. A summary of the OSAT findings include the following:

- OSAT, issued in December 2010, concluded that no recoverable *Macondo* oil remained in the water column. In addition, none of the roughly 17,000 water samples collected and analyzed exceeded the USEPA's benchmarks for protection of human health.
- OSAT-2, issued in February 2011, found that residual oil in nearshore and sandy shoreline areas was highly weathered, and concentrations of constituents of concern were well below levels of concern for human health (OSAT-2, 2011).
- The OSAT Ecotoxicity Addendum, issued in July 2011, found that, with respect to the indicators considered in the OSAT (2010) report, the results discussed in this addendum are consistent with the OSAT conclusions that "no exceedances of the USEPA's dispersant benchmarks were observed" and that "since 3 August 2010 (last day with potentially recoverable oil on the ocean surface), <1% of water samples and ~1% of sediment samples exceeded EPA's aquatic life benchmarks for polycyclic aromatic hydrocarbons (PAHs)." In addition, results of the toxicity tests support the conclusions of the OSAT report regarding the distribution of actionable (i.e., amenable to removal actions) oil and dispersant-related constituents (OSAT Addendum, 2011).
- OSAT-3, finalized in early 2014, used a sophisticated scientific approach to identify potential discrete pockets of subsurface material. The OSAT-3 information was used to locate and recover potential subsurface material (British Petroleum, 2014a). The OSAT-3 report also identified actions to be taken for reducing the potential recurrence of oil along the northeastern shores of the Gulf of Mexico. In addition, the report evaluated the feasibility of each action taken to recover or remove *Macondo* oil and the net environmental benefit of employing each recovery technique recommended. This scientific support was provided to the Federal On-Scene

Coordinator with shoreline segment-specific information to facilitate the operational decisionmaking process to recover residual *Macondo* oil (OSAT-3, 2013).

If a shoreline is oiled, the selection of the type of shoreline remediation to be used will depend on the following: (1) the type and amount of oil on the shore; (2) the nature of the affected coastline; (3) the depth of oil penetration into the sediments; (4) the accessibility and the ability of vehicles to travel along the shoreline; (5) the possible ecological damage of the treatment to the shoreline environment; (6) weather conditions; (7) the current state of the oil; and (8) jurisdictional considerations. To determine which cleanup method is most appropriate during a spill response, decisionmakers must assess the severity and nature of the injury using Shoreline Cleanup and Assessment Team survey observations. These onsite decisionmakers must also estimate the time it will take for an area to recover in the absence of cleanup (typically considering short term to be 1-3 years, medium term to be 3-5 years, and long term greater than 5 years) (National Response Team, 2010).

B.2.4.1. Response Considerations for Sand Beaches, Marshes, and Nearshore Waters for both Shallow-Water and Deepwater Spills

Once oiled, it can be expected that the shoreline response techniques employed in the initial phase of a response will become more extensive and continue for some time (**Chapters B.2.3.5.3, B.2.3.5.4, and B.2.3.5.5**). For example, spill response post-*Macondo* continued for years in some of the more heavily oiled areas in Louisiana and in other areas, such as Florida, Mississippi, and Alabama, which experienced periodic re-oiling from submerged oil mats that lie in the inshore surf zone in troughs between the sand bars or from buried oil onshore that resurfaces. The three types of oil residue that were identified as challenging or potentially damaging to the environment if removed includes the following: (1) supra-tidal buried oil (buried below the 6-in [15-cm] surface cleaning depth restriction near sensitive habitats); (2) small surface residual balls, which are oil residue left behind after beaches are cleaned; and (3) surf zone submerged oil mats. Active shoreline cleanup ended in June 2013 for the States of Florida, Mississippi, and Alabama. Active shoreline cleanup for Louisiana ended on April 15, 2014 (British Petroleum, 2014a). However, efforts will continue to clean up any reported re-oiled shoreline in the GOM area as it is reported to the USCG. Although the re-oiling of some areas was anticipated to sporadically continue, it was determined that a better and more efficient long-term cleanup effort at this stage could be handled through the USCG. As of April 15, 2014, aerial reconnaissance flights were flown across approximately 14,000 mi (22,531 km) of shoreline during this spill response effort. Nearly 4,400 mi (7,081 km) were ground-surveyed, with teams identifying 1,104 mi (1,777 km) that experienced some level of oiling and 778 mi (1,252 km) that required some measure of cleaning (British Petroleum, 2014a).

Amenity beaches were generally cleaned to depths of up to 5 ft (1.5 m) using mechanical equipment that sifts out residual oil and other debris from below the beach surface while returning clean sand to the beach. Nonrecreational beaches and environmentally sensitive areas were generally hand-cleaned to depths of up to 6 in (15 cm), but they were cleaned deeper if it was ecologically safe and approved by the USCG, stakeholders, and others. Multiple techniques were used to treat oiled marsh areas, with the goal of promoting natural attenuation without causing further damage. A scientific effort was launched in mid-2012 to locate and remove potential pockets of subsurface material in Louisiana. During this effort, more than 40,000 holes and pits were excavated across seven barrier islands. The vast majority either had no visible oil or levels so low that treatment was not appropriate or required. For example, just 3 percent of the more than 16,000 auger holes had oiling levels that required cleanup and less than 2 percent of the over 24,000 pits had heavy or moderate oiling. Assessment teams continuously surveyed the shoreline and recommended treatment options. More than 100,000 tons of material were collected from the cleanup efforts. The total consists of not only the mixed residual material, which was typically 10-15 percent residual oil and 85-90 percent sand, shells, and water, but, during the first year of operations, it also included other solid material such as debris and protective clothing (British Petroleum, 2014a). Additional information regarding shoreline response considerations can be found in **Chapter 3.2.1.9**.

B.3. DESCRIPTION OF THE ENVIRONMENT AND IMPACT ANALYSIS

B.3.1. Long Duration—Large Volume Spill within the Gulf of Mexico

The following resource descriptions and impact analyses examined only the applicable portions of the scenario (described fully in **Chapter 3** and summarized in **Table B-4**).

B.3.1.1. Air Quality

Phase 1—Initial Event

A catastrophic blowout close to the water surface would initially emit large amounts of methane and other gases into the atmosphere. If high concentrations of sulfur are present in the produced gas, hydrogen sulfide (H_2S) could present a hazard to personnel. The natural gas H_2S concentrations in the Gulf of Mexico OCS are generally low; however, there are areas such as the Norphlet formation in the northeastern Gulf of Mexico, for example, that contain levels of H_2S up to 9 percent. Ignition of the blowout gas and subsequent fire would result in emissions of nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO), volatile organic compounds (VOCs), particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$). The fire could also produce PAHs, which are known to be hazardous to human health. The pollutant concentrations would decrease with downwind distance. A large plume of black smoke would be visible at the source and may extend a considerable distance downwind. However, with increasing distance from the fire, the gaseous pollutants would undergo chemical reactions, resulting in the formation of fine particulate matter ($PM_{2.5}$) that includes nitrates, sulfates, and organic matter. The $PM_{2.5}$ concentrations in the plume would have the potential to temporarily degrade visibility in any affected Prevention of Significant Deterioration (PSD) Class I areas (i.e., National Wilderness Areas and National Parks) and other areas where visibility is of significant value. Organic aerosols formed downwind from the *Macondo* well blowout and spill (de Gouw et al., 2011), during which the lightest compounds, the VOCs, in the oil from the *Macondo* well blowout and spill evaporated within hours and during which the heavier compounds took longer to evaporate, contributing to the formation of air pollution particles downwind.

Phase 2—Offshore Spill

In the Gulf of Mexico, evaporation from the oil spill would result in concentrations of VOCs in the atmosphere, including chemicals that are classified as being hazardous. The VOC concentrations would occur anywhere where there is an oil slick, but they would be highest at the source of the spill because the rate of evaporation depends on the volume of oil present at the surface. The VOC concentrations would decrease with distance as the layer of oil gets thinner. The lighter compounds of VOCs would be most abundant in the immediate vicinity of the spill site. The heavier compounds would be emitted over a longer period of time and over a larger area. Some of the compounds emitted could be hazardous to workers in close vicinity of the spill site. The hazard to workers can be reduced by monitoring and using protective gear, including respirators, as well as limiting exposure through limited work shifts, rotating workers in close vicinity of the spill site. The hazard to workers can be reduced by monitoring and using protective gear, including respirators, as well as limiting exposure through limited work shifts, rotating workers out of high exposure areas, and pointing vessels into the wind. During the *Macondo* well blowout and spill, air samples collected by individual offshore workers of British Petroleum (BP), the Occupational Safety and Health Administration (OSHA), and USCG showed levels of benzene, toluene, ethylbenzene, and xylene that were mostly under detection levels. All samples had concentrations below the OSHA permissible exposure limits and the more stringent ACGIH (American Conference of Governmental Industrial Hygienists) threshold limit values (U.S. Dept. of Labor, OSHA, 2010a).

The VOC emissions that result from the evaporation of oil contribute to the formation of particulate matter ($PM_{2.5}$) in the atmosphere. In addition, VOCs could cause an increase in ozone levels, especially if the release were to occur on a hot, sunny day with sufficient concentrations of NO_x present in the lower atmosphere. However, because of the distance of the proposed WPA lease sale area from shore, the oil slick would not likely have any effects on onshore ozone concentrations; however, if there were any effects to onshore ozone concentrations, they would be likely only be temporary in nature and last at most the length of time of the spill duration.

It is assumed that response efforts would include hundreds of in-situ or controlled burns, which would remove an estimated 5-10 percent of the volume of oil spilled. This could be as much as 720,000 bbl of oil for a spill of 60,000 bbl per day for 90 days. In-situ burning would result in ambient concentrations of CO, NO_x, SO_2, PM_{10}, and $PM_{2.5}$ very near the site of the burn and would generate a plume of black smoke. The levels of $PM_{2.5}$ could be a hazard to personnel working in the area, but this could be effectively mitigated through monitoring and relocating vessels to avoid areas of highest concentrations. In an experiment of an in-situ burn off Newfoundland, it was found that CO, SO_2, and NO_2 were measured only at background levels and were frequently below detection levels (Fingas et al., 1995). Limited amounts of formaldehyde and acetaldehyde were measured, but concentrations were close to background levels. Measured values of dioxins and dibenzofurans were at background levels. Measurements of PAH in the crude oil, the residues, and the air indicated that the PAH in the crude oil are largely destroyed during combustion (Fingas et al., 1995).

While containment operations may be successful in capturing some of the escaping oil and gas, recovery vessels may not be capable of storing the crude oil or may not have sufficient storage capacity. In this case, excess oil would be burned; captured gas cannot be stored or piped to shore so it would be flared. For example, in the *Macondo* well blowout and spill, gas was flared at the rate of 100-200 million cubic feet per day and oil burned at the rate of 10,000-15,000 bbl per day. The estimated NO_x emissions are about 13 tons per day. The SO_2 emissions would be dependent on the sulfur content of the crude oil. For crude oil with a sulfur content of 0.5 percent, the estimated SO_2 emissions are about 16 tons per day. Particulate matter in the plume would also affect visibility. Flaring or burning activities upwind of a PSD Class I area, e.g., the Breton National Wilderness Area, could adversely affect air quality there because of increased levels of SO_2, PM_{10}, and $PM_{2.5}$, and because of reduced visibility.

Phase 3—Onshore Contact

As the spill nears shore, there would be low-level concentrations of odor-causing pollutants associated with evaporative emissions from the oil spill. These may cause temporary eye, nose, or throat irritation, nausea, or headaches, but the doses are not thought to be high enough to cause long-term harm (USEPA, 2010a). However, responders could be exposed to levels higher than OSHA occupational permissible exposure levels (U.S. Dept. of Labor, OSHA, 2010b). During the *Deepwater Horizon* explosion, oil spill, and response, USEPA took air samples at various onshore locations along the length of the Gulf coastline. All except three measurements of benzene were below 3 parts per billion (ppb). The highest level was 91 ppb. Emissions of benzene to the atmosphere result from gasoline vapors, auto exhaust, and chemical production and user facilities. Ambient concentrations of benzene up to and greater than 5 ppb have been measured in industrial areas such as Houston, Texas; in various urban areas during rush hour; and inside the homes of smokers (U.S. Dept. of Health and Human Services, 2007). The following daily median benzene air concentrations were reported in the Volatile Organic Compound National Ambient Database (1975-1985): remote (0.16 ppb); rural (0.47 ppb); suburban (1.8 ppb); urban (1.8 ppb); indoor air (1.8 ppb); and workplace air (2.1 ppb). The outdoor air data represent 300 cities in 42 states, while the indoor air data represent 30 cities in 16 states (Shah and Singh, 1988).

During the *Deepwater Horizon* explosion, oil spill, and response, air samples collected by BP, OSHA, and USCG near shore showed levels of benzene, toluene, ethylbenzene, and xylene that were mostly under detection levels. Among the 28,000 personal benzene samples taken by BP, there was only 1 sample where benzene exceeded the OSHA occupational permissible exposure limits, and 6 additional validated constituents were in excess of the ACGIH threshold limit value. All other sample concentrations were below the more stringent ACGIH threshold limit values (U.S. Dept. of Labor, OSHA, 2010a). All measured concentrations of toluene, ethylbenzene, and xylene were well within the OSHA occupational permissible exposure levels and ACGIH threshold limit values.

Phase 4—Post-Spill, Long-Term Recovery and Response

There would be some residual air quality impacts after the well is capped or killed. As most of the oil would have been burned, evaporated, or weathered over time, air quality would return to pre-oil spill conditions. While impacts to air quality are expected to be localized and temporary, adverse effects that may occur from the exposure of humans and wildlife to air pollutants could have long-term consequences.

Overall Summary and Conclusion (Phases 1-4)

The OCS oil- and gas-related catastrophic event could include the release of oil, condensate, or natural gas or chemicals used offshore or pollutants from the burning of these products. The air pollutants include criteria National Ambient Air Quality Standards (NAAQS) pollutants, volatile and semi-volatile organic compounds, H_2S, and methane. If a fire was associated with the event, it would produce a broad array of pollutants, including all NAAQS-regulated primary pollutants, including NO_2, CO, SO_x, VOC, PM_{10}, and $PM_{2.5}$. Response activities that could impact air quality include in-situ burning, the use of flares to burn gas and oil, and the use of dispersants applied from aircraft. Measurements taken during an in-situ burning show that a major portion of compounds was consumed in the burn; therefore, pollutant concentrations would be expected to be within the NAAQS. In a recent analysis of air in coastal communities, low levels of dispersant components, which are also used in everyday household products, were identified. These response activities are temporary in nature and occur offshore; therefore, there are little expected impacts from these actions to onshore air quality. Catastrophic events involving high concentrations of H_2S could result in deaths as well as environmental damage. Regulations and NTLs mandate safeguards and protective measures, which are in place, to protect workers from H_2S releases. Other emissions of pollutants into the atmosphere from catastrophic events are not projected to have significant impacts on onshore air quality because of the prevailing atmospheric conditions, emissions height, emission rates, and the distance of these emissions from the coastline.

Overall, since loss of well-control events, blowouts, and fires are rare events and of short duration, potential impacts to air quality are not expected to be significant except in the rare case of a catastrophic event. To date, air monitoring conducted following the *Macondo* well blowout and spill, has not found any pollutants at levels expected to cause long-term harm (USEPA, 2010b).

B.3.1.2. Water Quality

Phase 1—Initial Event

Offshore Water Quality

During the initial phase of a catastrophic blowout, water quality impacts include the disturbance of sediments and the release and suspension of oil and natural gas (primarily methane) into the water column. These potential impacts are discussed below. As this chapter deals with the immediate effects of a blowout that would be located at least 3 nmi (3.5 mi; 5.6 km) from shore, it is assumed that there would be no impacts on coastal water quality during this initial stage.

Disturbance of Sediments

A catastrophic blowout below the seafloor, outside the wellbore (**Table B-1**) has the potential to resuspend sediments and disperse potentially large quantities of bottom sediments. Some sediment could travel several kilometers, depending on particle size and subsea current patterns. In the deep Gulf of Mexico, surficial sediments are mostly composed of silt and clay, and, if resuspended, could stay in the water column for several hours to days. Bottom current measurements in the deep Gulf of Mexico were synthesized as part of the MMS Deepwater Reanalysis study and have been measured to reach 90 centimeters/second (cm/sec) (35.4 inches/second [in/sec]) with mean flows of 0.4-21 cm/sec (0.2-8.3 in/sec) (Nowlin et al., 2001). At these mean flow rates, resuspended sediment could be transported 0.3-18 km per day (0.2-11 mi per day).

Sediment resuspension can lead to a temporary change in the oxidation-reduction chemistry in the water column, including a localized and temporal release of any formally sorbed metals, as well as nutrient recycling (Caetano et al., 2003; Fanning et al., 1982). Sediments also have the potential to become contaminated with oil components.

A subsea release also has the potential to destabilize the sediments and create slumping or larger scale sediment movements along depth gradients. These types of events would have the potential to move and/or damage any infrastructure in the affected area.

Release and Suspension of Oil into the Water Column

A subsea release of hydrocarbons at a high flow rate has the potential to disperse and suspend plumes of oil droplets (chemically dispersed or otherwise) within the water column and to induce large patches of sheen and oil on the surface. These dispersed hydrocarbons may adsorb onto marine detritus (marine snow), suspended sediments, or may be mixed with drilling mud and deposited near the source. Mitigation efforts such as burning may introduce hydrocarbon byproducts into the marine environment, which would be distributed by surface currents. The acute and chronic sublethal effects of these dilute suspended "plumes" are not well understood and require future research efforts.

As a result of the *Macondo* well blowout and spill, a subsurface oil and gas plume was discovered in deep waters between ~1,100 and 1,300 m (3,609 and 4,265 ft) (e.g., Diercks et al., 2010) in addition to the surface slick. Measurable amounts of hydrocarbons (dispersed or otherwise) were detected in the subsurface plumes and on the seafloor in the vicinity of the release (e.g., Diercks et al., 2010; OSAT, 2010). In the *Macondo* well blowout and spill subsurface plume, half-lives were estimated for petroleum hydrocarbons and n-alkanes on the order of 1 month and several days, respectively, indicating the impacts of various weathering processes (Reddy et al., 2011 and references therein). After the *Ixtoc I* well blowout and spill in 1979, which was located 50 mi (80 km) offshore in the Bay of Campeche, Mexico, some subsurface oil was also observed dispersed within the water column (Boehm and Fiest, 1982); however, the scientific investigations were limited (Reible, 2010). The water quality of offshore waters would be affected by the dissolved components and oil droplets that are small enough that they do not rise to the surface or are mixed down by surface turbulence. In the case of subsurface oil plumes, it is important to remember that these plumes would be affected by subsurface currents, dilution, and natural physical, chemical, and biological degradation processes including weathering.

Large quantities of oil put into offshore water may alter the chemistry of the sea with unforeseeable results. The properties and persistence of oil, including oil in the Gulf of Mexico, is further discussed in **Chapter B.2.2.4**. The VOCs, including benzene, toluene, ethylbenzene, and xylenes (also referred to as BTEX), are highly soluble and can have acutely toxic effects; however, VOCs are light-weight oil components and tend to evaporate rather than persist in the environment (Michel, 1992). Middle-weight organic components tend to pose the greatest risk in the environment because they are more persistent in the environment, are more bioavailable, and include PAHs, which have high toxicities (Michel, 1992). To determine the overall toxicity of PAHs in water or sediment, the contributions of every individual PAH compound in the petroleum mixture must be included (USEPA, 2011). This approach was used during the *Macondo* well blowout, spill and response in determining the potential risk of PAHs in both water and sediment to humans or animals in the environment (OSAT, 2010). Heavier components of crude oil tend to pose less risk of toxicity because they are not very soluble in water and therefore are less bioavailable.

The oil that entered the Gulf of Mexico from the *Macondo* well blowout and spill was a South Louisiana sweet crude oil (i.e., low in sulfur) (USDOC, NOAA, 2010b). This oil is less toxic than other crude oils in general because this oil is lower in PAHs than many other crude oils. Studies indicate that the oil contained approximately 3.9 percent PAHs by weight, which results in an estimated release of 2.1×10^{10} grams of PAHs (Reddy et al., 2011; Reddy, official communication, 2012). The oil was also fairly high in alkanes (organic compounds containing only carbon and hydrogen and single bonds, sometimes called paraffin or aliphatic compounds) (USDOC, NOAA, 2010b). Because alkanes are simple hydrocarbons, these oils are likely to undergo biodegradation more easily (USDOC, NOAA, 2010b).

Release of Natural Gas (Methane) into the Water Column

A catastrophic blowout could release natural gas into the water column; the amount of gas released is dependent upon the water depth, the natural gas content of the formation being drilled, and its pressure. Methane is the primary component of natural gas. Methane may stay in the marine environment for long periods of time (Patin, 1999; page 237), as methane is highly soluble in seawater at the high pressures and cold temperatures found in deepwater environments (NRC, 2003; page 108). However, methane diffusing through the water column would likely be oxidized in the aerobic zone and would rarely reach the air-water interface (Mechalas, 1974; page 23). In addition to methane, natural gas contains smaller percentages of other gases such as ethane, propane, and to a much lesser degree H_2S (NaturalGas.org, 2012), which can be toxic in the environment. The majority of natural gas components including methane are carbon sources, and their introduction into the marine environment could result in reducing the dissolved oxygen levels because of microbial degradation potentially creating hypoxic or "dead" zones. Unfortunately, little is known about methane toxicity in the marine environment, but there is concern as to how methane in the water column might affect fish. Further discussion of natural gas released during the *Macondo* well blowout and spill is given in **Chapter B.2.2.5**.

Phase 2—Offshore Spill

Offshore Water Quality

The water offshore of the Gulf's coasts can be divided into two regions: the continental shelf and slope (<1,000 ft; 305 m) and deep water (>1,000 ft; 305 m). Waters on the continental shelf and slope are heavily influenced by the Mississippi and Atchafalaya Rivers, the primary sources of freshwater, sediment, nutrients, and pollutants from a huge drainage basin encompassing 55 percent of the continental U.S. (Murray, 1998). Lower salinities are characteristic nearshore where freshwater from the rivers mix with Gulf waters. The presence or extent of a nepheloid layer, a body of suspended sediment at the sea bottom (Kennett, 1982, page 524), affects water quality on the shelf and slope. Deep waters east of the Mississippi River are affected by the Loop Current and associated warm-core (anti-cyclonic) eddies, which flush the area with clear, low-nutrient water (Muller-Karger et al., 2001) (**Figure B-2**). However, cold-core cyclonic eddies (counter-clockwise rotating) also form at the edge of the Loop Current and are associated with upwelling and nutrient-rich, high-productivity waters, although the extent of this flushing can vary seasonally.

While response efforts would decrease the fraction of oil remaining in Gulf waters, significant amounts of oil would remain. Natural processes will physically, chemically, and biologically aid the degradation of oil (NRC, 2003). The physical processes involved include evaporation, emulsification, and dissolution, while the primary chemical and biological degradation processes include photo-oxidation and biodegradation (i.e., microbial oxidation). Water quality would not only be impacted by the oil, gas, and their respective components, but also to some degree, from cleanup and mitigation efforts, such as from increased vessel traffic and the addition of dispersants and methanol to the marine environment.

In the case of a catastrophic subsea blowout in deep water, it is assumed that large quantities of subsea dispersants would be used. The positive effect of using dispersants is that the oil, once dispersed, may be more available to be degraded (however, we note that contrary findings for beached oil were presented by Hamdan and Fulmer, 2011). The negative effect is that the oil, once dispersed, is also more bioavailable to have toxic effects to microorganisms as well. The toxicity of dispersed oil in the environment would depend on many factors, including the effectiveness of the dispersion, temperature, salinity, degree of weathering, type of dispersant, and degree of light penetration in the water column (NRC, 2005). The toxicity of dispersed oil is primarily because of the toxic components of the oil itself (Australian Maritime Safety Authority, 2010).

As a result of the use of dispersants, it would be more likely for clouds or plumes of dispersed oil to occur near the blowout site as was seen during the *Macondo* well blowout and spill. Dissolved oxygen levels are a concern with any release of a carbon source, such as oil and natural gas, and became a particular concern during the *Macondo* well blowout and spill since dispersants were used in deep waters for the first time. In areas where plumes of dispersed oil were previously found, dissolved oxygen levels decreased by about 20 percent from long-term average values in the GOM of ~6.9 milligrams/liter (spring climatological mean at 1,500-m [4,921 -ft] depth); however, scientists reported that these levels stabilized and were not low enough to be considered hypoxic (Joint Analysis Group, 2010; USDOC, NOAA, 2010c). The drop in oxygen, which did not continue over time, has been attributed to microbial degradation of the oil.

Phase 3—Onshore Contact

Coastal Water Quality

Water quality governs the suitability of waters for plant, animal, and human use. Water quality is important in the bays, estuaries, and nearshore coastal waters of the Gulf because these waters provide feeding, breeding, and/or nursery habitat for many invertebrates and fishes, as well as sea turtles, birds, and marine mammals. A catastrophic spill would significantly impact coastal water quality in the Gulf of Mexico. Water quality prior to the *Macondo* well blowout and spill was rated as fair while sediment quality was rated as poor (USEPA, 2008). In addition, the coastal habitat index, a rating of wetlands habitat loss, was also rated as poor. Both the sediment quality and the coastal habitat index affect water quality.

Though response efforts would decrease the amount of oil remaining in Gulf waters and reduce the amount of oil contacting the coastline, significant amounts of oil would remain. Coastal water quality would be impacted not only by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts. Increased vessel traffic, hydromodification, and the addition of dispersants and methanol in an effort to contain, mitigate, or clean up the oil may also tax the environment.

The use of dispersants as a response tool involves a tradeoff. The purpose of chemical dispersants is to facilitate the movement of oil into the water column in order to encourage weathering and biological breakdown of the oil (i.e., biodegradation) (NRC, 2005; Australian Maritime Safety Authority, 2010). Thus, the tradeoff is generally considered to be oiling of the shoreline and surface of the water versus the water column and benthic resources (NRC, 2005). If the oil moves into the water column and is not on the surface of the water, it is less likely to reach sensitive shore areas (USEPA, 2010a). Since sea birds are often on the surface of the water or in shore areas, dispersants are also considered to be very effective in reducing the exposure of sea birds to oil (Australian Maritime Safety Authority, 2010). In addition to dispersion being enhanced by artificial processes, oil may also be dispersed from natural processes including both (bio)chemical and physical processes. For instance, microbial metabolism of crude oil results in the dispersion of oil (Bartha and Atlas, 1983), and conditions at the source of the oil/gas leak (e.g., orifice size and shape) may cause physical dispersion of the oil. Dispersion has both positive and negative effects. The positive effect is that the oil, once dispersed, is more available to be degraded. The negative effect is that the oil, once dispersed, is also more bioavailable to have toxic effects to microorganisms as well. For example, a recent study using mesocosm experiments suggested that dispersed oil could disrupt coastal microbial foodwebs in the northern Gulf of Mexico, reducing the flow of carbon to higher trophic levels (Ortmann et al., 2012). The toxicity of dispersed oil in the environment will depend on many factors, including the effectiveness of the dispersion, temperature, salinity, the degree of weathering, type of dispersant, and the degree of light penetration in the water column (NRC, 2005). The toxicity of dispersed oil is primarily because of the toxic components of the oil itself (Australian Maritime Safety Authority, 2010).

Oxygen and nutrient concentrations in coastal waters vary seasonally. The zone of hypoxia (depleted oxygen) on the Louisiana-Texas shelf occurs seasonally and is affected by the timing of freshwater discharges from the Mississippi and Atchafalaya Rivers. The hypoxic conditions continue until local wind-driven circulation mixes the water again. The 2010 hypoxic zone could not be linked to the *Macondo* well blowout and spill in either a positive or a negative manner (Louisiana Universities Marine Consortium, 2010). Nutrients from the Mississippi River nourished phytoplankton and contributed to the formation of the hypoxic zone.

Phase 4—Post-Spill, Long-Term Recovery and Response

The leading source of contaminants that impairs coastal water quality in the Gulf of Mexico is urban runoff. It can include suspended solids, heavy metals, pesticides, oil, grease, and nutrients (such as from lawn fertilizer). Urban runoff increases with population growth, and the Gulf Coast region has experienced a 109 percent population growth since 1970, with an additional expected 15 percent increase expected by 2020 (USDOC, NOAA, 2011b). Other pollutant source categories include (1) agricultural runoff, (2) municipal point sources, (3) industrial sources, (4) hydromodification (e.g., dredging), and (5) vessel sources (e.g., shipping, fishing, and recreational boating). The NRC (2003, Table I-4, page 237) estimated that, on average, approximately 26,324 bbl of oil per year entered Gulf waters from petrochemical and oil refinery industries in Louisiana and Texas. The Mississippi River introduced approximately 3,680,938 bbl per year (NRC, 2003, Table I-9, page 242) into the waters of the Gulf. Hydrocarbons also enter the Gulf of Mexico through natural seeps in the Gulf at a rate of approximately 980,392 bbl per year (a range of approximately 560,224-1,400,560 bbl per year) (NRC, 2003, page 191). Produced water (formation water) is, by volume, the largest waste stream from the oil and gas industry that enters Gulf waters (e.g., **Table B-3**). The NRC has estimated the quantity of oil in produced water entering the Gulf per year to be 473,000 bbl (NRC, 2003, page 200, Table D-8).[1] These sources total about 5.5 MMbbl of oil per year that routinely enters Gulf of Mexico waters. In comparison, a catastrophic spill of 30,000-60,000 bbl per day for 90-120 days would spill a total of 2.7-7.2 MMbbl of oil. When added to the other sources of oil listed above, this would result in a 48- to 129-percent increase in the volume of oil entering the water during the year of the spill. In addition, the oil from a catastrophic spill will be much more concentrated in some locations than the large number of other activities that release oil into the Gulf of Mexico. **Chapter B.2.2.4** discusses the properties and persistence of oil in the environment.

Overall Summary and Conclusion (Phases 1-4)

During Phase 1 of the catastrophic blowout scenario, impacts are not expected to coastal water quality. Instead, the initial impacts will include degradation of offshore water quality, disturbance and degradation of sediments, and the release and suspension of oil and natural gas into the water column, including the possible formation of plumes. Fine sediments could be transported away from the spill site.

As the spill continues during Phase 2, response efforts and natural degradation processes would decrease the amount of oil in the Gulf, but significant amounts of oil would remain to impact water and sediment quality. Water and sediment quality would not only be impacted by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts. The use of dispersants as a response tool may make the oil more available to degradation, but it can also make the oil more bioavailable to have toxic effects on microorganisms as well. Furthermore, dispersed oil is more likely to form a plume.

Onshore contact is made during Phase 3, so coastal sediment and water quality will be significantly impacted during this phase despite response efforts. Response efforts may even tax the coast to some degree. Natural and chemical dispersion may reduce the contact of oil with the shoreline but result in more oil in the water column and greater bioavailability of the dispersed oil.

The long-term recovery (Phase 4) of the water and sediment quality of the Gulf will depend on the properties and persistence of the oil as noted in **Chapter B.2.2.4**. Though the spill will increase the amount of oil entering the Gulf of Mexico, oil regularly enters the Gulf through sources such as oil refineries, the Mississippi River, produced water, and natural seeps. However, oil from a spill will be more concentrated than the oil input from these other sources.

B.3.1.3. Coastal Barrier Beaches and Associated Dunes

Phase 1—Initial Event

There would likely be no adverse impacts to coastal barrier beaches and associated dunes as a result of the events and the potential impact-producing factors that could occur throughout Phase 1 of a catastrophic spill event because these resources would not be contacted until the oil reached the shoreline.

Phase 2—Offshore Spill

There would likely be no adverse impacts to coastal barrier beaches and associated dunes as a result of the events and the potential impact-producing factors that could occur throughout Phase 2 of a catastrophic spill event because these resources would not be contacted until the oil reached the shoreline.

Phase 3—Onshore Contact

Barrier islands make up more than two-thirds of the northern Gulf of Mexico shore. Each of the barrier islands is either high profile or low profile, depending on the elevations and morphology of the island (Morton et al., 2004). The distinguishing characteristics of the high- and low-profile barriers relate to the width of the islands along with the continuity of the frontal dunes. Low-profile barriers are narrow with discontinuous frontal dunes easily overtopped by storm surge, which makes the island susceptible to

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1 These numbers were generated from converting the units reported in the noted reference and do not imply any level of significance.

over wash and erosion. This over wash can create channels to bring sand onto the island or into lagoons formed on these islands. High-profile barrier islands are generally wider than the low-profile islands and have continuous, vegetated, frontal dunes with elevations high enough to prevent over wash from major storm surge and, therefore, are less susceptible to erosion. The sand stored in these high-profile dunes allows the island to withstand prolonged erosion and therefore prevents breaching, which could result in damaging the island core.

The effects from oil spills depend on the geographic location, volume, and rate of the spill; type of oil; oil-slick characteristics; oceanic conditions and season at the time of the spill; and response and cleanup efforts. The effects could include changes in plant species diversity that could result in changes in forage areas for species using microfauna as a food base (Teal and Howarth, 1984). Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

As a result of a catastrophic spill, many of the barrier islands and beaches would receive varying degrees of oiling. Oil disposal on sand and vegetated sand dunes was shown in experiments by Webb (1988) to have little deleterious effects on the existing vegetation or on the recolonization of the oiled sands by plants. However, other studies have documented toxic effects of oil on barrier beach vegetation (Ko and Day, 2004). The depth of oiling would be variable, based on the wave environment and sediment source at a particular beach head. Layering of oil and sand could occur if it was not cleaned before another tidal cycle. However, most areas of oiling are expected to be light, and sand removal during cleanup activities should be minimized. The severity of oiling dictates the appropriate cleanup method to be utilized (refer to **Table B-4**).

In areas designated as natural wilderness areas (e.g., Breton National Wildlife Refuge and Gulf Islands National Seashore), land managers may require little to no disruption of the natural system. In these environments, it is preferred to let the oil degrade naturally without aggressive and intrusive cleanup procedures. Manual rather than mechanized removal techniques would be used in these areas and only if heavy oiling has occurred. Thus, these areas may not be treated as thoroughly as other shorelines. Oil would remain in place longer, weathering gradually while continuing to contaminate habitat, though mechanical disturbance would be minimized.

Once oil has reached the beaches and barrier islands and becomes buried or sequestered, it becomes difficult to treat. During wave events when the islands and beaches erode, the oil can become remobilized and transported. Thus, the fate of oil is not as simple as either reaching land, becoming sequestered, or being treated; but, it must be considered in terms of a continuing process of sequestration, remobilization, and transport.

For spilled oil to move onto beaches or across dunes, strong southerly winds must persist for an extended time prior to or immediately after the spill to elevate water levels. Strong winds, however, could reduce the impact severity at a landfall site by accelerating the processes of oil-slick dispersal, spill spreading, and oil weathering.

Bik et al. (2012) found that, despite the disappearance of visible surface oil on heavily oiled Gulf beaches impacted by the *Macondo* well blowout and spill, microbial communities showed significant changes in community structure, with a decrease in diversity and a shift toward dominance by fungal taxa, particularly known hydrocarbon-degrading genera. Likewise, nematode communities showed decreased diversity and increased dominance by predatory and scavenger taxa alongside an increased abundance of juveniles.

Due to the distance of beaches from deepwater blowouts and the combination of weathering and dispersant treatment of the oil offshore, the toxicity and quantity of the oil reaching shore should be greatly reduced, thereby minimizing the chances of irreversible damage to the impacted areas. A blowout in shallower waters near shore may have equal or greater impacts because of a shorter period of weathering and dispersion prior to shoreline contact, even though a smaller volume of spilled oil would be expected.

Vessel traffic in close proximity to barrier islands has been shown to move considerably more bottom sediment than tidal currents, thus increasing coastal and barrier island erosion rates. If staging areas for cleanup of a catastrophic spill are in close proximity to these islands, recovery time of the barrier islands could be greatly extended because of the large number of response vessels.

Phase 4—Post-Spill, Long-Term Recovery and Response

Oil or its components that remain in the sand after cleanup may be (1) released periodically when storms and high tides resuspend or flush beach sediments, (2) decomposed by biological activity, or (3) volatilized and dispersed. While it is assumed that the majority of spilled oil would be dissipated offshore within 1-2 months (depending on season and temperature) of stopping the flow, oil has the potential to persist in the environment long after a spill event. For example on sandy beaches, oil can sink deep into the sediments. As stranded oil weathers, some oil may become buried through natural beach processes and appear as surface residual balls (SRBs; <10 cm [4 in]) or as surface residual patties (SRPs; 10 cm to 1 m [4 in to 3 ft]) (**Table B-4**). Such balls continue to provide a source of contamination with accompanying toxic effects.

The cleanup impacts of a catastrophic spill could result in short-term (up to 2 years) adjustments in beach profiles and configurations as a result of sand removal and disturbance during cleanup operations. Some oil contact to lower areas of sand dunes is expected. This contact would not result in significant destabilization of the dunes. The long-term stressors to barrier beach communities caused by the physical effects and chemical toxicity of an oil spill may lead to decreased primary production, plant dieback, and hence, further erosion (Ko and Day, 2004).

The protection once afforded to inland marshes by coastal barrier beaches has been greatly reduced because of decreased elevations and the continued effect of subsidence, sea-level rise, and saltwater intrusion. A catastrophic spill has the potential to contribute to this reduction through increased erosion as a result of plant dieback and cleanup efforts.

Overall Summary and Conclusion (Phases 1-4)

As a result of a catastrophic spill, many of the barrier islands and beaches would receive varying degrees of oiling. However, most areas of oiling are expected to be lightly oiled, and sand removal during cleanup activities should be minimal. The long-term stressors to barrier beach communities caused by the physical effects and chemical toxicity of an oil spill may lead to decreased primary production, plant dieback, and hence, further erosion.

B.3.1.4. Wetlands

Phase 1—Initial Event

There would likely be no adverse impacts to wetlands as a result of the events and the potential impact-producing factors that could occur throughout Phase 1 of a catastrophic spill event because these resources would not be contacted until the oil reached the shoreline.

Phase 2—Offshore Spill

There would likely be no adverse impacts to wetlands as a result of the events and the potential impact-producing factors that could occur throughout Phase 2 of a catastrophic spill event because these resources would not be contacted until the oil reached the shoreline.

Phase 3—Onshore Contact

Coastal wetland habitats in the Gulf of Mexico occur as bands around waterways; broad expanses of saline, brackish, and freshwater marshes; mud and sand flats; and forested wetlands of cypress-tupelo swamps and bottomland hardwoods. Offshore oil spills would have a low probability of contacting and damaging any wetlands along the Gulf Coast, except in the case of a catastrophic event. This is because of the distance of the spill to the coast, the likely weathered condition of oil (through evaporation, dilution, and biodegradation) should it reach the coast, and because wetlands are generally protected by barrier islands, peninsulas, sand spits, and offshore currents.

While a catastrophic spill from a shallow-water blowout is expected to be lower in volume than a deepwater blowout, a potential shallow-water site could be closer to shore, allowing less time for oil to be weathered, dispersed, and recovered before it impacted coastal resources. A spill from a catastrophic blowout could oil a few to several hundred acres of wetlands depending on the depth of inland penetration

(Burdeau and Collins, 2010). This would vary from moderate to heavy oiling. One study of the impacts of the *Deepwater Horizon* explosion, oil spill, and response to salt marshes in Louisiana estimated the area affected to be between 350 and 400 km^2 (135 and 154 mi^2) (Mishra et al., 2012). Further detail on the catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

The NOAA Environmental Sensitivity Index (ESI) ranks shorelines according to their sensitivity to oil, the natural persistence of oil, and the expected ease of cleanup after an oil spill. These factors cause oil to persist in coastal and estuarine areas (USDOI, MMS, 2010). According to the ESI, the most sensitive shoreline types (i.e., sheltered tidal flats, vegetated low banks, salt/brackish-water marshes, freshwater marshes/swamps, and scrub-shrub wetlands) tend to accumulate oil and are difficult to clean, thus causing oil to persist in these coastal and estuarine areas (USDOI, MMS, 2010).

In the case of catastrophic spills in the GOM, preemptive oil-response strategies would be initiated and include the deployment of oil booms, skimmer ships, and barge barriers to protect the beaches and adjacent wetlands. Boom deployment must also include plans for monitoring and maintaining the protective boom systems to assure that these systems are installed and functioning properly and that they are not damaging the wetlands they are trying to protect. In most cases, the beach face would take the most oil; however, in areas where the marsh is immediately adjacent to the beach face or embayments, or in the case of small to severe storms, marshes would be oiled. For example, in Alabama, Mississippi, and Florida, severe weather could push oil into the tidal pools and back beach areas that support tidal marsh vegetation.

The primary factors that affect vegetation responses to oil are toxicity of the oil and extent of plant coverage, amount of contact with and penetration of the soil, plant species affected, oiling frequency, season, and cleanup activities (Mendelssohn et al., 2012). Previous studies of other large spills have shown that, when oil has a short residence time in the marsh and it is not incorporated into the sediments, the marsh vegetation has a high probability of survival, even though aboveground die-off of marsh vegetation may occur (Lin et al., 2002). However, if re-oiling occurs after the new shoots from an initial oiling are produced, such that the new shoots are killed, then the marsh plants may not have enough stored energy to produce a second round of new shoots. Other studies noted the utilization of dispersants in the proper dosages results in a reduction in marsh damage from oiling (Lin and Mendelssohn, 2009). The works of several investigators (Webb et al., 1981 and 1985; Alexander and Webb, 1983 and 1987; Lytle, 1975; Delaune et al., 1979; Fischel et al., 1989) evaluated the effects of potential spills to area wetlands. For wetlands along the central Louisiana coast, the critical oil concentration is assumed to be 0.025 gallons per ft^2 (1.0 liter per m^2) of marsh. Concentrations less than this may cause diebacks for one growing season or less, depending upon the concentration and the season during which contact occurs. The duration and magnitude of a spill resulting from a catastrophic blowout could result in concentrations above this critical level and would result in longer term effects to wetland vegetation, including some plant mortality and loss of land.

Due to the distance of deep water from shore, the possibility of a spill from a deepwater blowout reaching coastal wetlands with the toxicity to significantly impact the coastal wetlands is low because of the response procedures implemented during a catastrophic spill. (It is assumed that oil would reach shore within 2-4 weeks.) Therefore, a spill from a shallow-water blowout is more likely to contribute to wetland damage. However, for the few deepwater areas that are located closer to shore, such as in the Mississippi Canyon Area, the amount of time before shoreline contact could occur could be estimated to be the same as the estimate given for the shallow-water scenario, i.e., 1-3 weeks.

Offshore skimming, burning, and dispersal treatments for the oil near the spill site would result in capture, detoxification, and dilution of the majority of oil spilled. The utilization of nearshore booming protection for beaches and wetlands could also help to reduce oiling of these resources, if done correctly. Booms deployed adjacent to marsh shorelines can be lifted by wave action onto marsh vegetation, resulting in plant mortality under the displaced booms. The activity of oil cleanup can result in additional impacts on wetlands if not done properly. During the *Deepwater Horizon* explosion, oil spill, and response, aggressive onshore and marsh cleanup methods (such as the removal by mechanized equipment, in-situ burning, etc.) were not extensively utilized. The severity of oiling is the main factor that dictates the appropriate marsh cleanup method to be utilized (refer to **Table B-4**).

Phase 4—Post-Spill, Long-Term Recovery and Response

Wetlands serve a number of important ecological functions. For example, Louisiana's coastal wetlands support more than two-thirds of the wintering waterfowl population of the Mississippi Flyway (State of Louisiana, Dept. of Wildlife and Fisheries, 2012). Therefore, loss of wetlands would also impact a significant portion of the waterfowl population. Another important ecological function of wetlands is their use as a nursery for estuarine-dependent species of fish and shellfish. Wetland loss would reduce the available nursery habitat.

The duration and magnitude of a spill resulting from a catastrophic blowout could result in high concentrations of oil that would result in long-term effects to wetland vegetation, including some plant mortality and loss of land. Silliman et al. (2012) found that after the *Macondo* well blowout and spill, oil coverage of Louisiana salt marshes was primarily concentrated on their seaward edges. Oil-driven plant death on the edges of these marshes more than doubled the rates of shoreline erosion, further driving marsh platform loss that is likely to be permanent. Eighteen months after the *Macondo* well blowout and spill, in previously oiled, noneroded areas, marsh grasses had largely recovered, and the elevated shoreline retreat rates observed at oiled sites had decreased to levels at reference marsh sites. Studies of impacted wetlands have demonstrated that wetlands can recover from the impacts of oil spills, but the recovery process varies from extremely slow in mangrove swamps (Burns et al., 1993 and 1994) to relatively rapid in grass-dominated marshes subject to in-situ burning of oil (Baustian et al., 2010).

Land loss caused by the oiling of wetlands would add to continuing impacts of other factors, such as hurricanes, subsidence, saltwater intrusion, and sea-level rise. The wetlands along the Gulf Coast have already been severely damaged by the 2005 and 2008 hurricane seasons, leaving the mainland less protected. It was estimated in 2000 that coastal Louisiana would continue to lose land at a rate of approximately 2,672 hectares/year (10 mi^2/year) over the next 50 years. Further, it was estimated that an additional net loss of 132,794 hectares (512 mi^2) may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands (Barras et al., 2003). Barras (2006) indicated an additional 562 km^2 (217 mi^2) of land lost during the 2005 hurricane season. A catastrophic spill occurring nearshore would contribute further to this landloss. Following Hurricanes Katrina and Rita, another series of hurricanes (Gustav and Ike) made landfall along the Louisiana and Texas coasts in September 2008. Hurricane Gustav made landfall as a Category 2 storm near Cocodrie, Louisiana, pushing large surges of saline water into the fresh marshes and coastal swamps of Louisiana from Grand Isle westward. While Hurricane Gustav did not impact the quantity of wetlands that Hurricanes Katrina and Rita impacted, it did have a severe and continuing effect on the coastal barrier islands and the wetlands associated with backshore (back of the island) and foreshore (front of the island). While Hurricane Gustav affected the eastern portion of the Louisiana coast closer to Grand Isle and Houma, Hurricane Ike concentrated on Louisiana's western coast. The Texas coast received the brunt of Hurricane Ike where it made landfall slightly east of Galveston. The storm surge heavily eroded the dune systems and significantly lowered the beach elevations along the eastern portion of the Texas coast near Galveston and the Bolivar Peninsula. The erosion and wash-over associated with Hurricane Ike's tidal surge breeched beach ridges and opened the inland freshwater ponds and their associated wetlands to the sea. As a result of the four successive storms, the Louisiana and Texas coasts have lost protective elevations, barrier islands, and wetlands, and they now have the potential for transitioning to a less productive salt-marsh system in areas where fresh-marsh systems once existed. In addition, the loss of these protective elevations has increased the vulnerability of coastal wetlands to catastrophic oil-spill events.

A poorly executed oil cleanup can result in additional impacts. Aggressive onshore and marsh cleanup methods (such as removal by mechanized equipment, in-situ burning, marsh cutting, and foot entry into the marsh for manual removal) probably would not be initiated until the oil spill has been stopped. Depending on the marsh remediation methods used, further impacts to the wetlands may occur from cleanup activities. Boat traffic in marsh areas from the thousands of response vessels associated with a catastrophic spill would produce an incremental increase in erosion rates, sediment resuspension, and turbidity (i.e., an adverse but not significant impact to coastal wetland and seagrass habitats).

Overall Summary and Conclusion (Phases 1-4)

A spill from a catastrophic blowout could impact a few to several hundred square kilometers of wetlands depending on the depth of inland penetration (Burdeau and Collins, 2010; Mishra et al., 2012).

This would vary from moderate to heavy oiling. Impacts to wetlands would vary according to the severity of the oiling. The duration and magnitude of the spill could result in severe oiling of wetlands in some areas, causing long-term effects to wetland vegetation, including some plant mortality and loss of land.

B.3.1.5. Seagrass Communities

Phase 1—Initial Event

There would likely be no adverse impacts to submerged vegetation as a result of the events and the potential impact-producing factors that could occur throughout Phase 1 of a catastrophic spill event because of the likely distance from the spill event to the nearest submerged vegetation beds.

Phase 2—Offshore Spill

There would likely be no adverse impacts to submerged vegetation as a result of the events and the potential impact-producing factors that could occur throughout Phase 2 of a catastrophic spill because of the likely distance from the spill event to the nearest submerged vegetation beds.

Phase 3—Onshore Contact

According to the most recent and comprehensive data available, approximately 500,000 hectares (1.25 million acres; 505,857 hectares) of submerged seagrass beds are estimated to exist in exposed, shallow coastal waters and embayments of the northern Gulf of Mexico, and over 80 percent of this area is in Florida Bay and Florida coastal waters (calculated from Handley et al., 2007). Submerged vegetation distribution and composition depend on an interrelationship among a number of environmental factors that include water temperature, depth, turbidity, salinity, turbulence, and substrate suitability (Kemp, 1989; Onuf, 1996; Short et al., 2001). Marine seagrass beds generally occur in shallow, relatively clear, protected waters with predominantly sand bottoms (Short et al., 2001). Freshwater submerged aquatic vegetation (SAV) species occur in the low-salinity waters of coastal estuaries (Castellanos and Rozas, 2001). Seagrasses and freshwater SAVs provide important nursery and permanent habitat for sunfish, killifish, immature shrimp, crabs, drum, trout, flounder, and several other nekton species, and they provide a food source for species of wintering waterfowl and megaherbivores (Rozas and Odum, 1988; Rooker et al., 1998; Castellanos and Rozas, 2001; Heck et al., 2003; Orth et al., 2006). Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

If oil comes into areas with submerged beds, increased water turbulence from waves, storms, or vessel traffic could break apart the surface oil sheen and disperse some oil into the water column or mix oil with sediments that would settle and coat an entire plant. Coating of the plat from the oil and sediment mixture would cause reduced chlorophyll production and could lead to a decrease in vegetation (Teal and Howarth, 1984; Burns et al., 1994; Erftemeijer and Lewis, 2006). This coating situation also happens when oil is treated with dispersants because the dispersants break down the oil and it sinks into the water column (Thorhaug et al., 1986; Runcie et al., 2004). However, as reviewed in Runcie et al. (2004), oil mixed with dispersants has shown an array of effects on seagrass depending on the species and dispersant used. With a greater distance from shore, there is a greater chance of the oil being weathered by natural and mechanical processes by the time it reaches the nearshore habitat.

Depending on the species and environmental factors (e.g., temperature and wave action), seagrasses may exhibit minimal impacts, such as localized loss of pigmentation, from a spill; however, communities residing within the beds could accrue greater negative outcomes (den Hartog and Jacobs, 1980; Jackson et al., 1989; Kenworthy et al., 1993; Taylor et al., 2006). Community effects could range from either direct mortality due to smothering or indirect mortality from loss of food sources and habitat to a decrease in ecological performance of the entire system depending on the severity and duration of the spill event (Zieman et al., 1984).

Prevention and cleanup efforts could also affect the health of submerged vegetation communities (Zieman et al., 1984). Many physical prevention methods such as booms, barrier berms, and diversions can alter hydrology, specifically changing salinity and water clarity. These changes would harm certain species of submerged vegetation because they are tolerant to specific salinities and light levels (Zieman et al., 1984; Kenworthy and Fonseca, 1996; Frazer et al., 2006). With cleanup, there is increased boat and human traffic in these sensitive areas that generally are protected from this degree of human disturbance prior to the response. Increased vessel traffic would lead to elevated water turbidity and increased propeller scarring. While the elevated levels of water turbidity from vessels would be short-term and the possible damages from propellers could be longer, both events would be localized during the prevention and cleanup efforts (Zieman, 1976; Dawes et al., 1997).

Phase 4—Post-Spill, Long-Term Recovery and Response

According to the most recent and comprehensive data available, approximately 500,000 hectares (1.25 million acres; 505,857 hectares) of submerged seagrass beds are estimated to exist in exposed, shallow coastal waters and embayments of the northern Gulf of Mexico, and over 80 percent of this area is in Florida Bay and Florida coastal waters (calculated from Handley et al., 2007). Submerged vegetation distribution and composition depend on an interrelationship among a number of environmental factors that include water temperature, depth, turbidity, salinity, turbulence, and substrate suitability (Kemp, 1989; Onuf, 1996; Short et al., 2001). Seagrasses and freshwater SAVs provide important nursery and permanent habitat for sunfish, killifish, immature shrimp, crabs, drum, trout, flounder, and several other nekton species, and they provide a food source for species of wintering waterfowl and megaherbivores (Rozas and Odum, 1988; Rooker et al., 1998; Castellanos and Rozas, 2001; Heck et al., 2003; Orth et al., 2006).

A source of potential long-term impacts to submerged beds from a catastrophic spill event is the possibility of buried or sequestered oil becoming resuspended after a disturbance, which would have similar effects as the original oiling event. This could occur in the event of hurricane impacts, which exacerbate the problem with numerous other short-terms stresses, such as turbidity, abrasion, breakage, uprooting SAV and seagrasses, and the alteration of bottom profiles and hydrology. Because different species have different levels of sensitivity to oil, it is difficult to compare studies and extrapolate what variables caused the documented differences in vegetation and community health (Thorhaug et al., 1986; Runcie et al., 2004). In general, studied seagrasses did not show significant negative effects from an oil spill (den Hartog and Jacobs, 1980; Kenworthy et al., 1993; Taylor et al., 2006 and 2007).

If bays and estuaries accrue oil, there is an assumption that there would be a decrease in seagrass cover and negative community impacts. Submerged vegetation serves important ecological functions. For example, seagrasses and freshwater SAVs provide important habitat and are a food source for a wide range of species in multiple life history stages (Castellanos and Rozas, 2001; Short and Coles, 2001; Caldwell, 2003). Therefore, loss of submerged vegetation would adversely impact these species with a loss of valuable habitat and food.

Overall Summary and Conclusion (Phases 1-4)

Because of the likely distance of an initial catastrophic spill event to submerged vegetation communities, there would be no adverse impacts to submerged vegetation resulting from the initial event (Phase 1). Also, with regards to an offshore spill event, there would likely be no adverse impacts to submerged vegetation before the spill reaches shore (Phase 2). An estimated probability of oil contacting its coastline from the WPA example OSRA run can be found in Appendix C of the WPA 238/246/248 Supplemental EIS (Phase 3). It is assumed when these coastlines are contacted with oil, all associated habitat are considered oiled. If oil comes into areas with submerged beds, oil mixed with sediments or with dispersants could settle and coat an entire plant and could cause reduced chlorophyll production and could lead to a decrease in vegetation. Depending on the species and environmental factors (e.g., temperature and wave action), seagrasses may exhibit minimal impacts, such as localized loss of pigmentation, from an oil spill; however, communities residing within the beds could accrue greater negative outcomes. Increased vessel traffic from cleanup efforts would lead to elevated water turbidity and increased propeller scarring. A source of potential long-term impacts to submerged beds from a catastrophic spill event is the possibility of buried or sequestered oil becoming resuspended after a disturbance, which would have similar effects as the original oiling event (Phase 4). While there are impacts on submerged vegetation from an oiling event, the probabilities of an event to occur and contact coastlines are generally low and any impacts that can occur depend on a variety of factors (e.g., plant species, oil type, current environmental conditions, etc.). In general, studied seagrasses did not show significant negative effects from a spill (den Hartog and Jacobs, 1980; Kenworthy et al., 1993; Taylor et al., 2006 and 2007).

B.3.1.6. Live Bottoms (Pinnacle Trend and Low Relief)

The Gulf of Mexico has hard bottom features upon which encrusting and epibenthic organisms attach on the continental shelf in water depths less than 300 m (984 ft). Live bottom features occur in the northeastern portion of the CPA and in the EPA. The Pinnacle Trend is located in the northeastern portion of the central Gulf of Mexico at the outer edge of the Mississippi-Alabama shelf between the Mississippi River and De Soto Canyon. Live bottom (Pinnacle Trend) features are defined in NTL 2009-G39 as “small, isolated, low to moderate relief carbonate reefal features or outcrops of unknown origin or hard substrates exposed by erosion that provide area for the growth of sessile invertebrates and attract large numbers of fish.” Fish are attracted to outcrops that provide hard substrate for sessile invertebrates to attach. BOEM does not allow bottom-disturbing activities to occur within 30 m (98 ft) of any hard bottoms/pinnacles in 74 lease blocks in the CPA (each block is typically 3 mi x 3 mi).

Live bottom (low relief) features are defined in NTL 2009-G39 as “seagrass communities; areas that contain biological assemblages consisting of sessile invertebrates living upon and attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography; and areas where hard substrate and vertical relief may favor the accumulation of turtles, fishes, or other fauna”. These features also include the reef communities like those found on the Florida Escarpment. BOEM has stipulations to protect these features from impacts, including bottom-disturbing activity. This chapter discusses the hard substrate, as seagrasses are covered in **Chapter B.3.1.5**.

Phase 1—Initial Event

A blowout from an oil well could result in a catastrophic spill event. A catastrophic blowout would result in released oil rapidly rising to the sea surface because all known reserves in the GOM have specific gravity characteristics that would preclude oil from sinking immediately after release at a blowout site. The oil would surface almost directly over the source location. However, if the oil is ejected under high pressure, micro-droplets of oil may form and become entrained in the water column (Boehm and Fiest, 1982; Adcroft et al., 2010). The upward movement of the oil may be reduced if methane mixed with the oil is dissolved into the water column, reducing the oil’s buoyancy (Adcroft et al., 2010). Large oil droplets would rise to the sea surface, but smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010; Joint Analysis Group, 2010). Dispersed oil in the water column begins to biodegrade and may flocculate with particulate matter, promoting sinking of the particles. Subsea plumes or sinking oil on particulates may contact live bottom features.

A catastrophic blowout outside the well casing and below the seafloor or at the seafloor-water interface could resuspend large quantities of bottom sediments and create a large crater, destroying many organisms within a few hundred meters of the wellhead. Some fine sediment could travel up to a few thousand meters before redeposition, negatively impacting a localized area of benthic communities. If a blowout were to occur close enough to a live bottom feature, suspended sediment may impact the organisms living on the feature.

A catastrophic blowout that occurs above the seabed (at the rig, along the riser between the seafloor and sea surface, or through leak paths on the BOP/wellhead) would not disturb the sediment.

The use of subsea dispersants would increase the exposure of offshore benthic habitats to dispersed oil droplets in the water column, as well as the chemicals used in the dispersants. The use of subsea dispersants is not likely to occur for seafloor blowouts outside the well casing.

Impacts to Live Bottom Features

Impacts that occur to benthic organisms on live bottom features as a result of a blowout would depend on the type of blowout, distance from the blowout, relief of the biological feature, and surrounding physical characteristics of the environment (e.g., turbidity). The distancing of bottom-disturbing activities from Pinnacle and live bottom, low-relief features helps to prevent blowouts in the immediate vicinity of a live bottom feature or its associated biota. Much of the oil released from a blowout would rise to the sea surface, therefore minimizing the impact to benthic communities by direct oil exposure. However, small droplets of oil that are entrained in the water column for extended periods of time may migrate into areas that have live bottom features. Although these small oil droplets will not sink themselves, they may attach to suspended particles in the water column and then be deposited on the seafloor (McAuliffe et al., 1975). The resultant long-term impacts, such as reduced recruitment success, reduced growth, and reduced coral or other epibenthic cover, as a result of impaired recruitment, are discussed in Phase 4 ("Post-Spill, Long-Term Recovery and Response"). Also, if the blowout were to occur beneath the seabed, suspension and subsequent deposition of disturbed sediment may smother localized areas of live bottom communities.

Following a catastrophic, subsurface blowout, benthic communities on a live bottoms exposed to large amounts of resuspended and then deposited sediments could be subject to sediment suffocation, exposure to resuspended toxic contaminants and to reduced light availability. Impacts to fauna found on hard bottoms as a result of sedimentation would vary based on species, the height to which the organism grows, degree of sedimentation, length of exposure, burial depth, and the organism's ability to clear the sediment. Impacts may range from sublethal effects (such as reduced or slower growth, alteration in form, and reduced recruitment and productivity) to suffocation and death (Rogers, 1990; Fucik et al., 1980).

The initial blowout impact would be greatest to communities located in clear waters that experience heavy sedimentation. The most sensitive organisms are typically elevated above soft sediments, making them less likely to be buried, and it is unlikely that corals would experience heavy sedimentation because they are located within Live Bottom (Low Relief) Stipulation blocks that distance bottom-disturbing activity from the features. None of the Live Bottom Stipulation blocks were included in the current proposed lease sale, farther distancing oil and gas activity from live bottoms. In addition, BOEM conducts case-by-case reviews of plans submitted by operators to ensure that the proposed activity will not impact sensitive seafloor features. It is possible, however, for some live bottoms to experience some turbidity or sedimentation impacts from a blowout if they are downstream of a current transporting sediment. Corals may experience discoloration or bleaching as a result of sediment exposure, although recovery from such exposure may occur within 1 month (Wesseling et al., 1999).

Initial impacts would be much less extreme in a turbid environment (Rogers, 1990). For example, the Pinnacle Trend community exists in a relatively turbid environment, starting just 65 km (37 mi) east of the mouth of the Mississippi River and trending to the northeast, and many low-relief live bottoms are frequently covered with a thin sand veneer that moves with waves and bottom currents, exposing and covering up areas with movement (Phillips et al., 1990; Gittings et al., 1992). Sediment from a blowout, if it occurred nearby, may have a reduced impact on these communities compared with an open-water reef community, as these organisms are more tolerant of suspended sediment (Gittings et al., 1992). Many of the organisms that predominate in this community also grow tall enough to withstand the sedimentation that results from their turbid environment or have flexible structures that enable the passive removal of sediments (Gittings et al., 1992). Those organisms that have a lesser relief could experience sedimentation, abrasion, and suffocation. However, many organisms present in the lower relief, live bottom habitat are motile, can burrow in the sediment, or have mechanisms for dealing with turbidity and can be tolerant of short-term high turbidity events. For example, bivalves can reduce their filtration rates if the suspended sediment concentrations become elevated and can reject excess sediment through pseudofeces (Clarke and Wilber, 2000). Many crustaceans are able to tolerate high levels of suspended sediment; for example, crabs and shrimp spend a portion of their lives in estuaries and nearshore waters that are turbid (Wilber et al., 2005). These organisms are also able to move away from turbid areas that have sediment concentrations that become too high (Clarke and Wilber, 2000; Wilber et al., 2005). Oysters, on the other hand, are not able to move away from turbidity, but they are tolerant of this environmental factor as they tend to live near the mouths of rivers that deposit sediment into their habitat (Wilber et al., 2005). Many of these organisms can also rapidly repopulate an area affected by sedimentation (Fucik et al., 1980).

A portion or the entire rig may sink to the seafloor as a result of a blowout. The benthic features and communities upon which the rig settles would be destroyed or smothered. Encrusting organisms would be crushed by a rig if it lands on a live bottom feature. A settling rig may suspend sediments, which may smother nearby benthic communities if the sediment is redeposited on sensitive features. The habitats beneath the rig may be permanently lost; however, the rig itself may become an artificial reef upon which epibenthic organisms may settle. The surrounding benthic communities that were smothered by sediment would repopulate from nearby stocks through spawning recruitment and immigration if the hard substrate upon which they live was not physically destroyed. Destruction of a live bottom community by a sinking rig is highly unlikely because BOEM requires infrastructure to be distanced from live bottoms.

Phase 2—Offshore Spill

A spill from a shallow-water blowout could impact benthic communities on the continental shelf because of the blowout's proximity to these habitats. The scenario (**Table B-4**) for a catastrophic spill on the continental shelf is assumed to last 2-5 months and to release 30,000 bbl per day. A total volume of 0.9-3.0 MMbbl of South Louisiana midrange paraffinic sweet crude oil could be released, which will float (APIº >10). An anticipated 35,000 bbl of dispersant may be applied to the surface waters.

A spill from a deepwater blowout could also impact shelf communities if surface oil is transported to these areas. The scenario (**Table B-4**) for a catastrophic spill in deep water is assumed to last 4-6 months and to release 30,000-60,000 bbl per day. A total volume of 2.7-7.2 MMbbl of South Louisiana midrange paraffinic sweet crude oil will be released, which will float (APIº >10). Oil properties may change as it passes up the well and through the water column, and it may become emulsified. An anticipated 33,000 bbl of dispersant may be applied to the surface waters and 16,500 bbl may be applied subsea. Weathering and dilution of the oil will also occur as it travels from its release point. It is unlikely that a subsurface plume from a deepwater blowout would impact shelf communities. The oil is anticipated to remain in deep water and to be directed by water currents in the deep water. These currents do not typically transit from deep water up onto the shelf (Pond and Pickard, 1983; Inoue et al., 2008).

Impacts to Live Bottom Features

Impacts from Surface Oil

Sensitive live bottom communities can flourish on hard bottoms in the Gulf of Mexico. The eastern Gulf of Mexico contains scattered, low-relief live bottoms, including areas of flat limestone shelf rock and the Pinnacle Trend area, located on the Mississippi Alabama continental shelf, which includes low- and high-relief features that are 60-120 m (197-394 ft) below the sea surface. The depth at which Pinnacles and most live bottom, low-relief features flourish below the sea surface helps to protect these habitats from a surface oil spill. Rough seas may mix the oil into subsurface water layers, where it may impact sessile biota. The longer the seas are rough, the greater the amount of oil from a surface slick would be mixed into the water column. Measurable amounts of oil have been documented to mix from the surface down to a 10-m (33-ft) depth, although modeling exercises have indicated such oil may reach a depth of 20 m (66 ft). At this depth, however, the oil is found at concentrations several orders of magnitude lower than the amount shown to have an effect on corals and other benthic organisms (Lange, 1985; McAuliffe et al., 1975 and 1981a; Knap et al., 1985; Scarlett et al., 2005; Hemmer et al., 2010; George-Ares and Clark, 2000). Low-relief, live bottom habitats located in shallow coastal water may be at greater risk of surface oil mixing to the depth where their active growth occurs; however, because oil and gas activities currently take place far from the coastlines where nearshore live bottoms are located, the surface oil will be well dispersed and diluted by the time it reaches waters above the shallow live bottoms. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

Impacts from Subsurface Oil

The presence of a subsurface oil plume on the continental shelf from a shallow-water blowout may affect benthic communities on live bottom features. A majority of oil released is expected to rise rapidly to the sea surface above the release point because of the specific gravity characteristics of the oil reserves in the GOM, thus not impacting sensitive benthic communities. If oil is ejected under high pressure, oil droplets may become entrained in the water column (Boehm and Fiest, 1982; Adcroft et al., 2010). The upward movement of the oil may be reduced if methane mixed with the oil is dissolved into the water column, reducing the oil's buoyancy (Adcroft et al., 2010). Large oil droplets would rise to the sea surface, but smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010; Joint Analysis Group, 2010). Dispersed oil in the water column begins to biodegrade and may flocculate with particulate matter, promoting sinking of the particles. Subsurface plumes generated by high-pressure dissolution of oil may come in contact with live bottom habitats. A sustained spill would continuously create surface slicks and possibly subsurface spill plumes. Some of the oil in the water column will become diluted or evaporated over time, reducing any localized transport to the seafloor (Vandermeulen, 1982). In addition, microbial degradation of the oil occurs in the water column so that the oil would be less toxic as it travels from the source (Hazen et al., 2010). However, a sustained spill may result in elevated exposure concentrations to benthic communities if the plume reaches them. The longer the spill takes to stop, the longer the exposure time and the higher the exposure concentration may be.

Live bottom, low-relief features have a greater chance of being impacted by subsea plumes than some Pinnacle features because currents may sweep around the larger features, as they do with topographic features (Rezak et al., 1983; McGrail, 1982). The lower relief live bottoms (including low-relief features in the Pinnacle Trend) may fall in the path of the plume because the feature is not large enough to divert a current. Low-level exposures of organisms to oil from a subsea plume may result in chronic or temporary impacts. For example, feeding activity or reproductive ability may be reduced when coral is exposed to low levels of oil; however, impacts may be temporary or unable to be measured over time. Experiments indicated that oil exposure reduced the normal feeding activity of coral, and oiled reefs produced smaller gonads than unoiled reefs, resulting in reproductive stress (Lewis, 1971; Guzmán and Holst, 1993). In addition, photosynthesis and growth may be reduced with oil exposure, and petroleum may be incorporated into coral tissue (Cook and Knap, 1983; Dodge et al., 1984; Burns and Knap, 1989; Knap et al., 1982; Kennedy et al., 1992). Sublethal responses of other marine invertebrates on live bottoms may result in population level changes (Suchanek, 1993) at concentrations as low as 1-10 ppb (Hyland and Schneider, 1976). Sublethal impacts may include reduced feeding rates, reduced ability to detect food, erratic movement, ciliary inhibition, tentacle retraction, reduced movement, decreased aggression, and altered respiration (Scarlett et al., 2005; Suchanek, 1993). Embryonic life stages of benthic organisms may experience toxic effects at lower levels than adult stages (Fucik et al., 1995; Suchanek, 1993; Beiras and Saco-Álvarez, 2006; Byrne, 1989).

It is unlikely that a subsurface plume from a deepwater blowout would impact live bottom shelf communities. The oil is anticipated to remain in deep water and be directed by water currents in the deep water. These currents do not typically transit from deep water up onto the shelf (Pond and Pickard, 1983; Inoue et al., 2008).

Impacts from Dispersed Oil

If dispersants are used at the sea surface, oil may mix into the water column. If applied subsea, they can travel with currents through the water, and they may contact or settle on sensitive features. Note that, as indicated above, a deepwater plume would not travel onto the continental shelf, but a plume formed on the continental shelf could impact live bottom features. If near the source, the dispersed oil could be concentrated enough to harm the community. If the oil remains suspended for a longer period of time, it would be more dispersed and present at lower concentrations. Reports on dispersant usage on surface oil indicate that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a). Dispersant usage also reduces the oil's ability to stick to particles in the water column, minimizing oil adhering to sediments and traveling to the seafloor (McAuliffe et al., 1981a). However, after the *Deepwater Horizon* oil spill, there was the formation of a dense layer of marine snow that aggregated and collected everything that it came in contact with it as it fell through the water column and settled on the seafloor (Passow et al., 2012).

Dispersed oil reaching live bottoms in the Gulf of Mexico would be expected to occur at very low concentrations (<1 part per million [ppm]) (McAuliffe et al., 1981a). Such concentrations would not be life threatening to larval or adult stages at this depth below the sea surface based on experiments conducted with benthic organisms. Any dispersed oil in the water column that comes in contact with live bottoms may evoke short-term negative responses by the organisms (Wyers et al., 1986; Cook and Knap, 1983; Dodge et al., 1984; Scarlett et al., 2005; Renzoni, 1973).

The impact of dispersants on benthic organisms is dependent on the dispersant used, length of exposure, and the physical barriers the organism has to protect itself from the dispersant. Organisms with shells appear to be more tolerant of dispersants than those with only a tissue barrier (Scarlett et al., 2005). In addition, organisms that produce mucus, such as coral, have an elevated tolerance for oil exposure (Mitchell and Chet, 1975; Ducklow and Mitchell, 1979). Concentrations of 100 ppm and 1,000 ppm oil plus dispersant in a ratio of 4:1 were necessary for oyster and mussel fertilization and development to become reduced when the larvae was exposed to the mixture (Renzoni, 1973). After 48 hours of exposure to dispersants, the blue mussel (*Mytilus edulis*) died at dispersant concentrations of 250 ppm, although reduced feeding rates were observed at 50 ppm (Scarlett et al., 2005). The snakelocks anemone (*Anemonia viridis*), which does not have a protective shell, was much more sensitive to dispersants. It retracted its tentacles and failed to respond to stimuli after 48 hours of exposure to 40 ppm dispersant (Scarlett et al., 2005). Corals exposed to dispersed oil showed mesenterial filament extrusion, extreme tissue contraction, tentacle retraction, localized tissue rupture, and reduced photosynthesis (Wyers et al., 1986; Cook and Knap, 1983). Respiratory damage to organisms does not appear to be reversible; however, if the exposure is short enough, nervous system damage may be reversed and organisms may recover (Scarlett et al., 2005). Experiments using both anemones and corals showed recovery after exposure to dispersants (Scarlett et al., 2005; Wyers et al., 1986).

Concentrations used in historical experiments are generally much higher than the exposure that would occur in the field (Renzoni, 1973; George-Ares and Clark, 2000). Although historical experiments seem to indicate that the toxicity of oil increases with the addition of the dispersant, the toxicity of the oil actually remains the same as it was when it was not dispersed, but exposure increases due to the dispersed components of the oil (George-Ares and Clark, 2000). However, the increase of oil into the water column with the addition of dispersants is temporary, as the dispersed oil is more easily diluted with the surrounding water and biodegraded by bacteria (George-Ares and Clark, 2000). Therefore, concentrated dispersants are not anticipated to reach live bottoms, and any impacts that do occur should be sublethal and temporary.

Impacts from Oil Adhering to Sediments

BOEM's policy, described in NTL 2009-G39, prevents wells from being placed immediately adjacent to sensitive communities. In the event of a seafloor blowout, however, some oil could be carried to live bottoms as a result of oil droplets adhering to suspended particles in the water column. Oiled sediment that settles to the seafloor may affect organisms attached to hard bottom substrates. Impacts may include reduced recruitment success, reduced growth, and reduced benthic cover as a result of impaired recruitment. Experiments have shown that the presence of oil on available substrate for larval coral settlement has inhibited larval metamorphosis and larval settlement in the area. Oil exposure also increased the number of deformed polyps after metamorphosis occurred (Kushmaro et al., 1997). In addition, exposure to oiled sediment has also been shown to reduce the growth rate of clams (Dow, 1975).

The majority of organisms exposed to sedimented oil are expected to experience low-level concentrations because as oiled sediments settle to the seafloor they become widely dispersed. Many organisms on live bottoms will be able to protect themselves from low levels of oiled sediment that may settle out of the water column. Organisms with shells will not experience direct contact with the oil, and mobile organisms will be able to move away from areas where oiled sediment has accumulated. Coral may also be able to protect itself from low concentrations of sedimented oil that settles from the water column through mucus that will not only act as a barrier to protect coral from the oil in the water column but which also been shown to aid in the removal of oiled sediment on coral surfaces (Bak and Elgershuizen, 1976). In addition, because many organisms in live bottom habitats are tolerant of turbidity and sedimentation, slight addition of sediment to the area should not impact survival.

Impacts from Oil-Spill Response Activity

Oil-spill-response activity may also impact sessile benthic features. Booms anchored to the seafloor are sometimes used to control the movement of oil at the water surface. Boom anchors can physically impact sessile benthic organisms, especially when booms are moved around by waves (USDOC, NOAA, 2010d). Vessel anchorage and decontamination stations set up during response efforts may also break or kill live bottoms that have unmapped locations if anchors are set on the habitat. Injury to live bottom habitat as a result of anchor impact may result in long-lasting damage or failed recovery. Effort should be made to keep vessel anchorage areas as far from sensitive benthic features as possible to minimize impact.

Drilling muds comprised primarily of barite may be pumped into a well to stop a blowout. If a "kill" is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath the extruded drilling mud would be buried. Based on stipulations as described in NTL 2009-G39, a well should be far enough away from a Pinnacle feature to prevent extruded drilling muds from smothering sensitive benthic communities. However, if drilling muds were to travel far enough or high enough in the water column to contact a sensitive community, the fluid would smother the existing community. Burial may lead to the elimination of a live bottom community.

Phase 3—Onshore Contact

There would likely be no adverse impacts to live bottom features as a result of the events and the potential impact-producing factors that could occur throughout Phase 3 of a catastrophic spill because the live bottom features are located offshore.

Phase 4—Post-Spill, Long-Term Recovery and Response

Live bottoms exposed to large amounts of resuspended sediments following a catastrophic, subsurface blowout could be subject to sediment suffocation, exposure to resuspended toxic contaminants, and reduced light penetration. The greatest impacts would occur to communities that exist in clear water with very low turbidity, such as the live bottoms off Florida. The consequences of a blowout near one of these features could be long lasting, although the occurrence of a blowout near such sensitive communities is unlikely because of stipulations described in NTL 2009-G39, which distances bottom-disturbing activity from live bottom features. In addition, BOEM conducts case-by-case reviews of submitted plans and pipelines so that sensitive seafloor habitat is avoided. Impacts to a community in more turbid waters, such as those on the Mississippi-Alabama Shelf, would be greatly reduced, as the species are tolerant of suspended sediments, and recovery would occur quicker. Recovery time from sediment exposure would depend on the amount of sediment an organism was exposed to, if an entire population was demolished, and the extent of the loss.

Impacts may also occur from low-level or long-term oil exposure. This type of exposure has the potential to impact live bottom communities, resulting in impaired health. Long-term impacts such as reduced recruitment success, reduced growth, and reduced organism cover as a result of impaired recruitment may occur. Recovery may be fairly rapid from brief, low-level exposures, but it could be much longer if acute concentrations of oil contact organisms. Recovery time would then depend on recruitment from outside populations that were not affected by oiling.

Overall Summary and Conclusion (Phases 1-4)

A catastrophic spill on the continental shelf would have a greater impact on live bottom features than a deepwater spill. Surface oil from a deepwater spill would be weathered and diluted by the time it reaches the surface waters over live bottom features (if it ever reaches them), and it would be unlikely, except in shallow coastal waters, that it would mix to the depth of the live bottoms in concentrations that could cause toxicity. Subsea plumes formed in deep water would not travel onto the continental shelf because deep-sea currents do not travel up a slope.

A catastrophic blowout and spill on the continental shelf has a greater chance to impact live bottom features. If a blowout on the continental shelf occurs close enough to sensitive features, the organisms may be smothered by settling sediment that is displaced by the blowout. The farther a feature is from the blowout, the lower its chance of being covered with settling sediment or sediment upon which oil adhered. The distancing of oil and gas activity from live bottom features helps to prevent heavy sedimentation, as well as features being crushed by a sinking rig.

In most cases, the impacts from oil would be sublethal. Surface oil is not expected to mix to the zone of active growth, and any oil components that do reach that depth would be at sublethal concentrations. Subsea plumes may contact the live bottom features; however, because currents tend to travel around instead of over large seafloor features, the Pinnacle features should be protected from subsea plumes, while lower relief live bottoms may be impacted. The current oil and gas activity in the GOM, however, is distanced from low-relief live bottoms because no live bottom, low-relief blocks have been leased with the current proposed lease sales. Overall impacts of dispersed oil would be similar to subsea plumes. Spill response activity may impact low-relief, live bottom features if they are unmarked on nautical charts and vessels anchor on the features, but it is doubtful that a vessel would anchor on a marked Pinnacle feature.

Overall, a catastrophic spill would have a fairly low probability of impacting live bottom features because the bottom-disturbing activities of oil and gas activities are distanced from live bottom features within the Live Bottom Stipulation blocks, as described in NTL 2009-G39, and because BOEM conducts a case-by-case review of all plans to ensure that activities do not impact these seafloor features. In addition, the Live Bottom Stipulation blocks have not been leased as part of these proposed lease sales, creating farther distance between oil and gas activities and live bottoms. Also, live bottom features are protected by the limited mixing depth of surface oil compared with the depth of the live bottom features, currents sweeping around larger features, and the weathering and dispersion of oil that would occur with distance from the source as it travels toward the features. Low-relief features could have impacts from a blowout as their relief would not divert currents. In addition, the locations of these features are not all known so accidental anchor impacts may result in breakage of the features and possibly destruction. These low-relief features, however, would be protected by the regulated distance of current oil and gas activities, which increases the chance of oil becoming well dispersed before it reaches the features.

B.3.1.7. Topographic Features

The Gulf of Mexico has a series of topographic features (banks or seamounts) on the continental shelf in water depths less than 300 m (984 ft). Topographic features are isolated areas of moderate to high relief that provide habitat for hard bottom communities of high biomass and moderate diversity. These features support prolific algae, invertebrate, and fish communities, and they provide shelter and food for large numbers of commercially and recreationally important fish. There are 37 named topographic features in the Gulf of Mexico with specific BOEM protections, including the Flower Garden Banks. BOEM has created "No Activity Zones" around topographic features in order to protect these habitats from disruption by oil and gas activities. A "No Activity Zone" is a protective perimeter drawn around each feature that is associated with a specific isobath (depth contour) surrounding the feature in which structures, drilling rigs, pipelines, and anchoring are not allowed. These "No Activity Zones" are areas where activity is prohibited based on BOEM's policy. NTL 2009-G39 recommends that drilling should not occur within 152 m (500 ft) of a "No Activity Zone" of a topographic feature.

Potentially sensitive biological features (PSBFs) are features that have moderate to high relief (8 ft [2 m] or higher), provide hard surface for sessile invertebrates, and attract fish, but they are not located within the "No Activity Zone" of topographic features. These features are frequently located near topographic features. No bottom-disturbing activities that may cause impact to these features are permitted.

Phase 1—Initial Event

A blowout from an oil well could result in a catastrophic spill event. A catastrophic blowout would result in released oil rapidly rising to the sea surface because all known reserves in the GOM have specific gravity characteristics that would preclude oil from sinking immediately after release at a blowout site. The oil would surface almost directly over the source location. However, if the oil is ejected under high pressure, micro-droplets of oil may form and become entrained in the water column (Boehm and Fiest, 1982; Adcroft et al., 2010). The upward movement of the oil may be reduced if methane mixed with the oil is dissolved into the water column, reducing the oil's buoyancy and slowing its rise to the surface (Adcroft et al., 2010). Large oil droplets would rise to the sea surface, but smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010; Joint Analysis Group, 2010). Dispersed oil in the water column begins to biodegrade and may flocculate with particulate matter, promoting sinking of the particles. Subsea plumes or sinking oil on particulates may contact topographic features.

A catastrophic blowout outside the well casing and below the seafloor or at the seafloor-water interface could resuspend large quantities of bottom sediments and create a large crater, destroying many organisms within a few hundred meters of the wellhead. Fine sediment could travel up to a few thousand meters before redeposition, negatively impacting a localized area of benthic communities. If a blowout were to occur near a topographic feature, suspended sediment may impact the organisms living on the lower levels of the topographic feature (since water currents flow around the banks rather than traveling uphill).

A catastrophic blowout that occurs above the seabed (at the rig, along the riser between the seafloor and sea surface, or through leak paths on the BOP/wellhead) would not disturb the sediment.

The use of subsea dispersants would increase the exposure of offshore benthic habitats to dispersed oil droplets in the water column, as well as the chemicals used in the dispersants. The use of subsea dispersants is not likely to occur for seafloor blowouts outside the well casing.

Impacts to Topographic Features

Impacts that occur to benthic organisms on topographic features as a result of a blowout would depend on the type of blowout, distance from the blowout, relief of the biological feature, and surrounding physical characteristics of the environment (e.g., turbidity). The NTL 2009-G39 recommends the use of buffers to prevent blowouts in the immediate vicinity of a topographic feature or its associated biota. Much of the oil released from a blowout would rise to the sea surface, therefore minimizing the impact to benthic communities by direct oil exposure. However, small droplets of oil that are entrained in the water column for extended periods of time may migrate into No Activity Zones that surround the topographic feature. In addition, they may come in contact with PSBFs. Although these small oil droplets will not sink themselves, they may attach to suspended particles in the water column and then be deposited on the seafloor (McAuliffe et al., 1975). The resultant long-term impacts, such as reduced recruitment success, reduced growth, and reduced coral cover as a result of impaired recruitment, are discussed in Phase 4 (Post-Spill, Long-Term Recovery and Response). Also, if the blowout were to occur beneath the seabed, suspension and subsequent deposition of disturbed sediment may smother localized areas of benthic communities, possibly including organisms within No Activity Zones or on PSBFs.

Benthic communities on a topographic feature or PSBF exposed to large amounts of resuspended and deposited sediments following a catastrophic, subsurface blowout could be subject to sediment suffocation, exposure to resuspended toxic contaminants, and reduced light availability. Impacts to corals as a result of sedimentation would vary based on coral species, the height to which the coral grows, degree of sedimentation, length of exposure, burial depth, and the coral's ability to clear the sediment. Impacts may range from sublethal effects such as reduced growth, alteration in form, and reduced recruitment and productivity to slower growth or death (Rogers, 1990). Corals may also experience discoloration or bleaching as a result of sediment exposure, although recovery from such exposure may occur within 1 month (Wesseling et al., 1999).

The initial blowout impact would be greatest to communities located in clear waters with little suspended sediment that experience heavy sedimentation as a result of the blowout. Reef-building corals are sensitive to turbidity and may be killed by heavy sedimentation (Rogers, 1990; Rice and Hunter, 1992). However, it is unlikely that reef-building corals would experience heavy sedimentation as a result of a blowout because drilling activity is not allowed near sensitive organisms in the No Activity Zones based on the lease stipulations as described in NTL 2009-G39. The most sensitive organisms are also typically elevated above soft sediments, making them less likely to be buried. The lower levels of topographic banks and the PSBFs, which are generally small features with only a few meters of relief, typically experience turbid conditions. Vigorous bottom currents (often generated by storms) frequently resuspend bottom sediments and bathe these features in turbid waters, which results in sedimentation. As a result, the organisms that live in this environment near the seafloor are those adapted to frequent sedimentation.

Initial impacts would be much less extreme in a turbid environment (Rogers, 1990). For example, the South Texas Banks exist in a relatively turbid environment (the Nepheloid Zone). They generally have lower relief than the farther offshore banks at the shelf edge, may have a sediment cover, and exhibit reduced biota. Sediment from a blowout, if it occurred nearby, may have a reduced impact on these communities compared with an open-water reef community, as these organisms are more tolerant of suspended sediment (Gittings et al., 1992). Many of the organisms that predominate in this community also grow tall enough to withstand the sedimentation that results from their turbid environment or have flexible structures that enable the passive removal of sediments (Gittings et al., 1992).

A portion or the entire rig may sink to the seafloor as a result of a blowout. The benthic features and communities upon which the rig settles would be destroyed or smothered. Encrusting organisms would be crushed by a rig if it lands on a topographic feature or PSBF. A settling rig may suspend sediments, which may smother nearby benthic communities if the sediment is redeposited on sensitive features. The habitats beneath the rig may be permanently lost; however, the rig itself may become an artificial reef upon which epibenthic organisms may settle. The surrounding benthic communities that were smothered by sediment would repopulate from nearby stocks through spawning recruitment and immigration if the hard substrate upon which they live was not physically destroyed.

Phase 2—Offshore Spill

A spill from a shallow-water blowout could impact benthic communities on the continental shelf because of the blowout's proximity to these habitats. The scenario (**Table B-4**) for a catastrophic spill on the continental shelf is assumed to last 2-5 months and to release 30,000 bbl per day. A total volume of 0.9-3.0 MMbbl of South Louisiana midrange paraffinic sweet crude oil could be released, which will float (API° >10). An anticipated 35,000 bbl of dispersant may be applied to the surface waters.

A spill from a deepwater blowout could also impact shelf communities if surface oil is transported to these areas. The scenario (**Table B-4**) for a catastrophic spill in deep water is assumed to last 4-6 months and to release 30,000-60,000 bbl per day. A total volume of 2.7-7.2 MMbbl of South Louisiana midrange paraffinic sweet crude oil will be released, which will float (API° >10). Oil properties may change as it passes up the well and through the water column, and it may become emulsified. An anticipated 33,000 bbl of dispersant may be applied to the surface waters and 16,500 bbl may be applied subsea. Weathering and dilution of the oil will also occur as it travels from its release point. It is unlikely that a subsurface plume from a deepwater blowout would impact shelf communities. The oil is anticipated to remain in deep water and be directed by water currents in the deep water. These currents do not typically transit from deep water up onto the shelf (Pond and Pickard, 1983; Inoue et al., 2008).

Impacts to Topographic Features

Impacts from Surface Oil

Sensitive reef communities flourish on topographic features and PSBFs in the Gulf of Mexico. Their depth below the sea surface helps to protect these habitats from a surface oil spill. Rough seas may mix the oil into subsurface water layers, where it may impact sessile biota. The longer the amount of time the seas are rough, the greater the amount of oil from a surface slick would be mixed into the water column. Measurable amounts of oil have been documented to mix from the surface down to a 10-m (33-ft) water depth, although modeling exercises have indicated such oil may reach a water depth of 20 m (66 ft). At this depth, however, the oil is found at concentrations several orders of magnitude lower than the amount shown to have an effect on corals (Lange, 1985; McAuliffe et al., 1975 and 1981a; Knap et al., 1985). None of the topographic features or PSBFs in the GOM are shallower than 10 m (33 ft), and only the Flower Garden Banks are shallower than 20 m (66 ft). Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA238/246/248 Supplemental EIS.

Impacts from Subsurface Oil

The presence of a subsurface oil plume on the continental shelf from a shallow-water blowout may affect benthic communities on topographic features and PSBFs. A majority of the oil released is expected to rise rapidly to the sea surface above the release point because of the specific gravity characteristics of the oil reserves in the GOM, thus not impacting sensitive benthic communities. If the oil is ejected under high pressure, oil droplets may become entrained in the water column (Boehm and Fiest, 1982; Adcroft et al., 2010). The upward movement of the oil may be reduced if methane mixed with the oil is dissolved into the water column, reducing the oil's buoyancy and slowing its rise to the surface (Adcroft et al., 2010). Large oil droplets would rise to the sea surface, but smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010; Joint Analysis Group, 2010). Dispersed oil in the water column begins to biodegrade and may flocculate with particulate matter, promoting sinking of the particles. Subsurface plumes generated by high-pressure dissolution of oil may come in contact with topographic features and PSBFs. A sustained spill would continuously create surface slicks and possibly subsurface spill plumes. Some of the oil in the water column will become diluted or evaporated over time, reducing any localized transport to the seafloor (Vandermeulen, 1982). In addition, microbial degradation of the oil occurs in the water column so that the oil would be less toxic as it travels from the source (Hazen et al., 2010). However, a sustained spill may result in elevated exposure concentrations to benthic communities if the plume reaches them. The longer the spill takes to stop, the longer the exposure time and higher the exposure concentration may be.

The PSBFs have a greater chance of being impacted by subsea plumes than topographic features because currents tend to sweep around topographic features (Rezak et al., 1983; McGrail, 1982). The lower relief PSBFs may fall in the path of the plume because the feature is not large enough to divert a current. Low-level exposures of corals to oil from a subsea plume may result in chronic or temporary impacts. For example, feeding activity or reproductive ability may be reduced when coral is exposed to low levels of oil; however, impacts may be temporary or unable to be measured over time. Experimental simulations of exposure indicated that normal feeding activity of *Porites porites* and *Madracis asperula* were reduced when exposed to 50 ppm oil (Lewis, 1971). In addition, reefs of *Siderastrea siderea* that were oiled in a spill produced smaller gonads than unoiled reefs, resulting in reproductive stress (Guzmán and Holst, 1993).

Elevated concentrations of oil may be necessary to measure reduced photosynthesis or growth in corals. Photosynthesis of the zooxanthellae in *Diplora strigosa* exposed to approximately 18-20 ppm crude oil for 8 hours was not measurably affected, although other experiments indicate that photosynthesis may be impaired at higher concentrations (Cook and Knap, 1983). Measurable growth of *Diploria strigosa* exposed to oil concentrations up to 50 ppm for 6-24 hours did not show any reduced growth after 1 year (Dodge et al., 1984).

Corals exposed to subsea oil plumes may incorporate petroleum hydrocarbons into their tissue. Records indicate that *Siderastrea siderea*, *Diploria strigosa*, and *Montastrea annularis* accumulate oil from the water column and incorporate petroleum hydrocarbons into their tissues (Burns and Knap, 1989; Knap et al., 1982; Kennedy et al., 1992). Most of the petroleum hydrocarbons are incorporated into the coral tissues, not their mucus (Knap et al., 1982). However, hydrocarbon uptake may also modify lipid ratios of coral (Burns and Knap, 1989). If lipid ratios are modified, mucus synthesis may be impacted, adversely affecting the coral's ability to protect itself from oil through mucus production (Burns and Knap, 1989).

It is unlikely that a subsurface plume from a deepwater blowout would impact shelf communities. The oil is anticipated to remain in deep water and be directed by water currents in the deep water. These currents do not typically transit from deep water up onto the shelf (Pond and Pickard, 1983; Inoue et al., 2008).

Impacts from Dispersed Oil

If dispersants are used at the sea surface, oil may mix into the water column, or if applied subsea, they can travel with currents through the water and may contact or settle on sensitive features. Note that, as indicated above, a deepwater plume would not travel onto the continental shelf, but a plume formed on the continental shelf could impact topographic features and PSBFs. If located near the source, the dispersed oil could be concentrated enough to harm the community. If the oil remains suspended for a longer period of time, it would be more dispersed and exist at lower concentrations. Reports on dispersant usage on surface oil indicate that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a). Dispersant usage also reduces the oil's ability to stick to particles in the water column, minimizing oil adhering to sediments and traveling to the seafloor (McAuliffe et al., 1981a). However, after the *Deepwater Horizon* oil spill, there was the formation of a dense layer of marine snow that aggregated and collected everything that it came in contact with it as it fell through the water column and settled on the seafloor (Passow et al., 2012).

Dispersed oil reaching the topographic features and PSBFs in the Gulf of Mexico would be expected to be at very low concentrations (<1 ppm) (McAuliffe et al., 1981a). Such concentrations would not be life threatening to larval or adult stages at the depth of the features based on experiments conducted with coral. Any dispersed oil in the water column that comes in contact with corals may evoke short-term negative responses by the organisms (Wyers et al., 1986; Cook and Knap, 1983; Dodge et al., 1984).

Reductions in feeding and photosynthesis could occur in coral exposed to dispersed oil. Short-term, sublethal responses of *Diploria strigosa* were reported after exposure to dispersed oil at a concentration of 20 ppm for 24 hours. Although concentrations in this experiment were higher than what is anticipated for dispersed oil at depth, effects exhibited included mesenterial filament extrusion, extreme tissue contraction, tentacle retraction, and localized tissue rupture (Wyers et al., 1986). Normal behavior resumed within 2 hours to 4 days after exposure (Wyers et al., 1986). *Diploria strigosa* exposed to dispersed oil (20:1, oil:dispersant) showed an 85 percent reduction in zooxanthellae photosynthesis after 8 hours of exposure to the mixture (Cook and Knap, 1983). However, the response was short term, as recovery occurred between 5 and 24 hours after exposure and return to clean seawater. Investigations 1 year after *Diploria strigosa* was exposed to concentrations of dispersed oil between 1 and 50 ppm for periods between 6 and 24 hours did not reveal any impacts to growth (Dodge et al., 1984).

Historical studies indicate dispersed oil to be more toxic to coral species than oil or dispersant alone. The greater toxicity may be a result of an increased number of oil droplets caused by the use of dispersant, resulting in greater contact area between oil, dispersant, and water (Elgershuizen and De Kruijf, 1976). The dispersant causes a higher water-soluble amount of oil to contact the cell membranes of the coral (Elgershuizen and De Kruijf, 1976). The mucus produced by coral, however, can protect the organism from oil. Both hard and soft corals have the ability to produce mucus, and mucus production has been shown to increase when corals are exposed to crude oil (Mitchell and Chet, 1975; Ducklow and Mitchell, 1979). Dispersed oil, however, which has very small oil droplets, does not appear to adhere to coral mucus, and larger untreated oil droplets may become trapped by the mucus barrier (Knap, 1987; Wyers et al., 1986). However, entrapment of the larger oil droplets may increase the coral's long-term exposure to oil if the mucus is not shed in a timely manner (Knap, 1987; Bak and Elgershuizen, 1976). Additionally, more recent field studies, using more realistic concentrations of dispersants did not result in the toxicity historically reported (Yender and Michel, 2010).

Although historical studies indicated dispersed oil may be more toxic than untreated oil to corals during exposure experiments, untreated oil may remain in the ecosystem for long periods of time, while dispersed oil does not (Baca et al., 2005; Ward et al., 2003). Twenty years after an experimental oil spill in Panama, oil and impacts from untreated oil were still observed at oil treatment sites, but no oil or impacts were observed at dispersed oil or reference sites (Baca et al., 2005). Long-term recovery of the coral at the dispersed oil site had already occurred as reported in a 10-year monitoring update, and the site was not significantly different from the reference site (Ward et al., 2003).

Impacts from Oil Adhering to Sediments

BOEM's policy, as described in NTL 2009-G39, prevents wells from being placed immediately adjacent to sensitive communities. In the event of a seafloor blowout, however, some oil could be carried to topographic features or PSBFs as a result of oil droplets adhering to suspended particles in the water column. Oiled sediment that settles to the seafloor may affect organisms attached to hard bottom substrates. Impacts may include reduced recruitment success, reduced growth, and reduced coral cover as a result of impaired recruitment. Experiments have shown that the presence of oil on available substrate for larval coral settlement has inhibited larval metamorphosis and larval settlement in the area. An increase in the number of deformed polyps after metamorphosis also took place because of exposure to oil (Kushmaro et al., 1997).

The majority of organisms exposed to sedimented oil are expected to experience low-level concentrations because as the oiled sediments settle to the seafloor they are widely distributed. Coral may also be able to protect itself from low concentrations of sedimented oil that settles from the water column. Coral mucus may not only act as a barrier to protect coral from the oil in the water column, but it has also been shown to aid in the removal of oiled sediment on coral surfaces (Bak and Elgershuizen, 1976). Coral may use a combination of increased mucus production and the action of cilia to rid themselves of oiled sediment (Bak and Elgershuizen, 1976).

Impacts from Oil-Spill-Response Activity

Oil-spill-response activity may also impact sessile benthic features. Booms anchored to the seafloor are sometimes used to control the movement of oil at the water surface. Boom anchors can physically impact corals and other sessile benthic organisms, especially when booms are moved around by waves (USDOC, NOAA, 2010d). Vessel anchorage and decontamination stations set up during response efforts may also break or kill PSBFs if their location is unmapped and anchors are set on the features. Injury to coral reefs as a result of anchor impact may result in long-lasting damage or failed recovery (Rogers and

Garrison, 2001). Effort should be made to keep vessel anchorage areas as far from sensitive benthic features as possible to minimize impact.

Drilling muds comprised primarily of barite may be pumped into a well to stop a blowout. If a “kill” is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath the extruded drilling mud would be buried. Based on stipulations as described in NTL 2009-G39, a well should be far enough away from a topographic feature to prevent extruded drilling muds from smothering sensitive benthic communities. However, if drilling muds were to travel far enough or high enough in the water column to contact a sensitive community, the fluid would smother the existing community. Experiments indicate that corals perish faster when buried beneath drilling mud than when buried beneath carbonate sediments (Thompson, 1980). Burial may lead to the elimination of a live bottom community.

Phase 3—Onshore Contact

There would likely be no adverse impacts to topographic features and PSBFs as a result of the events and the potential impact-producing factors that could occur throughout Phase 3 of a catastrophic spill because the topographic features and PSBFs are located offshore.

Phase 4—Post-Spill, Long-Term Recovery and Response

Topographic features and PSBFs exposed to large amounts of resuspended sediments following a catastrophic, subsurface blowout could be subject to sediment suffocation, exposure to resuspended toxic contaminants, and reduced light penetration. The greatest impacts would occur to communities that exist in clear water with very low turbidity. The consequences of a blowout along, directly on, or near one of these features could be long lasting, although the occurrence of a blowout near such sensitive communities is unlikely because of stipulations described in NTL 2009-G39, which prevents drilling activity near sensitive hard bottom habitats. Impacts to a community in more turbid waters, such as the South Texas Banks, would be greatly reduced, as the species on these features are tolerant of suspended sediments, and recovery would occur quicker.

Impacts may also occur from low-level or long-term oil exposure. This type of exposure has the potential to impact reef communities, resulting in impaired health. Recovery may be fairly rapid from brief, low-level exposures, but it could be much longer with acute concentrations or long-term exposure to oil, such as in observations from Panama where untreated oil remained in the ecosystem for long periods of time, inhibiting coral recovery (Baca et al., 2005; Ward et al., 2003). Recovery time would therefore depend on recruitment from outside populations that were not affected by oiling and residence time of oil in an ecosystem.

Overall Summary and Conclusion (Phases 1-4)

A catastrophic spill on the continental shelf would have a greater impact on topographic features and PSBFs than a deepwater spill. Surface oil from a deepwater spill would be weathered and diluted by the time it reaches the surface waters over topographic features and PSBFs (if it ever reaches them), and it would be unlikely that it would mix to the depth of active growth in concentrations that could cause toxicity. Subsea plumes formed in deepwater would not travel onto the continental shelf because deep-sea currents do not travel up a slope.

A catastrophic blowout and spill on the continental shelf has a greater chance to impact topographic features and PSBFs. If the blowout occurs close enough to sensitive features, the organisms may be smothered by settling sediment that was displaced by the blowout. The farther the feature is from the blowout, the less its chance of being covered with settling sediment or sediment upon which oil adhered. In addition, distancing oil and gas activities from topographic features prevents the settlement of a sinking rig on top of a topographic feature, although it may destroy a PSBF.

In most cases, impacts from oil would be sublethal. Surface oil is not expected to mix to the zone of active growth, and any oil components that do reach that depth would be in sublethal concentrations. Subsea plumes may contact the features; however, because currents tend to travel around, instead of over, topographic features, the topographic features should be protected from subsea plumes, while lower relief PSBFs may be impacted. Overall impacts of dispersed oil would be similar to subsea plumes. Spill response activity should not impact topographic features because it is unlikely that vessels would anchor on the features, but they could anchor on unmapped, lower relief PSBFs.

Overall, a catastrophic spill would have a low probability of impacting topographic features because of the distancing requirements included in leases, as described in NTL 2009-G39, of oil and gas activities from topographic features, the depth of mixing of surface oil compared with the depth of the active growing zone, currents that sweep around the topographic features, and the weathering and dispersion of oil that would occur with distance from the source as it travels toward the features. The PSBFs could have greater impacts from a blowout as oil and gas activities are not as far distanced from them as topographic features; they have a lower relief than topographic features, which would not divert currents; and the locations of these features are not all known so accidental anchor impacts may result in breakage of the features and possibly destruction. The PSBFs would, however, have similar protection as for topographic features from surface oil.

B.3.1.8. Sargassum *Communities*

Pelagic *Sargassum* algae is a floating brown algae that occurs in all parts of the GOM throughout the year. It has a seasonal cycle so that its abundance greatly increases spring through fall, when it is carried by water currents around the south of Florida and then up the east coast (Gower and King, 2011). It occurs in patches, floating on and near the sea surface. Wind and water currents commonly drive it into long lines or windrows; when conditions are turbulent, it becomes more scattered and mixed into the upper water column. A key to understanding impacts to *Sargassum* is that the algae is ubiquitous and occurs in scattered patches in the very top part of the water column. *Sargassum* also provides habitat for pelagic species, including fish, invertebrates, and sea turtles.

Phase 1—Initial Event

During the initial phase of a catastrophic blowout, impacts may include disturbance of sediments, destruction of the drilling rig, release of oil and natural gas (methane), and emergency response efforts. This chapter deals with the immediate effects of a blowout that would be located at least 3 nmi (3.5 mi; 5.6 km) from shore.

Since *Sargassum* is a floating pelagic (open ocean) algae, it would only be affected by impacts that occur in the top-most part of the water column. In deep water (≥ 300 m, 984 ft), sediment disturbed by the blowout would not affect *Sargassum* because the sediment would not reach the surface waters. However, in shallow water, sediment from a blowout could have minor effects on *Sargassum* algae in the immediate vicinity. The sediment would have little effect on the algae itself, producing only slight, temporary silting that could reduce photosynthesis. If the sediment is contaminated with oil, then the oil could have adverse effects on the algae. Depending on the severity of oiling, the algae could be damaged or destroyed; but this would only affect the algae in the local vicinity of the blowout. Sediment and oil would have a more acute effect on the associated invertebrate, fish, and sea turtle community that utilizes the habitat of the *Sargassum*. Impacts to these organisms may include "changes in respiration rate, abrasion and puncturing of structures, reduced feeding, reduced water filtration rates, smothering, delayed or reduced hatching of eggs, reduced larval growth or development, abnormal larval development, or reduced response to physical stimulus" (Anchor Environmental CA, L.P., 2003).

Destruction of the oil drilling rig and associated equipment could have an acute effect on patches of *Sargassum* algae that happen to be caught in the structure (if it sinks) or destroyed by fuel leaks and possible fire on the sea surface. This could destroy local patches of *Sargassum*, but it would have no measurable effect on the *Sargassum* community as a whole.

The release of oil during the initial blowout event would be expected to cover local patches of *Sargassum* algae with oil, destroying the algae and associated organisms. Methane gas may also bathe local patches of algae as it rises through the sea surface; it would have little effect on the algae itself but may poison associated organisms. The initiation of oil and gas release (as defined for this phase) at the site of the blowout event would affect only local patches of *Sargassum*, but it would have no measurable effect on the *Sargassum* community as a whole.

Emergency response activities would have minor impacts to *Sargassum* algae that comes in contact with vessels. This is mostly the simple impingement of the algae on the ships' water intake screens, including water that may be pumped in fire-fighting efforts. This minor and local effect would have no measurable effect on the *Sargassum* community as a whole.

Phase 2—Offshore Spill

During the second phase of a catastrophic blowout, the major impact of concern is the release of oil and methane over time. Response efforts may produce additional minor impacts to *Sargassum*. This chapter deals with the growing effects of a blowout that releases oil and methane into the offshore environment.

Since *Sargassum* is a floating pelagic (open ocean) algae, it would be affected by impacts that occur in the top-most part of the water column. This makes *Sargassum* habitat particularly susceptible to damage from offshore oil spills. Oceanographic processes that concentrate *Sargassum* into mats and rafts would also concentrate toxic substances. Therefore, it may be assumed that *Sargassum* would be found in areas where oil, dispersants, and other chemicals have accumulated following a catastrophic spill. Oil spreads on the sea surface to form extremely thin layers (0.01-0.1 micrometers) that cover large areas (MacDonald et al., 1996). Since *Sargassum* is ubiquitous in surface waters of the GOM, oil spreading on the sea surface can be expected to coincide with floating mats of the algae. The larger the quantity of spill and the longer it flows, the larger the area of sea surface it would cover. A catastrophic spill would cover a large area and result in impacts to a large quantity of *Sargassum* algae. For example, *Macondo* well oil spill covered up to one-third of the northern GOM (McCrea-Strub and Pauly, 2011; USDOC, NMFS, 2011a) and may have affected about one-third of the *Sargassum* algae in the northern GOM at the time.

The severity of oiling to *Sargassum* depends largely on physical conditions. Factors include the quantity of oil at a particular launch point and its physical state, distance from the source, weather conditions, and the possible use of dispersants. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

Obviously, more oil leads to increased oiling, but the physical state of the oil changes as it weathers, biodegrades, dissipates, and emulsifies over time and distance. Storms can mix oil into the water column (expected maximum of 10-20 m [33-66 ft]; Lange, 1985; McAuliffe et al., 1975 and 1981a; Knap et al., 1985; Scarlett et al., 2005; Hemmer et al., 2010; George-Ares and Clark, 2000), possibly increasing its contact with *Sargassum* as it also mixes the *Sargassum* into the water column. However, when storms are not mixing the oil, they are also not mixing the *Sargassum*, so the *Sargassum* would float near the sea surface, just as the oil would. Convergence zones, places in the ocean where strong opposing currents meet, would collect both oil and *Sargassum*. Sea turtles, especially post-hatchlings and juveniles, use these areas for food and cover. Witherington et al. (2012) surveyed sea turtles in the eastern Gulf of Mexico and Atlantic Ocean off Florida and found that 89 percent of the turtles documented were observed within 1 m (3 ft) of floating *Sargassum*. The use of dispersants on surface oil slicks could increase the exposure of *Sargassum* to oil by promoting mixing of oil into the upper few meters of the water column. This also promotes the dispersion of oil, speeding its decline toward low concentrations that would be less toxic. Regardless, any exposure that is enough to cause visible oiling can be expected to have significant detrimental effects on the organisms associated with *Sargassum* and, likely, effects on the *Sargassum* itself. Heavy oiling of *Sargassum* near the source of the spill would destroy the affected algae. Very light exposure far from the oil source may have little effect.

The specific effects of oil on *Sargassum* depend on the severity of oiling. High to moderate levels of oiling would likely cause complete mortality. Low levels of exposure may result in a range of sublethal effects to the algae and its associated community. Powers et al. (2013) suggest that exposure to oil and/or dispersants can result in direct, sublethal, and indirect effects to *Sargassum*, resulting in death or a decrease in *Sargassum*-related ecosystem services. Sublethal responses in organisms associated with *Sargassum* may occur at concentrations as low as 1-10 ppb (Hyland and Schneider, 1976). Rogers (1990) documented impacts such as reduced growth, alteration in form, and reduced recruitment and productivity. Other sublethal impacts may include reduced feeding rates, reduced ability to detect food, erratic movement, ciliary inhibition, tentacle retraction, reduced movement, decreased aggression, and altered respiration (Scarlett et al., 2005; Suchanek, 1993). Embryonic life stages of organisms may experience toxicity at lower levels than the adult stages (Fucik et al., 1995; Suchanek, 1993; Beiras and Saco-Álvarez, 2006; Byrne, 1989). The algae itself would be less sensitive than many of its associates, since the algae produces oils of its own and has a waxy coating that may protect it from physical oiling.

Response efforts aimed at removing oil from the affected area would have minor impacts on *Sargassum* algae as well. Response vessels would impinge a small amount of the algae on their propellers and cooling-water intakes. Cleanup processes such as booming, skimming, and in-situ burning would also trap and destroy patches of *Sargassum*; however, these activities would take place in areas of high concentration of surface oil, where *Sargassum* would likely be destroyed by oil contamination even if the cleanup activity were absent.

Phase 3—Onshore Contact

This third phase of a catastrophic blowout focuses on the approach of oil to the shoreline. This involves the possible oiling of coastal resources including beaches, wetlands, SAV and seagrasses, the shallow seafloor, and any resources drifting in the water column (e.g., *Sargassum*). Response efforts can produce additional serious impacts.

There would likely be little additional impact to pelagic *Sargassum* algae as oil approaches a shoreline. Since both the algae and surface oil approaching shore would be guided by the same forces (wind and water currents), they would likely be already traveling together, with the algae already contaminated. Once it is onshore, the *Sargassum* would die, regardless of oil contamination. *Sargassum* that washes ashore has some value to the ecosystem as it provides food and shelter for some organisms as it decays. This value would be mostly lost if the *Sargassum* is oiled when it reaches shore.

Phase 4—Post-Spill, Long-Term Recovery and Response

The final phase of a catastrophic blowout is the long-term response of the ecosystem and its recovery. Both, the natural rate of recovery and the persistence of oil in natural habitats over time determine the long-term effects. Contaminants biodegrade over time, but they may become sequestered as inert forms (e.g., buried in sediment) until disturbed (by storms) and re-activated, producing renewed impacts.

Sargassum algae has a yearly seasonal cycle of growth and a yearly cycle of migration from the GOM to the western Atlantic. A catastrophic spill could affect a large portion of the annual crop of the algae. A large event, such as the *Macondo* well blowout and spill, could reduce the standing crop of *Sargassum* in the GOM and subsequently in the western Atlantic if it coincided with a period when *Sargassum* distribution was limited to the northwest GOM in an area known to be a nursery area. This could have a cascading effect down current (in the Atlantic) that would stress the cycles of other organisms that depend on the *Sargassum* habitat. However, the effect can be expected to diminish with remoteness from the direct impacts of the spill, i.e., the algae community itself would be most affected, with lesser effects on organisms that utilize the habitat as a nursery, for feeding, as shelter, or other purposes.

While a large spill event could affect a large portion of the standing crop of *Sargassum*, several factors contribute to the quick recovery of the habitat. *Sargassum* algae is predominately found in the open-ocean pelagic habitat. Once the spill event subsides, the pelagic habitat would quickly regain its typically very high water quality. The pelagic habitat far from shore is also far from land-based sources of pollution. Only part of the *Sargassum* stocks would be affected; algae not affected by the spill event would continue to grow normally and repopulate the habitat. Since *Sargassum* has a seasonal cycle of growth in the summer and reduction in the winter, populations in the winter following a catastrophic event may be similar to populations of any other year. Relatively small populations survive each winter, subsequently repopulating the habitat each year. With this pattern, recovery from the effects of a catastrophic event is expected within 1-2 growing seasons.

Overall Summary and Conclusion (Phases 1-4)

Pelagic *Sargassum* algae is one of the most likely habitats to be affected by a catastrophic offshore oil spill; however, because of its ubiquitous distribution and seasonal cycle, recovery is expected within 1-2 years. *Sargassum* algae floats on and near the sea surface and occurs in patches that can be collated into windrows by wind and water currents. Oil from a spill offshore would accumulate in the same waters, making it inevitable that some patches of *Sargassum* would be severely affected.

The initial catastrophic event (Phase 1) could destroy *Sargassum* patches in the immediate vicinity of the accident. Impingement, fire, and the initial concentrated spillage of oil and fuels would destroy local patches. Sediments disturbed by the accident would only affect *Sargassum* if the event occurred in shallow waters.

The duration of the spill event (Phase 2) would have the most effect on floating *Sargassum* algae. Patches of algae within the entire coverage of the oil slick would be subject to severe damage and death. Algae in areas farther from the spill, receiving lower level impacts, may still suffer damage, especially the sensitive invertebrate and fish communities associated with the habitat. Efforts to remove the oil could gather *Sargassum* with the oil, but these algae patches would likely be destroyed by the oil anyway since the collection activities would occur in areas of concentrated oil.

As oil approaches shore (Phase 3), impacts to floating *Sargassum* algae would not increase much, as the algae would likely already be exposed to the oil since wind and water currents drive both the algae and the oil.

The recovery of floating *Sargassum* algae (Phase 4) may occur within 1-2 years because the algae has a yearly cycle of subsidence and re-growth. As long as the nursery grounds are not completely saturated with oil, the pelagic habitat would quickly regain its high level of water quality after the cessation of a spill. Not all of the *Sargassum* habitat would be affected, even by a catastrophic spill; healthy algae would continue to grow and replenish the population. Within 1-2 years, the *Sargassum* algae community may have completely recovered from the impacts of a catastrophic spill.

B.3.1.9. Chemosynthetic Deepwater Benthic Communities

Deepwater benthic communities of the Gulf of Mexico include soft bottom, chemosynthetic, and coral habitats. Deep water, for ecology in the GOM, is defined as water depths over 300 m (984 ft) because chemosynthetic communities and *Lophelia* coral habitats have not been found in waters shallower than these depths. The possible impacts to these benthic communities from a catastrophic blowout depend on the location and the nature of the event.

Phase 1—Initial Event

During the initial phase of a catastrophic blowout, impacts may include the disturbance of sediments, destruction of the drilling rig, release of oil and natural gas (methane), and emergency response efforts. This chapter deals with the immediate effects of a blowout located at least 3 nmi (3.5 mi; 5.6 km) from shore.

A catastrophic blowout outside the well casing and below the seafloor or at the seafloor-water interface could resuspend large quantities of bottom sediments and create a large crater, destroying many organisms within a few hundred meters of the wellhead. Some fine sediment could travel up to a few thousand meters before redeposition, negatively impacting a localized area of benthic communities. If a blowout were to occur close enough to a chemosynthetic community, suspended sediment may impact the organisms. Restrictions described in NTL 2009-G40 require drilling to be removed at least 610 m (2,000 ft) from possible chemosynthetic communities. During a blowout, sediment may become contaminated with oil and subsequently deposit that oil down-current from the source. The highest concentrations of contamination would be nearest the well, and concentrations would diminish with distance. A catastrophic blowout that occurs above the seabed (at the rig, along the riser between the seafloor and sea surface, or through leak paths on the BOP/wellhead) would not disturb the sediment.

Destruction of the oil drilling rig and associated equipment could have an acute effect on any chemosynthetic communities caught under the direct impact of the equipment when it falls to the seafloor. However, the restrictions described in NTL 2009-G40 require drilling locations to be 610 m (2,000 ft) from any possible indications of chemosynthetic communities, reducing the possibility that a rig would settle directly on sensitive habitat.

A catastrophic blowout would likely result in released oil rapidly rising to the sea surface because typical reserves in the GOM have specific gravity characteristics that are much lighter than water (refer to **Chapter 3.2.1.3** of this Supplemental EIS; Environment Canada, 2011; Trudel et al., 2001). The oil would surface almost directly over the source location. Oil floating to the sea surface would be effectively removed from affecting chemosynthetic communities on the seafloor. Even oil treated with chemical dispersants on the sea surface would not be expected to have widespread impacts to deepwater communities. Reports on dispersant usage on surface oil indicate that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a; Lewis and Aurand, 1997). Lubchenco et al. (2010) reports that chemically dispersed surface oil from the *Macondo* well blowout and oil spill remained in the top 6 m (20 ft) of the water column where it mixed with surrounding waters and biodegraded. However, if the oil is ejected under high pressure, micro-droplets of oil may form and become entrained in the water column (Boehm and Fiest, 1982; Adcroft et al., 2010). Upward movement of oil may also be reduced if methane mixed with the oil is dissolved into the water column, reducing the buoyancy of the oil/gas stream (Adcroft et al., 2010). Large oil droplets would rise to the sea surface, but smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010; Joint Analysis Group, 2010). It is unlikely that any chemosynthetic community would be affected by the initial stage of a catastrophic event due to the required separation of drilling activities from sensitive habitats, because released oil would rise rapidly to a level above the habitat, and because surface oil would not mix to the depths of the chemosynthetic communities. The required separation distance would also allow for a subsea plume to mix with the surrounding water and become diluted before it reached a deepwater community.

Phase 2—Offshore Spill

During the second phase of a catastrophic blowout, the major impact of concern is the release of oil and methane over time. Response efforts may produce additional impacts. This chapter deals with the growing effects of a blowout that releases oil and methane into the offshore environment.

A spill resulting from a catastrophic blowout in deep water has the potential to impact offshore benthic communities; however, it is not likely that deepwater benthic communities would be affected by a spill from a shallow-water blowout. Although subsurface plumes can be generated when oil is ejected under high pressure or dispersants are used subsea, a majority of the oil originating from a seafloor blowout in deep water is expected to rise rapidly to the sea surface. Upward movement of the oil may also be reduced if methane mixed with the oil is dissolved into the water (Adcroft et al., 2010). A sustained spill would continuously create surface slicks and possibly subsurface spill plumes. Some of the oil in the water column would become diluted over time, reducing transport to the seafloor (Vandermeulen, 1982). Concentrations of dispersed and dissolved oil in the *Macondo* well blowout and spill subsea plume were reported to be in the part per million range or less and were generally lower away from the water's surface and away from the wellhead (Adcroft et al., 2010; Haddad and Murawski, 2010; Joint Analysis Group, 2010; Lubchenco et al., 2010). In addition, microbial degradation of oil occurs in the water column rendering oil less toxic when it contacts the seafloor (Hazen et al., 2010). Oil can precipitate to the seafloor by adhering to other particles, much like rainfall (Kingston et al., 1995; International Tanker Owners Pollution Federation Limited, 2011). Oil would also reach the seafloor through planktonic consumption and associated excretion, which is distributed over the seafloor (International Tanker Owners Pollution Federation Limited, 2011). These mechanisms would result in a wide distribution of small amounts of oil. Throughout these processes, oil would be biodegraded from bacterial action, which would continue on the seafloor, resulting in scattered microhabitats with an enriched carbon environment (Hazen et al., 2010).

A sustained spill may result in elevated exposure concentrations to chemosynthetic features if a subsea oil plume contacts them directly. Dispersed oil is mixed with water, and its movement is then dictated by water currents and the physical, chemical, and biodegradation pathways. BOEM's policy (refer to NTL 2009-G39) prevents wells from being placed immediately adjacent to sensitive communities; however, in the event of a seafloor blowout, some oil could be carried to chemosynthetic communities by subsea plumes. Impacts may include reduced recruitment success, reduced growth, and reduced biological cover as a result of impaired recruitment. Concentrated oil plumes reaching chemosynthetic communities could cause oiling of organisms, resulting in the death of entire populations on localized sensitive habitats. The longer the oil remains suspended in the water column, the more dispersed, less concentrated, and more biodegraded it would become. Depending on how long oil remained suspended in the water column, it may be thoroughly degraded by biological action before contacting the seafloor (Hazen et al., 2010; Valentine et al., 2010). Biodegradation rates in cold, deepwater environments are not well understood at this time. In general, potential impacts to chemosynthetic communities would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. While a few patch habitats may be affected, the Gulfwide ecosystem of chemosynthetic communities would be expected to suffer no significant effects.

Drilling muds comprised primarily of barite may be pumped into a well to stop a blowout. If a "kill" is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath the extruded drilling mud would be buried. Based on stipulations as described in NTL 2009-G40, a well should be far enough away from a chemosynthetic community to prevent extruded drilling muds from smothering sensitive benthic communities.

Phase 3—Onshore Contact

The third phase of a catastrophic blowout focuses on the approach of oil to the shoreline. This involves the possible oiling of coastal resources including beaches, wetlands, SAV and seagrasses, the shallow seafloor, and any resources drifting in the water column. Response efforts can produce additional serious impacts. There would be no additional adverse impacts to chemosynthetic communities in deep water as a result of the events and the potential impact-producing factors that could occur throughout Phase 3 of a catastrophic spill because the chemosynthetic communities are located offshore in deep water (>300 m, 610 ft).

Phase 4— Post-Spill, Long-Term Recovery and Response

The final phase of a catastrophic blowout is the long-term response of the ecosystem and its recovery. Both the natural rate of recovery and the persistence of oil in natural habitats over time determine what long-term effects may occur. Contaminants degrade over time but may become sequestered as inert forms (e.g., buried in sediment) until disturbed and reactivated, producing renewed impacts.

If oil is ejected under high pressure or dispersants are applied at the source near the seafloor, oil would mix into the water column, be carried by underwater currents, and eventually contact the seafloor in some form, either concentrated (near the source) or dispersed and decayed (farther from the source). The oil could then impact patches of chemosynthetic community habitat in its path. The farther the dispersed oil travels, the more diluted it would become as it mixes with surrounding water. Chemosynthetic communities located at more than 610 m (2,000 ft) away from a blowout could experience minor impacts from suspended sediments that travel with currents, although the sediment concentration would be diluted with distance from the well. Studies indicate that periods of decades to hundreds of years are required to reestablish a seep community once it has disappeared (depending on the community type) (Powell, 1995; Fisher, 1995). There is evidence that substantial impacts on these communities could permanently prevent reestablishment, particularly if hard substrate required for recolonization is buried by resuspended sediments from a blowout. A catastrophic spill combined with the application of dispersant has the potential to cause devastating effects on local patches of habitat in the path of subsea plumes where they physically contact the seafloor. Sublethal effects are possible for communities that receive a lower level of impact. Examples of these effects could include temporary lack of feeding, expenditure of energy to remove the oil, loss of gametes and reproductive delays, and loss of tissue mass. Oil plumes that remain in the water column for longer periods would disperse and decay, having only minimal effect. Depending on how long it remains in the water column, oil may be thoroughly degraded by biological action before contacting the seafloor. Water currents can carry a plume to contact the seafloor directly but a more likely scenario would be for oil to adhere to other particles and precipitate to the seafloor, much like rainfall (Kingston et al., 1995; International Tanker Owners Pollution Federation Limited, 2011). Oil would also reach the seafloor through planktonic consumption and associated excretion, which is distributed over the seafloor (International Tanker Owners Pollution Federation Limited, 2011). These mechanisms would result in a wide distribution of small amounts of oil (or oil by-products). This oil would be in the process of biodegradation from bacterial action, which would continue on the seafloor, resulting in scattered microhabitats with an enriched carbon environment (Hazen et al., 2010). Habitats directly under the path of the oil plume as it disperses and "rains" down to the seafloor may experience minor effects, but since the oil would be deposited in a widely scattered and decayed state, little effect is anticipated.

Overall Summary and Conclusion (Phases 1-4)

Chemosynthetic communities would potentially be subject to detrimental effects from a catastrophic seafloor blowout. Sediment and oiled sediment from the initial event (Phase 1) are not likely to reach chemosynthetic communities in heavy amounts because of requirements described in NTL 2009-G40. Fine sediment from a blowout may reach the location of sensitive habitats, producing sublethal effects. The initial accident could result in the drilling rig and equipment falling on a sensitive seafloor habitat if the structure travels more than 610 m (2,000 ft) from the well site.

The ongoing spill event (Phase 2) would have the most effect on chemosynthetic communities. Chemosynthetic communities are at risk from subsea oil plumes that could directly contact localized patches of sensitive habitat. Oil plumes reaching chemosynthetic communities could cause oiling of organisms, resulting in the death of entire populations on localized sensitive habitats. However, potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. The more likely scenario would be exposure to widely dispersed, biodegraded particles that "rain" down from a passing oil plume. While a few patch habitats may be affected, the Gulfwide ecosystem of chemosynthetic communities would be expected to suffer no significant effects.

As oil approaches shore (Phase 3), there would be no additional adverse impacts to chemosynthetic communities because the chemosynthetic communities are located offshore in deep water (>300 m; 610 ft).

The recovery of chemosynthetic communities (Phase 4) depends on the severity of initial impacts. A catastrophic spill combined with the application of dispersant has the potential to cause devastating effects on local patches of habitat in the path of subsea plumes where they physically contact the seafloor. Studies indicate that periods from decades to hundreds of years are required to reestablish a seep community once it has disappeared (depending on the community type) (Powell, 1995; Fisher, 1995). The burial of hard substrate could permanently prevent recovery. Sublethal effects are possible for communities that receive a lower level of impact. Examples of these effects could include temporary lack of feeding, expenditure of energy to remove the oil, loss of gametes and reproductive delays, and loss of tissue mass. However, most chemosynthetic community habitats are expected to experience no impacts from a catastrophic seafloor blowout because of the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution.

B.3.1.10. Nonchemosynthetic Deepwater Benthic Communities

Deepwater benthic communities of the Gulf of Mexico include soft bottom, chemosynthetic, and live bottom communities (mostly deepwater coral communities). Deep water, for ecology in the GOM, is defined as water depths over 300 m (984 ft) because nonchemosynthetic communities and *Lophelia* coral habitats have not been found in waters shallower than these depths. The possible impacts to nonchemosynthetic deepwater benthic communities from a catastrophic blowout depend on the location and the nature of the event.

Phase 1—Initial Event

During the initial phase of a catastrophic blowout, impacts may include disturbance of sediments, destruction of the drilling rig, release of oil and natural gas (methane), and emergency response efforts. This phase deals with the immediate effects of a blowout located at least 3 nmi (3.5 mi; 5.6 km) from shore.

A catastrophic blowout outside the well casing and below the seafloor or at the seafloor-water interface could resuspend large quantities of bottom sediments and create a large crater, destroying many organisms within a few hundred meters of the wellhead. A blowout that occurs outside the well casing can rapidly deposit 30 cm (12 in) or more of sediment within a few hundred meters and may smother much of the soft bottom community in a localized area. Some fine sediment could travel up to a few thousand meters before redeposition, negatively impacting a localized area of benthic communities. Many of the organisms on soft bottoms live within the sediment and have the ability to migrate upward in response to burial by sedimentation. In situations where soft bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft bottom substrate would be expected over a relatively short period of time for all size ranges of organisms, in a matter of days for bacteria and probably less than 1 year for most macrofauna and megafauna species. Recolonization could take longer for areas affected by direct contact of concentrated oil.

If a blowout were to occur close enough to a sensitive deepwater live bottom community, suspended sediment may impact the organisms. Restrictions described in NTL 2009-G40 require drilling to be removed at least 610 m (2,000 ft) from possible live bottom communities. During a blowout, suspended sediment may become contaminated with oil and subsequently deposit that oil down-current from the source. The highest concentrations of contamination would be nearest the well, and concentrations would diminish with distance. A catastrophic blowout that occurs above the seabed (at the rig, along the riser between the seafloor and sea surface, or through leak paths on the BOP/wellhead) would not disturb the sediment.

Destruction of the oil drilling rig and associated equipment could have an acute effect on any nonchemosynthetic communities caught under the direct impact of the equipment when it falls to the seafloor. However, the restrictions described in NTL 2009-G40 require drilling locations to be 610 m (2,000 ft) from any possible indications of sensitive live bottom communities, reducing the possibility that a rig would settle directly on sensitive habitat.

A catastrophic blowout would likely result in released oil rapidly rising to the sea surface because typical reserves in the GOM have specific gravity characteristics that are much lighter than water (refer to **Chapter 3.2.1.3** of this Supplemental EIS; Environment Canada, 2011; Trudel et al., 2001). The oil would surface almost directly over the source location. Oil floating to the sea surface would be effectively removed from affecting nonchemosynthetic communities on the seafloor. Even oil treated with chemical dispersants on the sea surface would not be expected to have widespread impacts to deepwater communities. Reports on dispersant usage on surface oil indicate that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a; Lewis and Aurand, 1997). Lubchenco et al. (2010) report that chemically dispersed surface oil from the *Macondo* well blowout and oil spill remained in the top 6 m (20 ft) of the water column where it mixed with surrounding waters and biodegraded. However, if the oil is ejected under high pressure, micro-droplets of oil may form and become entrained in the water column (Boehm and Fiest, 1982; Adcroft et al., 2010). Upward movement of the oil may also be reduced if methane mixed with the oil is dissolved into the water column, reducing the buoyancy of the oil/gas stream (Adcroft et al., 2010). Large oil droplets would rise to the sea surface, but smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010; Joint Analysis Group, 2010). It is unlikely that any deepwater live bottom community would be affected by the initial stage of a catastrophic event due to the required separation of drilling activities from sensitive habitats, because released oil would rapidly rise to a level above the habitat, and because surface oil would not mix to the depths of such communities. The required separation distance would also allow for a subsea plume to mix with the surrounding water and become diluted before it reached a deepwater community.

Phase 2—Offshore Spill

During the second phase of a catastrophic blowout, the major impact of concern is the release of oil and methane over time. Response efforts may produce additional impacts. This chapter deals with the growing effects of a blowout that releases oil and methane into the offshore environment.

A spill resulting from a catastrophic blowout in deep water has the potential to impact offshore benthic communities; however, it is not likely that deepwater benthic communities would be affected by a spill from a shallow-water blowout. Although subsurface plumes can be generated when oil is ejected under high pressure or when dispersants are used subsea, a majority of the oil originating from a seafloor blowout in deep water is expected to rise rapidly to the sea surface. Oil and chemical spills that originate at the sea surface are not considered to be a potential source of measurable impacts on deepwater, live bottom communities because of the water depths at which these communities are located. Oil spills at the surface would tend not to sink, and the risk of weathered components of a surface slick reaching the benthos in any measurable concentration would be very small. Surface oil also could not physically mix to depths of deepwater communities under natural conditions (Lange, 1985; McAuliffe et al., 1975 and 1981a; Tkalich and Chan, 2002).

Upward movement of the oil may also be reduced if methane mixed with the oil is dissolved into the water (Adcroft et al., 2010). A sustained spill would continuously create surface slicks and possibly subsurface spill plumes. One deepwater coral site at a depth of 1,370 m (4,495 ft) has been reported as severely damaged following the *Macondo* well blowout and oil spill. The site is in Mississippi Canyon

Block 294, 11 km (7 mi) southwest of the spill location. The site includes hard substrate supporting coral in an area approximately 10 x 12 m (33 x 39 ft) (White et al., 2012). The published results document damage to the coral community. Forty-three coral colonies were analyzed via close-up imagery: 86 percent exhibited signs of impact; 46 percent exhibited impact to at least 50 percent of the colony; and 23 percent of the colonies sustained impact to more than 90 percent of the colony (White et al., 2012). Many other associated invertebrates also exhibited signs of stress. This appears to be an exceptional case, since the numerous other communities investigated since the spill remained healthy (White et al., 2012). Some of the oil in the water column would become diluted over time, reducing transport to the seafloor (Vandermeulen, 1982). Concentrations of dispersed and dissolved oil in the *Macondo* well blowout and spill subsea plume were reported to be in the part per million range or less and were generally lower away from the water's surface and away from the wellhead (Adcroft et al., 2010; Haddad and Murawski, 2010; Joint Analysis Group, 2010; Lubchenco et al., 2010). In addition, microbial degradation of the oil occurs in the water, rendering the oil less toxic when it contacts the seafloor (Hazen et al., 2010). However, as evidenced by the report of White et al. (2012), subsea plumes can still retain toxic concentrations over a distance of at least 11 km (7 mi). Oil in a plume can adhere to other particles and precipitate to the seafloor, much like rainfall (Kingston et al., 1995; International Tanker Owners Pollution Federation Limited, 2011). Oil also would reach the seafloor through consumption by plankton, with excretion distributed over the seafloor (International Tanker Owners Pollution Federation Limited, 2011). These mechanisms would result in a wide distribution of small amounts of oil. Throughout these processes, oil would be biodegraded from bacterial action, which would continue on the seafloor, resulting in scattered microhabitats with an enriched carbon environment (Hazen et al., 2010).

A sustained spill may result in elevated exposure concentrations to live bottom features if a subsea oil plume contacts them directly. Dispersed oil is mixed with water, and its movement is then dictated by water currents and the physical, chemical, and biological degradation pathways. BOEM's policy (refer to NTL 2009-G40) prevents wells from being placed immediately adjacent to sensitive communities; however, in the event of a seafloor blowout, some oil could be carried to live bottom communities by subsea plumes. Impacts may include reduced recruitment success, reduced growth, and reduced biological cover as a result of impaired recruitment. Concentrated oil plumes reaching live bottom communities could cause oiling of organisms, resulting in the death of entire populations on localized sensitive habitats. The longer the oil remains suspended in the water column the more dispersed, less concentrated, and more degraded it would become. Depending on how long oil remained suspended in the water column, it may be thoroughly degraded by biological action before contacting the seafloor (Hazen et al., 2010; Valentine et al., 2010). Biodegradation rates in cold, deepwater environments are not well understood at this time. In general, the potential impacts to deepwater live bottom communities would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. While a few patch habitats may be affected, the Gulfwide ecosystem of deepwater live bottom communities would be expected to suffer no significant effects.

Drilling muds comprised primarily of barite may be pumped into a well to stop a blowout. If a "kill" is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath the extruded drilling mud would be buried. Based on stipulations as described in NTL 2009-G40, a well should be far enough away from sensitive live bottom communities to prevent extruded drilling muds from smothering them.

Phase 3—Onshore Contact

The third phase of a catastrophic blowout focuses on the approach of oil to the shoreline. This involves the possible oiling of coastal resources including beaches, wetlands, SAV and seagrasses, the shallow seafloor, and any resources drifting in the water column. Response efforts can produce additional serious impacts. There would be no adverse impacts to nonchemosynthetic benthic communities in deep water as a result of the events and the potential impact-producing factors that could occur throughout Phase 3 of a catastrophic spill because the communities are located offshore in deep water (>300 m; 610 ft).

Phase 4—Post-Spill, Long-Term Recovery and Response

The final phase of a catastrophic blowout is the long-term response of the ecosystem and its recovery. Both the natural rate of recovery and the persistence of oil in natural habitats over time determine what long-term effects may occur. Contaminants degrade over time, but they may become sequestered as inert forms (e.g., buried in sediment) until disturbed and re-activated, producing renewed impacts.

Although deepwater coral and other live bottom communities often live in close association with hydrocarbon seeps (since the carbonate substrate is precipitated by chemosynthetic communities), this does not mean they are necessarily tolerant to the effects of oil contamination. Natural seepage is very constant and at very low rates as compared with the potential volume of oil released from a catastrophic event (blowout or pipeline rupture). In addition, live bottom organisms, such as *Lophelia pertusa*, inhabit areas around the perimeter of seeps and sites where hydrocarbon seepage has reduced its flow or stopped. Typical Gulf of Mexico oil is light and floats rapidly to the surface rather than being carried horizontally across benthic communities by water currents (Johansen et al., 2001; MacDonald et al., 1995; Trudel et al., 2001). So, although deepwater live bottom communities are found near oil seeps, they are not typically exposed to concentrated oil.

If oil is ejected under high pressure or dispersants are applied at the source near the seafloor, oil would mix into the water column, be carried by underwater currents, and eventually contact the seafloor in some form, either concentrated (near the source) or dispersed and decayed (farther from the source). The oil could then impact patches of live bottom community habitat in its path. The farther the dispersed oil travels, the more diluted it would become as it mixes with surrounding water. Sensitive live bottom communities located at more than 610 m (2,000 ft) away from a blowout could experience minor impacts from suspended sediments that travel with currents, although the sediment concentration would be diluted with distance from the well.

There have been no experiments showing the response of deepwater corals to oil exposure. Experiments with shallow tropical corals indicate that corals have a high tolerance to oil exposure. The mucus layers on coral resist penetration of oil and slough off the contaminant. Longer exposure times and areas of tissue where oil adheres to the coral are more likely to result in tissue damage and death of polyps. Corals with branching growth forms appear to be more susceptible to damage from oil exposure (Shigenaka, 2001). The most common deepwater coral, *Lophelia pertusa*, is a branching species. Tests with shallow tropical gorgonians indicate relatively low toxic effects to the coral (Cohen et al., 1977), suggesting deepwater gorgonians may have a similar response. Depending on the level of exposure, the response of deepwater coral to oil from a catastrophic spill would vary. Exposure to widely dispersed oil adhering to organic detritus and partially degraded by bacteria may be expected to result in little effect. Direct contact with plumes of relatively fresh dispersed oil droplets in the vicinity of the incident could cause the death of affected coral polyps through exposure and potential feeding on oil droplets by polyps. Median levels of exposure to dispersed oil in a partly degraded condition may result in effects similar to those of shallow tropical corals, with often no discernible effects other than temporary contraction and some sloughing. The health of corals may be degraded by the necessary expenditure of energy as the corals respond to oiling (Shigenaka, 2001). Communities exposed to more concentrated oil may experience detrimental effects, including death of affected organisms, tissue damage, lack of growth, interruption of reproductive cycles, and loss of gametes. Many invertebrates associated with deepwater coral communities, particularly the crustaceans, would likely be more susceptible to damage from oil exposure. The recolonization of severely damaged or destroyed communities could take years or decades. Burial of hard substrate could permanently prevent recovery. However, because of the scarcity of deepwater hard bottoms, their comparatively low surface area, and the distancing requirements set by BOEM in NTL 2009-G40, it is unlikely that a sensitive habitat would be located adjacent to a seafloor blowout or that concentrated oil would contact the site.

A catastrophic spill combined with the application of dispersant has the potential to cause devastating effects on local patches of habitat in the path of subsea plumes where they physically contact the seafloor. Sublethal effects are possible for communities that receive a lower level of impact. Examples of these effects could include temporary lack of feeding, expenditure of energy to remove the oil, loss of gametes and reproductive delays, and loss of tissue mass. Oil plumes that remain in the water column for longer periods would disperse and decay, having only minimal effect. Depending on how long it remains in the water column, oil may be thoroughly degraded by biological action before contacting the seafloor. Water currents can carry a plume to contact the seafloor directly, but a more likely scenario would be for oil to adhere to other particles and precipitate to the seafloor, much like rainfall (Kingston et al., 1995; International Tanker Owners Pollution Federation Limited, 2011). Oil also would reach the seafloor through consumption by plankton with excretion distributed over the seafloor (International Tanker Owners Pollution Federation Limited, 2011). These mechanisms would result in a wide distribution of small amounts of oil (or oil by-products). This oil would be in the process of biodegradation from bacterial action, which would continue on the seafloor, resulting in scattered microhabitats with an enriched carbon environment (Hazen et al., 2010). Habitats directly under the path of the oil plume as it disperses and "rains" down to the seafloor may experience minor effects, but since the oil would be deposited in a widely scattered and decayed state, little effect is anticipated.

Overall Summary and Conclusion (Phases 1-4)

Nonchemosynthetic communities would potentially be subject to detrimental effects from a catastrophic seafloor blowout. Sediment and oiled sediment from the initial event (Phase 1) are not likely to reach sensitive live bottom communities in heavy amounts because of requirements described in NTL 2009-G40. Fine sediment from a blowout may reach the location of sensitive habitats, producing sublethal effects. The initial accident could result in the drilling rig and equipment falling on a sensitive seafloor habitat if the structure travels more than 610 m (2,000 ft) from the well site.

The ongoing spill event (Phase 2) would have the most effect on nonchemosynthetic communities. Deepwater live bottom communities are at risk from subsea oil plumes that could directly contact localized patches of sensitive habitat. Oil plumes reaching live bottom communities could cause oiling of organisms, resulting in the death of entire populations on localized sensitive habitats. However, the potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. The more likely result would be exposure to widely dispersed, biodegraded particles that "rain" down from a passing oil plume. While a few patch habitats may be affected, the Gulfwide ecosystem of live bottom communities would be expected to suffer no significant effects.

As oil approaches shore (Phase 3), there would be no adverse impacts to nonchemosynthetic communities because the communities are located offshore in deep water (>300 m; 610 ft).

The recovery of nonchemosynthetic communities (Phase 4) depends on the severity of initial impacts. A catastrophic spill combined with the application of dispersant has the potential to cause devastating effects on local patches of sensitive habitat in the path of subsea plumes where they physically contact the seafloor. The recolonization of severely damaged or destroyed communities could take years or decades. Burial of hard substrate could permanently prevent recovery. Sublethal effects are possible for communities that receive a lower level of impact. Examples of these effects could include temporary lack of feeding, expenditure of energy to remove the oil, loss of gametes and reproductive delays, and loss of tissue mass. However, most live bottom community habitats are expected to experience no impacts from a catastrophic seafloor blowout because of the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution.

B.3.1.11. Soft Bottom Benthic Communities

The seafloor on the continental shelf in the Gulf of Mexico consists primarily of muddy to sandy sediments. Benthic organisms found on the seafloor include infauna (animals that live in the substrate, including mostly burrowing worms, crustaceans, and mollusks) and epifauna (animals that live on or are attached to the substrate; mostly crustaceans, as well as echinoderms, mollusks, hydroids, sponges, soft and hard corals, and demersal fishes). Infauna is comprised of meiofauna, small organisms (63-500 μm) that live among the grains of sediment; and macroinfauna, slightly larger organisms (>0.5 mm; 0.02 in) that live in the sediment (Dames and Moore, Inc., 1979). Shrimp and demersal fish are closely associated with the benthic community. The most abundant organisms on the continental shelf are the deposit-feeding polychaetes. The slope and deep sea consist of vast areas of primarily fine sediments that support benthic communities with lower densities and biomass but higher diversity than the continental shelf (Rowe and Kennicutt, 2001).

Phase 1—Initial Event

A blowout from an oil well could result in a catastrophic spill event. A catastrophic blowout would result in released oil rapidly rising to the sea surface because all known reserves in the GOM have specific gravity characteristics that would preclude oil from sinking immediately after release at a blowout site. The oil would surface almost directly over the source location. However, if the oil is ejected under high pressure, micro-droplets of oil may form and become entrained in the water column (Boehm and Fiest, 1982; Adcroft et al., 2010). The upward movement of the oil may be reduced if methane mixed with the oil is dissolved into the water column, reducing the oil's buoyancy (Adcroft et al., 2010). Large oil droplets would rise to the sea surface, but smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010; Joint Analysis Group, 2010). Dispersed oil in the water column begins to biodegrade and may flocculate with particulate matter, promoting sinking of the particles. Subsea plumes or sinking oil on particulates may contact portions of the seafloor.

A catastrophic blowout outside the well casing and below the seafloor or at the seafloor-water interface could resuspend large quantities of bottom sediments and create a large crater, destroying many organisms within a few hundred meters of the wellhead. Some fine sediment could travel up to a few thousand meters before redeposition, negatively impacting a localized area of benthic communities. The localized seafloor habitat around which a seafloor blowout occurs would be impacted by suspended and redeposited sediment.

A catastrophic blowout that occurs above the seabed (at the rig, along the riser between the seafloor and sea surface, or through leak paths on the BOP/wellhead) would not disturb the sediment.

The use of subsea dispersants would increase the exposure of offshore benthic habitats to dispersed oil droplets in the water column, as well as the chemicals used in the dispersants. The use of subsea dispersants is not likely to occur for seafloor blowouts outside the well casing.

Impacts to Soft Bottom Benthic Communities

Impacts that occur to benthic organisms as a result of a blowout would depend on the type of blowout and their distance from the blowout. Also, if the blowout were to occur beneath the seabed, soft sediment habitat would be destroyed by the formation of a crater, and the suspension and subsequent deposition of disturbed sediment would smother localized areas of benthic communities. A blowout that occurs outside the well casing can rapidly deposit 30 cm (12 in) or more of sediment within a few hundred meters and may smother much of the soft bottom community in a localized area. Benthic communities exposed to large amounts of resuspended and deposited sediments following a catastrophic, subsurface blowout could be subject to smothering, sediment suffocation, and exposure to resuspended toxic contaminants. Impacts to organisms as a result of sedimentation would vary based on species tolerance, degree of sedimentation, length of exposure, burial depth, and vertical migration ability through sediment.

A portion or the entire rig may sink to the seafloor as a result of a blowout. The benthic features and communities upon which the rig settles would be destroyed or smothered. A settling rig may suspend sediments, which may smother nearby benthic communities. The habitats beneath the rig may be permanently lost; however, the rig itself may become an artificial reef upon which epibenthic organisms may settle. The surrounding benthic communities that were smothered by sediment would repopulate from nearby stocks through spawning recruitment and immigration if the hard substrate upon which they live was not physically destroyed.

Phase 2—Offshore Spill

A spill from a shallow-water blowout could impact benthic communities on the continental shelf. The scenario (**Table B-4**) for a catastrophic spill on the continental shelf is assumed to last 2-5 months and to release 30,000 bbl per day. A total volume of 0.9-3.0 MMbbl of South Louisiana midrange paraffinic sweet crude oil could be released, which would float (API° >10). An anticipated 35,000 bbl of dispersant may be applied to the surface waters.

A spill from a deepwater blowout could also impact shelf communities and deepwater communities. The scenario (**Table B-4**) for a catastrophic spill in deep water is assumed to last 4-6 months and to release 30,000-60,000 bbl per day. A total volume of 2.7-7.2 MMbbl of South Louisiana midrange paraffinic sweet crude oil could be released, which would float (API° >10). Oil properties may change as it passes up the well and through the water column, and it may become emulsified. An anticipated 33,000 bbl of dispersant may be applied to the surface waters and 16,500 bbl may be applied subsea. Weathering and dilution of the oil would also occur as it travels from its launch point. It is unlikely that a subsurface plume from a deepwater blowout would impact shelf communities. The oil is anticipated to remain in deep water and be directed by water currents in the deep water. These currents do not typically transit from deep water up onto the shelf (Pond and Pickard, 1983; Inoue et al., 2008).

Impacts to Soft Bottom Benthic Communities

Impacts from Surface Oil

Surface oil slicks can spread over a large area; however, the majority of the slick is comprised of a very thin surface layer of oil moved by winds and currents (Lewis and Aurand, 1997). The potential of surface oil slicks to affect benthic habitats is limited by its ability to mix into the water column. Soft bottom benthic communities below 10-m (33-ft) water depth are protected from surface oil because of its lack of ability to mix with water (Lange, 1985; McAuliffe et al., 1975 and 1981a; Tkalich and Chan, 2002). Benthic organisms would not become physically coated or smothered by surface oil. However, if this surface oil makes its way into the water column through physical mixing, the use of dispersants, or the sedimenting to particles in the water column, benthic communities may be impacted. These scenarios are discussed in later sections.

Disturbance of the sea surface by storms can mix surface oil into the water column, but the effects are generally limited to the upper 10-20 m (33-66 ft) (Lange, 1985; McAuliffe et al., 1975 and 1981a; Tkalich and Chan, 2002). Therefore, soft bottom benthic communities located in shallow water have the potential to be fouled by oil that is floating on shallow water and mixes to the depth of the seafloor. Nearshore oil deposits that occur in sheltered areas, such as bays, may remain in the sediment and impact organisms for long periods. Oil in nearshore sediments was found in high concentrations 8 years following the *Exxon Valdez* spill (Dean and Jewett, 2001). Benthic communities located in deeper water would not be impacted by oil physically mixed into the water column. However, if dispersants are used, they would enable oil to mix into the water column and possibly impact organisms in deeper water. Dispersants are discussed later in this chapter. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

Impacts from Subsurface Oil

The presence of a subsurface oil plume on the continental shelf from a shallow-water blowout may affect soft bottom benthic communities. A majority of the oil released is expected to rise rapidly to the sea surface above the launch point because of the specific gravity characteristics of the oil reserves in the GOM, thus not directly sinking to the seafloor and smothering benthic communities. If the oil is ejected under high pressure, oil droplets may become entrained in the water column (Boehm and Fiest, 1982; Adcroft et al., 2010). The upward movement of the oil may be reduced if methane mixed with the oil is dissolved into the water column, reducing the oil's buoyancy (Adcroft et al., 2010). Large oil droplets would rise to the sea surface, but smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010; Joint Analysis Group, 2010). Dispersed oil in the water column begins to biodegrade and may flocculate with particulate matter, promoting sinking of the particles. Subsurface plumes generated by high-pressure dissolution of oil may come in contact with portions of the seafloor as it travels from the source. A sustained spill would continuously create surface slicks and possibly subsurface plumes. Some of the oil in the water column will become diluted or evaporated over time, reducing any localized transport to the seafloor (Vandermeulen, 1982). In addition, microbial degradation of the oil occurs in the water column so that the oil would be less toxic as it travels from the source (Hazen et al., 2010). However, a sustained spill may result in elevated exposure concentrations to benthic communities if the plume reaches them. The longer the spill takes to stop, the longer the exposure time and higher the exposure concentration may be.

Soft bottom infaunal communities that come into direct contact with oil may experience sublethal and/or lethal effects. The greatest effects of oil exposure would occur close to the well and impacts would decrease with distance. A subsurface plume that contacts the seafloor may result in acute toxicity. The water accommodated fraction (WAF) or water soluble fraction (WSF) of oil that dissolves in water may be the most toxic to organisms, especially larvae and embryos in the water column or at the water sediment interface. Lethal effects for marine invertebrates have been reported at exposures between 0.10 ppm to 100 ppm WSF of oil (Suchanek, 1993). The WSF of petroleum hydrocarbons was reportedly highly toxic to the embryos of oysters and sea urchins, while sediment containing weathered fuel was not toxic to the same species (Beiras and Saco-Álvarez, 2006). Quahog clam embryos and larvae also experienced toxicity and deformation of several different crude oils at WSF concentrations between 0.10 ppm and 10 ppm (Byrne and Calder, 1977). An experiment indicated that the WSF of No. 2 fuel oil at a concentration of 5 ppm disrupted the cellular development of 270 out of 300 test organisms within 3 hours of exposure (Byrne, 1989). After 48 hours exposure, all of the test organisms died and the 48-hour LC_{50} (lethal concentration for 50% of the test population) was calculated to be 0.59 ppm (Byrne, 1989). Another experiment indicated that a WSF of 0.6 ppm and greater of No. 2 fuel oil depressed respiration, reduced mobility of sperm, interfered with cell fertilization and embryonic cleavage, and retarded larval development of sand dollar eggs (Nicol et al., 1977). Experiments that exposed sea urchin embryos to 10-30 ppm WSF of diesel oil for 15-45 days resulted in defective embryonic development and nonviable offspring (Vashchenko, 1980). Therefore, any dissolved petroleum hydrocarbon constituents that reach larval benthic organisms may cause acute toxicity and other developmental effects to this life stage. The WAF and WSF, however, should be considered “worst-case scenario” values as they are based on a closed system at equilibrium with the contaminant and, due to its size and complexity, the GOM will not reach equilibrium with released oil.

Oil in the water column may impact pelagic eggs and larvae of invertebrates. Toxicity tests indicated that eggs of many species were killed by diesel oil in seawater, and in general, the smaller eggs died earlier (Chia, 1973). Bivalve fertilization and sperm fertility were depressed with exposure to crude oil (Renzoni, 1975). The WSF of crude oil was also highly toxic to gametes, embryos, and larvae of bivalves (Renzoni, 1975). Oil concentrations of 0.1 and 1 ppm caused a decrease in fertilization, development of embryos, survival or larvae, and larval growth in the bivalves *Crassostrea virginica* and *Mulinia lateralis* (Renzoni, 1975). Another experiment, however, calculated the LC_{50} for a 6-hour exposure of the gametes, eggs, and larvae of three bivalves (*Crassostrea angulata*, *Crassostrea gigas*, and *Mytilus galloprovincialis*) to be 1,000 ppm oil and 1,000 ppm oil plus dispersant (Renzoni, 1973). Toxicity varies widely among species and oil types.

Sublethal responses of marine invertebrates may result in population level changes (Suchanek, 1993). Such sublethal responses may occur at concentrations as low as 1-10 ppb (Hyland and Schneider, 1976). Sublethal impacts may include reduced feeding rates, reduced ability to detect food, ciliary inhibition, reduced movement, decreased aggression, and altered respiration (Suchanek, 1993).

The farther a subsea plume travels, the more physical and biological changes occur to the oil before it reaches benthic organisms. Oil would become diluted as it physically mixes with the surrounding water, and significant evaporation occurs from surface slicks. The most toxic compounds of oil are lost within the first 24 hours of a spill, leaving the heavier, less toxic compounds in the system (Ganning et al., 1984). An even greater component of the lighter fuel oils dissipates through evaporation. Water currents could carry a plume to contact the seafloor directly, but a likely scenario would be for the oil to adhere to other particles and precipitate to the seafloor, much like rainfall (International Tanker Owners Pollution Federation Limited, 2011; Kingston et al., 1995). Oil also would reach the seafloor through consumption by plankton, with excretion distributed over the seafloor (International Tanker Owners Pollution Federation Limited, 2011). The longer and farther a subsea plume travels in the sea, the more dilute the oil would be (Vandermeulen, 1982; Tkalich and Chan, 2002). In addition, microbial degradation of the oil occurs in the water column, reducing toxicity (Hazen et al., 2010; McAuliffe et al., 1981b). The oil would move in the direction of prevailing currents (S.L. Ross Environmental Research Ltd., 1997) and, although the oil would weather with the distance it travels, low levels of oil transported in subsea plumes would impact benthic communities. These mechanisms would result in a wide distribution of small amounts of oil. This oil would be in the process of biodegradation from bacterial action, which would continue on the seafloor, resulting in scattered microhabitats with an enriched carbon environment (Hazen et al., 2010).

Localized areas of lethal effects would be recolonized by populations from neighboring soft bottom substrate once the oil in the sediment has been sufficiently reduced to a level able to support marine life (Sanders et al., 1980; Lu and Wu, 2006; Ganning et al., 1984; Gómez Gesteira and Dauvin, 2000; Dean and Jewett, 2001). This initial recolonization process may be fairly rapid, but full recovery may take up to 10 years depending on the species present, substrate in the area, toxicity of oil spilled, concentration and dispersion of oil spilled, and other localized environmental factors that may affect recruitment (Kingston et al., 1995; Gómez Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982). Opportunistic species would take advantage of the barren sediment, repopulating impacted areas first. These species may occur within the first recruitment cycle of the surrounding populations or from species immigration from surrounding stocks and may maintain a stronghold in the area until community succession begins (Rhodes and Germano, 1982; Sanders et al., 1980).

It is unlikely that a subsurface plume from a deepwater blowout would impact shelf communities. The oil is anticipated to remain in deep water and be directed by water currents in the deep water. These currents do not typically transit from deep water up onto the shelf (Pond and Pickard, 1983; Inoue et al., 2008). However, the impacts to deepwater soft bottom benthic communities as a result of a blowout would similar to those on the continental shelf.

Impacts from Dispersed Oil

If dispersants are used at the sea surface, oil may mix into the water column, and if they are applied subsea, dispersed oil can travel with currents and contact the seafloor. Chemically dispersed oil from a surface slick is not anticipated to result in lethal exposures to organisms on the seafloor. The chemical dispersion of oil may increase the weathering process and allow surface oil to be diluted by greater amounts of water. Reports on dispersant usage on surface plumes indicate that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981a). Dispersant usage also reduces the oil's ability to stick to particles in the water column, minimizing oiled sediments from traveling to the seafloor (McAuliffe et al., 1981a). If applied, subsea benthic communities near the source could be exposed to dispersed oil that is concentrated enough to harm the benthic community. If the oil remains suspended for a longer period of time, it would be more dispersed and less concentrated. There is very little information on the behavior of subsea dispersants.

Dispersed oil used at the sea surface reaching the benthic communities in the Gulf of Mexico would be expected to be at very low concentrations (<1 ppm) (McAuliffe et al., 1981a). Such concentrations would not be life threatening to larval or adult stages on the seafloor based on experiments conducted with benthic and pelagic species (Scarlett et al., 2005; Hemmer et al., 2010; George-Ares and Clark, 2000). Any dispersed oil in the water column that comes in contact with benthic communities may evoke short-term negative responses by the organisms (Scarlett et al., 2005). Sublethal responses may include reduced feeding rate, erratic movement, and tentacle retraction (Scarlett et al., 2005). In addition, although dispersants were detected in waters off Louisiana after the *Macondo* well blowout and spill, they were below USEPA benchmarks of chronic toxicity (OSAT, 2010). The rapid dilution of dispersants in the water column and lack of transport to the seafloor was also reported by OSAT (2010) where no dispersants were detected in sediment on the Gulf floor following the *Macondo* well blowout and spill.

Impacts from Oil Adhering to Sediments

Oiled sediment that settles to the seafloor may affect organisms upon which it settles. The greatest impacts would be closest to the well where organisms may become smothered by particles and exposed to hydrocarbons. High concentrations of suspended sediment in the water column may lend to large quantities of oiled sediment (Moore, 1976). Deposition of oiled sediment is anticipated to begin occurring within days or weeks of the spill and may be fairly deep near the source (Ganning et al., 1984; Gómez Gesteira and Dauvin, 2000). Oily sand layers were reported to be 10 cm (4 in) deep on the seafloor near the *Amoco Cadiz* spill (Gómez Gesteira and Dauvin, 2000). Acute toxicity may occur near the spill, eliminating benthic communities.

Much of the oil released from a blowout would rise to the sea surface, therefore dispersing the released oil before it makes its way back to the seafloor through flocculation, by deposition from organisms that pass it through their systems with food, and by adhering to sinking particles in the water column. In addition, small droplets of oil that are entrained in the water column for extended periods of time may migrate a great distance from their point of release and may attach to suspended particles in the water column and later be deposited on the seafloor (McAuliffe et al., 1975). The majority of organisms exposed to oiled sediment are anticipated to experience low-level concentrations because as the oiled sediments settle to the seafloor they are widely dispersed. Impacts may include reduced recruitment success, reduced growth, and altered community composition as a result of impaired recruitment.

Impacts from Oil-Spill-Response Activity

Continued localized disturbance of soft bottom communities may occur during oil-spill response efforts. Anchors used to set booms to contain oil or vessel anchors in decontamination zones may affect infaunal communities in the response activity zone. Infaunal communities may be altered in the anchor scar, and deposition of suspended sediment may result from the setting and resetting of anchors. The disturbed benthic community should begin to repopulate from the surrounding communities during their next recruitment event and through immigration of organisms from surrounding stocks. Any decontamination activities, such as cleaning vessel hulls of oil, may also contaminate the sediments of the decontamination zone, as some oil may settle to the seabed, impacting the underlying benthic community.

If a blowout occurs at the seafloor, drilling muds (primarily barite) may be pumped into a well in order to "kill" it. If a kill is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath heavy layers of the extruded drilling mud would be buried. Base fluids of drilling muds are designed to be low in toxicity and biodegradable in offshore marine sediments (Neff et al., 2000). However, as bacteria and fungi break down the drilling fluids, the sediments may temporarily become anoxic (Neff et al., 2000). Benthic macrofaunal recovery would occur when drilling mud concentrations are reduced to levels that enable the sediment to become re-oxygenated (Neff et al., 2000). Complete community recovery from drilling mud exposure may take 3-5 years, although microbial degradation of drilling fluids, followed by an influx of tolerant opportunistic species, is anticipated to begin almost immediately (Neff et al., 2000). In addition, the extruded mud may bury hydrocarbons from the well, making them a hazard to the infaunal species and difficult to remove.

Phase 3—Onshore Contact

There would likely be no additional adverse impacts to soft bottom benthic communities as a result of events and the potential impact producing factors that could occur throughout Phase 3 of a catastrophic spill because these soft bottom benthic communities are located below the water line.

Phase 4—Post-Spill, Long-Term Recovery and Response

Benthic Habitats

In situations where soft bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft bottom substrate would be expected over a relatively short period. Recolonization would begin with recruitment and immigration of opportunistic species from surrounding stocks. More complex communities would follow with time. Repopulation could take longer for areas affected by direct oil contact in higher concentrations.

Many of the organisms on soft bottoms live within the sediment and have the ability to migrate upward in response to burial by sedimentation. A blowout that occurs outside the well casing can rapidly deposit 30 cm (12 in) or more of sediment within a few hundred meters and may smother much of the soft bottom community in a localized area. In situations where soft bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft bottom substrate would be expected over a relatively short period of time for all size ranges of organisms, in a matter of days for bacteria, and probably less than 1 year for most macrofauna and megafauna species. Recolonization could take longer for areas affected by direct contact of concentrated oil. Initial repopulation from nearby stocks of pioneering species, such as tube-dwelling polychaetes or oligochaetes, may begin with the next recruitment event (Rhodes and Germano, 1982). Full recovery would follow as later stages of successional communities overtake the pioneering species (Rhodes and Germano, 1982). The time it takes to reach a climax community may vary depending on the species and degree of impact. Full benthic community recovery may take years to decades if the benthic habitat is heavily oiled (Gómez Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982). A slow recovery rate would result in a community with reduced biological diversity and possibly a lesser food value for predatory species.

Localized areas of lethal effects would be recolonized by populations from neighboring soft bottom substrate once the oil in the sediment has been sufficiently reduced to a level able to support marine life (Sanders et al., 1980; Lu and Wu, 2006; Ganning et al., 1984; Gómez Gesteira and Dauvin, 2000; Dean and Jewett, 2001). This initial recolonization process may be fairly rapid, but full recovery may take up to 10 years depending on the species present, substrate in the area, toxicity of oil spilled, concentration and dispersion of oil spilled, and other localized environmental factors that may affect recruitment (Kingston et al., 1995; Gómez Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982). Opportunistic species would take advantage of the barren sediment, repopulating impacted areas first. These species may occur within the first recruitment cycle of the surrounding populations or from species immigration from surrounding stocks and may maintain a stronghold in the area until community succession begins (Rhodes and Germano, 1982; Sanders et al., 1980).

Overall Summary and Conclusion (Phases 1-4)

A catastrophic blowout and spill would have the greatest impact on the soft bottom benthic communities in the immediate vicinity of the spill. Turbidity, sedimentation, and oiling would be heaviest closest to the source, and decrease with distance from the source. Complete loss of benthic populations may occur with heavy sedimentation and oil deposition. Farther from the well, a less thick layer of sediment would be deposited and oil would be dispersed from the source, resulting in sublethal impacts. The recovery of benthic populations would begin with recruitment from surrounding areas fairly rapidly.

B.3.1.12. Marine Mammals

Phase 1—Initial Event

Phase 1 of the scenario is the initiation of a catastrophic blowout event. Impacts, response, and intervention depend on the spatial location of the blowout and leak. For this analysis, an explosion and subsequent fire are assumed to occur. If a blowout associated with the drilling of a single exploratory well occurs, this could result in a fire that would burn for 1 or 2 days. If a blowout occurs on a production platform, other wells could feed the fire, allowing it to burn for over a month. The drilling rig or platform may sink. If the blowout occurs in shallow water, the sinking rig or platform may land in the immediate vicinity; if the blowout occurs in deep water, the rig or platform could land a great distance away, beyond avoidance zones. Regardless of water depth, the immediate response would be from search and rescue vessels and aircraft, such as USCG cutters, helicopters, and rescue planes, and firefighting vessels. Potential impacts reflect the explosion, subsequent fire for 1-30 days, and the sinking of the platform in the immediate vicinity and up to 1 mi (1.6 km) from the well.

Depending on the type of blowout, the pressure waves and noise generated by the eruption of gases and fluids would likely be significant enough to harass, injure, or kill marine mammals, depending on the proximity of the animal to the blowout. A high concentration of response vessels could result in harassment or displacement of individuals and could place marine mammals at a greater risk of vessel collisions, which would likely cause fatal injuries.

The scenarios for each phase, including cleanup methods, can be found in **Table B-4**.

Phase 2—Offshore Spill

Phase 2 of the analysis focuses on the spill and response in Federal and State offshore waters. A catastrophic spill would likely spread hundreds of square miles. Also, the oil slick may break into several smaller slicks, depending on local wind patterns that drive the surface currents in the spill area. Potential impacts reflect spill and response in Federal and State offshore waters. Season and temperature variations can result in different resource impacts due to variations in oil persistence and oil and dispersant toxicity and because of differences in potential exposure of the resources throughout various life cycle stages.

An oil spill and related spill-response activities can impact marine mammals that come into contact with oil and remediation efforts. The marine mammals' exposure to hydrocarbons persisting in the sea may result in sublethal impacts (e.g., decreased health, reproductive fitness, longevity, and increased vulnerability to disease), some soft tissue irritation, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. More detail on the potential range of effects to marine mammals from contact with spilled oil can be found in Geraci and St. Aubin (1990). The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on marine mammals. For example, it is expected that the large amount of chemical dispersants being used on the oil may act as an irritant on the marine mammals' tissues and sensitive membranes.

The increased human presence after an oil spill (e.g., vessels) would likely add to changes in behavior and/or distribution, thereby potentially stressing marine mammals further and perhaps making them more vulnerable to various physiologic and toxic effects. In addition, the large number of response vessels could place marine mammals at a greater risk of vessel collisions, which could cause fatal injuries.

The potential biological removal (PBR) level is defined by the Marine Mammal Protection Act as the maximum number of animals, not including natural mortalities that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. However, in the Gulf of Mexico, many marine mammal species have unknown PBRs or PBRs with outdated abundance estimates, which are considered undetermined. The biological significance of any injury or mortality would depend, in part, on the size and reproductive rates of the affected stocks, as well as the number, age, and size of the marine mammals affected.

The *Deepwater Horizon* explosion, oil spill, and response in Mississippi Canyon Block 252 (including use of dispersants) have impacted marine mammals that have come into contact with oil and remediation efforts. According to the "Dolphins and Whales of the Gulf of Mexico Oil Spill" website, within the designated *Deepwater Horizon* explosion, oil spill, and response area, 171 marine mammals (89% of which were deceased) were reported. This includes 155 bottlenose dolphins, 2 Kogia spp., 2 melon-headed whales, 6 spinner dolphins, 2 sperm whales, and 4 unknown species (USDOC, NMFS, 2011b). All marine mammals collected either alive or dead were found east of the Louisiana/Texas border through Apalachicola, Florida. The highest concentration of strandings has occurred off eastern Louisiana, Mississippi, and Alabama, with a significantly lesser number off western Louisiana and western Florida (USDOC, NMFS, 2011b). Due to known low-detection rates of carcasses, it is possible that the number of deaths of marine mammals is underestimated (Williams et al., 2011). It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that many, some, or no carcasses collected were related to the *Deepwater Horizon* explosion, oil spill, and response. These stranding numbers are significantly greater than reported in past years; though it should be further noted that stranding coverage (i.e., effort in collecting strategies) has increased considerably due to the *Deepwater Horizon* explosion, oil spill, and response. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

Phase 3—Onshore Contact

Phase 3 focuses on nearshore (e.g., inside bays and in close proximity to shoreline) and onshore spill response and oil initially reaching the shoreline during the spill event or while the oil still persists in the offshore environment once the spillage has been stopped. It is likely that Phases 2 and 3 could occur simultaneously. The duration of the initial shoreline oiling is measured from initial shoreline contact until the well is capped or killed and the remaining oil dissipates offshore. Re-oiling of already cleaned or previously impacted areas could be expected during Phase 3. In addition to the response described in Phase 2, nearshore and onshore efforts would be introduced in Phase 3 as oil entered coastal areas and contacted shore. Potential impacts reflect the spill and response in very shallow coastal waters and once along the shoreline. Season and temperature variations can result in different resource impacts due to variations in oil persistence and oil and dispersant toxicity and because of differences in potential exposure of the resources throughout various life cycle stages.

A high-volume oil spill lasting 90 days could directly impact over 22 species of marine mammals. As a spill enters coastal waters, manatees and coastal and estuarine dolphins would be the most likely to be affected.

Manatees primarily inhabit open coastal (shallow nearshore) areas and estuaries, and they are also found far up in freshwater tributaries. Florida manatees have been divided into four distinct regional management units: the Atlantic Coast Unit that occupies the east coast of Florida, including the Florida Keys and the lower St. Johns River north of Palatka, Florida; the Southwest Unit that occurs from Pasco County, Florida, south to Whitewater Bay in Monroe County, Florida; the Upper St. Johns River Unit that occurs in the river south of Palatka, Florida; and the Northwest Unit that occupies the Florida Panhandle south to Hernando County, Florida (Waring et al., 2012). Manatees from the Northwest Unit are more likely to be seen in the northern GOM, and they can be found as far west as Texas; however, most sightings are in the eastern GOM (Fertl et al., 2005).

During warmer months (June to September), manatees are common along the Gulf Coast of Florida from the Everglades National Park northward to the Suwannee River in northwestern Florida. Although manatees are less common farther westward, manatee sightings increase during the warmer summer months. Winter habitat use is primarily influenced by water temperature as animals congregate at natural (springs) and/or artificial (power plant outflows) warm water sources (Alves-Stanley et al., 2010). Manatees are infrequently found as far west as Texas (Powell and Rathbun, 1984; Rathbun et al., 1990; Schiro et al., 1998). If a catastrophic oil spill reached the Florida coast when manatees were in or near coastal waters, the spill could have population-level effects.

It is possible that manatees could occur in coastal areas where vessels traveling to and from the spill site could affect them. A manatee present where there is vessel traffic could be injured or killed by a vessel strike (Wright et al., 1995). Due to the large number of vessels responding to a catastrophic spill both in coastal waters and traveling through coastal waters to the offshore site, manatees would have an increased risk of collisions with boats. Vessel strikes are the primary cause of death of manatees.

The best available count of Florida manatees is 4,824 animals, based on a January 2014 aerial survey of warm water refuges (Florida Fish and Wildlife Conservation Commission, 2014a). By February 2014, there were 114 manatee carcasses collected in Florida, 20 of these animals died of human causes (Florida Fish and Wildlife Conservation Commission, 2014b). Human causes included water control structures, entanglement in and ingestion of marine debris, entrapment in pipes/culverts, and collisions with watercraft. Seventy percent of the manatees that died of human causes were killed by watercraft (Florida Fish and Wildlife Conservation Commission, 2014b). Therefore, if a catastrophic spill and response vessel traffic occurred near manatee habitats in the eastern Gulf of Mexico, population-level impacts could occur because the possibility exists for the number of mortalities to exceed the potential biological removal.

There have been no experimental studies and only a few observations suggesting that oil impacts have harmed any manatees (St. Aubin and Lounsbury, 1990). Types of impacts to manatees and dugongs from contact with oil include (1) asphyxiation because of inhalation of hydrocarbons, (2) acute poisoning because of contact with fresh oil, (3) lowering of tolerance to other stress because of the incorporation of sublethal amounts of petroleum components into body tissues, (4) nutritional stress through damage to food sources, and (5) inflammation or infection and difficulty eating because of oil sticking to the sensory hairs around their mouths (Preen, 1989, in Sadiq and McCain, 1993; Australian Maritime Safety Authority, 2003). For a population whose environment is already under great pressure, even a localized incident could be significant (St. Aubin and Lounsbury, 1990). Spilled oil might affect the quality or availability of aquatic vegetation, including seagrasses, upon which manatees feed.

Bottlenose dolphins were the most affected species of marine mammals from the *Deepwater Horizon* explosion, oil spill, and response. Bottlenose dolphins can be found throughout coastal waters in the Gulf of Mexico. Like manatees, dolphins could be affected, possibly to population level, by a catastrophic oil spill if it reaches the coast (as well as affecting them in the open ocean), through direct contact, inhalation, ingestion, and stress, as well as through collisions with cleanup vessels.

Phase 4—Post-Spill, Long-Term Recovery and Response

Phase 4 focuses on long term recovery once the well has been capped and the spill has stopped. During the final phase of a catastrophic blowout and spill, it is presumed that the well has been capped or killed and cleanup activities are concluding. While it is assumed that the majority of spilled oil would be dissipated offshore within 1-2 months (depending on season and temperature) of stopping the flow, oil has the potential to persist in the environment long after a spill event and has been detected in sediment 30 years after a spill. On sandy beaches, oil can sink deep into the sediments. In tidal flats and salt marshes, oil may seep into the muddy bottoms. Potential impacts reflect long term persistence of oil in the environment and residual and long term clean-up efforts.

Even after the spill is stopped, oilings or deaths of marine mammals would still likely occur because of oil and dispersants persisting in the water, past marine mammal/oil or dispersant interactions, and ingestion of contaminated prey. The animals' exposure to hydrocarbons persisting in the sea may result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) and some soft tissue irritation, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil and/or tar, and temporary displacement from preferred habitats or migration routes. A catastrophic oil spill could lead to increased mortalities, resulting in potential population-level effects for some species/populations (USDOC, NMFS, 2010a).

On December 13, 2010, NMFS declared an unusual mortality event (UME) for cetaceans (whales and dolphins) in the Gulf of Mexico. An UME is defined under the Marine Mammal Protect Act as a “stranding that is unexpected, involves a significant die-off of any marine mammal population, and demands immediate response.” Evidence of the UME was first noted by NMFS as early as February 1, 2010, before the *Deepwater Horizon* explosion, oil spill, and response. As of December 14, 2014, a total of 1,295 cetaceans (6% stranded alive and 94% stranded dead) have stranded since the start of the UME, with a vast majority of these strandings between Franklin County, Florida, and the Louisiana/Texas border. After the initial response phase ended, there were nine dolphins killed during a fish-related scientific study and one dolphin killed incidental to trawl relocation for a dredging project. More detail on the UME can be found on NMFS’s website (USDOC, NMFS, 2014).

On May 9, 2012, NOAA declared an UME for bottlenose dolphins in five Texas counties. The cause of this UME is unknown and cannot be attributed directly to the *Deepwater Horizon* explosion, oil spill, and response. The strandings were coincident with a harmful algal bloom of *Karenia brevis* that started in September 2011 in southern Texas, but researchers have not determined that was the cause of the event. The UME lasted from November 2011-March 2012, when 126 bottlenose dolphins stranded in Aransas, Calhoun, Kleberg, Galveston, and Brazoria Counties in Texas. Of the 126 animals stranded, only 4 were found alive. Preliminary findings included infection in the lung, poor body condition, discoloration of the teeth, and in four animals, a black/grey, thick mud-like substance in the stomachs was found. Currently, there are no red tide blooms occurring in the region, and stranding rates have returned to normal levels (USDOC, NMFS, 2013).

Overall Summary and Conclusion (Phases 1-4)

Accidental events related to a WPA proposed action have the potential to have adverse, but not significant impacts to marine mammal populations in the GOM. Accidental blowouts, oil spills, and spill-response activities may impact marine mammals in the GOM. Characteristics of impacts (i.e., acute vs. chronic impacts) depend on the magnitude, frequency, location, and date of accidents; characteristics of spilled oil; spill-response capabilities and timing; and various meteorological and hydrological factors.

B.3.1.13. Sea Turtles

Phase 1—Initial Event

Phase 1 of the scenario is the initiation of a catastrophic blowout incident. Impacts, response, and intervention depend on the spatial location of the blowout and leak. For this analysis, an explosion and subsequent fire are assumed to occur. If a blowout associated with the drilling of a single exploratory well occurs, this could result in a fire that would burn for 1-2 days. If a blowout occurs on a production platform, other wells could feed the fire, allowing it to burn for over a month. The drilling rig or platform may sink. If the blowout occurs in shallow water, the sinking rig or platform may land in the immediate vicinity; if the blowout occurs in deep water, the rig or platform could land a great distance away, beyond avoidance zones. Regardless of water depth, the immediate response would be from search and rescue vessels and aircraft, such as USCG cutters, helicopters, and rescue planes, and firefighting vessels. Potential impacts reflect the explosion, subsequent fire for 1-30 days, and the sinking of the platform in the immediate vicinity and up to 1 mi (1.6 km) from the well.

Five species of sea turtles are found in the waters of the Gulf of Mexico: green, leatherback, hawksbill, Kemp’s ridley, and loggerhead. All species are protected under the Endangered Species Act (ESA), and all are listed as endangered except the loggerhead turtle, which is listed as threatened. Depending on the type of blowout, an eruption of gases and fluids may generate significant pressure waves and noise that may harass, injure, or kill sea turtles, depending on their proximity to the accident. A high concentration of response vessels could place sea turtles at a greater risk of fatal injuries from vessel collisions. All sea turtle species and life stages are vulnerable to the harmful effects of oil through direct contact or by fouling of their habitats and prey.

Further, mitigation by burning puts turtles at risk because they tend to be gathered up in the corralling process necessary to concentrate the oil in preparation for the burning. Trained observers should be required during any mitigation efforts that include burning. The scenarios for each phase, including cleanup methods, can be found in **Table B-4**.

Phase 2—Offshore Spill

Phase 2 of the analysis focuses on the spill and response in Federal and State offshore waters. A catastrophic spill would likely spread hundreds of square miles. Also, the oil slick may break into several smaller slicks, depending on local wind patterns that drive the surface currents in the spill area. Potential impacts reflect spill and response in Federal and State offshore waters. Season and temperature variations can result in different resource impacts due to variations in oil persistence and oil and dispersant toxicity and because of differences in potential exposure of the resources throughout various life cycle stages.

Sea turtles are more likely to be affected by a catastrophic spill in shallow water than in deep water because not all sea turtles occupy a deepwater habitat. For example, Kemp's ridley sea turtles are unlikely to be in water depths of 160 ft (49 m) or greater. Hawksbill sea turtles are commonly associated with coral reefs, ledges, caves, rocky outcrops, and high energy shoals. Green sea turtles are commonly found in coastal benthic feeding grounds, although they may also be found in the convergence zones of the open ocean. Convergence zones are areas that also may collect oil. Leatherback sea turtles are commonly pelagic and are the sea turtle species most likely to be affected by a deepwater oil spill. As the spilled oil moves toward land, additional species of sea turtles are more likely to be affected.

The *Deepwater Horizon* explosion, oil spill, and response in Mississippi Canyon Block (including use of dispersants) have impacted sea turtles that have come into contact with oil and remediation efforts. For the latest available information on oiled or affected sea turtles documented in the area, refer to NMFS's "Sea Turtles and the Gulf of Mexico Oil Spill" website (USDOC, NMFS, 2011c).

According to this NMFS website, 1,146 sea turtles have been collected (537 alive, 609 deceased) as of February 15, 2011. Of these, 201 were greens, 16 hawksbills, 809 Kemp's ridleys, 88 loggerheads, and the remaining 32 unknown (USDOC, NMFS, 2011c). Individuals were documented either through strandings or directed offshore captures. Due to low detection rates of carcasses in prior events, it is possible that the number of deaths of sea turtles is underestimated (Epperly et al., 1996). It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the *Deepwater Horizon* explosion, oil spill, and response. Over the last 2 years, NOAA has documented increased numbers of sea turtle strandings in the northern GOM. Many of the stranded turtles were reported from Mississippi and Alabama waters, and very few showed signs of external oiling (believed to be related to the *Deepwater Horizon* explosion, oil spill, and response). Necropsy results from many of the stranded turtles indicate mortality due to forced submergence, which is commonly associated with fishery interactions. In May 2012, NMFS published the Draft EIS to reduce incidental bycatch and mortality of sea turtles in the southeastern U.S. shrimp fishery (*Federal Register*, 2012). Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

The *Ixtoc I* well blowout and spill in the Bay of Campeche, Mexico, on June 3, 1979, resulted in the release of 500,000 metric tons (140 million gallons) of oil and the transport of this oil into the Gulf of Mexico (ERCO, 1982). Three million gallons of oil impacted Texas beaches (ERCO, 1982). According to the ERCO study, "Whether or not hypoxic conditions could, in fact, be responsible for areawide reductions in [invertebrate] faunal abundance is unclear, however." Of the three sea turtles found dead in the U.S., all had petroleum hydrocarbons in the tissues examined, and there was selective elimination of portions of this oil, indicating chronic exposure (Hall et al., 1983). Therefore, the effects of the *Ixtoc I* well blowout and spill on sea turtles in waters off Texas are still unknown.

Phase 3—Onshore Contact

Phase 3 focuses on nearshore (e.g., inside bays and in close proximity to shoreline) and onshore spill response, and on oil initially reaching the shoreline during the spill event or while the oil still persists in the offshore environment once the spillage has been stopped. It is likely that Phases 2 and 3 could occur simultaneously. The duration of the initial shoreline oiling is measured from initial shoreline contact until the well is capped or killed and the remaining oil dissipates offshore. The re-oiling of already cleaned or previously impacted areas could be expected during Phase 3. In addition to the response described in Phase 2, nearshore and onshore efforts would be introduced in Phase 3 as oil entered coastal areas and contacted shore. Potential impacts reflect the spill and response in very shallow coastal waters and once along the shoreline. Season and temperature variations can result in different resource impacts due to variations in oil persistence and oil and dispersant toxicity and because of differences in potential exposure of the resources throughout various life cycle stages.

Out of the five species of sea turtle that occur in the Gulf of Mexico, only four nest in the GOM. The largest nesting location for the Kemp's ridley sea turtle is in Rancho Nuevo, Mexico, but they also nest in Texas and Alabama. Loggerhead sea turtles nest in all states around the Gulf of Mexico. Green sea turtles have been cited nesting in Texas, Alabama, and Florida. Leatherback sea turtles mostly nest on the east coast of Florida but are recorded in Texas. Kemp's ridley, loggerhead, and green sea turtles are therefore most likely to be affected by a catastrophic oil spill when there is onshore and/or offshore contact.

Several recent reports are available concerning Gulf of Mexico loggerheads' nesting habitats and movements (Hart et al., 2013), post-nesting behavior (Foley et al., 2013), foraging sites (Foley et al., 2014), and body size effects on growth rates (Bjorndal et al., 2013). These reports confirm the importance of Gulf of Mexico beaches, specifically for loggerheads. On September 22, 2011, NMFS issued the final rule to list 9 Distinct Population Segments (DPSs) of loggerhead sea turtles under the ESA and designated the GOM as the Northwest Atlantic Ocean DPS (*Federal Register*, 2011).

Female sea turtles seasonally emerge during the warmer summer months to nest on beaches. Thousands of sea turtles nest along the Gulf Coast, and turtles could build nests on oiled beaches. Nests could also be disturbed or destroyed by cleanup efforts. Untended booms could wash ashore and become a barrier to sea turtle adults and hatchlings (USDOC, NOAA, 2010c). Hatchlings, with a naturally high mortality rate, could traverse the beach through oiled sand and swim through oiled water to reach preferred habitats of *Sargassum* floats. Response efforts could include mass movement of eggs from hundreds of nests or thousands of hatchlings from Gulf Coast beaches to the east coast of Florida or to the open ocean to prevent hatchlings entering oiled waters (Jernelöv and Lindén, 1981; USDOI, FWS, 2010b). Due to poorly understood mechanisms that guide female sea turtles back to the beaches where they hatched, it is uncertain if relocated hatchlings would eventually return to the Gulf Coast to nest (Florida Fish and Wildlife Conservation Commission, 2010). Therefore, shoreline oiling and response efforts may affect future population levels and reproduction (USDOI, NPS, 2010). Sea turtle hatchling exposure to, fouling by, or consumption of tarballs persisting in the sea following the dispersal of an oil slick would likely be fatal.

As a preventative measure during the *Deepwater Horizon* explosion, oil spill, and response, NMFS and FWS translocated a number of sea turtle nests and eggs that were located on beaches affected or potentially affected by spilled oil. The NMFS stranding network website (USDOC, NMFS, 2011c) translocated a total of 274 nests from GOM beaches to the east coast of Florida. These nests were mainly for hatchlings that would enter waters off Alabama and Florida's northwest Gulf Coast. Of these, 4 were from green turtles, 5 from Kemp's ridley, and 265 were loggerheads. The translocation effort ended August 19, 2010, at the time when biologists determined that risks to hatchlings emerging from beaches and entering waters off Alabama and Florida's northwest Gulf Coast had diminished significantly and that the risks of translocating nests during late incubation to the east coast of Florida outweighed the risks of letting hatchlings emerge into the Gulf of Mexico. The hatchlings resulting from the translocations were all released as of September 9, 2010.

In addition to the impacts from direct contact with hydrocarbons, spill-response activities could adversely affect sea turtle habitat and cause displacement from suitable habitat to inadequate areas. Impacting factors might include artificial lighting from night operations, booms, machine and human activity, equipment on beaches and in intertidal areas, sand removal and cleaning, and changed beach landscape and composition. Some of the resulting impacts from cleanup could include interrupted or deterred nesting behavior, crushed nests, entanglement in booms, and increased mortality of hatchlings because of predation during the increased time required to reach the water (Newell, 1995; Lutcavage et al., 1997). The strategy for cleanup operations should vary, depending on the season.

Phase 4—Post-Spill, Long-Term Recovery and Response

Phase 4 focuses on long-term recovery once the well has been capped and the spill has stopped. During the final phase of a catastrophic blowout and spill, it is presumed that the well has been capped or killed and that cleanup activities are concluding. While it is assumed that the majority of spilled oil would be dissipated offshore within 1-2 months (depending on season and temperature) of stopping the flow, oil has the potential to persist in the environment long after a spill event and has been detected in sediment 30 years after a spill. On sandy beaches, oil can sink deep into the sediments. In tidal flats and salt marshes, oil may seep into the muddy bottoms. Potential impacts reflect long-term persistence of oil in the environment and residual and long-term cleanup efforts.

Sea turtles take many years to reach sexual maturity. Green sea turtles reach maturity between 20 and 50 years of age; loggerheads may be 35 years old before they are able to reproduce; and hawksbill sea turtles typically reach lengths of 27 in (69 cm) for males and 31 in (79 cm) for females before they can reproduce (USDOC, NMFS, 2010a). Declines in the food supply for sea turtles, which include invertebrates and sponge populations, could also affect sea turtle populations. While all of the pathways that an oil spill or the use of dispersants can affect sea turtles is poorly understood, some pathways may include the following: (1) oil or dispersants on the sea turtle's skin and body can cause skin irritation, chemical burns, and infections; (2) inhalation of volatile petroleum compounds or dispersants can damage the respiratory tract and lead to diseases; (3) ingesting oil or dispersants may cause injury to the gastrointestinal tract; and (4) chemicals that are inhaled or ingested may damage internal organs. In most foreseeable cases, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick would result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity and increased vulnerability to disease) to sea turtles. Other possible internal impacts might include harm to the liver, kidney, and brain function, as well as causing anemia and immune suppression, or they could lead to reproductive failure or death. The deaths of subadult and adult sea turtles may also drastically reduce the population.

Since January 1, 2011, a notable increase in sea turtle strandings has occurred in the northern GOM, primarily in Mississippi. While turtle strandings in this region typically increase in the spring, the recent increase is a cause for concern. The Sea Turtle Stranding and Salvage Network is monitoring and investigating this increase. The network encompasses the coastal areas of the 18 states from Maine through Texas and includes portions of the U.S. Caribbean. There are many possible reasons for the increase in strandings in the northern GOM, both natural and human caused (USDOC, NMFS, 2012a). One sea turtle had a small amount of tar from the *Deepwater Horizon* explosion, oil spill, and response on its shell. No visible external or internal oil was observed in any other animals. These sea turtle species include loggerhead, green, Kemp's ridley, leatherback, hawksbill, and unidentified. The NMFS has also identified strandings in Texas (upper Texas coast—Zone 18). Refer to **Chapter 4.1.1.12** for updated turtle stranding data for the Gulf of Mexico.

Over the last 2 years, NOAA has documented necropsy results from many of the stranded turtles, indicating mortality due to forced submergence, which is commonly associated with fishery interactions, and acute toxicosis. On May 10, 2012, NMFS published the Draft EIS to reduce incidental bycatch and mortality of sea turtles in the southeastern U.S. shrimp fishery (*Federal Register*, 2012).

Overall Summary and Conclusion (Phases 1-4)

Accidental blowouts, oil spills, and spill-response activities resulting from a WPA proposed action have the potential to impact small to large numbers of sea turtles in the GOM, depending on the magnitude and frequency of accidents, the ability to respond to accidents, the location and date of accidents, and various meteorological and hydrological factors. Impacts on sea turtles from smaller accidental events are likely to affect individual sea turtles in the spill area, but they are unlikely to rise to the level of population effects (or significance) given the size and scope of such spills.

Unavailable information on the effects to sea turtles from the *Deepwater Horizon* explosion, oil spill, and response and increased stranding events (and thus changes to the sea turtle baseline in the affected environment) makes an understanding of the effects less clear.

For low-probability catastrophic spills, this analysis concludes that there is a potential for a low-probability catastrophic event to result in significant, population-level effects on affected sea turtle species.

B.3.1.14. Diamondback Terrapins

Phase1—Initial Event

Phase 1 of the scenario is the initiation of a catastrophic blowout event. Impacts, response, and intervention depend on the spatial location of the blowout and leak. For this analysis, an explosion and subsequent fire are assumed to occur. If a blowout associated with the drilling of a single exploratory well occurs, this could result in a fire that would burn for 1-2 days. If a blowout occurs on a production platform, other wells could feed the fire, allowing it to burn for over a month. The drilling rig or platform may sink. If the blowout occurs in shallow water, the sinking rig or platform may land in the immediate vicinity; if the blowout occurs in deep water, the rig or platform could land a great distance away, beyond avoidance zones. Regardless of water depth, the immediate response would be from search and rescue vessels and aircraft, such as USCG cutters, helicopters, and rescue planes, and firefighting vessels. Potential impacts reflect the explosion, subsequent fire for 1-30 days and the sinking of the platform in the immediate vicinity and up to 1 mi (1.6 km) from the well.

The scenarios for each phase, including cleanup methods, can be found in **Table B-4**.

There would likely be no adverse impacts to diamondback terrapins as a result of the events and the potential impact-producing factors that could occur throughout Phase 1 of a catastrophic spill event because these species exclusively inhabit estuarine waters and salt marshes.

Phase 2—Offshore Spill

Phase 2 of the analysis focuses on the spill and response in Federal and State offshore waters. A catastrophic spill would likely spread hundreds of square miles. Also, the oil slick may break into several smaller slicks, depending on local wind patterns that drive the surface currents in the spill area. Potential impacts reflect spill and response in Federal and State offshore waters. Season and temperature variations can result in different resource impacts due to variations in oil persistence and oil and dispersant toxicity and because of differences in potential exposure of the resources throughout various life cycle stages.

There would likely be no adverse impacts to diamondback terrapins as a result of the events and the potential impact-producing factors that could occur throughout Phase 2 of a catastrophic spill event because these species exclusively inhabit estuarine waters and salt marshes.

Phase 3—Onshore Contact

Phase 3 focuses on nearshore (e.g., inside bays and in close proximity to shoreline) and onshore spill response and on oil initially reaching the shoreline during the spill event or while the oil still persists in the offshore environment once the spillage has been stopped. It is likely that Phases 2 and 3 could occur simultaneously. The duration of the initial shoreline oiling is measured from initial shoreline contact until the well is capped or killed and the remaining oil dissipates offshore. The re-oiling of already cleaned or previously impacted areas could be expected during Phase 3. In addition to the response described in Phase 2, nearshore and onshore efforts would be introduced in Phase 3 as oil entered coastal areas and contacted shore. Potential impacts reflect the spill and response in very shallow coastal waters and once along the shoreline. Season and temperature variations can result in different resource impacts due to variations in oil persistence and oil and dispersant toxicity and because of differences in the potential exposure of the resources throughout various life cycle stages.

The major impact-producing factors resulting from the low-probability catastrophic event at may affect the five terrapin subspecies that occur in the WPA and CPA include offshore and coastal oil spills and spill-response activities.

Terrapins inhabit brackish waters including coastal marshes, tidal flats, creeks, and lagoons behind barrier beaches (Hogan, 2003). Their diet consists of fish, snails, worms, clams, crabs, and marsh plants (Cagle, 1952). Courtship and mating occur in March and April, and the nesting season extends through July, with possibly multiple clutches (U.S. Dept. of the Army, COE, 2002; Butler et al., 2006). Terrapins nest on dunes, beaches, sandy edges of marshes, islands, and dike roads (Roosenburg, 1994). The common factor for proper egg development is sandy soil, which does not clog eggshell pores, thus allowing sufficient gas exchange between the developing embryo and the environment (Roosenburg, 1994). Nesting occurs primarily in the daytime during high tide on high sand dunes with gentle slopes and minimal vegetation (Burger, 1977). Clutch size ranges from 4 to 22 eggs, and incubation time ranges from 61 to 104 days (Butler et al., 2006; Burger, 1977). Female terrapins may nest 2-3 times in the same nesting season. Gender determination is temperature dependent. Hatching occurs from July through October in northeastern Florida (Butler et al., 2004).

Spending most of their lives at the aquatic-terrestrial boundary in estuaries, terrapins are susceptible to habitat destruction from oil-spill cleanup efforts as well as direct contact with oil. However, most impacts cannot be quantified at this time. Even after oil is no longer visible, terrapins may still be exposed while they forage in the salt marshes lining the edges of estuaries, where oil may have accumulated under the sediments and within the food chain. Terrapin nests can also be disturbed or destroyed by cleanup efforts. The range of the possible chronic effects from contact with oil and dispersants include lethal or sublethal oil-related injuries that may include skin irritation from the oil or dispersants, respiratory problems from the inhalation of volatile petroleum compounds or dispersants, gastrointestinal problems caused by the ingestion of oil or dispersants, and damage to other organs because of the ingestion or inhalation of these chemicals.

Accidental blowouts, oil spills, and spill-response activities resulting from a WPA proposed action have the potential to impact small to large numbers of terrapins within their habitat, depending on the magnitude and frequency of accidents, the ability to respond to accidents, the location and date of accidents, and various meteorological and hydrological factors. Populations of terrapins in the Gulf may be exposed to residuals of oils spilled as a result of a WPA proposed action during their lifetimes. Chronic or acute exposure may result in the harassment, harm, or mortality to terrapins occurring in the GOM. In the most likely scenarios, exposure to hydrocarbons persisting within the wetlands following the dispersal of an oil slick could result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease). Terrapin hatchling exposure to, fouling by, or consumption of tarballs persisting inland following the dispersal of an oil slick could likely be fatal but unlikely. Impacts from the dispersants are unknown, but they may have similar irritants to tissues and sensitive membranes as are known to occur in seabirds and sea turtles (NRC, 2005). The impacts to diamondback terrapins from chemical dispersants could include nonlethal injury (e.g., tissue irritation and inhalation), long-term exposure through bioaccumulation, and potential shifts in distribution from some habitats.

Burger (1994) described the behavior of 11 female diamondback terrapins that were oiled during the January 1990 spill of No. 2 fuel oil in Arthur Kill, New York. The terrapins were hibernating at the time of the spill, and when they emerged from hibernation, they were found to be oiled. The terrapins voided oil from their digestive tracks for 2 weeks in rehabilitation. At 3 weeks, the terrapins scored low on strength tests and were slow to right themselves when placed on their backs. At 4 weeks, they developed edema and appetite suppression. Eight of the 11 died; these animals had traces of oil in their tissues and exhibited lesions in their digestive tract consistent with oil exposure (Burger, 1994). Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

The *Deepwater Horizon* explosion, oil spill, and response may have potentially impacted the terrapin community. Impacts from a catastrophic spill may impact terrapin communities. Impacts can be either direct (mortality or injury) or indirect (e.g., reduced prey availability); however, most impacts cannot be quantified at this time. The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on the potentially affected terrapin environment. Current available information includes photographic evidence of one terrapin found oiled on Grand Terre Island, Louisiana, on June 8, 2010 (State of Louisiana, Coastal Protection and Restoration, 2012).

Phase 4—Post-Spill, Long-Term Recovery and Response

Phase 4 focuses on long term recovery once the well has been capped and the spill has stopped. During the final phase of a catastrophic blowout and spill, it is presumed that the well has been capped or killed and cleanup activities are concluding. While it is assumed that the majority of spilled oil would be dissipated offshore within 1-2 months (depending on season and temperature) of stopping the flow, oil has the potential to persist in the environment long after a spill event and has been detected in sediment 30 years after a spill. On sandy beaches, oil can sink deep into the sediments. In tidal flats and salt marshes, oil may seep into the muddy bottoms. Potential impacts reflect long term persistence of oil in the environment and residual and long-term cleanup efforts.

The *Deepwater Horizon* explosion, oil spill, and response and associated oil spill may have impacted the terrapin community and associated brackish habitats. According to OSAT-2 (2011), possible environmental effects from the *Deepwater Horizon* explosion, oil spill, and response could occur within terrapin marsh habitat via food or to nesting habitat since no active intervention (natural remediation) is the preferred protocol.

Behavioral effects and nonfatal exposure to or intake of OCS oil- and gas-related contaminants or discarded debris may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources. Even after the oil is no longer visible, terrapins may still be exposed while they forage in the salt marshes lining the edges of estuaries where oil may have accumulated under the sediments and within the food chain (Burger, 1994; Roosenburg et al., 1999). Nests can also be disturbed or destroyed by cleanup efforts. Through NRDA, ongoing research and analysis of the presence of contaminants in terrapin eggs following the *Deepwater Horizon* oil spill is being conducted (USDOC, NOAA, 2012a). Hatching success studies at various oiled nesting sites of the northern diamondback terrapin suggest that spills may result in a reduction in nest size and increased mortality of spring emergers (hatched turtles) at the oiled sites (Wood and Hales, 2001). However, research on the PAH exposure and toxicology of eggs in the vicinity of a spill site found no correlation to substrate PAHs when compared with egg toxicology. The level of PAHs found in the eggs may be the result of maternal transfer and represent the exposure level of the nesting female rather than environmental exposure to PAHs from oil at the site of the nest (Holliday et al., 2008).

Habitat destruction, road construction, drowning in crab traps, and nest predation are the most recent threats to diamondback terrapins. Tropical storms, hurricanes, and beach erosion threaten their preferred nesting habitats. Destruction of the remaining habitat because of a catastrophic spill and response efforts could drastically affect future population levels and reproduction.

Overall Summary and Conclusion (Phases 1-4)

Impacts on diamondback terrapins from smaller accidental events are likely to affect individual diamondback terrapins in the spill area, as described above, but are unlikely to rise to the level of population effects (or significance) given the probable size and scope of such spills. Possible catastrophic environmental effects from an oil spill and cleanup could occur within terrapin marsh habitat via food or to the nesting habitat. Since terrapins do not move far from where they are hatched, it is possible that entire subpopulations could incur high mortality rates and community disruptions, though this would be highly localized depending on the time, place, and size of the spill.

The OSRA analyses in this Supplemental EIS conclude that there is a low probability for catastrophic spills and that there is a potential for a low-probability catastrophic event to result in significant, population-level effects on affected diamondback terrapin species.

For those terrapin populations that may not have been impacted by the *Deepwater Horizon* explosion, oil spill, and response, it is unlikely that a future accidental event related to a WPA proposed action would result in significant impacts due to the distance of most terrapin habitat from offshore OCS energy-related activities.

B.3.1.15. Beach Mice

Phase 1—Initial Event

There would likely be no adverse impacts to beach mice as a result of the events and the potential impact-producing factors that could occur throughout Phase 1 of a catastrophic spill event because Phase 1 is the initiation of a catastrophic blowout incident, and initiation would occur well offshore from beach mouse habitat.

Phase 2—Offshore Spill

There would likely be no adverse impacts to beach mice as a result of the events and the potential impact-producing factors that could occur throughout Phase 2 of a catastrophic spill event because Phase 2 of the analysis focuses on the spill and response in Federal and State offshore waters away from beach mouse habitat.

Phase 3—Onshore Contact

Five subspecies of the field mouse, collectively known as beach mice, live along the Gulf Coast, and two beach mouse subspecies live on the Atlantic Coast of Florida. Five subspecies of beach mice (Alabama, Perdido Key, Choctawhatchee, St. Andrew, and Anastasia Island) are listed as State and federally endangered; also, the southeastern beach mouse is listed as federally threatened. Beach mice are restricted to the coastal barrier sand dunes along the Gulf Coasts of Alabama and Florida. Erosion caused by the loss of vegetation because of oiling would likely cause more damage than the direct oiling of beach mice because of the degradation or loss of habitat. In addition, vehicular traffic and activity associated with cleanup can trample or bury beach mice nests and burrows or cause displacement from preferred habitat. Improperly trained personnel and vehicle and foot traffic during shoreline cleanup of a catastrophic spill would disturb beach mouse populations and would degrade or destroy habitat.

The Alabama, Choctawhatchee, St. Andrew, Perdido Key, Anastasia Island, and southeastern beach mice are designated as protected species under the Endangered Species Act, mostly because of the loss and fragmentation of coastal habitat (*Federal Register*, 1989; USDOI, MMS, 2007). Some of the subspecies have coastal habitat that is designated as their critical habitat. For example, the endangered Alabama beach mouse's (*Peromyscus polionotus ammobates*) designated critical habitat is 1,211 acres (450 hectares) of frontal dunes covering just 10 mi (16 km) of shoreline (USDOI, FWS, 2007). Critical habitat is the specific geographic areas that are essential for the conservation of a threatened or endangered species.

All designated critical habitat for beach mice officially extends landward from the mean high water line (*Federal Register*, 2006; USDOI, FWS, 2007). Therefore, spilled oil could contact critical habitat even without a concurrent storm surge; contact would require only that the water level would be at mean high tide. However, a concurrent storm surge of considerable height would be required to oil the portion of the critical habitat substantially landward of the mean high water line (over the tops of the primary, secondary, and tertial dunes). With the potential oiling of over 1,000 mi (1,609 km) of shoreline that could result from a catastrophic spill event and a concurrent storm surge of considerable height that occurs within a close proximity to the critical habitat, there is the potential for the entire critical habitat for a subspecies of beach mice to be completely oiled. Thus, destruction of critical habitat because of a catastrophic spill, a concurrent storm surge of considerable height and over a considerable length of shoreline, and cleanup activities would increase the threat of extinction of several subspecies of beach mice. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

Phase 4—Post-Spill, Long-Term Recovery and Response

Within the last 20-30 years, the combination of habitat loss because of beachfront development, the isolation of the remaining beach mouse habitat areas and populations, and the destruction of the remaining habitat by tropical storms and hurricanes has increased the threat of extinction of several subspecies of beach mice. On sandy beaches, oil can sink deep into the sediments and become exposed again after erosion of sand by wave action. Oil may therefore persist near beach mouse habitat for the long term. The destruction of the remaining habitat because of a catastrophic spill and cleanup activities would increase the threat of extinction.

Overall Summary and Conclusion (Phases 1-4)

Impacts to beach mice would vary according to the severity of the oiling. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

B.3.1.16. Coastal, Marine, and Migratory Birds

Phase 1—Initial Event

Some migratory birds use offshore platforms or rigs as potential stopover sites during their long-distance migrations across the GOM during the spring and fall (Russell, 2005). In addition, it has been well documented that seabirds are attracted to offshore platforms and rigs for a myriad of reasons; i.e., concentrations of baitfish, roost sites, etc. (Tasker et al., 1986; Wiese et al., 2001; Burke et al., 2012).

The numbers of birds present at a platform or rig tend to be greater on platforms or rigs closer to shore, particularly during drilling operations (Baird, 1990). Birds resting on the drilling rig or platform during a catastrophic blowout at the surface (similar to the *Deepwater Horizon* explosion, oil spill, and response) are more likely to be killed by the explosion. While it is assumed that most birds in trans-Gulf migration would likely avoid the fire and smoke plume during the day, it is possible that the light from the fire could interfere with nocturnal migration, especially during poor visibility conditions, i.e., fog or low clouds. It has been documented that seabirds are attracted to natural gas flares at rigs and platforms (Russell, 2005; Wiese et al., 2001); therefore, additional bird fatalities could result from the fire following the blowout. Though different species migrate differentially throughout the year, the largest number of species migrates through the proposed area from mid-April through mid-May (spring migration back north) and from mid-August through early November (fall migration south) (Russell, 2005, Table 6.12; Farnsworth and Russell, 2007). A blowout during this time would potentially result in a greater number of bird fatalities (see below).

Of the four phases considered herein, avian mortality associated with this Phase is certainly expected to be much lower than avian mortality associated with either Phase 2 or Phase 3. However, this anticipated result is highly dependent on the location of the platform and the timing of the event. The only scenario considered is the case where a blowout and explosion occurred at the surface (**Table B-4**). If the catastrophic event, in this case a blowout and explosion at the surface (refer to **Table B-4**), occurs more proximal to the coast during the breeding season or during a peak migration period (late March to late May and mid-August to early November), then the level of avian mortality is expected to be higher. In comparison, a blowout and explosion at the surface on a platform more distant from the coast (greater than or equal to the distance of the *Macondo* well from the coast) would result in much lower avian mortality, particularly if the event did not overlap temporally with either the breeding season or either of the trans-Gulf migrations.

While the species composition and species-specific mortality estimates are unknown and would be dependent on the blowout location and time of year, the initial mortalities would almost certainly not result in population-level impacts for species present at the time of the blowout and resulting fire (Arnold and Zink, 2011; also refer to Table 4-7 of the 2012-2017 WPA/CPA Multisale EIS). If the event occurred during the breeding season or wintering period, species of seabirds or diving birds would have the greatest potential to be affected, whereas if the event occurred during either the spring or fall migration, species of passerines would most likely have the greatest potential to be affected due to the diversity and sheer numbers of individuals in this avian species group (Rappole and Ramos, 1994; Lincoln et al., 1998; Russell, 2005; also refer to **Chapter 4.1.1.14** of this Supplemental EIS, Chapter 4.1.1.14.1 of the 2012-2017 WPA/CPA Multisale EIS, and Chapter 4.1.1.14 of the WPA 233/CPA 231 Supplemental EIS).

Phase 2—Offshore Spill

During Phase 2 of a catastrophic spill, the primary concern for marine and migratory birds would be their vulnerability to oiling or ingesting oil, which is primarily a function of their behavior and diets. Wading birds (e.g., herons, egrets, etc.) and species that feed by plunge-diving into the water to catch small fish (e.g., pelicans, gannets, terns, gulls, and pelagic birds) and those that use water as a primary means of locomotion, foraging (e.g., black skimmers), or resting and preening (e.g., diving ducks, cormorants, pelicans, etc.) are highly vulnerable to becoming oiled and also to ingesting oil (**Table B-5** of this Supplemental EIS; also refer to Table 4-13 and Figure 4-13 of the 2012-2017 WPA/CPA Multisale EIS). Seabirds, in particular, tend to feed and concentrate in convergence zones, eddies, upwellings, and near *Sargassum* mats (Haney, 1986a-c; Moser and Lee, 2012). In addition to concentrating prey, these areas are also known to aggregate oil (Unified Incident Command, 2010d). Oiling interferes with the birds' ability to fly (thus to obtain food) and compromises the insulative characteristics of down and contour feathers, making it difficult to regulate body temperature. Attempts by oiled birds to remove the oil via preening can cause them to ingest oil and may result in mortality. In addition, the ingestion of contaminated prey can result in physiological impairment and even death. Refer to Chapter 4.1.1.14.3 of the 2012-2017 WPA/CPA Multisale EIS for additional detailed information on oiling effects to birds.

Though several species or species groups are mentioned above, the most vulnerable species to spilled oil in the offshore environment in the GOM during Phase 2 would be representatives of the diving bird (≤10 species) and seabird (≥20 species) groups (King and Sanger, 1979; Ribic et al., 1997; Davis et al., 2000). Unlike Phase 1, where passerines may be affected depending on the timing of the catastrophic event, timing or seasonal effects would be less important under the Phase 2 scenario (**Table B-4**) due to the spilled oil being restricted to the offshore environment, thereby limiting the potential impacts to the several avian species groups relegated to the coastal and nearshore environment (**Table B-5** of this Supplemental EIS; also refer to **Chapter 4.1.1.14** of this Supplemental EIS, Chapter 4.1.1.14.1 of the 2012-2017 WPA/CPA Multisale EIS, and Chapter 4.1.1.14 of the WPA 233/CPA 231 Supplemental EIS). However, it is highly probable that representative species of diving birds and seabirds would differentially be impacted (**Table B-5** of this Supplemental EIS; also refer to Table 4-12 of the 2012-2017 WPA/CPA Multisale EIS). Table 4-12 of the 2012-2017 WPA/CPA Multisale EIS shows the actual number of birds identified to the species level for each of the species groups. This number is fairly representative of the suite of species available to be oiled. However, this number is dependent on efforts to correctly assign species to unidentified birds or unknowns, which is also a function of search effort. Search effort likely declined dramatically once the *Macondo* well was plugged/capped. The species composition and species-specific mortality estimates associated with a Phase 2 catastrophic event are unknown and would be dependent primarily on the blowout location, as well as the distribution, coverage, and proximity to the shoreline of spilled oil. Overall, avian mortalities for this Phase would probably not result in population-level impacts for species present at the time of the blowout (refer to **Table B-5** of this Supplemental EIS and to Figure 4-13 of the 2012-2017 WPA/CPA Multisale EIS). However, it should be clear that many species of seabirds and diving birds have life-history strategies that do not allow subpopulations to recover quickly from major mortality events or perturbations (Ricklefs, 1983 and 1990; Russell, 1999; Saether et al., 2004; also refer to Table 4-13 and Figure 4-18 of the 2012-2017 WPA/CPA Multisale EIS).

Some discussion of available information provided from the *Deepwater Horizon* explosion, oil spill, and response is relevant here with respect to temporal aspects of oiled birds (**Figure B-3**). The first oiled bird (northern gannet, a seabird) recovered after the *Macondo* well event was collected just 10 days post-blowout. While gannets breed in coastal colonies in the Canadian North Atlantic, the population, including a major concentration in the northern GOM, over-winters in the deeper waters of the offshore environment. Belanger et al. (2010) provided some interesting results relative to live versus dead birds collected based on the actual date each bird was collected. Interestingly, they documented a dramatic and statistically significant decline in the number of live birds collected after 110 days compared with live birds collected during the first 72 days. These authors also documented a dramatic and statistically significant increase in the number of dead birds collected after 110 days (Belanger et al., 2010, Figures 2 and 3). As a temporal reference, oil reached the shoreline near Venice, Louisiana, ≥10 days post-blowout, covering a distance of approximately 90 mi (145 km) (Oil Spill Commission, 2011; also refer to Chapter 4.2.1.3.1 of the 2012-2017 WPA/CPA Multisale EIS and Chapter 4.2.1.3 of the WPA 233/CPA 231 Supplemental EIS) (**Figure B-3**). It should be understood that, for the Phase 2 scenario considered here, it is assumed that spilled oil will not contact the shoreline.

Overall, avian mortality estimates are unknown and are difficult to predict given the uncertainty (Conroy et al., 2011, pages 1209-1210; Williams, 2011, page 1348) associated with the scenario and specific characteristics associated with the spill (refer to Appendix C of the WPA 238/246/248 Supplemental EIS), as well as environmental conditions that are probably a function of spill location and timing. Even recognizing the uncertainty associated with the scenario, spill characteristics, and the environmental conditions at the time of the spill, Phase 2 would likely be second only to Phase 3 in total avian mortality. Phase 3 would include much greater avian species diversity and abundance due to the oil reaching nearshore, coastal beach/dune, salt- and brackish marsh habitats (**Table B-5** of this Supplemental EIS; also refer to Table 4-12 of the 2012-2017 WPA/CPA Multisale EIS).

Phase 3—Onshore Contact

Gulf coastal habitats are essential to the annual cycles of many species of breeding, wintering, and migrating diving birds, seabirds, shorebirds, passerines, marsh- and wading birds, and waterfowl (refer to **Chapter 4.1.1.14** of this Supplemental EIS, Chapter 4.1.1.14.1 of the 2012-2017 WPA/CPA Multisale EIS, and Chapter 4.1.1.14 of the WPA 233/CPA 231 Supplemental EIS). For example, the northern Gulf Coast supports a large proportion of populations of several beach-nesting bird species (USDOI, FWS, 2010c). During Phase 3, oil is expected to contact not only the beach but also other important habitats used by a diverse and abundant assemblage of avian species. Habitats potentially impacted by a catastrophic spill would also likely include the nearshore environment, as well as the salt- and brackish marsh habitats. Potential impacts and total avian mortality from Phase 3 would be greater than any of the other phases considered herein due to (1) avian diversity and abundance in the nearshore environment (**Table B-5** of this Supplemental EIS; also refer to Tables 4-9 through 4-11 of the 2012-2017 WPA/CPA Multisale EIS) and (2) the dispersion of oil from a catastrophic spill, which would reach the shoreline and enter the salt- and brackish marsh environments. Similar to Phases 1 and 2, the timing and location of the spill are important factors in determining the severity of impacts to the avian community. In addition, the duration of potential oil exposure to various species of birds would also be important.

As the *Macondo* well blowout and spill is the only historic catastrophic oil spill to occur in U.S. waters in the GOM, the information obtained from the *Deepwater Horizon* explosion, oil spill, and response relative to avian mortality may be reasonably relevant for any future catastrophic spills, recognizing of course the variation and uncertainty associated with individual oil spills. At present, the estimates of avian mortality associated with the *Exxon Valdez* oil spill far exceed current estimates of avian mortality associated with the *Deepwater Horizon* explosion, oil spill, and response even though the *Deepwater Horizon* spill volume/size far exceed that of the *Exxon Valdez* (refer to Table 4-15 of the 2012-2017 WPA/CPA Multisale EIS). Based on data from the *Deepwater Horizon* explosion, oil spill, and response, a similar catastrophic spill would probably result in >10,000 carcasses collected (*Deepwater Horizon* explosion, oil spill, and response = 7,258 collected) representing >100 potentially impacted species (*Deepwater Horizon* explosion, oil spill, and response = 104 species identified) (refer to **Table B-5**, superscript 1 and also superscript b). It should be recognized that the number of avian carcasses collected post-spill represents some unknown fraction or proportion of the total modeled estimate of realized mortality (Flint et al., 1999; Byrd et al., 2009; Ford and Zafonte, 2009); the number of avian carcasses collected is biased low (Piatt et al., 1990a-b; Piatt and Ford, 1996; Castège et al., 2007). Figure 4-13 of the 2012-2017 WPA/CPA Multisale EIS should provide reasonable estimates of oiling rates for the seven avian species groups in the northern Gulf of Mexico if another catastrophic spill were to occur and the timing, oil spill characteristics, and spill behavior were similar to the *Deepwater Horizon* explosion, oil spill, and response. It should be noted that the top five most impacted (based on number collected) avian species from the *Deepwater Horizon* explosion, oil spill, and response were all representatives of the seabird group: laughing gull (n = 2,981, 40% oiling rate); brown pelican (n = 826, 41% oiling rate); northern gannet (n = 475, 63% oiling rate); royal tern (n = 289, 52% oiling rate); and black skimmer (n = 253, 22% oiling rate) (**Table B-5** of this Supplemental EIS and Figure 4-13 of the 2012-2017 WPA/CPA Multisale EIS).

Additional information is provided herein from an OSRA catastrophic oil-spill analysis (refer to Appendix C of the WPA 238/246/248 Supplemental EIS, Tables C-4 and C-5).

It should be noted that oil from the *Deepwater Horizon* explosion and oil spill reached the shoreline less than 14 days after the blowout occurred (Oil Spill Commission, 2011). The OSRA does not take into account or consider the following with respect to avian resources and their habitats: (1) species-specific densities; (2) species-specific habitat preferences, food habits, or behavior; (3) relative vulnerabilities to oiling among the avian species groups or among species within each of the groups (**Table B-5** of this Supplemental EIS and Figure 4-13 of the 2012-2017 WPA/CPA Multisale EIS; also refer to Williams et al., 1995; Camphuysen, 2006); and (4) it does not take into account or consider species-specific life-history strategies, their demography, or a species' recovery potential (refer to Table 4-13 and Figures 4-18 and 4-19 of the 2012-2017 WPA/CPA Multisale EIS).

In summary, Phase 3 of a catastrophic oil spill has the greatest potential for negative impacts (i.e., direct mortality) to avian resources due to its contact with the shoreline and inundation of other habitats occupied by a much greater diversity and abundance of birds, particularly during the breeding season. Avian mortality estimates are presently unknown and are difficult to predict with any level of precision given the uncertainty associated with the scenario, specific characteristics associated with the spill, spatial and temporal variation in environmental conditions, and recognition that the avian resources (both species diversity and abundance) available to be oiled will also vary temporally and spatially. A worst-case scenario in the event of a catastrophic oil spill that reached the nearshore environment would occur in the presence of a hurricane with strength or magnitude similar to Hurricanes Katrina, Rita, or Ike during the breeding season. Such an overlap of two low-probability events during the breeding season could potentially push spilled oil even farther inland and also distribute oil vertically into the vegetation. Such an event would not only negatively impact diving birds, seabirds, shorebirds, marsh- and wading birds, and waterfowl but also the more terrestrial avian species groups including passerines and raptors. Such effects would most likely be long-term (due to direct mortality of individuals, but also due to major habitat loss) and could potentially result in population-level impacts to a number of avian species.

Threatened and endangered avian species would likely be the most severely impacted by such an event depending on the spatial and temporal aspects of both the spill and the hurricane.

Endangered and Threatened Birds

A detailed discussion of threatened and endangered species is provided in Chapter 4.1.1.14.1 of the 2012-2017 WPA/CPA Multisale EIS. Of the 17 species considered, 12 species are known to occur in the WPA (**Table B-6**). However, only the piping plover (*Charadrius melodus*), roseate tern (*Sterna dougallii dougallii*), wood stork (*Mycteria americana*), whooping crane (*Grus americana*), Mississippi sandhill crane (*Grus canadensis pulla*), bald eagle (*Haliaeetus leucocephalus*), eastern brown pelican (*Pelecanus occidentalis*), and red knot (*Calidris canutus rufa*) were analyzed and are considered further here. Phase 3 would likely result in the greatest net negative impacts (primarily direct mortality) to threatened and endangered avian species due to contact with the shoreline and potential movement of spilled oil inland to other habitats during this phase (**Table B-4**). In addition, the presence of spilled oil would result in indirect and potentially long-term effects to threatened and endangered avian species' habitats and their preferred foods. Phases 1 and 2 would likely result in very limited impacts, if any, due to the scenarios as defined with oil restricted to the offshore environment.

In general, the potential direct impact (i.e., mortality) to any or all of these threatened or endangered (including recently delisted and candidate) species is directly a function of their presence at the time of a catastrophic oil spill. Indirect effects from a catastrophic oil spill could negatively affect the quality and functional availability of their habitats and the availability, distribution, and energetic benefits of their preferred foods in the absence of a given species. Of the species listed, the wood stork, Mississippi sandhill crane, bald eagle, eastern brown pelican, and Cape Sable seaside sparrows are year-round residents, whereas the piping plover, roseate tern, whooping crane, and red knot represent either wintering species or transients that utilize coastal habitats in the GOM as staging areas during migration. There are "resident" whooping cranes considered as "nonessential, experimental flocks" within the Gulf Coast States of Alabama, Louisiana, Mississippi, and Florida. These birds would be considered as "resident," whereas the component of the ESA-listed species occurring primarily as a wintering flock in Texas (i.e., the Aransas National Wildlife Refuge) is considered a migratory flock. It is important to recognize these differences relative to whether or not individuals of a given species would be present and available to be oiled should a catastrophic oil spill event occur. Similarly, species-specific differences in habitat use and behavior would further separate which species would be most vulnerable to a spill given the timing of the spill, spill distribution, and other spill-related characteristics.

Of the species considered, probably only the eastern brown pelican and possibly the bald eagle (ingestion of contaminated fish and birds) would potentially be impacted during Phases 1 and 2. The other species are restricted to the nearshore, coastal, salt- and brackish, and upland habitats, which would not be impacted during these phases given the scenario (**Table B-4**). Phase 4 impacts to threatened and endangered avian species would probably be limited to short-term disturbance-related effects and potential impacts to habitats including destruction, alteration, or fragmentation from associated recovery activities (American Bird Conservancy, 2010; National Audubon Society, Inc., 2010).

As the *Macondo* well blowout and spill is the only historic catastrophic oil spill to occur in U.S. waters in the GOM, the information obtained from the *Deepwater Horizon* explosion, oil spill, and response relative to avian mortality may be reasonably relevant for any future catastrophic spills, recognizing of course the variation and uncertainty associated with individual oil spills. Of the threatened and endangered avian species considered, only a single, unoiled piping plover was collected as part of the post-*Deepwater Horizon* explosion, oil spill, and response monitoring program (**Table B-5**). There were 106 least terns (*Sterna antillarum*) collected (n = 106, 46% oiling rate), but these individuals were considered as members of the coastal breeding population and not the ESA-listed population (Interior or noncoastal population). Of the species considered, only the eastern brown pelican was impacted by the *Deepwater Horizon* explosion, oil spill, and response (n = 826, 41% oiling rate); this species was delisted on November 17, 2009 (*Federal Register*, 2009). No other carcasses of threatened and endangered species were collected as part of the post-*Deepwater Horizon* explosion, oil spill, and response monitoring efforts (**Table B-5**; USDOI, FWS, 2011a).

Additional information is provided herein from an OSRA catastrophic oil-spill analysis (refer to Appendix C of the WPA 238/246/248 Supplemental EIS, Tables C-4 and C-5).

Caveats regarding the OSRA catastrophic run with respect to avian resources were addressed above and would also apply to threatened and endangered avian resources considered here.

Phase 4—Post-Spill, Long-Term Recovery and Response

There is a high probability of underestimating the impacts of oil spills on avian species potentially encountering oil. Despite being oiled, some birds are capable of flight and may later succumb to the oiling for a myriad of reasons (refer to Chapter 4.1.1.14 of the 2012-2017 WPA/CPA Multisale EIS for additional detailed information). Often overlooked and understudied are the long-term, sublethal, chronic effects due to sublethal exposure to oil (Butler et al., 1988; Alonso-Alvarez et al., 2007; Pérez et al., 2010). Also, individuals having been oiled in the Gulf of Mexico as the result of a catastrophic oil spill during the overwinter period or while staging in the GOM could exhibit carry-over effects to the northern breeding grounds. Affected individuals in poor body condition may arrive at their breeding grounds later than nonaffected individuals, which could, in turn, negatively affect habitat-use decisions, territory establishment, pairing success, and ultimately lead to reduced reproductive success (Norris, 2005; Norris et al., 2006; Harrison et al., 2011). Some oiled individuals may forego breeding altogether (Zabala et al., 2010). If oil-affected, long-distance migrants represent important prey items for various species of raptors, then the ingestion of affected individuals could also negatively affect individual birds of prey (Zuberogoitia et al., 2006). Refer to Henkel et al. (2012) for a review of potential carry-over effects to shorebirds potentially impacted by the *Deepwater Horizon* explosion, oil spill, and response.

The long-term impacts of potential food-induced stress for bird species from an altered ecosystem due to a catastrophic spill are unknown, but disturbances to the ecosystem can cause long-term sublethal impacts, including reduced food intake, prey switching, increased energy expenditures, decreased reproductive success, and decreased survival. Decreases in either reproductive success or survival (or both) could result in population-level effects as was observed for certain avian species more than 10 years after the *Exxon Valdez* catastrophic spill (Esler et al., 2002 and 2010; Golet et al., 2002). Long-term, sublethal, chronic effects may exceed immediate losses (i.e., direct mortality of oiled birds) if residual effects influence a significant proportion of the population or disproportionately impact an important aspect of the population demographic, i.e., breeding-age females (Croxall and Rothery, 1991; Oro et al., 2004). Depending on the effects and the life-history strategy of impacted species, some populations could take years or decades before reaching pre-spill population numbers and age-sex structure; some populations for some species may never recover (refer to Figure 4-13 of the 2012-2017 WPA/CPA Multisale EIS; refer to Peterson et al., 2003, but also to Wiens et al., 2010).

In general, potential effects associated with Phase 4 should be limited to short-term disturbance effects (personnel and equipment) and potential indirect effects to various avian species groups due to habitat loss, alteration, or fragmentation from restoration efforts. There may be cases whereby incubating individuals are flushed from nests exposing their eggs or young to either weather-related mortality or depredation by avian or mammalian predators (American Bird Conservancy, 2010; National Audubon Society, Inc., 2010). However, efforts to minimize potential effects of post-oil spill monitoring and restoration efforts, particularly during the breeding season, should be sufficient to protect nesting birds as a function of oversight by Federal and State agencies charged with the conservation of migratory bird resources.

Limited information available to date with respect to avian impacts from the *Deepwater Horizon* explosion, oil spill, and response suggests much lower mortality than would have been predicted by the spill size or volume alone (Belanger et al., 2010), though spill volume or size tends to be a poor predictor of avian mortality (Burger, 1993; Tan et al., 2010). The final modeled estimates of avian mortality will greatly exceed the number of avian carcasses collected (n = 7,258; **Table B-5**), but overall, the *Deepwater Horizon* explosion, oil spill, and response appears to have directly resulted in far fewer dead, oiled birds than the *Exxon Valdez* catastrophic spill (refer to Table 4-15 of the 2012-2017 WPA/CPA Multisale EIS). It should be recognized that the avian-related mortality associated with the *Deepwater Horizon* explosion, oil spill, and response (considered a catastrophic event) represents a small fraction of birds killed when compared with collisions with offshore oil and gas platforms. Russell (2005, page 304) states, "an average Gulf platform may cause 50 deaths by collision [only] per year," so using this number, the number of deaths the *Deepwater Horizon* rig would have caused through collisions had it remained intact for its 40-year term would be about 2,000. That is about 5,258 less than the number of avian carcasses collected due to the *Deepwater Horizon* explosion, oil spill, and response just given above. In the GOM, an estimated 200,000-321,000 avian deaths occur annually; primarily due to collisions with platforms (Table 4-7 of the 2012-2017 WPA/CPA Multisale EIS; also refer to Russell, 2005). Over the life of the GOM platform archipelago, the estimated total avian mortality is on the order of 7-12 million birds (refer to Figure 4-15 of the 2012-2017 WPA/CPA Multisale EIS). Oil spills, regardless of size, are but one of a myriad of anthropogenic avian mortality sources. Even the cumulative total avian mortality associated with all the North American oil spills to date is only a small fraction when compared with estimates of annual avian mortality attributed to collisions with buildings and windows, predation by housecats, and collisions with powerlines and communication towers (Klem, 2009; Manville, 2009; Table 4-7 of the 2012-2017 WPA/CPA Multisale EIS).

Overall Summary and Conclusion (Phases 1-4)

While the species composition and species-specific mortality estimates are unknown and would be dependent on the blowout location and time of year, the mortalities for the initial event (Phase 1) would almost certainly not result in population-level impacts for species present at the time of the blowout and resulting fire. Seabirds are highly vulnerable to becoming oiled and also to ingesting oil during Phase 2 (the offshore spill). Even recognizing the uncertainty associated with the scenario, spill characteristics, and the environmental conditions at the time of the spill, Phase 2 would likely be second only to Phase 3 (onshore contact) in total avian mortality. Phase 3 would include impacts to much greater avian species' richness and abundance (particularly during the breeding season) due to oil reaching habitats, including the nearshore, coastal beaches and dunes, and salt and brackish marshes. In general, the potential effects associated with Phase 4 (long-term recovery and response) should be limited to short-term disturbance effects (by cleanup personnel and equipment) and potential indirect effects to various bird species groups from habitat loss, alteration, or fragmentation from restoration efforts.

Phases 1 (initial event) and 2 (offshore spill) would likely result in very limited impacts to threatened and endangered bird species because the two scenarios have oil restricted to the offshore environment. Phase 3 (onshore contact) would likely result in the greatest net negative impacts to threatened and endangered bird species due to contact with the shoreline and potential movement of spilled oil inland to other habitats during this phase.

B.3.1.17. Fish Resources and Essential Fish Habitat

Phase 1—Initial Event

Depending on the type of blowout and the proximity of marine life to it (**Table B-1**), an eruption of gases and fluids may generate not only a toxic effect but also pressure waves and noise significant enough to injure or kill local biota. Within a few thousand meters of the blowout, resuspended sediments may clog fish gills and interfere with respiration. Settlement of resuspended sediments may, in turn, smother invertebrates or interfere with their respiration. Essential fish habitat (EFH) in the vicinity of the blowout could have adverse effects from the event. These EFH resources are discussed in the water quality (**Chapter B.3.1.2**), live bottoms (**Chapter B.3.1.6**), topographic features (**Chapter B.3.1.7**), *Sargassum* communities (**Chapter B.3.1.8**), chemosynthetic and nonchemosynthetic deepwater benthic communities (**Chapters B.3.1.9 and B**.**3.1.10**, respectively), and soft bottom benthic communities (**Chapter B.3.1.11**) chapters.

Phase 2—Offshore Spill

With the initiation of a catastrophic blowout incident, an explosion and subsequent fire are assumed to occur. If a blowout associated with the drilling of a single exploratory well occurs, this could result in a fire that would burn for 1 or 2 days, but if a blowout occurs on a production platform and other wells feed the fire, it could burn for over a month. The drilling rig or platform may sink, and if this occurs in shallow water, the sinking rig or platform may land in the immediate vicinity. If the blowout occurs in deep water, the rig or platform could land a great distance away and could be beyond avoidance zones. Regardless of water depth, the immediate response would be from search and rescue vessels and aircraft, such as USCG cutters, helicopters, rescue planes, and firefighting vessels.

Early life stages of animals are usually more sensitive to oil than adults (Boesch and Rabalais, 1987; NRC, 2005). Weathered crude oil has been shown in laboratory experiments to cause malformation, genetic damage, and even mortality at low levels in fish embryos of Pacific herring (Carls et al., 1999). Because natural crude oil found in the Gulf of Mexico would generally float on the surface, fish species whose eggs and larvae are found at or near the water surface are most at risk from an offshore spill. Species whose spawning periods coincide with the timing of the highest oil concentrations would be at greatest risk.

Adult fish may be less at risk than earlier life stages, in part because they are less likely to concentrate at the surface and may avoid contact with floating oil. The effects of oil on organisms can include direct lethal toxicity, sublethal disruption of physiological processes (internal lesions), the effects from direct coating by oil (suffocation by coating gills), incorporation of hydrocarbons in organisms (tainting or accumulation in the food chain), and changes in biological habitat (decreased dissolved oxygen) (Moore and Dwyer, 1974). The extent of the impacts of the oil would depend on the properties of the oil and the time of year of the event.

If there is a subsea catastrophic blowout, it is assumed dispersants would be used. Then there could be effects on multiple life history stages and trophic levels. There is limited knowledge of the toxicity of dispersants mixed with oil to specific species or life stages of ichthyoplankton and the likely extent of mortality because the combination of factors is difficult to determine. The combined toxic effects of the oil and any dispersants that may be used would not be apparent unless a significant portion of a year-class is absent from next year's fishery (e.g., shrimps, crabs, snapper, and tuna).

An example of a catastrophic event in the WPA was modeled using OSRA (Appendix C of the WPA 238/246/248 Supplemental EIS, Tables C-4 and C-5). Because fish occur throughout the GOM, it is assumed that some individuals would be contacted with oil. Specific habitats that are discussed with regards to the Western Planning Area OSRA example and in the Appendix are water quality (**Chapter B.3.1.2**), wetlands (**Chapter B.3.1.4**), seagrass communities (**Chapter B.3.1.5**), live bottoms (**Chapter B.3.1.6**), topographic features (**Chapter B.3.1.7**), *Sargassum* communities (**Chapter B.3.1.8**), chemosynthetic and nonchemosynthetic deepwater communities (**Chapters B.3.1.9 and B.3.1.10**, respectively), and soft bottom benthic communities (**Chapter B.3.1.11**).

Studies by USEPA, Office of Research and Development (2010) using representative species provide some indication of the relative toxicity of Louisiana sweet crude oil, dispersants, and oil/dispersant mixes. Bioassays were conducted using two Gulf species—a mysid shrimp (*Amercamysis bahia*) and a small estuarine fish, the inland silverside (*Menidia beryllinina*)—to evaluate the acute toxic effects of oil, eight dispersants, and oil/dispersant mixtures. In addition, USEPA used standard *in vitro* techniques using the same dispersants to (1) evaluate the acute toxicity on three cell lines over a range of concentrations and (2) evaluate the effects of these dispersants on androgen and estrogen function using human cell lines (to see if they are likely to disrupt hormonal systems). All dispersants showed cytotoxicity in at least one cell type at concentrations between 10 and 110 ppm. Results of the *in vitro* toxicity tests were similar to the whole animal tests. For all eight dispersants, for both species, the dispersants alone were less toxic than the dispersant/oil mixture. Louisiana sweet crude oil alone was determined to be more toxic to both the mysid shrimp and silverside fish than the dispersants alone. The results of the testing for disruption of androgen and estrogen function indicate that the dispersants do not show biologically significant endocrine activity via androgen or estrogen pathways (USEPA, Office of Research and Development, 2010).

The GOM waters out to 100 fathoms (182 m; 600 ft) have EFHs described and identified for managed species (GMFMC, 2005; USDOC, NOAA, 2009). There are Fisheries Management Plans for shrimp, red drum, reef fishes, coastal migratory pelagics, spiny lobsters, coral and coral reefs, and highly migratory species (GMFMC, 2004; USDOC, NOAA, 2009). These species could use the GOM for EFH at different life history stages. The Highly Migratory Species Fisheries Management Plan was recently amended to update EFH and Habitat Areas of Particular Concerns for the Atlantic bluefin tuna spawning area (USDOC, NOAA, 2009).

These EFHs in the Gulf of Mexico are discussed in various chapters of this Appendix: water column (**Chapter B.3.1.2**); wetlands (**Chapter B.3.1.4**); seagrass communities (**Chapter B.3.1.5**), live bottoms (**Chapter B.3.1.6**); topographic features (**Chapter B.3.1.7**), *Sargassum* communities (**Chapter B.3.1.8**); chemosynthetic and nonchemosynthetic deepwater benthic communities (**Chapters B.3.1.9 and B.3.1.10**, respectively), and soft bottom benthic communities (**Chapter B.3.1.11**); these EFHs are also summarized in Appendix D of the 2012-2017 WPA/CPA Multisale EIS. There are current NTLs (NTL 2009-G39 and NTL 2009-G40) and stipulations that provide guidance and clarification of the regulations with respect to many of these biologically sensitive underwater features and areas and benthic communities, which are considered EFH.

Plankton

Open-water organisms, such as phytoplankton and zooplankton, are essential to the marine food web. They play an important role in regulating climate, contribute to marine snow, and are an important source of nutrients for mesopelagic and benthic habitats. Also, monthly ichthyoplankton collections over the years 2004-2006 offshore of Alabama have confirmed that peak seasons for ichthyoplankton concentrations on the shelf are spring and summer (Hernandez et al., 2010). If a catastrophic blowout occurs in the spring and summer, it could cause greater harm to fish populations and not just individual fish. Therefore, an offshore oil spill would not only have an impact on these populations but also on the species that depend on them.

The microbial community can also be affected by an offshore oil spill. The microbial loop is an essential part of the marine ecosystem. Changes in the microbial community because of an oil spill could have significant impacts on the rest of the marine ecosystem. However, several laboratory and field experiments and observations have shown that impacts to planktonic and marine microbial populations are generally short lived and do not affect all groups evenly, and in some cases stimulate growth of important species (Gonzalez et al., 2009; Graham et al., 2010; Hing et al., 2011).

Phase 3—Onshore Contact

It is estimated that shoreline oiling would last 1-5 months from a shallow-water catastrophic spill event and 3-4 months from a deepwater catastrophic spill. It is estimated that there would be contact to the shoreline within 30 days of the spill for both shallow-water and deepwater spill locations. Though response methods would be monitored, there would also be some impact from these efforts on contacted coastal habitats. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

The life history of estuarine-dependent species involves spawning on the continental shelf; the transportation of eggs, larvae, or juveniles back to the estuary nursery grounds; and migration of the adults back to the sea for spawning (Deegan, 1989; Beck et al., 2001). Estuaries in the Gulf of Mexico are extremely important nursery areas and are considered EFH for fish and other aquatic life (Beck et al., 2001). Oiling of these areas, depending on the severity, can destroy nutrient-rich marshes and erode coastlines that have been significantly damaged by recent hurricanes.

The Gulf of Mexico supports a wide variety of finfish, and most of the commercial finfish resources are linked either directly or indirectly to the estuaries that ring the Gulf of Mexico. Darnell et al. (1983) observed that the density distribution of fish resources in the Gulf was highest nearshore off of the central Gulf Coast. For all seasons, the greatest abundance occurred between Galveston Bay and the mouth of the Mississippi River. Oyster beds could be damaged by freshwater diversions that release tens of thousands of cubic feet of freshwater per second for months in an effort to keep oil out of the marshes. Adult oysters survive well physiologically in salinities from those of estuarine waters (about 7.5 parts per thousand sustained) to full strength seawater (Davis, 1958). While oysters may tolerate small changes in salinity for a few weeks, a rapid decrease in salinity over months would kill oysters. In the event of a catastrophic oil spill, at least 1 year's oyster production in the area receiving fresh water would be lost because of exposure to freshwater and/or oil.

Phase 4—Post-Spill, Long-Term Recovery and Response

In addition to possible small fish kills because of direct impacts (as described under Phases 2 and 3), a catastrophic spill could affect fish populations in the long term. Due to a catastrophic spill, a significant portion of a year class of fish could be absent from the following year's fishery, reducing overall population numbers. However, sublethal impacts, especially for long-lived species (e.g., snapper and grouper), could be masked by reduced fishing pressure because of closures. In addition, healthy fish resources and fishery stocks depend on ideal habitat (EFH) for spawning, breeding, feeding, and growth to maturity. There could be long-term effects to coastal habitats from buried or sequestered oil becoming resuspended after a disturbance. Thus, a catastrophic spill that affects these areas could result in long-term impacts, including destruction to a portion of their natural habitats.

Overall Summary and Conclusion (Phases 1-4)

Depending on the type of blowout and the proximity of marine life to it, an eruption of gases and fluids may generate not only a toxic effect but also pressure waves and noise significant enough to injure or kill local biota and destroy habitat in the immediate vicinity (Phase 1). Adult fish may be less at risk than earlier life stages, in part because they are less likely to concentrate at the surface and may avoid contact with floating oil. Effects of oil on organisms can include direct lethal toxicity, sublethal disruption of physiological processes (internal lesions), the effects from direct coating by oil (suffocation by coating gills), incorporation of hydrocarbons in organisms (tainting or accumulation in the food chain), and changes in biological habitat (decreased dissolved oxygen) (Phase 2). Estuaries in the Gulf of Mexico are extremely important nursery areas and are considered EFH for fish and other aquatic life (Beck et al., 2001). Oiling of these areas, depending on the severity, can destroy nutrient-rich marshes and erode coastlines that have been significantly damaged by recent hurricanes (Phase 3). Due to a catastrophic spill, a significant portion of a year class of fish could be absent from the following year's fishery, reducing overall population numbers. However, sublethal impacts, especially for long-lived species (e.g., snapper and grouper), could be masked by reduced fishing pressure because of closures (Phase 4).

B.3.1.18. Commercial Fisheries

Phase 1—Initial Event

The initial explosion and fire could endanger commercial fishermen in the immediate vicinity of the blowout. Although commercial fishing vessels in the area would likely aid in initial search-and-rescue operations, the subsequent fire could burn for over a month, during which time commercial vessels would be expected to avoid the area so as to not interfere with response activities. This could impact the livelihood and income of these commercial fishermen. The extent of the economic impact on the fishing community would depend largely on the season during which the blowout occurred, the depth of water in which it occurred, and its distance from shore.

Phase 2—Offshore Spill

The Gulf of Mexico is one of the largest producers of seafood in the continental United States. In 2010 the Gulf of Mexico provided 40 percent of the commercial fishery landings in the continental U.S. (excluding Alaska), with over 1.5 billion pounds valued at nearly $670 million (USDOC, NMFS, 2012b). Various commercial species are fished from State waters through the Exclusive Economic Zone and are found throughout the water column as well as at the surface and near the seafloor. Commercial species occupy many different habitats throughout the area, and many commercial species occupy different habitats during different life stages. Most commercial species spend at least part of their life cycles in the productive shelf and estuarine habitat. In the event of a catastrophic offshore spill, it is assumed that a large quantity of oil would be released daily whether this spill occurred in State or Federal waters. Although the oil would generally float, it is also assumed that dispersants would be used preventing much of the oil from reaching the surface.

As an example of the areas that could be affected by such a catastrophic oil spill in the WPA, two OSRA model runs were performed using two different launch points as described in **Chapter B.1.2.3**. The resulting tables show conditional probabilities (expressed as percent chance) of an oil spill contacting resources in the GOM for each launch point and for each season, the condition being that a spill is assumed to have occurred at the given location. Because the commercial species are so widespread over the GOM, all of the tables are referenced (Appendix C of the WPA 238/246/248 Supplemental EIS, Tables C-4 and C-5).

Oil that is not volatilized, dispersed, or emulsified by dispersants has the potential to affect finfish through direct ingestion of hydrocarbons or ingestion of contaminated prey. Finfish are, however, mobile and generally avoid adverse conditions. Less mobile species or planktonic larval stages are more susceptible to the effects of oil and dispersants.

Actual effects of any oil that is released and comes in contact with populations of commercially important species will depend on the API gravity of the oil, its ability to be metabolized by microorganisms, and the time of year of the spill. The effects on the populations will be at a maximum during the spawning season of any commercially important population, exposing larvae and juveniles to oil. The effects on commercial species may also include tainting of flesh or the perception of tainting in the market. This can, depending on the extent and duration of the spill, affect marketability of commercial species.

Even though sensory testing may show no detectable oil or dispersant odors or flavors and the chemical test results could be well below the known levels of concern, NOAA Fisheries would be expected to close large portions of the Gulf of Mexico during a high-volume spill. This would be done as a precautionary measure to ensure public safety and to assure consumer confidence in Gulf seafood (USDOC, NMFS, 2010b). Up to 30-40 percent of the Gulf of Mexico's Exclusive Economic Zone could be closed to commercial fishing as the spill continues and expands (USDOC, NMFS, 2010c). This area could represent 50-75 percent of the Gulf's seafood production (Flynn, 2010). The size of the closure area may peak about 50 days into the spill and could persist another 2-3 months until the well is killed or capped and the remaining oil is recovered or dissipates. During this period, portions or all of individual State waters would also be closed to commercial fishing.

The economic impacts of closures on commercial fishing are difficult to predict because they are dependent on the season and would vary by fishery. If fishers cannot make up losses throughout the remainder of the season, a substantial part of their annual income would be lost. In some cases, commercial fishers will leave the industry and some may move to areas still open to fishing, but at a greater cost because of longer transit times. Marketing issues are also possible; even if the catch is uncontaminated, the public may lack confidence in the product. The duration of the public's perception of seafood tainting is also difficult to predict and depends to some extent on the duration of the spill and public awareness of the spill.

Phase 3—Onshore Contact

Shoreline contact of oil is estimated to persist from 1 to 5 months in the event of a shallow-water catastrophic spill and for up to 6 months from a deepwater catastrophic spill. The OSRA probability tables show the conditional probabilities (expressed as percent chance) for a shoreline contact for each season, the condition being that a spill is assumed to have occurred at the given location. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

This scenario, depending on the season of occurrence, would cause disruption in commercial fishing activity because many commercial fishermen operate inshore in State waters.

In addition to closures in Federal waters, portions of individual State waters would also be closed to commercial fishing. The economic impacts of closures on commercial fishing are complicated to predict because it is dependent on season and would vary by fishery. If fishers cannot make up losses in the remainder of the season, a substantial part of their annual income will be lost. In some cases, commercial fishers may move to areas still open to fishing, but at a greater cost because of longer transit times and, in some instances, additional license costs. Some commercial fishermen may also augment their income by aiding in the cleanup effort and/or renting the boats as vessels of opportunity.

Phase 4—Post-Spill, Long-Term Recovery and Response

The Gulf of Mexico is an important biological and economic area in terms of commercial seafood production and recreational fishing. Commercial fishermen in the Gulf of Mexico harvested over 1.5 billion pounds of finfish and shellfish in 2010 (USDOC, NMFS, 2012b). The economic impacts of closures on commercial fishing are complicated to predict because the economic effects are dependent on season and would vary by fishery. If fishermen cannot make up losses by fishing the remainder of the season or by participating as contractors in the cleanup, a substantial part of their annual income could be lost and may force them out of the industry. While the commercial fishing industry of Texas did not sustain measurable direct or indirect economic effects following the 1979 *Ixtoc I* blowout and spill (Restrepo et al., 1982), there is a documented phenomenon that, long after an incident, the perception of tainted fish and shellfish from the impacted area persists (Keithly and Diop, 2001). Data regarding the duration of the negative perception of Gulf seafood following the *Deepwater Horizon* explosion, oil spill, and response are not yet available. It is reasonable to assume that a negative perception could impact the value of commercial fish resources for several seasons.

Overall Summary and Conclusion (Phases 1-4)

The Gulf of Mexico is one of the largest producers of seafood in the continental United States. Various commercial species are fished from State waters through the Exclusive Economic Zone and are found throughout the water column. The primary economic impacts of oil spill on commercial fisheries are the closure of State or Federal waters to fishing and the perception of seafood tainting by the market. Both of these factors are difficult to predict. Closures depend on the size, timing, depth of water, and location of the spill as well as the fishery involved. Perception depends on length of the spill and public perception. Both of these factors could affect the livelihood of the fishing community.

B.3.1.19. Recreational Fishing

Phase 1—Initial Phase

About 20 percent of the recreational fishing activity in the Gulf of Mexico occurs within 300 ft (91 m) of oil and gas structures (Hiett and Milon, 2002). Therefore, an explosion and fire could endanger recreational fishermen and divers in the immediate vicinity of the blowout, especially if the blowout is located close to shore. Recreational vessels in the area would likely aid in initial search-and-rescue operations but they would also be in danger during the explosion and subsequent fire. The subsequent fire could burn for up to a month, during which recreational vessels would be expected to avoid the area and to not interfere with response activities. It is also possible that recreational fishing could be impacted in areas beyond the immediate area of the event due to the perceptions of the public.

Phase 2—Offshore Spill

If a catastrophic spill were to occur, a substantial portion of ocean waters could be closed. For example, 88,522 square miles (mi^2) (229,271 square kilometers [km^2]) were closed to recreational fishing activity at the peak of the *Macondo* well oil spill. However, the majority of recreational fishing activity occurs fairly close to shore. Therefore, while the spill remains offshore, the impacts would be particularly felt with respect to fishing of offshore species such as king mackerel and red snapper (the impacts of a catastrophic spill on fish populations are discussed in **Chapter B.3.1.17**). The NOAA's Center for Coastal Monitoring and Assessment (USDOC, NOAA, Center for Coastal Monitoring and Assessment, 2012) provides a set of maps that display the locations in the Gulf of Mexico where certain fish species are prevalent. However, even while the spill remains offshore, there could be impacts to inshore recreational fishing due to misperceptions regarding the extent of the spill or due to concerns regarding the tainting of fish species. These misperceptions could also reduce tourism activity, which would impact tourism-based recreational fishing activity.

In 2011, the percent of each Gulf Coast State's recreational fishing activity that occurred in State and Federal ocean waters combined (i.e., not inland waters) were as follows: Texas (6%); Louisiana (5%); Mississippi (2%); Alabama (42%); and West Florida (34%) (USDOC, NMFS, 2012c; Texas Parks and Wildlife Department, 2012). **Chapter 4.1.1.17** of this Supplemental EIS provides a further breakdown of recreational fishing activity by state. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

Phase 3—Onshore Contact

If a catastrophic spill were to reach shore, there would likely be noticeable impacts to recreational fishing activity. Since most recreational fishing activity occurs fairly close to shore, there would be a number of direct impacts to angler activity due to the fishing closures that would likely arise. This is particularly true since anglers would find it more difficult to find substitute fishing sites in the case of a catastrophic spill. In 2011, the percent of each Gulf State's recreational fishing activity that occurred inland were as follows: Texas (94%); Louisiana (95%); Mississippi (98%); Alabama (58%); and West Florida (66%) (USDOC, NMFS, 2012c; Texas Parks and Wildlife Department, 2012). The impacts to recreational fishing would also depend on the time of year of the spill. In 2011, 31 percent of angler trips in the Gulf occurred between January and April, 41 percent of angler trips occurred between May and August, and 28 percent of angler trips occurred between September and December (USDOC, NMFS, 2012c). In addition, fishing tournaments are often scheduled for the summer months and would be difficult to reschedule in the aftermath of a catastrophic spill. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

There would also be various economic impacts along the recreational fishing supply chain. Gentner Consulting Group (2010) estimates that recreational fishing activity supports $9.8 million in direct expenditures and $23 million in total sales per day in the Gulf of Mexico. There could be further impacts if the fishing closures persisted long enough to affect purchases of boats and other durable fishing equipment. There could also be further impacts if the loss of opportunities for recreational fishing activity exacerbated the fall in tourism activity that would arise due to the spill.

Phase 4—Post-Spill, Long-Term Recovery and Response

The long-term impacts of a catastrophic spill on recreational fishing activity would primarily depend on the extent to which fish populations recover (refer to **Chapter B.3.1.17** for more information). However, the longer term impacts of a spill on recreational fishing activity would also depend on the extent to which public perceptions of fish tainting can be assuaged. In addition, the longer-term impacts would depend on the extent to which the various firms that serve the recreational fishing industry would be able to weather the downturn in activity resulting from the spill.

Overall Summary and Conclusion (Phases 1-4)

Recreational fishing activity could be noticeably impacted in the event of a catastrophic spill. This is particularly the case if the spill reached shore or if the spill occurred during peak times and places of recreational fishing activity. The long-term impacts of a catastrophic spill would depend on the extent to which fish populations recover and the length of time it would take to convince the public that it was again safe to fish in the affected areas.

B.3.1.20. Recreational Resources

Phase 1—Initial Event

The most immediate impacts of a catastrophic spill would be on the recreational fishing and recreational diving activity in the vicinity of the blowout. About 20 percent of the recreational fishing activity and 90 percent of the recreational diving activity in the Gulf of Mexico from Alabama to Texas occurs within 300 ft (91 m) of oil and gas structures (Hiett and Milon, 2002). The impacts on recreational fishing and recreational diving would be greater the closer the blowout occurred to shore. The immediate response activities could also impact ocean-based recreational activity. Finally, there could be impacts to tourism activity since a catastrophic spill would likely receive a large amount of media attention.

Phase 2—Offshore Spill

While the spill is still offshore, there could be some ocean-dependent recreation that is affected (e.g., fishing, diving, and boating), as discussed above. In addition, there may be some effects due either to perceived damage to onshore recreational resources that has not yet materialized or to general hesitation on the part of travelers to visit the overall region because of the spill. A Congressional hearing into this matter (U.S. House of Representatives, 2010) provides a broad overview of some of the effects that were felt along the Gulf Coast subsequent to the *Deepwater Horizon* explosion, oil spill, and response. For example, a representative of Pinellas County estimated that this area had lost roughly $70 million in hotel revenue even though beaches in this area did not receive any oil damage. This type of effect could be due to misperceptions about the spill, uncertainty about the future of the spill, or concerns about whether a tourism experience will be affected even if the destination is only within close proximity to a spill.

As previously mentioned, recreational diving is one offshore recreational activity that would be particularly affected by a catastrophic oil spill. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

Phase 3—Onshore Contact

A catastrophic spill has the potential to noticeably impact the Gulf Coast recreation and tourism industries. The water-dependent and beach-dependent components of these industries would be particularly vulnerable. Environmental Sensitivity Indexes (ESIs) provide overall measures of the sensitivity of a particular coastline to a potential oil spill. The ESIs rank coastlines from 1 (least sensitive) to 10 (most sensitive). Marshes and swamps are examples of resources that have ESIs of 10 due to the extreme difficulty of removing oil from these areas; marsh and swamp areas are particularly prevalent in Louisiana. The ESIs for beach areas generally range from 3 to 6, depending on the type of sand and the extent to which gravel is mixed into the beach area; beach areas are particularly prevalent in Texas, Mississippi, Alabama, and Florida. The ESI maps for any coastline along the Gulf of Mexico can be viewed using the National Oceanic and Atmospheric Administration’s ERMA mapping system (USDOC, NOAA, 2012b; USDOC, NOAA, Office of Response and Restoration, 2014). The ESI maps also provide point indicators for recreational resources.

A catastrophic spill would also raise a number of issues regarding recreational activity that is based on tourism. One important point is that a spill of the *Deepwater Horizon*’s dimensions can influence a much broader range of individuals and firms than can a smaller spill. For example, a small, localized spill may lead some travelers to seek substitute recreational opportunities in nearby areas. However, a large spill is more likely to dissuade travelers from visiting a broader economic region. Similarly, small- and mid-sized restaurant chains and hotels may be able to find other customers or to simply weather a smaller spill. However, a spill the size of the *Deepwater Horizon* is more likely to affect these types of firms since they are less able to diversify their customer base. These effects can be seen in the makeup of those who filed damage claims with BP (Gulf Coast Claims Facility, 2012); the Gulf Coast Claims Facility closed in early 2012 subsequent to preliminary court approval of a settlement program. For example, the bulk of the claims by individuals have been made in the food, beverage, and lodging sector and in the retail, sales, and service sector. Claims have also been made by individuals and firms in a broad range of geographic regions, many of which were not directly impacted by oil.

Murtaugh (2010) provides data on the change in hotel and sales tax receipts for individual Gulf Coast counties in the months immediately following the *Deepwater Horizon* explosion, oil spill, and response. During the summer of 2010, the spill caused substantial declines in hotel receipts in the following counties: Baldwin, Alabama (33.2% decline); Santa Rosa, Florida (24.8% decline); Okaloosa, Florida (24.1% decline); Walton, Florida (12.3% decline); and Bay, Florida (7.4% decline). However, coastal counties west of Baldwin, Alabama (as far west as St. Mary, Louisiana), generally experienced noticeable increases in hotel receipts. This was particularly true in Mobile, Alabama; Jackson, Mississippi; and in the coastal parishes of Louisiana. For example, in Louisiana, St. Mary, Terrebonne, and Lafourche Parishes each reported increases in hotel tax receipts of over 80 percent in the summer of 2010. These effects are likely due to the influx of oil-spill relief workers to these areas in the immediate aftermath of the *Deepwater Horizon* explosion, oil spill, and response. Overall sales tax receipts in counties from Baldwin, Alabama, eastward also generally fell during 2010, although to a lesser extent than hotel tax receipts. Sales tax receipts in counties and parishes west of Baldwin, Alabama, did not show as clear a pattern as did hotel tax receipts. For example, overall sales tax receipts fell by 12.5 percent in Hancock County (Mississippi), receipts were almost unchanged in Harrison County (Mississippi), and receipts increased by 8.3 percent in Orleans Parish (Louisiana). These results suggest that the impacts of a future catastrophic spill will be influenced by the structure of a particular county/parish’s recreational economy, as well as by the extent to which oil-spill-response activities will mitigate some of the negative impacts of the spill in certain areas.

There could also be effects on tourist activities in areas far away from the areas directly affected by oil. For example, in Texas subsequent to the *Deepwater Horizon* explosion, oil spill, and response, some tourists may have stayed away from Texas Gulf Coast beaches due to misperceptions regarding the extent to which these beaches were damaged due to the spill. Conversely, there may have been some substitution of beach visitation away from beaches in the eastern Gulf towards the beaches in Texas, which were farther from the spill. While it is difficult to quantify these effects, some anecdotal evidence regarding this substitution effect can be found in Pack (2010). Hotel occupancy data suggest that these two effects may have largely offset each other. Source Strategies Inc. (2010) reports that total hotel occupancy in the three metro regions in Texas closest to the Gulf Coast increased just 1.9 percent during the third quarter of 2010 compared with the third quarter of 2009. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

Phase 4—Post-Spill, Long-Term Recovery and Response

The longer-term implications of a catastrophic event on tourism would depend on the extent to which any structural/ecological damage can be repaired and the extent to which economic mitigation actions would occur. The long-term implications of a catastrophic spill would also depend on the extent to which public confidence in the various components of the recreational and tourism economies can be restored. For example, restaurants in the region would be impacted to the extent to which they are perceived to use seafood products caught or raised in contaminated waters. Similarly, although beaches can be decontaminated not long after a spill has been stopped, lingering perceptions can be expected to negatively impact tourism even after a spill has ended.

Oxford Economics (2010) attempts to quantify these effects by analyzing the impacts of recent catastrophic events on recreational economies. For example, they analyzed the *Ixtoc I* well blowout and spill of 1979, the scale and nature of which was reasonably similar to the *Macondo* well blowout and spill of 2010. In this example, it took approximately 3 years for beaches to be cleaned and for recreational activity to return to similar levels as before the spill. They also looked at the *Prestige* oil spill of 2002 off the coast of Spain. Given the nature and size of that spill, recreational activity was able to return to pre-spill levels in approximately 1 year. Alaska's tourism economy took approximately 2 years to recover from the *Exxon Valdez* spill.

Overall Summary and Conclusion (Phases 1-4)

A catastrophic spill can cause noticeable impacts to recreational resources such as beaches. A catastrophic spill can also have complex effects on recreational activity that depends on tourism. The longer-term implications of a catastrophic oil spill on tourism would depend on the extent to which any structural/ecological damage can be repaired, the extent to which economic mitigation actions would occur, and the speed at which public confidence in the various components of the affected recreational and tourism economies would be restored.

B.3.1.21. Archaeological Resources

Phase 1—Initial Event

Offshore Archaeological Resources

BOEM protects all known, discovered, and potentially historic and prehistoric archaeological resources on the OCS by requiring appropriate avoidance criteria as well as directives to investigate these resources. Onshore archaeological resources, prehistoric and historic sites, would not be immediately impacted during the initial phase of a catastrophic blowout because the distance of a blowout site from shore is at least 3 nmi (3.5 mi; 5.6 km). However, offshore catastrophic blowouts, when compared with spills of lesser magnitude, may initially impact multiple archaeological resources. Resources adjacent to a catastrophic blowout could be damaged by the high volume of escaping gas, buried by large amounts of dispersed sediments, crushed by the sinking of the rig or platform, destroyed during emergency relief well drilling, or contaminated by the hydrocarbons.

Based on historical information, over 2,100 potential shipwreck locations have been identified on the Gulf of Mexico OCS (USDOI, MMS, 2007). This number is a conservative estimate and is heavily weighted toward post-19th century, nearshore shipwrecks, where historic records documenting the loss of the vessels were generated more consistently. BOEM currently has confirmed locational data for approximately 380 potential wreck sites, although the historic significance for the majority of these sites has not been determined.

BOEM's Regional Director may require the preparation of an archaeological report to accompany the exploration plan, development operations coordination document, or development and production plan, under 30 CFR § 550.194, and BSEE's Regional Director may do likewise under 30 CFR § 250.194 if a potential wreck is encountered during operations. As part of the environmental reviews conducted for postlease activities, available information is evaluated regarding the potential presence of archaeological resources within a WPA proposed action area to determine if additional archaeological resource surveys and mitigations are warranted. Having complete knowledge of seafloor resources before a spill occurs would enable responders to quickly plan countermeasures in a way that would minimize adverse effects occurring from the spill response.

Phase 2—Offshore Spill

Offshore Archaeological Resources

Due to the response methods (i.e., subsea dispersants) and magnitude of the response (i.e., thousands of vessels), a catastrophic blowout and spill have a greater potential to impact offshore archaeological resources than other accidental events.

Deep Water

In contrast to smaller spills or spills in shallow water, large quantities of subsea dispersants could be used for a catastrophic subsea blowout in deep water. This could result in currently unknown effects from dispersed oil droplets settling to the seafloor. Though information on the actual impacts to submerged cultural resources is inconclusive at this time, oil settling to the seafloor could come in contact with archaeological resources. At present, there is no evidence of this having occurred. A recent experimental study has suggested that, while the degradation of wood in terrestrial environments is initially retarded by contamination with crude oil, at later stages, the biodeterioration of wood is accelerated (Ejechi, 2003). While there are different environmental constraints that affect the degradation of wood in terrestrial and waterlogged environments, soft-rot fungal activity, one of the primary wood degrading organisms in submerged environments, was shown to be increased in the presence of crude oil (Ejechi, 2003). There is a possibility that oil from a catastrophic blowout could come in contact with wooden shipwrecks and artifacts on the seafloor and accelerate their deterioration.

Ancillary damages from vessels associated with oil-spill-response activities (e.g., anchoring) in deep water are unlikely because of the use of dynamically positioned vessels responding to a deepwater blowout. If response and support vessels were to anchor near a deepwater blowout site, the potential to damage undiscovered vessels in the area would be high because of the required number and the size of anchors and the length of mooring chains needed to safely secure vessels. Additionally, multiple offshore vessel decontamination stations would likely be established in shallow water outside of ports or entrances to inland waterways, as seen for the *Deepwater Horizon* explosion, oil spill, and response. The anchoring of vessels could result in damage to both known and undiscovered archaeological sites; the potential to impact archaeological resources increases as the density of anchoring activities in these areas increases.

Shallow Water

The potential for damaging archaeological resources increases as the oil spill and related response activities progress landward. In shallower waters, most of the damage would be associated with oil cleanup and response activities. Thousands of vessels would respond to a shallow-water blowout and would likely anchor, potentially damaging both known and undiscovered archaeological sites. Additional anchoring would be associated with offshore vessel decontamination stations, as described above. As the spill moves into the intertidal zone, the chance of direct contact between the oil and archaeological resources increases. As discussed above, this could result in increased degradation of wooden shipwrecks and artifacts.

Additionally, in shallower waters, shipwrecks often act as a substrate to corals and other organisms, becoming an essential component of the marine ecosystem. These organisms often form a protective layer over the shipwreck, virtually encasing the artifacts and hull remains. If these fragile ecosystems were destroyed as a result of the oil spill and the protective layer was removed, the shipwreck would then be exposed to increased degradation until it reaches a new level of relative stasis with its surroundings.

Regardless of water depth, because oil is a hydrocarbon, heavy oiling could contaminate organic materials associated with archaeological sites, resulting in erroneous dates from standard radiometric dating techniques (e.g., ^{14}C-dating). Interference with the accuracy of ^{14}C-dating would result in the loss of valuable data necessary to understand and interpret the sites.

Phase 3—Onshore Contact

Onshore Archaeological Resources

Regardless of the water depth in which the catastrophic blowout occurs, it is assumed that more than 1,000 mi (1,609 km) of shoreline could be oiled to some degree. Onshore prehistoric and historic sites would be impacted to some extent by a high-volume spill from a catastrophic blowout that reaches shore. Sites on barrier islands could suffer the heaviest impact, and a few prehistoric sites located inland from the coastline, in the marsh, and along bayous could also experience some light oiling. Impacts would include the loss of ability to accurately date organic material from archaeological sites because of contamination or increased research costs to clean samples for analysis. Efforts to prevent coastal cultural resources from becoming contaminated by oil would likely be overwhelmed in the event of a hurricane and by the magnitude of shoreline impacted.

The most significant damage to archaeological sites could be related to cleanup and response efforts. Fortunately, important lessons were learned from the *Exxon Valdez* spill in Alaska in 1989, in which the greatest damage to archaeological sites was related to cleanup activities and looting by cleanup crews rather than from the oil itself (Bittner, 1996). As a result, cultural resources were recognized as significant early in the *Deepwater Horizon* response and cleanup, and archaeologists were embedded in Shoreline Cleanup Assessment Teams (SCAT) and consulting with cleanup crews. Historic preservation representatives were present at both the Joint Incident Command as well as each Area Command under the general oversight of the National Park Service to coordinate response efforts (Odess, official communication, 2010). Despite these efforts, some archaeological sites suffered damage from looting or from spill cleanup activities, most notably the parade ground at Fort Morgan, Alabama (Odess, official communication, 2011).

Phase 4—Post-Spill, Long-Term Recovery and Response

Onshore Archaeological Resources

Regardless of the water depth in which the catastrophic blowout occurs, it is assumed that more than 1,000 mi (1,609 km) of shoreline could be oiled to some degree. Onshore prehistoric and historic sites would be impacted to some extent by a high-volume spill from a catastrophic blowout that reaches shore. A few prehistoric sites in Louisiana, located inland from the coastline in the marsh and along bayous, could experience some light oiling. As discussed above, impacts would include the permanent loss of ability to accurately date organic material from archaeological sites because of contamination. The most significant damage to archaeological sites would be related to cleanup and response efforts. Long-term recovery would prove difficult if not impossible. Historic structures such as coastal forts that are exposed to oiling are generally constructed of brick or other porous, friable materials that are difficult to clean without causing further damage (Chin and Church, 2010). Funding for any sort or archaeological recovery is problematic outside of Federal lands because of existing laws and regulations (Varmer, 2014). Most coastal prehistoric sites in Louisiana, for example, are on private lands where there is no mechanism to recover damages. Section 106 of the National Historic Preservation Act is triggered by a Federal undertaking, which in the case of a spill, would be the response and not the actual spill. The Natural Resource Damage Assessment (NRDA) process codified by the Oil Pollution Act of 1990 is a legal process to determine the type and amount of restoration needed to compensate the public for harm to natural resources that occurs as a result of an oil spill, but it does not cover cultural, archaeological, or historic properties.

Overall Summary and Conclusion (Phases 1-4)

Archaeological resources are finite, unique, irreplaceable, nonrenewable records of mankind’s past, which, once destroyed or damaged, are gone forever. In the event of a catastrophic oil spill, the most likely source of irreversible impact is, ironically, from the spill response, and the danger increases dramatically as the response approaches the shoreline. This damage can, to a large extent, be mitigated by the early integration of archaeologists and State and Tribal historic preservation officers in the response to protect sites from impact. Mitigation of impacts from the oil itself is likely to meet with varied success depending upon the type of site and availability of funding.

B.3.1.22. Land Use and Coastal Infrastructure

Phase 1—Initial Event

There would likely be no adverse impacts to land use and coastal infrastructure as a result of the events and the potential impact-producing factors that could occur throughout Phase 1 of a catastrophic spill event because of the long distance (>3 nmi; 3.5 mi; 5.6 km) from shore and the short duration of the initial event, fire, and/or explosion.

Phase 2—Offshore Spill

Impacts to tourism and recreational resources are addressed in **Chapter B.3.1.20**. Possible fisheries closures are addressed in **Chapters B.3.1.18 and B.3.1.19**. As cleanup and remediation efforts evolve, there would be increased activity at ports and coastal cities, leading to increased traffic on road infrastructure and at port facilities. This follows from consideration of BOEM's scenario estimates of up to 3,000 vessels, 25-50 planes/helicopters, and up to 25,000 workers for a shallow-water event and up to 7,000 vessels, 50-100 planes/helicopters, and up to 50,000 workers for a deepwater event. Waste disposal activities associated with boom deployment and retrieval would increase demand at waste disposal facilities. BOEM's scenario estimates 5 million feet (1.5 million meters) of boom deployment and 35,000 bbl of dispersant applied at the surface for a shallow-water event or 11 million feet (3.4 million meters) of boom deployment and 33,000 bbl of dispersant applied at the surface and 16,500 bbl of dispersant applied subsea for a deepwater event. Also, vessel decontamination sites would be set up offshore and the staffing/maintenance of these sites would contribute to increased activity at port facilities and traffic congestion on coastal waterways and highways.

Phase 3—Onshore Contact

In the event of a catastrophic spill, impacts on land use and infrastructure would be temporary and variable in nature. The scale of impact would depend on the nature of the event and whether it occurs in shallow or deep water. These impacts would include land use in staging areas, waste disposal locations and capacities, and potential delays because of vessel decontamination stations near ports, as described below.

For a shallow-water event, BOEM estimates 5-10 staging areas and 200-300 skimmers. For a deepwater event, scenario estimates call for 10-20 staging areas and 500-600 skimmers. Given these estimates and the several thousand responders that would be involved in the effort, BOEM expects a further increase in traffic congestion and some possible competing land-use issues near the staging areas, depending on the real estate market at the time of the event. Some infrastructure categories, such as vessels, ports, docks and wharves, would likely become very engaged in response activities and this could result in a shortage of space and functionality at infrastructure facilities if ongoing drilling activities were simultaneously occurring. However, if drilling were to be suspended, conflicting demands on infrastructure facilities would likely fail to materialize.

In the category of waste disposal, the impacts would be more visible as thousands of tons of oily liquid and solid wastes from the oil-spill cleanup would be disposed of in onshore landfills. As was the case in the *Deepwater Horizon* explosion, oil spill, and response, USEPA, in consultation with USCG, would likely issue solid-waste management directives to address the issue of contaminated materials and solid or liquid wastes that are recovered as a result of cleanup operations (USEPA, 2010c and 2010d).

For navigation and port use, there would also be the potential for delays in cargo handling and slow vessel traffic because of decontamination operations at various sites along the marine transportation system (USDOT, 2010). However, vessel decontamination activities most likely would be complete within a year of the event, so impacts would be expected to be limited in duration.

Phase 4—Post-Spill, Long-Term Recovery and Response

Based on the rapid recovery of infrastructure that was heavily damaged by the catastrophic 2005 hurricane season and the region's experience in the few years since the *Deepwater Horizon* explosion, oil spill, and response, BOEM would not expect any long-term impacts to land use and coastal infrastructure as a result of a catastrophic oil-spill event. However, if a catastrophic oil spill were to occur, BOEM would (as it is currently with regard to the *Deepwater Horizon* explosion, oil spill, and response) monitor the post-spill, long-term recovery phase of the event for any changes that indicate otherwise. A catastrophic spill could generate several thousand tons of oil-impacted solid materials disposed in landfills along the Gulf Coast. This waste may contain debris, beach, or marsh material (sand/silt/clay), vegetation, and personal protection equipment collected during cleanup activities. BOEM does not expect that landfill capacity would be an issue at any phase of the oil-spill event or the long-term recovery. In the case of the *Deepwater Horizon* explosion, oil spill, and response, USEPA reported that existing landfills receiving oil-spill waste had plenty of capacity to handle waste volumes; the *Deepwater Horizon* explosion, oil spill, and response's waste that was disposed of in landfills represented less than 7 percent of the total daily waste normally accepted at these landfills (USEPA, 2012).

It is not expected that any long-term, land-use impacts would arise from properties that are utilized for restoration activities and would somehow have their future economic use compromised. The rise or fall of property values would not be solely a function of some kind of economic impact from a catastrophic oil-spill event. There are many other factors that influence the value of property and its best economic use. To date, it is not clear from past experiences whether vegetation loss or erosion created by a spill could result in changes in land use. The amount and location of erosion and vegetation loss could be influenced by the time of year the spill occurs, its location, and weather patterns, including hurricane landfalls.

Overall Summary and Conclusion (Phases 1-4)

There would likely be no adverse impacts to land use and coastal infrastructure throughout Phase 1 of a catastrophic spill event. Response efforts in Phases 2 and 3 would require considerable mobilization of equipment and people. While these efforts might temporarily displace traditional users of coastal land and infrastructure, these interruptions would not be long lasting. The post-spill, long-term recovery and response efforts during Phase 4 could generate several thousand tons of oil-impacted solid materials disposed in landfills along the Gulf Coast, but this would account for no more than 7 percent of the total daily waste normally accepted in these landfills. It is also not expected that any properties utilized for restoration activities throughout Phase 3 would not suffer any long-term land use or economic impacts.

B.3.1.23. Demographics

Phase 1—Initial Event

The impacts of a catastrophic spill on demographics would primarily be driven by the spill's impacts on employment (refer to **Chapter B.3.1.24**). Since the impacts of a catastrophic spill on employment would take time to evolve, the initial impacts on demographics would be minimal. Therefore, there would likely be no adverse impacts to demographics as a result of the events and the potential impact-producing factors that could occur throughout Phase 1 of a catastrophic spill event.

Phase 2—Offshore Spill

The impacts of a catastrophic spill on demographics would primarily be driven by the spill's impacts on employment (refer to **Chapter B.3.1.24**). For example, there could be some suspension of oil/gas activities in the immediate aftermath of the spill. This could cause some workers to seek employment outside of the OCS industry, for example in onshore oil/gas extraction or on overseas offshore projects. However, since the OCS oil and gas industry would likely eventually recover, the long-term impacts on demographics would be small. There could also be impacts on demographics if employment in recreation, tourism, or fishing industries were affected, due to either actual or perceived impacts of the spill. However, the impacts on these industries would become more acute if the spill were to reach shore.

Phase 3—Onshore Contact

The impacts of a catastrophic spill on demographics would primarily be driven by the spill's impacts on employment (refer to **Chapter B.3.1.24**). For example, impacts to recreation/tourism and recreational and commercial fishing activities would become more acute if the spill were to reach shore. There would also be a larger presence of cleanup workers in some areas if the spill were to reach shore. For example, 48,200 workers were employed in response activities at the peak of the response effort following the *Macondo* well blowout and spill (RestoreTheGulf.gov, 2011). However, these impacts would be temporary and would be governed by the dynamics of the particular spill. There could also be impacts to demographics if there were impacts on the response workers' health or if the demographics of the response workers were noticeably different from the local population.

Phase 4—Post-Spill, Long-Term Recovery and Response

The impacts of a catastrophic spill on demographics would primarily be driven by the spill's impacts on employment (refer to **Chapter B.3.1.24**). The spill's impacts on employment, and therefore demographics, would primarily be felt in the oil/gas, recreational fishing, commercial fishing, and recreation/tourism industries. However, it is unlikely that a catastrophic spill would cause substantial long-term changes to a region's demographics. For example, the demographics data in Woods and Poole Economics, Inc. (2011) did not suggest large demographic changes to any Gulf regions subsequent to the *Deepwater Horizon* explosion, oil spill, and response.

Overall Summary and Conclusion (Phases 1-4)

The impacts of a catastrophic spill on demographics would primarily be driven by the spill's impacts on employment (refer to **Chapter B.3.1.24**). These impacts would likely be temporary and would be governed by the particular dynamics of the spill.

B.3.1.24. Economic Factors

Phase 1—Initial Event

The most immediate economic impacts of a catastrophic spill would be on the oil/gas production and employment associated with the area of the spill. There could also be impacts on commercial fishing (**Chapter B.3.1.18**), recreational fishing (**Chapter B.3.1.19**), and recreational resources (**Chapter B.3.1.20**). However, the primary economic impacts of a catastrophic spill would depend how the spill evolves, which is discussed in subsequent sections.

Phase 2—Offshore Spill

In contrast to a less severe accidental event, suspension of some oil and gas activities would be likely following a catastrophic event. Depending on the duration and magnitude, this could impact hundreds of oil-service companies that supply the steel tubing, engineering services, drilling crews, and marine supply boats critical to offshore exploration. An interagency economic report estimated that the suspension arising from the *Deepwater Horizon* explosion, oil spill, and response may have directly and indirectly resulted in up to 8,000-12,000 fewer jobs along the Gulf Coast (USDOC, Economics and Statistics Administration, 2010). Greater New Orleans, Inc. (2012) provides an overview of the impacts of decreased oil and gas industry operations subsequent to the *Deepwater Horizon* explosion, oil spill, and response. This report provides survey evidence regarding the various economic strains felt by businesses in Louisiana due to the *Deepwater Horizon* explosion, oil spill, and response. For example, this report found that 41 percent of the respondents were not making a profit due to the slowdown in operations. The economic impacts of a catastrophic spill would likely be more heavily concentrated in smaller businesses than in the larger companies due to their difficulty in finding substitute revenue sources. Much of the employment loss would be concentrated in coastal oil-service parishes in Louisiana (St. Mary, Terrebonne, Lafourche, Iberia, and Plaquemines Parishes) and counties/parishes where drilling-related employment is most concentrated (Harris County, Texas, in which Houston is located, and Lafayette Parish, Louisiana). There could also be economic impacts due to the impacts on commercial fishing (**Chapter B.3.1.18**), recreational fishing (**Chapter B.3.1.19**), and recreational resources (**Chapter B.3.1.20**).

Phase 3—Onshore Contact

By the end of a catastrophic spill, a large number of personnel (up to 25,000 in the event of a shallow-water spill and up to 50,000 in the event of a deepwater spill) would be expected to have responded to protect the shoreline and wildlife and to cleanup vital coastlines. The degree to which new cleanup jobs offset job losses would vary greatly from county to county (or parish to parish). However, these new jobs would not make up for lost jobs, in terms of dollar revenue. In most cases, cleanup personnel are paid less (e.g., $15-$18 per hour compared with roughly $45 per hour on a drilling rig), resulting in consumers in the region having reduced incomes overall and thus, spending less money in the economy (Aversa, 2010). In addition, the economic impacts of relief workers would likely vary by county or parish, causing noticeable positive economic impacts to some counties or parishes while having fairly small positive impacts in other counties or parishes (Murtaugh, 2010). However, the influx of relief workers could also cause some negative impacts if it disrupted some of the normal functioning of economies. In addition, if the spill reaches shore, the impacts to commercial fishing (**Chapter B.3.1.18**), recreational fishing (**Chapter B.3.1.19**), and recreational resources (**Chapter B.3.1.20**) would likely be greater.

In the unfortunate event of a future disaster, the creation of a large financial claims administration process, similar to the Gulf Coast Claims Facility, would be likely. This administrative body would be responsible for distributing funds made available by the responsible party to parties financially hurt by the disaster. As demonstrated by the actions of Gulf Coast Claims Facility recipients following the *Deepwater Horizon* explosion, oil spill, and response, funds will likely be used by individuals to pay for necessities such as mortgages or groceries, while businesses who receive funds will likely use them to maintain payroll and current payments on equipment. As of March 2012, over $6 billion had been paid through the Gulf Coast Claims Facility, which mitigated some of the economic impacts of the *Deepwater Horizon* explosion, oil spill, and response (Gulf Coast Claims Facility, 2012).

Phase 4—Post-Spill, Long-Term Recovery and Response

While a catastrophic spill could immediately impact several Gulf Coast States for several months through fishing closures, loss of tourism, and any suspension of oil and gas activities, anticipating the long-term economic and employment impacts in the Gulf of Mexico is a difficult task. Many of the potentially affected jobs, like fishing charters, are self-employed. Thus, they would not necessarily file for unemployment and will not be included in business establishment surveys used to estimate State unemployment levels. In addition, unemployment numbers in states are based on nonagricultural jobs, and the fishing industry is considered within the agriculture category. On the other side, it is also a challenge to estimate how many of these displaced workers have been hired to clean up the spill. For example, while thousands of vessels of opportunity would be active in the spill response, not all of these would be displaced commercial fishermen from the affected areas. The positive employment impacts related to response activities are likely to be shorter term than the negative impacts discussed above. However, the long-term economic impacts of a catastrophic spill will likely depend on the speed at which the oil/gas, commercial fishing, recreational fishing, and recreational industries recover.

Overall Summary and Conclusion (Phases 1-4)

There would be a number of economic impacts that would arise from a catastrophic oil spill. The most direct effects would be on the recreation/tourism, commercial fishing, and recreational fishing industries that depend on damaged resources. There could also be substantial negative effects on the oil/gas industry due to moratoriums or rule changes that would arise. Finally, there could be substantial impacts due to the relief operations and economic mitigation activities that would occur in the aftermath of a catastrophic spill.

B.3.1.25. Environmental Justice

Phase 1—Initial Event

There would likely be no adverse impacts to environmental justice as a result of the events and the potential impact-producing factors that could occur throughout Phase 1 of a catastrophic spill event because of the long distance (>3 nmi; 3.5 mi; 5.6 km) from shore and the short duration of the initial event, fire, and/or explosion.

Phase 2—Offshore Spill

The environmental justice policy, based on Executive Order 12898 of February 11, 1994, directs agencies to incorporate into NEPA documents an analysis of potentially disproportionate and detrimental environmental and health effects of their proposed actions on minorities and low-income populations and communities. While the spill is still offshore, the primary environmental justice concern would be large commercial fishing closures disproportionately impacting minority fishers. In the event of a catastrophic spill, Federal and State agencies would be expected to close substantial portions of the Gulf to commercial and recreational fishing (USDOC, NOAA, 2010e). While oystering occurs "onshore," oyster beds are also likely to be closed to harvests during Phase 2 of a catastrophic spill because of concerns about oil contamination and increased freshwater diversions to mitigate oil intrusion into the marshes. These closures would directly impact commercial fishermen and oystermen, and indirectly impact such downstream activities as shrimp processing facilities and oyster shucking houses. The mostly African-American communities of Phoenix, Davant, and Point a la Hache in Plaquemines Parish, Louisiana, are home to families with some of the few black-owned oyster leases. Just as these leases have been threatened by freshwater diversion projects for coastal restoration, they could be threatened by Phase 2 of a catastrophic spill (Mock, 2010).

The Gulf Coast hosts multiple minority and low-income groups whose use of natural resources of the offshore and coastal environments make them vulnerable to fishing closures. While not intended as an inventory of the area's diversity, we have identified several Gulf Coast populations of particular concern. An estimated 20,000 Vietnamese American fishermen and shrimpers live along the Gulf Coast; by 1990, over 1 in 20 Louisiana fishers and shrimpers had roots in Southeast Asia even though they comprised less than half a percent of the State's workforce (Bankston and Zhou, 1996). Vietnamese Americans account for about one-third of all the fishermen in the central Gulf of Mexico (Ravitz, 2010). Islaños, African Americans, and Native American groups are also engaged in commercial fishing and oystering. Historically, Vietnamese Americans and African Americans have worked in the fish processing and oyster shucking industries. Shucking houses particularly, have provided an avenue into the mainstream economy for minority groups.

Therefore, fishing closures during Phase 2 of a catastrophic spill impacting the central Gulf of Mexico may disproportionately affect such minority groups as the Vietnamese Americans, Native Americans, African Americans, and Islaños (Hemmerling and Colten, 2003).

Phase 3—Onshore Contact

While most coastal populations along the Gulf Coast are not generally minority or low income, several communities on the coasts of St. Mary, Lafourche, Terrebonne, St. Bernard, and Plaquemines Parishes, Louisiana, have minority or low-income population percentages that are higher than their state average. These minority populations are predominately Native American, Islaños, or African American. For example, a few counties or parishes along the Gulf Coast have more than a 2-percent Native American population (USDOI, MMS, 2007); about 2,250 Houma Indians (a State of Louisiana recognized tribe) are concentrated in Lafourche Parish, Louisiana, comprising 2.4 percent of the parish's population, and about 800 Chitimacha (a federally recognized tribe) make up 1.6 percent of St. Mary Parish's population. While these are not significant numbers on their own, viewed in the context of Louisiana's overall 0.6 percent Native American average, these communities take on greater environmental justice importance.

Gulf Coast minority and low-income groups are particularly vulnerable to the coastal impacts of a catastrophic oil spill due to their greater than average dependence on the natural resources in the offshore and coastal environments. Besides their economic reliance on commercial fishing and oystering, coastal low-income and minority groups rely heavily on these fisheries and other traditional subsistence fishing, hunting, trapping, and gathering activities to augment their diets and household incomes (refer to Hemmerling and Colton, 2003, for an evaluation of environmental justice considerations for south Lafourche Parish). Regular commuting has continued this reliance on the natural resources of the coastal environments even when populations have been forced to relocate because of landloss and the destruction from hurricane events.

State fishery closures because of a catastrophic oil spill could disproportionately affect minority and low-income groups. Shoreline impacts could generate additional subsistence-related effects. Therefore, these minority groups may be disproportionately affected if these coastal areas were impacted by a catastrophic spill and the resulting response.

Phase 4—Post-Spill, Long-Term Recovery and Response

After the spill is stopped, the primary environmental justice concerns relate to possible long-term health impacts to cleanup workers, a predominately minority population, and to possible disposal of oil-impacted solid waste in predominantly minority areas.

An analysis of socioeconomic characteristics shows that people of Cajun ethnicity in the Gulf Coast States are often found to be of a comparatively low socioeconomic status and to work jobs in the textile and oil industries (Henry and Bankston, 1999). Past studies suggest that a healthy offshore petroleum industry also indirectly benefits low-income and minority populations (Tolbert, 1995). One BOEM-funded study in Louisiana found income inequality decreased during the oil boom of the 1980's and increased with the decline (Tolbert, 1995). If there is a suspension of oil and gas activities in response to a catastrophic spill, many oil- and gas-related service industries would attempt to avoid massive layoffs by cutting costs and deferring maintenance during the recovery. This was the case with the *Deepwater Horizon* explosion, oil spill, and response, and the long-term impacts are still not fully understood.

Onshore and Offshore Cleanup Workers

By the end of a catastrophic spill, up to 25,000 (shallow water) or 50,000 (deepwater) personnel would be expected to be responding to the spill. The majority of these would be field responders (United Incident Command, 2010e). As seen by the *Deepwater Horizon* explosion, oil spill, and response, the racial composition of cleanup crews was so conspicuous that Ben Jealous, the president of the National Association for the Advancement of Colored People, sent a public letter to BP Chief Operations Officer Tony Hayward on July 9, 2010, demanding to know why African Americans were over-represented in "the most physically difficult, lowest paying jobs, with the most significant exposure to toxins" (National Association for the Advancement of Colored People, 2010). While regulations require the wearing of protective gear and only a small percentage of cleanup workers suffer immediate illness and injuries (Center for Disease Control and Prevention, 2010), exposure could have long-term health impacts (e.g., increased rates of some types of cancer) (Savitz and Engel, 2010; Kirkeleit et al., 2008). Aguilera et al. (2010) compiled and reviewed existing studies on the repercussions of spilled oil exposure on human health for patterns of health effects and found evidence of the relationship between exposure and "acute physical, psychological, genotoxic, and endocrine effects in the exposed individuals." Acute symptoms from exposure to oil, dispersants, and degreasers include headaches, nausea, vomiting, diarrhea, sore eyes, runny nose, sore throat, cough, nose bleeds, rash, blisters, shortness of breath, and dizziness (Sathiakumar, 2010). The USEPA's monitoring data have not shown that the use of dispersants during the *Deepwater Horizon* explosion, oil spill, and response resulted in a presence of chemicals that surpassed human health benchmarks (Trapido, 2010). The potential for the long-term human health effects are largely unknown. However, the National Institute of Environmental Health Sciences is conducting a study known as the "Gulf Long-Term Follow-Up Study" that should provide a better understanding of the long-term and cumulative health impacts, such as the consequences of working close to a spill and of consuming contaminated seafood. The "Gulf Long-Term Follow-up Study" will monitor oil-spill cleanup workers for 10 years and represents a national effort to determine if the Gulf oil spill led to physical or mental health problems (U.S. Dept. of Health and Human Services, NIEHS, 2010). The study has a target goal of 55,000 participants. As of October 2012, the National Institute of Environmental Health Sciences announced that over 29,000 cleanup workers and volunteers have enrolled in the "Gulf Long-Term Follow-up Study" (U.S. Dept. of Health and Human Services, NIEHS, 2012). Prior research on post-spill cleanup efforts found that the duration of cleaning work was a risk factor for acute toxic symptoms and that seamen had the highest occurrence of toxic symptoms compared with volunteers or paid workers. Therefore, participants in the "Vessels of Opportunity" program, which recruited local boat owners (including Cajun, Houma Indian, and Vietnamese American fishermen) to assist in cleanup efforts, would likely be one of the most exposed groups. African Americans are thought to have made up a high percentage of the cleanup workforce. The Occupational Safety and Health Administration (OSHA) released two matrices of gear requirements for onshore and offshore Gulf operations that were organized by task (U.S. Dept. of Labor, OSHA, 2010a). Of past oil-spill workers, uninformed and poorly informed workers were at more risk of exposure and symptoms, demonstrating the importance of education and proper training of workers (Sathiakumar, 2010). Therefore, a catastrophic spill may disproportionately affect seamen and onshore workers such as Cajuns, Vietnamese Americans, Houma Indian, and African Americans.

Solid-Waste Disposal

Following a catastrophic spill, environmental justice concerns arise related to the disposal of cleanup-related wastes near minority and/or low-income communities (Schleifstein, 2010). It is estimated that a catastrophic spill could generate several thousand tons of oil-impacted solid materials that would be disposed in landfills along the Gulf Coast. While no new landfills would be built because of a catastrophic spill, the use of existing landfills might exacerbate existing environmental justice issues. For example, Mobile, Alabama, and Miami, Florida, are majority minority urban centers with a majority of minority residents living within a 1-mi (1.6-km) radius of chosen landfills or liquid processing centers. While only a small percentage of *Deepwater Horizon* explosion, oil spill, and response waste was sent to these facilities—13 percent of the liquid waste to Liquid Environmental Solutions in Mobile and only 0.28 percent of the total liquid waste to Cliff Berry in Miami—they may receive more from potential future spills. Disposal procedures for the *Deepwater Horizon* explosion, oil spill, and response involved sorting waste materials into standard "waste stream types" at small, temporary stations, and then sending each type to existing facilities that were licensed to dispose of them. The location of temporary sorting stations was linked to the location of containment and cleanup operations. Hence, future locations of any sorting stations are not predictable since they would be determined by the needs of cleanup operations. However, waste disposal locations were determined by the specializations of existing facilities and by contractual relationships between them and the cleanup and containment firms. Louisiana received about 82 percent of the *Deepwater Horizon* explosion, oil spill, and response liquid waste recovered; of this, 56 percent was manifested to mud facilities located in Venice in Plaquemines Parish, Louisiana, and to Port Fourchon in Lafourche Parish, Louisiana, and then transferred to a processing facility in Port Arthur, Texas. The waste remaining after processing was sent to deep well injection landfills located in Fannett and Big Hill, Texas. The sites located in Venice and Port Fourchon, Louisiana, and in Port Arthur, Fannett, and Big Hill, Texas, have low-minority populations, but a few of these areas have substantial poverty rates relative to State and parish/county means.

Overall Summary and Conclusion (Phases 1-4)

For Phase 1 (Initial Event) of a catastrophic spill, there would likely be no adverse impacts to minority and low-income communities because of the long distance (>3 nmi; 3.5 mi; 5.6 km) from shore, as well as the short duration of the initial event, fire, and/or explosion. The primary environmental justice concerns during Phase 2 (Offshore Spill) would be large-scale fishing closures, oyster bed contamination and closures, and subsequent impacts to downstream activities such as shrimp processing facilities and oyster shucking houses. These may disproportionately affect such minority groups as the Vietnamese Americans, Native Americans, African Americans, and Islaños. Phase 3 (Onshore Contact), depending on the location, could result in disproportional impacts to those groups that rely heavily on oystering, commercial fishing, and other traditional subsistence fishing, hunting, trapping, and gathering activities to augment their diets and household incomes. During Phase 4 (Post-Spill, Long-Term Recovery and Response), the primary environmental justice concerns relate to possible long-term health impacts to cleanup workers, a predominately minority population, and to the possible disposal of oil-impacted solid waste in predominantly minority areas. As in the case of the *Deepwater Horizon* explosion, oil spill, and response, understanding long-term impacts would be dependent on the outcome of ongoing research by various interested parties, such as the National Institutes of Health and BOEM. Overall, depending on a number of mainly geographic variables such as the location of fisheries closures and oyster bed contamination and closures, as well as the demographic composition of cleanup workers, and if waste disposal was not distributed across the region at many different facilities, a catastrophic oil-spill event may have disproportionate effects on minority and low-income populations.

B.3.1.26. Species Considered due to U.S. Fish and Wildlife Service Concerns

Phase 1—Initial Event

Phase 1 of the scenario is the initiation of a catastrophic blowout incident. Impacts, response, and intervention depend on the spatial location of the blowout and leak. For this analysis, an explosion and subsequent fire are assumed to occur. If a blowout associated with the drilling of a single exploratory well occurs, this could result in a fire that would burn for 1 or 2 days. If a blowout occurs on a production platform, other wells could feed the fire, allowing it to burn for over a month. The drilling rig or platform may sink. If the blowout occurs in shallow water, the sinking rig or platform may land in the immediate vicinity; if the blowout occurs in deep water, the rig or platform could land a great distance away, beyond avoidance zones. Regardless of water depth, the immediate response would be from search and rescue vessels and aircraft, such as USCG cutters, helicopters, and rescue planes, and firefighting vessels. The potential impacts reflect the explosion, subsequent fire for 1-30 days, and the sinking of the platform in the immediate vicinity and up to 1 mi (1.6 km) from the well.

The scenarios for each phase, including cleanup methods, can be found **Table B-4**.

BOEM has only focused on species within coastal counties and parishes because those are the species that could be potentially impacted by oil and gas development activities, including a potential OCS spill. There would likely be no adverse impacts to the species considered due to FWS concerns as a result of the events and the potential impact-producing factors that could occur throughout Phase 1 of a catastrophic spill event due to the distance of most activities, the heavy regulation of infrastructure and pipelines, and permitting and siting requirements.

Phase 2—Offshore Spill

Phase 2 of the analysis focuses on the spill and response in Federal and State offshore waters. A catastrophic spill would likely spread hundreds of square miles. Also, the oil slick may break into several smaller slicks, depending on local wind patterns that drive the surface currents in the spill area. The potential impacts reflect spill and response in Federal and State offshore waters. Season and temperature variations can result in different resource impacts due to variations in oil persistence and oil and dispersant toxicity and because of differences in potential exposure of the resources throughout various life cycle stages.

There would likely be no adverse impacts to the species considered due to FWS concerns as a result of the events and the potential impact-producing factors that could occur throughout Phase 2 of a catastrophic spill event due to the distance of most activities, the heavy regulation of infrastructure and pipelines, and permitting and siting requirements.

Phase 3—Onshore Contact

Phase 3 focuses on nearshore (e.g., inside bays and in close proximity to shoreline) and onshore spill response and oil initially reaching the shoreline during the spill event or while the oil still persists in the offshore environment once the spillage has been stopped. It is likely that Phases 2 and 3 could occur simultaneously. The duration of the initial shoreline oiling is measured from initial shoreline contact until the well is capped or killed and the remaining oil dissipates offshore. Re-oiling of already cleaned or previously impacted areas could be expected during Phase 3. In addition to the response described in Phase 2, nearshore and onshore efforts would be introduced in Phase 3 as oil entered coastal areas and contacted shore. The potential impacts reflect the spill and response in very shallow coastal waters and once along the shoreline. Season and temperature variations can result in different resource impacts due to variations in oil persistence and oil and dispersant toxicity and because of differences in potential exposure of the resources throughout various life cycle stages.

The FWS has explicitly communicated interest in specific species within State boundaries along the Gulf Coast. The species within Louisiana, Mississippi, Alabama, and Florida have been designated as endangered, threatened, candidate, listed with critical habitat, proposed nonessential experimental population, or distinct vertebrate population. The greatest threats to the majority of these species are the loss of and/or modification to suitable habitat caused by urban and agricultural development. Further detail on this catastrophic OSRA run is contained in Appendix C of the WPA 238/246/248 Supplemental EIS.

At this time, there is no known record of a hurricane crossing the path of a large oil spill; the impacts of such have yet to be determined. The experience from Hurricanes Katrina and Rita in 2005 was that the oil released during the storms widely dispersed as far as the surge reached (USDOC, NOAA, National Weather Service, 2012). Due to their reliance on terrestrial habitats to carry out their life-history functions at a considerable distance from the GOM, the activities of a WPA proposed action are unlikely to have significant adverse effects on the size and recovery of any of the FWS-mentioned species or populations in Texas, Louisiana, Mississippi, Alabama, and Florida.

There would likely be no adverse impacts to the species considered due to FWS concerns as a result of the events and the potential impact-producing factors that could occur throughout Phase 3 of a catastrophic spill event due to the distance of most activities, the heavy regulation of infrastructure and pipelines, and permitting and siting requirements.

Phase 4—Post-Spill, Long-Term Recovery and Response

Phase 4 focuses on long-term recovery once the well has been capped and the spill has stopped. During the final phase of a catastrophic blowout and spill, it is presumed that the well has been capped or killed and cleanup activities are concluding. While it is assumed that the majority of spilled oil would be dissipated offshore within 1-2 months (depending on season and temperature) of stopping the flow, oil has the potential to persist in the environment long after a spill event and has been detected in sediment 30 years after a spill. On sandy beaches, oil can sink deep into the sediments. In tidal flats and salt marshes, oil may seep into the muddy bottoms. The potential impacts reflect long-term persistence of oil in the environment and residual and long-term cleanup efforts.

As data continue to be gathered and impact assessments completed, a better characterization of the full scope of impacts to populations in the GOM from the *Deepwater Horizon* explosion, oil spill, and response will be available. Relevant data on the status of populations after the *Deepwater Horizon* explosion, oil spill, and response may take years to acquire and analyze, and impacts from the *Deepwater Horizon* explosion, oil spill, and response may be difficult or impossible to discern from other factors. Therefore, it is not possible for BOEM to obtain this information within the timeline contemplated in this Supplemental EIS, regardless of the cost or resources needed. In light of the incomplete or unavailable information, BOEM's subject-matter experts have used available scientifically credible evidence in this analysis and applied it using accepted methods and approaches. Nevertheless, a complete understanding of the missing information is not essential to a reasoned choice among alternatives for this Supplemental EIS. As of August 2013, there are 1,380 active leases in the WPA with ongoing (or the potential for) exploration, drilling, and production activities. In addition, non-OCS energy-related activities will continue to occur in the WPA irrespective of a WPA proposed action (i.e., habitat loss and competition). The potential for effects from changes to the affected environment (post-*Deepwater Horizon* explosion, oil spill, and response), accidental spills (including low-probability catastrophic spills), and cumulative effects remains whether or not the No Action or an Action alternative is chosen under this Supplemental EIS.

There would likely be no adverse impacts to the species considered due to FWS concerns as a result of the events and the potential impact-producing factors that could occur throughout Phase 4 of a catastrophic spill event due to the distance of most activities, the heavy regulation of infrastructure and pipelines, and permitting and siting requirements.

Overall Summary and Conclusion (Phases 1-4)

Accidental blowouts, oil spills, and spill-response activities resulting from a WPA proposed action have the potential to impact small to large areas in the GOM, depending on the magnitude and frequency of accidents, the ability to respond to accidents, the location and date of accidents, and various meteorological and hydrological factors (including tropical storms). The incremental contribution of a WPA proposed action would not be likely to result in a significant incremental impact on the FWS-mentioned species within the WPA; in comparison, non-OCS-related activities, such as habitat loss and competition, have historically proved to be of greater threat to the FWS-mentioned species.

In conclusion, within the CPA, which is directly adjacent to the WPA, there is a long-standing and well-developed OCS Program (more than 50 years); there are no data to suggest that activities from the preexisting OCS Program are significantly impacting the FWS mentioned species populations; therefore, a WPA proposed action would be expected to have little or no effect on the FWS mentioned species.

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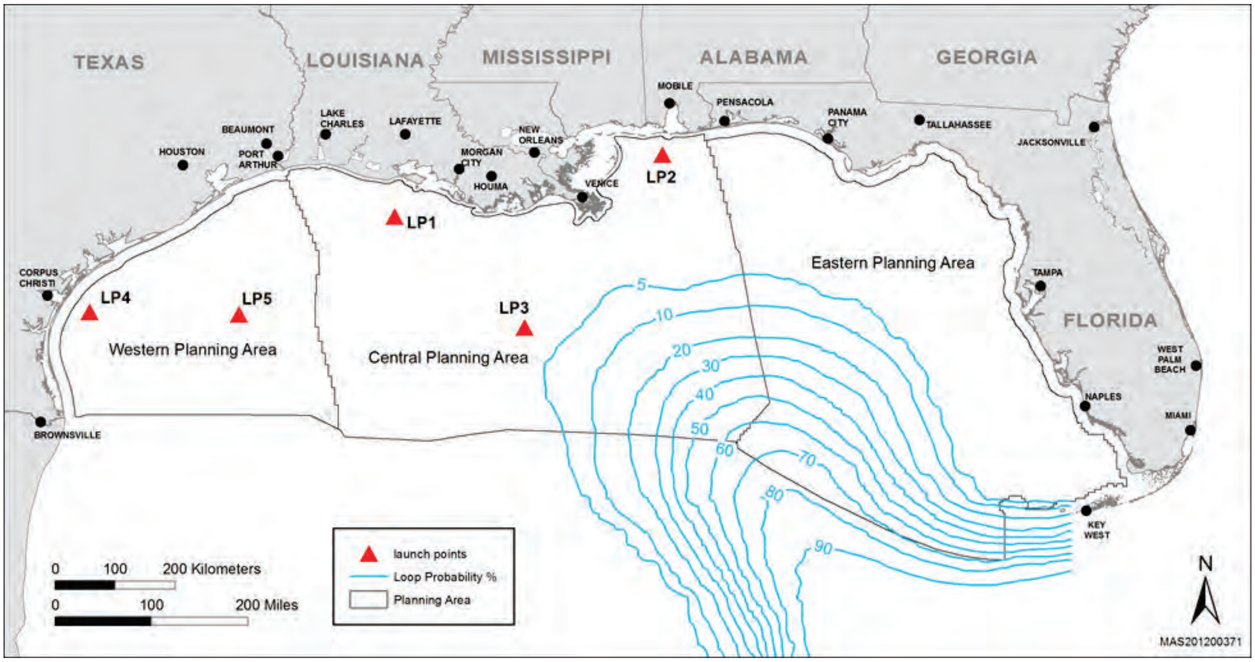

Figure B-1. Location of Five Hypothetical Oil-Spill Launch Points for OSRA within the Study Area. (Spatial variability of the Loop Current is from Vukovich [2007] and is shown as percent of time that the Loop Current watermass is associated with a particular location.)

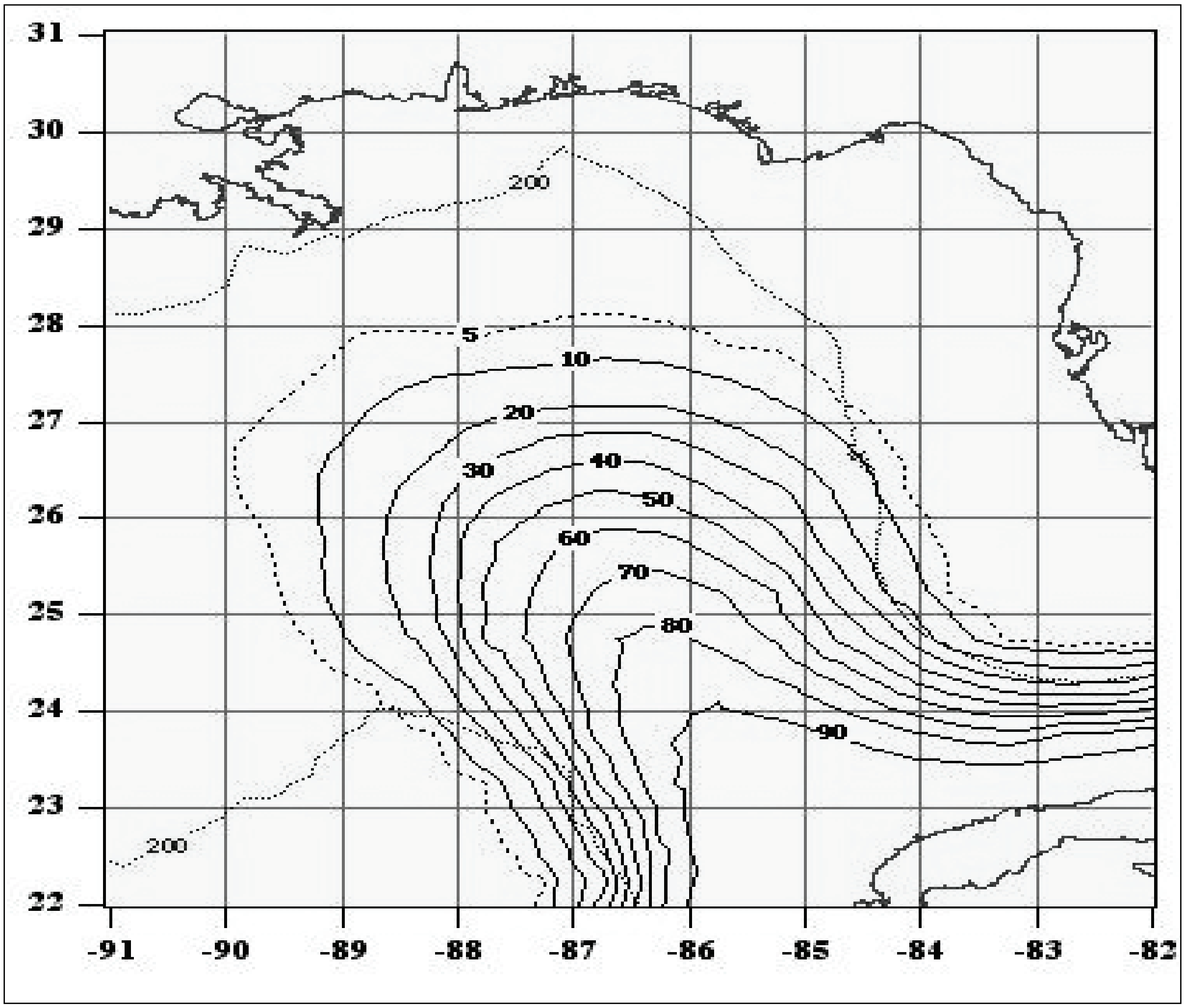

Figure B-2. Spatial Frequency (%) of the Watermass Associated with the Loop Current in the Eastern Gulf of Mexico based on Data for the Period 1976-2003 (Vukovich, 2005).

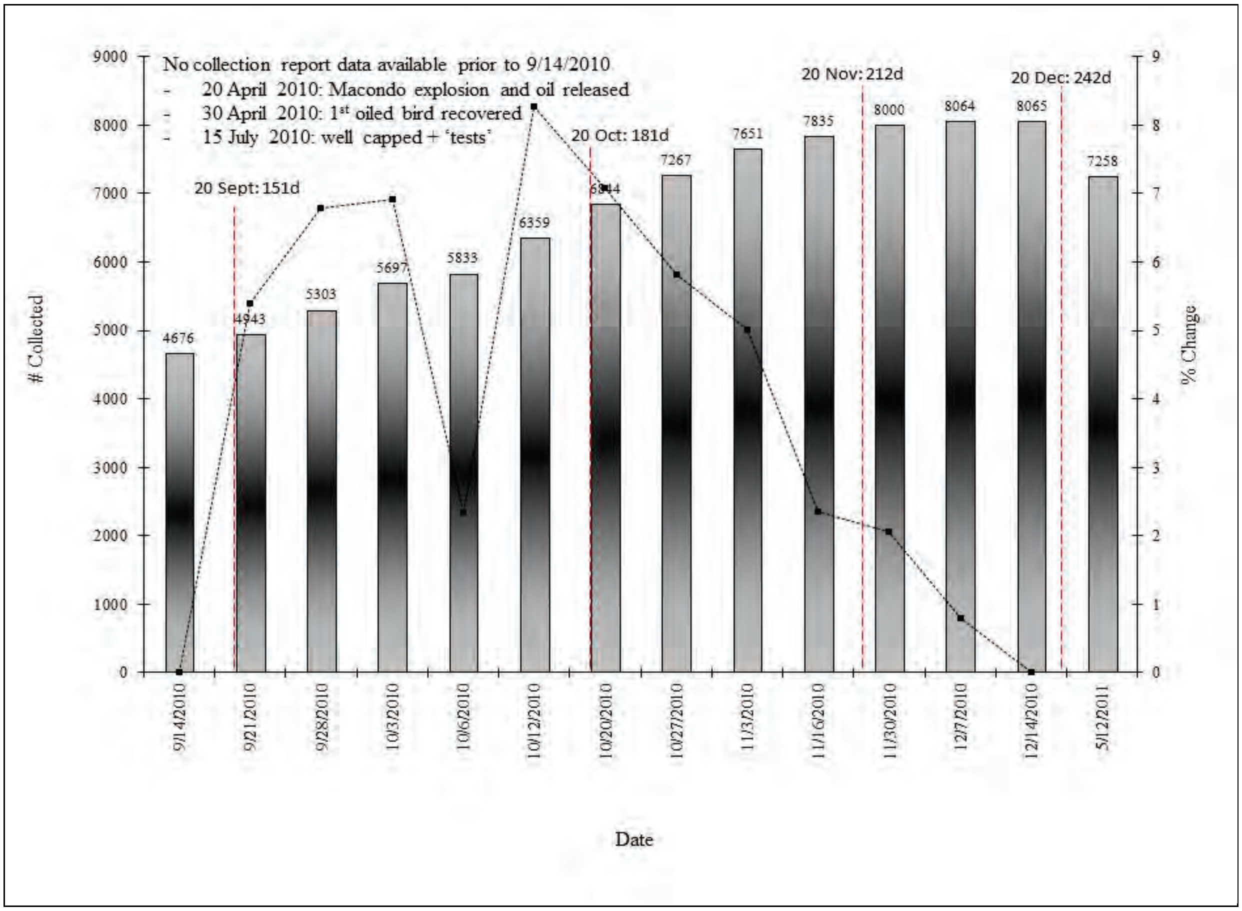

Figure B-3. Summary of Avian Species Collected by Date Obtained from the U.S. Fish and Wildlife Service as Part of the *Deepwater Horizon* Post-Spill Monitoring and Collection Process through May 12, 2011 (USDOI, FWS, 2011a). (This figure represents the date the data were released and reported and does not represent the actual date individual birds were collected. Data on the Y-axis reflects the cumulative # of individual birds collected, identified, and summarized by date; data on the Z-axis reflects proportional change from one reporting date to the next. The data used in this figure are verified as per FWS's QA/QC processes. The mean # of birds collected between intervals is 184.4 + 89.3 SE [-807 min, 526 max for 13 collection intervals] and the mean % change between intervals is 3.0 + 1.3% [-11.12% min., 8.27% max]. Unfortunately, we have no data on change in search effort temporally (or spatially) and also lack data prior to September 14, 2010; therefore, data at that point represent the baseline or "0" for determining interval differences. Disclaimer: All data should be considered provisional, incomplete, and subject to change. For more information, refer to FWS's Weekly Bird Impact Data and Consolidated Wildlife Reports [USDOI, FWS, 2011a]; for additional information on the chronological change in number of birds collected, refer to Belanger et al., 2010).

Table B-1

Blowout Scenarios and Key Differences in Impacts, Response, and/or Intervention

Location of Blowout and Leak	Key Differences in Impacts, Response, and/or Intervention
Blowout occurs at the sea surface (i.e., at the rig)	Offers the least chance for oil recovery because of the restricted access to the release point; therefore, greater impacts to coastal ecosystems. In addition to relief wells, there is potential for other intervention measures such as capping and possible manual activation of blowout-preventer (BOP) rams.
Blowout occurs along the riser anywhere from the seafloor to the sea surface. However, a severed riser would likely collapse, resulting in a leak at the seafloor.	In deep water, the use of subsea dispersants, if approved, may reduce impacts to coastal ecosystems; however, their use may increase exposure of deepwater marine resources to dispersed oil. There is a possibility for limited recovery of oil at the source. In addition to relief wells, there is potential for other intervention measures, such as capping and possible manual activation of BOP rams.
At the seafloor, through leak paths on the BOP/wellhead	In deep water, the use of subsea dispersant, if approved, may reduce impacts to coastal ecosystems; however, their use may increase exposure of deepwater marine resources to dispersed oil. With an intact subsea BOP, intervention may involve the use of drilling mud to kill the well. If the BOP and well stack are heavily compromised, the only intervention method may be relief wells. Greatest possibility for recovery of oil at the source, until the well is capped or killed.
Below the seafloor, outside the wellbore (i.e., broached)	Disturbance of a large amount of sediments resulting in the burial of benthic resources in the immediate vicinity of the blowout. The use of subsea dispersants would likely be more difficult (PCCI Marine and Environmental Engineering, 1999). Stopping this kind of blowout would probably involve relief wells. Any recovery of oil at the seabed would be very difficult.

Table B-2

Properties and Persistence by Oil Component Group

Properties and Persistence	Light-Weight	Medium-Weight	Heavy-Weight
Hydrocarbon Compounds	Up to 10 carbon atoms	10-22 carbon atoms	>20 carbon atoms
API º	>31.1º	31.1º-22.3º	<22.3º
Evaporation Rate	Rapid (within 1 day) and complete	Up to several days; not complete at ambient temperatures	Negligible
Solubility in Water	High	Low (at most a few milligrams/liter)	Negligible
Acute Toxicity	High because of monoaromatic hydrocarbons (BTEX)	Moderate because of diaromatic hydrocarbons (naphthalenes—2 ring PAHs)	Low except because of smothering (i.e., heavier oils may sink)
Chronic Toxicity	None, does not persist because of evaporation	PAH components (e.g., naphthalenes—2 ring PAHs)	PAH components (e.g., phenanthrene, anthracene—3 ring PAHs)
Bioaccumulation Potential	None, does not persist because of evaporation	Moderate	Low, may bioaccumulate through sediment sorption
Compositional Majority	Alkanes and cycloalkanes	Alkanes that are readily degraded	Waxes, asphaltenes, and polar compounds (not significantly bioavailable or toxic)
Persistence	Low because of evaporation	Alkanes readily degrade, but the diaromatic hydrocarbons are more persistent	High; very low degradation rates and can persist in sediments as tarballs or asphalt pavements

API = American Petroleum Institute.
BTEX = benzene, ethylbenzene, toluene, and xylene
PAH = polycyclic aromatic hydrocarbon

Sources: Michel, 1992; Canadian Center for Energy Information, 2010.

Table B-3

Annual Volume of Produced Water Discharged by Depth
(millions of barrels)

Year	Shelf 0-60 m	Shelf 60-200 m	Slope 200-400 m	Deepwater 400-800 m	Deepwater 800-1,600 m	Ultra-Deepwater 1,601-2,400 m	Ultra-Deepwater >2,400 m	Total
2000	370.6	193.1	35.5	25.6	12.2	0.0	0.0	637.0
2001	364.2	185.2	35.0	32.0	16.6	0.0	0.0	633.0
2002	344.6	180.4	32.5	35.2	21.4	0.0	0.0	614.1
2003	359.4	182.9	31.2	39.0	35.5	0.2	0.0	648.2
2004	346.7	160.5	29.3	36.9	39.2	1.9	0.0	614.5
2005	270.1	113.5	23.1	33.5	43.0	5.8	0.0	489.0
2006	260.3	99.7	20.6	35.1	61.5	12.4	0.0	489.6
2007	307.0	139.4	22.2	40.0	70.3	15.5	0.1	594.5
2008	252.7	118.6	15.9	32.7	60.1	16.5	0.1	496.6
2009	263.9	108.3	19.9	39.2	65.3	25.0	0.1	521.7

Source: USDOI, BOEMRE, 2010b.

Table B-4

Description of the Scenario for a Catastrophic Spill Event Occurring in Shallow Water or Deep Water
(assumptions are described in detail in the text)

Scenario	Shallow-Water Location	Deepwater Location
Phase 1. Initial Event		
Vertical Location of Blowout	4 possible locations including sea surface, along the riser, at the seafloor, and below the seafloor	4 possible locations including sea surface, along the riser, at the seafloor, and below the seafloor
Duration of Uncontrolled Fire	1-30 days	1-30 days
Phase 2. Offshore Spill		
Duration of Spill	2-5 months	4-6 months
Rate of Spill	30,000 bbl per day*	30,000-60,000 bbl per day
Total Volume of Spill (1)	0.9-3.0 MMbbl crude oil	2.7-7.2 MMbbl crude oil 10,000-20,000 bbl diesel fuel
API° Gravity	Fresh oil will float (API° >10)	Fresh oil will float (API° >10)
Characteristics of Oil Released	Typical South Louisiana midrange paraffinic sweet crude oil	Typical South Louisiana midrange paraffinic sweet crude oil; crude properties changed after oil traveled up the wellbore and passed through the water column, undergoing rapid depressurization and turbulence. Oil reached the surface as an emulsion stripped of many of its volatile components.
Response		
Number of Vessels	Up to 3,000	Up to 7,000
Number of Workers	Up to 25,000	Up to 50,000
Number of Planes/Helicopters	25/50	50/100
Boom (million feet)	5	13.5
Dispersant Application (surface application) (2)	35,000 bbl	33,000-bbl surface application and 16,500-bbl subsea application
Number of Miles of Shoreline Requiring Some Measure of Mechanical or Manual Cleaning	778	778
In-situ Burn	Yes, will occur	Yes, will occur
Vessel Decontamination Stations	Yes	Yes
Severe Weather	The potential for severe weather is noted, which could temporarily halt containment and response efforts.	The potential for severe weather is noted, which could temporarily halt containment and response efforts.
Fisheries Closure		During the peak, anticipate approximately 37% or 88,522 mi^2 (229,270 km^2) closed to recreational and commercial fishing.

Table B-4. Description of the Scenario for a Catastrophic Spill Event Occurring in Shallow Water or Deep Water (continued).

Scenario	Shallow-Water Location	Deepwater Location
	Phase 3. Onshore Contact	
Shoreline Oiling Duration	1-5 months	3-6 months
Response		
Number of Staging areas	5-10	10-20
Number of Skimmers	200-300	500-600
Length of Shoreline Contacted		
	30 days[1] = 0-50 miles[2]	30 days[1] = 0-50 miles[2]
	60 days = 50-100 miles	60 days = 50-100 miles
	90 days = 100-1,000 miles	90 days = 100-1,000 miles
	120 days = >1,000 miles	120 days = >1,000 miles
	[1] Not cumulative.	
	[2] Length was extrapolated.	
Oil Characteristics and Appearance		—Essentially stable emulsions mixed with sand. —Typically initially stranded as surface layers and as discrete droplets/summer 2010.
Response Considerations for Sand Beaches	—No mechanical techniques allowed in some areas. —Much of the beach cleanup conducted at night. —Typically sand sieving, shaking, and sifting beach cleaning machines. —Repetitive tilling and mixing using agriculture plows and discs in combination with beach cleaning machines. —Sand washing treatment—sand sieve/shaker to remove debris and large oil particles and heated washing systems. —Nearshore submerged oil difficult to recover and hard to locate; vacuums and snares could be used.	—No mechanical techniques allowed in some areas. —Much of the beach cleanup conducted at night. —Typically sand sieving, shaking, and sifting beach cleaning machines. —Repetitive tilling and mixing using agriculture plows and discs in combination with beach cleaning machines. —Sand washing treatment—sand sieve/shaker to remove debris and large oil particles and heated washing systems. —Nearshore submerged oil difficult to recover and hard to locate; vacuums and snares could be used.
Response Considerations for Marshes	—Lightly oiled—allowed to recovery naturally; degrade in place or removed by tidal or wave action. —Moderately/heavily oiled—vacuumed or skimmed from boats possibly in conjunction with flushing; low-pressure flushing (with water comparable to marsh type); manual removal by	—Lightly oiled—allowed to recovery naturally; degrade in place or removed by tidal or wave action. —Moderately or heavily oiled—vacuumed or skimmed from boats possibly in conjunction with flushing; low-pressure flushing (with water comparable to marsh type); manual removal by hand or mechanized equipment; and vegetation cutting.

Table B-4. Description of the Scenario for a Catastrophic Spill Event Occurring in Shallow Water or Deep Water (continued).

	hand or mechanized equipment; and vegetation cutting. —Heavily oiled areas—in-situ burning may be an option if water covers the sediment surface. —Bioremediation may be utilized but mostly as a secondary treatment after bulk removal.	—Heavily oiled areas—in-situ burning may be an option if water covers the sediment surface. —Bioremediation may be utilized but mostly as a secondary treatment after bulk removal.
Response Considerations for Nearshore Waters	Marsh areas—skimming and vacuum (in areas too shallow to use skimmers) systems used in conjunction with flushing, and booming to temporarily contain mobile slicks.	Marsh areas—skimming and vacuum (in areas too shallow to use skimmers) systems used in conjunction with flushing, and booming to temporarily contain mobile slicks.
Phase 4. Recovery Phase		
Response		
Number of Vessels – 24-36 months post-spill/greater than 36 months	Fewer than 10/0 designated—called up only if new residual oil reported	Fewer than 10/0 designated—called up only if new residual oil reported
Number of Workers – 24-36 months post-spill/greater than 36 months	230/0 designated—called up only if new residual oil reported	230/0 designated—called up only if new residual oil reported
Miles of Shoreline Undergoing Regular Patrolling and Maintenance – 30-36 months post-spill/greater than 36 months	Fewer than 20/0	Fewer than 20/0
End Date for Dispersant Application	No dispersant usage 2 weeks after spillage ends	No dispersant usage 2 weeks after spillage ends
Remaining Sources of Unrecoverable Weathered Oil	Buried or in surface pockets in coastal sand, sediment, or muddy bottoms and in pockets on the seafloor.	Buried or in surface pockets in coastal sand, sediment, or muddy bottoms and in pockets on the seafloor.
Oil Characteristics and Appearance		As stranded oil weathered, some became buried through natural beach processes and appeared as surface residual balls (SRB) <10 cm (4 in) or as patties (SRP) 10 cm-1 m (4 in-3 ft).
Response Considerations for Sand Beaches, Marshes, and Nearshore Waters	See Phase 3 above.	See Phase 3 above.

(1) A blowout may contain crude oil, natural gas, and condensate. Because the majority of environmental damage is due to the release of oil, this text assumes the spill to be an oil spill. However, a natural gas release would result in a less visible and less persistent adverse impact than an oil release.
(2) Subsea dispersal application must be individually approved.

Source: British Petroleum, 2014b.

Table B-5

Birds Collected and Summarized by the U.S. Fish and Wildlife Service:
Post-*Deepwater Horizon* Explosion, Oil Spill, and Response in the Gulf of Mexico[1, 2]

Common Name	Species Group[3]	Grand Total	Visibly Oiled			Not Visibly Oiled			Unknown Oiling			Oiling Rate[4]
			Dead	Alive	Total	Dead	Alive	Total	Dead	Alive	Total	
Amer. Coot	Marsh/Wading	3	2	2	2	0	0	0	1	0	1	0.67
Amer. Oystercatcher	Shorebird	13	7	3	7	3	0	3	1	3	3	0.54
Amer. Redstart	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Amer. White Pelican	Seabird	19	5	3	8	4	0	4	4	8	7	0.42
Audubon's Shearwater	Seabird	36	1	1	1	35	0	35	0	2	0	0.03
Barn Owl	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Barn Swallow	Passerine	1	1	0	1	0	0	0	0	0	0	1.00
Belted Kingfisher	Passerine	1	0	0	0	1	0	1	0	1	0	0.00
Bl.-crown. Night Heron	Marsh/Wading	18	6	3	8	7	0	7	1	4	3	0.44
Black Skimmer	**Seabird**	**253**	**51**	**16**	**55**	**153**	**0**	**153**	**40**	**14**	**45**	**0.22**
Black Tern	Seabird	9	1	0	1	7	0	7	1	3	1	0.11
Bl.-bell. Whistl. Duck	Waterfowl	2	0	0	0	0	0	0	0	2	2	0.00
Black-necked Stilt	Shorebird	3	0	0	0	3	0	3	0	0	0	0.00
Blue-winged Teal	Waterfowl	6	0	0	0	6	0	6	0	0	0	0.00
Boat-tailed Grackle	Passerine	1	0	0	0	1	0	1	0	1	0	0.00
Broad-winged Hawk	Raptor	1	0	0	0	1	0	1	0	1	0	0.00
Brown Pelican	**Seabird**	**826**	**152**	**227**	**339**	**248**	**0**	**248**	**177**	**149**	**239**	**0.41**
Brown-headed Cowbird	Passerine	1	0	0	0	0	0	0	0	1	1	0.00
Bufflehead	Waterfowl	1	0	1	1	0	0	0	0	0	0	1.00
Canada Goose	Waterfowl	4	0	1	1	1	0	1	1	2	2	0.25
Caspian Tern	Seabird	17	7	3	8	4	0	4	2	6	5	0.47
Cattle Egret	Marsh/Wading	36	4	4	7	25	0	25	3	4	4	0.19
Clapper Rail	Marsh/Wading	120	27	5	29	64	0	64	20	14	27	0.24

Table B-5. Birds Collected and Summarized by the U.S. Fish and Wildlife Service: Post-*Deepwater Horizon* Explosion, Oil Spill, and Response in the Gulf of Mexico[1, 2] (continued).

Common Name	Species Group[3]	Grand Total	Visibly Oiled			Not Visibly Oiled			Unknown Oiling			Oiling Rate[4]
			Dead	Alive	Total	Dead	Alive	Total	Dead	Alive	Total	
Common Loon	Diving	75	33	27	39	24	0	24	4	20	12	0.52
Common Moorhen	Marsh/Wading	4	1	0	1	3	0	3	0	0	0	0.25
Common Nighthawk	Passerine	1	0	0	0	0	0	0	0	1	1	0.00
Common Tern	Seabird	25	15	12	16	9	0	9	0	0	0	0.64
Common Yellowthroat	Passerine	2	0	0	0	2	0	2	0	0	0	0.00
Cooper's Hawk	Raptor	1	0	0	0	1	0	1	0	1	0	0.00
Cory's Shearwater	Seabird	4	0	0	0	3	0	3	0	1	1	0.00
Dbl-crest. Cormorant	Diving	23	2	1	2	17	0	17	2	7	4	0.09
Eastern Kingbird	Passerine	2	1	0	1	1	0	1	0	0	0	0.50
Eastern Meadowlark	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Eur. Collared-dove	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Eur. Starling	Passerine	2	0	1	1	1	0	1	0	0	0	0.50
Forster's Tern	Seabird	40	17	8	20	12	0	12	6	7	8	0.50
Fulvous Whistl. Duck	Waterfowl	1	0	0	0	0	0	0	0	1	1	0.00
Glossy Ibis	Marsh/Wading	2	1	1	1	1	0	1	0	0	0	0.50
Great Blue Heron	Marsh/Wading	42	5	3	6	26	0	26	4	16	10	0.14
Great Cormorant	Diving	1	0	0	0	1	0	1	0	0	0	0.00
Great Egret	Marsh/Wading	31	6	6	7	15	0	15	8	3	9	0.23
Great-horned Owl	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Greater Shearwater	Seabird	89	7	4	7	55	0	55	27	4	27	0.08
Green Heron	Marsh/Wading	16	2	0	2	8	0	8	1	6	6	0.13
Gull-billed Tern	Seabird	4	0	0	0	2	0	2	2	4	2	0.00
Herring Gull	Seabird	31	10	11	13	10	0	10	2	13	8	0.42
House Sparrow	Passerine	2	0	0	0	2	0	2	0	1	0	0.00
Killdeer	Shorebird	3	0	0	0	3	0	3	0	0	0	0.00

Table B-5. Birds Collected and Summarized by the U.S. Fish and Wildlife Service: Post-*Deepwater Horizon* Explosion, Oil Spill, and Response in the Gulf of Mexico[1, 2] (continued).

Common Name	Species Group[3]	Grand Total	Visibly Oiled			Not Visibly Oiled			Unknown Oiling			Oiling Rate[4]
			Dead	Alive	Total	Dead	Alive	Total	Dead	Alive	Total	
King rail	Marsh/Wading	1	0	0	0	0	0	0	0	1	1	0.00
Laughing Gull	**Seabird**	**2,981**	**1,025**	**355**	**1,182**	**1,390**	**0**	**1,390**	**304**	**371**	**409**	**0.40**
Leach's Storm-petrel	Seabird	1	1	0	1	0	0	0	0	1	0	1.00
Least Bittern	Marsh/Wading	4	0	0	0	4	0	4	0	2	0	0.00
Least Tern	Seabird	106	46	7	49	43	0	43	12	3	14	0.46
Less. Bl.-backed Gull	Seabird	4	1	1	1	1	0	1	1	2	2	0.25
Less. Scaup	Waterfowl	1	0	0	0	0	0	0	1	0	1	0.00
Little Blue Heron	Marsh/Wading	5	0	0	0	4	0	4	1	1	1	0.00
Long-bill. Dowitcher	Shorebird	1	0	0	0	0	0	0	0	1	1	0.00
Magnif. Frigatebird	Seabird	8	3	3	4	2	0	2	1	2	2	0.50
Mallard	Waterfowl	26	5	4	6	16	0	16	0	7	4	0.23
Manx Shearwater	Seabird	6	1	0	1	5	0	5	0	0	0	0.17
Masked Booby	Seabird	9	4	3	4	1	0	1	0	4	4	0.44
Mottled Duck	Waterfowl	6	0	0	0	5	0	5	1	1	1	0.00
Mourning Dove	Passerine	15	3	1	3	8	0	8	0	6	4	0.20
Muscovy Duck	Waterfowl	1	0	0	0	1	0	1	0	1	0	0.00
Neotropic Cormorant	Diving	5	0	0	0	2	0	2	3	0	3	0.00
Northern Cardinal	Passerine	3	0	0	0	3	0	3	0	0	0	0.00
Northern Gannet	**Seabird**	**475**	**225**	**189**	**297**	**99**	**0**	**99**	**30**	**107**	**79**	**0.63**
Northern Mockingbird	Passerine	5	0	0	0	4	0	4	0	2	1	0.00
Osprey	Raptor	11	2	1	3	6	0	6	0	3	2	0.27
Pied-billed Grebe	Diving	32	18	24	24	7	0	7	1	3	1	0.75
Piping Plover	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Purple Gallinule	Marsh/Wading	2	0	0	0	2	0	2	0	0	0	0.00
Purple Martin	Passerine	5	1	0	1	3	0	3	0	1	1	0.20

Table B-5. Birds Collected and Summarized by the U.S. Fish and Wildlife Service: Post-*Deepwater Horizon* Explosion, Oil Spill, and Response in the Gulf of Mexico[1, 2] (continued).

Common Name	Species Group[3]	Grand Total	Visibly Oiled			Not Visibly Oiled			Unknown Oiling			Oiling Rate[4]
			Dead	Alive	Total	Dead	Alive	Total	Dead	Alive	Total	
Red-breasted Merg.	Waterfowl	2	1	1	1	1	0	1	0	1	0	0.50
Reddish Egret	Marsh/Wading	2	1	1	1	1	0	1	0	1	0	0.50
Red-shouldered Hawk	Raptor	1	0	0	0	0	0	0	0	1	1	0.00
Red-tailed Hawk	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Red-winged Blackbird	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Ring-billed Gull	Seabird	2	0	1	1	1	0	1	0	0	0	0.50
Rock Dove (pigeon)	Passerine	16	2	2	3	4	0	4	2	10	9	0.19
Roseate Spoonbill	Marsh/Wading	15	7	3	7	3	0	3	5	1	5	0.47
Royal Tern	**Seabird**	**289**	**116**	**66**	**149**	**104**	**0**	**104**	**19**	**47**	**36**	**0.52**
Ruddy Duck	Waterfowl	1	1	0	1	0	0	0	0	0	0	1.00
Ruddy Turnstone	Shorebird	13	1	3	3	8	0	8	1	5	2	0.23
Sanderling	Shorebird	26	4	2	4	20	0	20	1	6	2	0.15
Sandwich Tern	Seabird	70	28	20	34	25	0	25	8	14	11	0.49
Seaside Sparrow	Passerine	9	4	0	4	5	0	5	0	0	0	0.44
Semipalm. Sandpiper	Shorebird	3	2	1	3	0	0	0	0	0	0	1.00
Short-bill. Dowitcher	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Snowy Egret	Marsh/Wading	22	12	9	14	6	0	6	2	3	2	0.64
Sooty Shearwater	Seabird	1	0	0	0	0	0	0	0	1	1	0.00
Sooty Tern	Seabird	3	0	1	1	2	0	2	0	1	0	0.33
Sora	Marsh/Wading	5	2	1	2	1	0	1	2	0	2	0.40
Spotted Sandpiper	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Surf Scoter	Waterfowl	1	1	1	1	0	0	0	0	0	0	1.00
Tri-colored Heron	Marsh/Wading	31	9	5	11	7	0	7	11	2	13	0.35
Virginia Rail	Marsh/Wading	3	0	0	0	3	0	3	0	1	0	0.00
White Ibis	Marsh/Wading	7	1	1	1	4	0	4	2	3	2	0.14

Table B-5. Birds Collected and Summarized by the U.S. Fish and Wildlife Service: Post-*Deepwater Horizon* Explosion, Oil Spill, and Response in the Gulf of Mexico[1, 2] (continued).

Common Name	Species Group[3]	Grand Total	Visibly Oiled			Not Visibly Oiled			Unknown Oiling			Oiling Rate[4]
			Dead	Alive	Total	Dead	Alive	Total	Dead	Alive	Total	
White-tail. Tropicbird	Seabird	1	0	0	0	1	0	1	0	0	0	0.00
White-wing. Dove	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Willet	Shorebird	13	2	1	3	8	0	8	1	3	2	0.23
Wilson’s Plover	Shorebird	3	0	0	0	2	0	2	1	0	1	0.00
Yellow-billed Cuckoo	Passerine	2	2	0	2	0	0	0	0	0	0	1.00
Yel.-cr. Night Heron	Marsh/Wading	9	1	0	1	7	0	7	0	3	1	0.11
Unid. Blackbird	Passerine	1	0	0	0	0	0	0	0	1	1	0.00
Unid. Booby	Seabird	1	0	0	0	1	0	1	0	1	0	0.00
Unid. Cormorant	Diving	14	3	0	3	10	0	10	1	0	1	0.21
Unid. Dowitcher	Shorebird	2	1	0	1	1	0	1	0	1	0	0.50
Unid. Duck	Waterfowl	2	0	0	0	1	0	1	1	0	1	0.00
Unid. Egret	Marsh/Wading	15	2	0	2	11	0	11	2	1	2	0.13
Unid. Flycatcher	Passerine	1	1	0	1	0	0	0	0	0	0	1.00
Unid. Grebe	Diving	4	2	1	2	2	0	2	0	0	0	0.50
Unid. Gull	Seabird	248	79	1	80	134	0	134	33	4	34	0.32
Unid. Hawk	Raptor	2	0	0	0	2	0	2	0	0	0	0.00
Unid. Heron	Marsh/Wading	15	5	0	5	8	0	8	1	1	2	0.33
Unid. Loon	Diving	7	2	2	4	3	0	3	0	1	0	0.57
Unid. Mockingbird	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Owl	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Passerine	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Pelican	Seabird	25	5	1	5	15	0	15	4	1	5	0.20
Unid. Pigeon	Passerine	14	2	1	3	6	0	6	1	6	5	0.21
Unid. Rail	Marsh/Wading	4	1	0	1	3	0	3	0	0	0	0.25
Unid. Raptor	Raptor	1	0	0	0	1	0	1	0	0	0	0.00

Table B-5. Birds Collected and Summarized by the U.S. Fish and Wildlife Service: Post-*Deepwater Horizon* Explosion, Oil Spill, and Response in the Gulf of Mexico[1, 2] (continued).

Common Name	Species Group[3]	Grand Total	Visibly Oiled			Not Visibly Oiled			Unknown Oiling			Oiling Rate[4]
			Dead	Alive	Total	Dead	Alive	Total	Dead	Alive	Total	
Unid. Sandpiper	Shorebird	2	0	0	0	2	0	2	0	2	0	0.00
Unid. Shearwater	Seabird	6	0	0	0	5	0	5	1	0	1	0.00
Unid. Shorebird	Shorebird	3	2	0	2	0	0	0	1	0	1	0.67
Unid. Skimmer	Seabird	6	0	0	0	5	0	5	1	0	1	0.00
Unid. Sparrow	Passerine	3	0	0	0	1	0	1	2	0	2	0.00
Unid. Swallow	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Tern	Seabird	132	38	1	39	79	0	79	13	2	14	0.30
Unid. Warbler	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Unknown spp.		593	51	2	53	451	0	451	88	1	89	0.09
Other		106	31	3	34	52	0	52	7	14	20	0.32
Column Totals		7,258	2,121		2,642	3,387		3,387	873		1,229	0.24

[1] Data obtained from the U.S. Fish and Wildlife Service (FWS) as part of the *Deepwater Horizon* post-spill monitoring and collection process are summarized for May 12, 2011 (USDOI, FWS, 2011a). The data used in this table are verified as per FWS's QA/QC processes. Disclaimer: All data should be considered provisional, incomplete, and subject to change (USDOI, FWS, 2011a). For more information, refer to the Weekly Bird Impact Data and Consolidated Wildlife Reports. Numbers in this table have been verified against the original data from FWS's website (USDOI, FWS, 2011a).

[2] As of May 12, 2011, 104 avian species had been collected and identified through the *Deepwater Horizon* post-spill monitoring and collection process (USDOI, FWS, 2011a). Note: Though the process was triggered by the *Deepwater Horizon* explosion and oil spill, not all birds recovered were oiled (36% = oiled, 47% = unoiled, 17% = unknown), suggesting that "search effort" alone accounted for a large proportion of the total (n = 7,258) birds collected (Piatt et al., 1990a, page 127). Some of the live birds collected may have been incapable of flight due to age or molt, and some of the dead birds collected may have died due to natural mortality, predation, or other anthropogenic sources of mortality. The overall oiling rate across species including "others" and "unknowns" was 0.24 versus 0.25 for individuals identified to species. The oiling rate for the **Top 5** (see bold rows in table) most-impacted avian species was 0.43 and included representatives only from the seabird group. These are listed in descending order based on the number collected: laughing gull (2,981 collected, 0.40 oiling rate); brown pelican (826 collected, 0.41 oiling rate); northern gannet (475 collected, 0.63 oiling rate); royal tern (289 collected, 0.52 oiling rate); and black skimmer (253 collected, 0.22 oiling rate). Note: There is a difference between the table structure here compared with the original table on FWS's website. Herein, columns for live birds that later died were not included. Totals associated with each larger grouping are correct and sum to those column totals for the May 12, 2011, Collection Report values. Six new species or rows were added and 3 species were removed between the December 14, 2010, Collection Report (USDOI, FWS, 2010d) and the May 12, 2011, Collection Report (USDOI, FWS, 2011a). The major difference in number (-807) between the more recent and older versions was due to an ~10% overestimate in the previous report representing live birds that later died, as these individuals were counted twice in the December 14, 2010, Collection Report (USDOI, FWS, 2010d).

[3] For additional information on oiling rates by Species Group and additional statistics, refer to Table 4-12 of the 2012-2017 WPA/CPA Multisale EIS.

Table B-5. Birds Collected and Summarized by the U.S. Fish and Wildlife Service: Post-*Deepwater Horizon* Explosion, Oil Spill, and Response in the Gulf of Mexico[1, 2] (continued).

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[4] Oiling Rate: For each species, an oiling rate was calculated by dividing the "total" number of oiled individuals (∑ alive + dead) /∑ of total individuals collected for a given species/row. In general, it has been well documented that the number of birds collected after a spill event represents a small fraction of the total oiled population (direct mortality) due to various factors: species-specific differences in vulnerability to spilled oil, species-specific differences in distribution, habitat use and behavior; species-specific differences in abundance; species-specific differences in carcass deposition rates, persistence rates, and detection probabilities; overall search effort and temporal and spatial variation in search effort; and carcass loss due to predation, habitat, weather, tides, and currents (Piatt et al., 1990a and 1990b; Ford et al., 1996; Piatt and Ford, 1996; Fowler and Flint, 1997; Flint and Fowler, 1998; Flint et al., 1999; Hampton and Zafonte, 2005; Ford, 2006; Castège et al., 2007; Ford and Zafonte, 2009; Byrd et al., 2009; Flint et al., 2010). For example, Piatt and Ford (1996, Table 1) estimated a mean carcass recovery rate of only 17% for a number of previous oil-bird impact studies. Burger (1993) and Wiese and Jones (2001) estimated recovery rates of 20% with the latter study based on a drift-block design to estimate carcass recovery rate from beached-bird surveys. Due to the fact that the coastline directly inshore of the well blowout location is primarily marsh and not sandy beaches, due to the distance from the blowout location to the coast, and due to predominant currents and wind directions during the event, the number of birds collected will likely represent a recovery estimate in the lower ranges of those provided in the literature to date (≤10%). A range of mortality estimates given the total number of dead birds collected through May 12, 2011, of 7,258 birds x recovery rates from the literature (0-59% in Piatt and Ford, 1996, Table 1) suggests a lower range of 12,302 birds* (59% recovery rate), an upper range of 725,800 birds* (0% recovery rate), and 42,694 birds based on the 17% mean recovery rate from Piatt and Ford (1996). The lower range of estimates (i.e., high carcass recovery rates) is likely biased low because it assumes no search effort after May 2011 (i.e., no more birds were collected after that date) and does not account for any of the detection probability parameters that are currently unknown. The actual avian mortality estimate will likely not be available until the NRDA process has been completed; this should include a combination of carcass drift experiments, drift-block experiments, corrections for carcass deposition and persistence rates, scavenger rates, and detection probability with additional modeling to more precisely derive an estimate. For additional information on oiling rates by Species Group and additional statistics, refer to Table 4-12 of the 2012-2017 WPA/CPA Multisale EIS. Note: Spill volume tends to be a poor predictor of bird mortality associated with an oil spill (Burger, 1993), though it should be considered for inclusion in any models to estimate total bird mortality, preferably with some metric of species composition and abundance (preferably density) pre-spill (Wilhelm et al., 2007).

* Corrected values are based on revisiting the original calculations after publication of the 2012-2017 WPA/CPA Multisale EIS. An additional estimate for total mortality based on Piatt and Ford (1996) is also provided.

Table B-6

Federally Listed Avian Species Considered by State and Associated Planning Area in the Gulf of Mexico[1]

Species	Status	Critical Habitat	IUCN Red List Status[2]	States	Planning Area
Red-cockaded Woodpecker	Endangered	No rules published	Vulnerable	AL, FL, LA, MS, TX	WPA, CPA, EPA
Least Tern[3]	Endangered	No rules published	Least Concern	AL, LA, TX (FL, MS)	WPA, CPA, EPA
Piping Plover	Threatened	Designated	Near Threatened	AL, FL, LA, MS, TX	WPA, CPA, EPA
Roseate Tern	Threatened	No rules published	Least Concern	FL only	EPA
Wood Stork	Endangered	No rules published	Least Concern	AL, FL, MS	CPA, EPA
Whooping Crane	Endangered	Designated	Endangered	TX, LA[4], FL[4]	WPA, CPA, EPA
Mississippi Sandhill Crane	Endangered	Designated	Not Yet Assessed	MS only	CPA
Attwater's Prairie Chicken	Endangered	No rules published	Not Yet Assessed	TX only	WPA
N. Aplomado Falcon	Endangered	No rules published	Not Yet Assessed	TX only	WPA
Everglades Snail Kite	Endangered	Designated	Not Yet Assessed	FL only	EPA
Cape Sable Seaside Sparrow	Endangered	Designated	Not Yet Assessed	FL only	EPA
Audubon's Crested Caracara	Threatened	No rules published	Not Yet Assessed	FL only	EPA
Sprague's Pipit	Candidate	NA – Priority 2	Vulnerable	LA, TX	WPA, CPA
Bald Eagle	Delisted	No rules published	Least Concern	AL, FL, LA, MS, TX	WPA, CPA, EPA
Peregrine Falcon	Delisted	Designated	Least Concern	AL, FL, LA, MS, TX	WPA, CPA, EPA
Eastern Brown Pelican	Delisted	No rules published	Least Concern	AL, FL, LA, MS, TX	WPA, CPA, EPA
Red Knot[5]	Proposed Threatened	NA – proposed threatened	Least Concern	FL, LA, TX	WPA, CPA, EPA

[1] Information contained in this table was obtained via an email attachment from the U.S. Fish and Wildlife Service (FWS) on April 6, 2012 (USDOI, FWS, 2012) and from FWS's "Endangered Species" website and associated queries for "species" available from FWS's website (USDOI, FWS, 2011b). Additional information for each species can be found at NatureServe Explorer (2011). Note: All species listed in this table are considered, but only the piping plover, roseate tern, whooping crane, wood stork, Mississippi sandhill crane, bald eagle, eastern brown pelican, and red knot will be analyzed.

[2] International Union for Conservation of Nature (IUCN) – The Red List classifies species as imperiled (Critically Endangered, Endangered, or Vulnerable), not imperiled (Near Threatened or Least Concern), extinct (Extinct, Extinct in the Wild), or Data Deficient (Butchart et al., 2004 and 2005; Harris et al., 2012). If species meet the quantitative thresholds of any of the following criteria, they will be added to the Red List: (1) decline in population size; (2) small geographic range; (3) small population size plus decline; (4) very small population size; or (5) quantitative analysis.

[3] The Interior population of the least tern was listed as endangered on May 28, 1985 (*Federal Register*, 1985) throughout much of its breeding range in the Midwest. This designation does not provide or extend Endangered Species Act (ESA) protection to the breeding population of Gulf Coast "population" of least terns. Similarly, ESA protection for breeding least terns only applies to certain segments or areas (inland rivers and lakes ~50 mi [80 km] inland) of Louisiana, Mississippi, and Texas.

[4] The whooping crane is considered endangered throughout its range in the U.S. except where nonessential, experimental flocks have been established. More recently, a release site (White Lake Wetlands Conservation Area, Vermilion Parish) was added in Louisiana (Table 4-14 of the 2012-2017 WPA/CPA Multisale EIS) with a release of 10 birds on February 22, 2011. To date, only 3 of the original 10 released cranes remain; an additional release of 16 cranes occurred on December 1, 2011. The Gulf Coast States that have these nonessential, experimental flocks include Alabama, Louisiana, Mississippi, and Florida; as well, wild whooping cranes may rarely occur as transients in Mississippi and Alabama, but they are not known to breed in either state.

[5] The red knot is currently a proposed threatened species as of September 30, 2013 (*Federal Register*, 2013).

KEYWORD INDEX

KEYWORD INDEX

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management Mission

The Bureau of Ocean Energy Management (BOEM) promotes energy independence, environmental protection, and economic development through responsible, science-based management of offshore conventional and renewable energy.