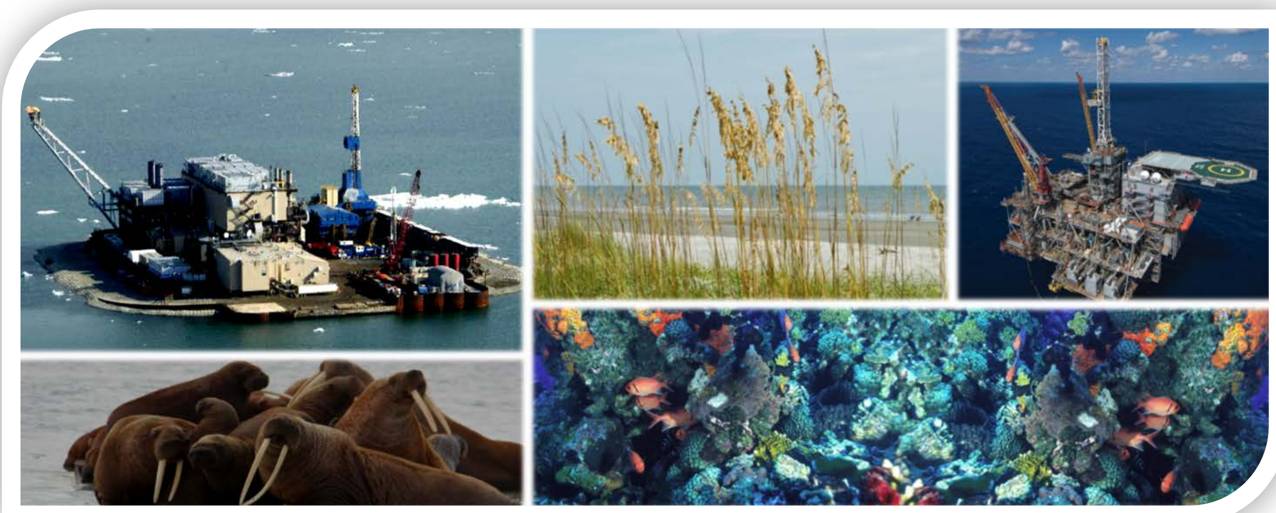
OCS EIS/EA
BOEM 2016-060

Outer Continental Shelf
Oil and Gas Leasing Program: 2017–2022

Final Programmatic Environmental Impact Statement

November 2016

Volume I: Chapters 1-6



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COVER SHEET

Programmatic Environmental Impact Statement for the Outer Continental Shelf Oil and Gas Leasing Program: 2017–2022

Draft ( ) **Final (x)**

Type of Action: Administrative (x) Legislative ( )

Area of Potential Impact: Offshore Marine Environment and Coastal States of Alaska, Texas, Louisiana, Mississippi, and Alabama

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ABSTRACT

This Programmatic Environmental Impact Statement (EIS) analyzes the environmental impacts from implementing the 2017–2022 Outer Continental Shelf (OCS) Oil and Gas Leasing Program, published as the Proposed Program in March 2016 (BOEM 2016a).

The Programmatic EIS is used to inform decisions on the 2017–2022 Program regarding OCS oil and gas leasing. In accordance with the National Environmental Policy Act and its implementing regulations, the Programmatic EIS addresses the purpose of and need for action; identifies alternatives and describes the alternatives development screening process; characterizes the affected environment; and analyzes the potential environmental impacts of the Proposed Action, alternatives, and expected and potential mitigation. Potential contributions of past, ongoing, and reasonably foreseeable future actions (effects baseline and cumulative actions and trends) are also analyzed in addition to activities associated with the Proposed Action. Hypothetical scenarios were developed for the Proposed Action to help estimate the levels of activities, number and size of accidental events (such as oil spills), and to focus analyses of potential impacts that could result from the activities associated with the Proposed Action under low-, mid-, and high-price cases for OCS oil and gas leasing. The Programmatic EIS also considers: (1) the lifecycle greenhouse gas emissions from oil and gas that could be produced under this Program; and (2) the lifecycle greenhouse gas emissions that would result from energy substitutes required to replace foregone production under current demand projections and existing policies in the absence of leasing under the 2017–2022 Program.

This Programmatic EIS explores alternatives and discloses potential environmental and socioeconomic effects of activities associated with OCS oil and natural gas leasing, exploration, development, production, and decommissioning in the OCS areas selected for leasing in the Proposed Program. This Programmatic EIS was prepared using the best scientific information publicly available at the time of preparation. Where relevant, if information on reasonably foreseeable significant adverse impacts was incomplete or unavailable, the need for the information was evaluated to determine if it was essential to making a reasoned choice among the alternatives, and, if so, it was either acquired or accepted scientific methodologies were applied in its place in the event it was impossible or exorbitant to acquire.

Additional copies of this Programmatic EIS can be obtained from the Bureau of Ocean Energy Management, Attn: Dr. Jill Lewandowski, by telephone at 703-787-1703, or it can be downloaded from the website http://www.boemoceaninfo.com.

SUMMARY

Background

Section 18 of the Outer Continental Shelf Lands Act (OCSLA) requires the Secretary of the Interior to prepare and maintain a schedule of proposed Outer Continental Shelf (OCS) oil and gas lease sales that "best meet national energy needs for the 5-year period following its approval or re-approval." BOEM is currently developing an oil and gas program for the years 2017 to 2022 (hereinafter the "Program"). Development of the Program occurs in three stages. At the first stage, the Draft Proposed Program analyzed all OCS Planning Areas. The Secretary of the Interior proposed a schedule of lease sales for the Program based on the Draft Proposed Program analyses and the discretion afforded her under OCSLA. At the second stage of the process, the schedule of lease sales was analyzed in the Proposed Program document and in the Draft Programmatic Environmental Impact Statement (Programmatic EIS). The Secretary of the Interior then provided in her Proposed Program decision a schedule of lease sales based on these updated analyses and the discretion afforded her under OCSLA. The final stage includes analysis of the schedule of lease sales in the Proposed Program decision. This analysis is contained in the Proposed Final Program and Final Programmatic EIS. The Secretary of the Interior then issued her Proposed Final Program decision based on these analyses and the discretion afforded her under OCSLA. This decision was released concurrently with the Proposed Final Program document and this Final Programmatic EIS.

BOEM has decided to prepare a Programmatic EIS under the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq*.) and its implementing regulations as a vehicle for conducting and disclosing the environmental analyses for the Program. The information in this Programmatic EIS addresses three factors under OCSLA and is intended to inform the Secretary's Program decision. BOEM's decision to prepare the Programmatic EIS is discretionary because the U.S. Court of Appeals for the District of Columbia has ruled that the approval of an oil and gas program does not constitute an irreversible and irretrievable commitment of resources, and that, in the context of BOEM's multiple-stage oil and gas leasing program, the obligation to fully comply with NEPA does not mature until leases are issued. This Final Programmatic EIS addresses potential environmental impacts that could result if activities occur under leases issued from the schedule of lease sales for 2017-2022, as outlined in the Secretary of the Interior's decision in the *2017–2022 OCS Oil and Gas Leasing Proposed Program* published on March 25, 2016.

Purpose of and Need for the Proposed Action (Chapter 1)

The purpose of the Proposed Action is to implement the requirements of Section 18 of OCSLA for the Secretary of the Interior to schedule size, timing, and location of the 2017-2022 proposed OCS oil and gas lease sales that would "balance the potential for environmental damage, the potential for the discovery of oil and gas, and the potential for adverse impacts on the coastal zone" (OCSLA Section 18(a)(3)). Oil and natural gas supplies are integral to meet current national energy demand. Domestic oil and natural gas supplies contribute to meeting domestic energy demand and enhance national economic security. The development of an OCS oil and gas lease sale schedule for 2017-2022 facilitates domestic oil and gas production to meet this ongoing need.

Alternatives (Chapter 2)

The Proposed Action (Alternative A)

The Proposed Action, or Alternative A, includes a schedule of 13 lease sales in 4 OCS program areas (**Table S-1**). Alternative A consists of 10 region-wide sales in the Gulf of Mexico (GOM) Program Area and one sale each in the Beaufort Sea, Chukchi Sea, and Cook Inlet Program Areas offshore Alaska.

Table S-1. Schedule of 2017–2022 Lease Sales Analyzed under the Proposed Action

Count	Sale Number	Program Area	Year
1	249	Gulf of Mexico	2017
2	250	Gulf of Mexico	2018
3	251	Gulf of Mexico	2018
4	252	Gulf of Mexico	2019
5	253	Gulf of Mexico	2019
6	254	Gulf of Mexico	2020
7	255	Beaufort Sea	2020
8	256	Gulf of Mexico	2020
9	257	Gulf of Mexico	2021
10	258	Cook Inlet	2021
11	259	Gulf of Mexico	2021
12	261	Gulf of Mexico	2022
13	262	Chukchi Sea	2022

Oil and gas activities can occur on OCS leases only after a lease sale is held pursuant to the selected alternative; these activities can extend over a period of 40 to 70 years. These activities could include: (1) geophysical surveys; (2) drilling of oil and natural gas exploration, development, and production wells; (3) installation and operation of OCS platforms and pipelines, onshore pipelines, and support facilities; (4) transport of hydrocarbons using pipelines or tankers to processing locations; and (5) decommissioning.

This Final Programmatic EIS analyzes four alternatives in detail (**Table S-2**), including the Proposed Action (Alternative A). Alternative B is the Exclusion or Programmatic Mitigation of Environmentally Important Areas (EIAs), Alternative C is the Reduced Proposed Action, and Alternative D is the No Action Alternative. The 2017–2022 Program and this Programmatic EIS take a landscape-scale approach to identify the suitability of areas for oil and gas development after considering economic, social, and environmental values of the renewable and nonrenewable OCS resources, and the potential impact of oil and gas exploration on other resource values of the OCS and the marine, coastal, and human environments. This approach aligns with numerous administrative orders and guidance, which are described in **Section 1.4.2**.

Alternative A includes a proposed schedule of lease sales in specified areas of the OCS (**Table S-1**). Alternative B analyzes possible reductions in the size or location of the areas available for leasing contained in the Proposed Action through exclusion from leasing or the application of programmatic mitigation within EIAs in relevant program areas. EIAs represent regions of important environmental value where there is potential for conflict between ecologically important or sensitive habitats; maintenance of social, cultural, and economic resources; and possible oil and gas development. Specific EIAs were included for analysis if they were determined to be geographically defined, supported by adequate data, and could affect the size or location of potential leasing in a program area (see **Table S-2**). Alternative C considers the exclusion of one or more program area(s), while maintaining the remaining complement of sales in the other program area(s). Under Alternative D, no new lease sales would be scheduled in any program area. Energy substitutes would be expected to replace the production foregone if no leasing occurs in one or more program areas (Alternative C) or all program areas (Alternative D) during the 2017-2022 Program (**Section 3.5.2**).

Table S-2. Alternatives Analyzed in Detail in the Programmatic EIS

Program Area	Alternative A*	Alternative B	Alternative C	Alternative D
Beaufort Sea	One sale in 2020 OR advance sale to 2019	B(1): Exclusion of or programmatic mitigation in: a) Barrow Canyon b) Camden Bay c) Cross Island and/or d) Kaktovik	C(1): No new leasing in Beaufort Sea Program Area for 2017–2022	No new leasing in any program area
Chukchi Sea	One sale in 2022	B(2): Exclusion of or programmatic mitigation in Hanna Shoal: a) Walrus Foraging Area and/or b) Walrus Movement Corridor	C(2): No new leasing in Chukchi Sea Program Area for 2017–2022	No new leasing in any program area
Cook Inlet	One sale in 2021	B(3): Exclusion of designated Cook Inlet Beluga Whale Critical Habitat	C(3): No new leasing in Cook Inlet Program Area for 2017-2022	No new leasing in any program area
GOM	Region-wide leasing: 10 sales offering all unleased acreage in the Western, Central, and portions of the Eastern Planning Areas not subject to Congressional moratorium or otherwise excluded. OR Traditional leasing of 10 separate, alternating sales (one sale each year in the Western and another sale in the combined Central and Eastern Planning Areas) for areas not subject to Congressional moratorium or otherwise excluded.	N/A	C(4): No new leasing in entire GOM Program Area for 2017-2022	No new leasing in any program area

Key: * = For the Proposed Action in the GOM, the supplemental 24-km (15-mi) no-leasing buffer south of Baldwin County, Alabama, could be incorporated in either option.

The Secretary of the Interior has identified Alternative C (Reduced Proposed Action) as the Preferred Alternative. Specifically, she has stated a preference for exclusion of the Beaufort Sea Program Area (C[1]) and the Chukchi Sea Program Area (C[2]) from the 2017–2022 Program while maintaining the complement of lease sales for the Cook Inlet and GOM Program Areas. The Preferred Alternative proposes eleven (11) lease sales in the 2017–2022 Program, consisting of ten (10) lease sales in the GOM and one (1) lease sale in the Cook Inlet. The Preferred Alternative reflects the Secretary's consideration and balancing of OCSLA Section 18 factors (including the analysis contained in this Programmatic EIS) as presented in the Proposed Final Program (BOEM 2016c). **Table S-3** presents the lease sale schedule for the 2017-2022 Program**.**

Table S-3. Schedule of 2017–2022 Lease Sales, Preferred Alternative

Count	Sale Number	Program Area	Year
1	249	Gulf of Mexico	2017
2	250	Gulf of Mexico	2018
3	251	Gulf of Mexico	2018
4	252	Gulf of Mexico	2019
5	253	Gulf of Mexico	2019
6	254	Gulf of Mexico	2020
7	256	Gulf of Mexico	2020
8	257	Gulf of Mexico	2021
9	258	Cook Inlet	2021
10	259	Gulf of Mexico	2021
11	261	Gulf of Mexico	2022

Section 4.4.3 describes the potential impacts associated with Alternative C. **Section 2.9** provides a comparison of the potential impacts across alternatives, including the Preferred Alternative.

In addition to the EIAs analyzed as part of Alternative B, the application of programmatic mitigation was considered separately for certain other EIAs:

Beaufort Sea: Harrison Bay

Chukchi Sea: Chukchi Corridor

Gulf of Mexico: Biologically Sensitive Underwater Features EIA

These EIAs were differentiated from the other areas included in Alternative B because the application of mitigation *would not* directly affect the size or location of potential leasing.

BOEM has also analyzed a programmatic mitigation that would require an oil and gas industry operator to submit a Conflict Management Plan (CMP) to BOEM as a submittal prior to beginning exploration or development activities. This programmatic mitigation arose from comments provided by a number of Alaska Native communities and organizations during the comment period on the Draft Programmatic EIS.

Analyses (Chapters 3 and 4)

Impact-Producing Factors

Chapter 3 presents the range, nature, and general timing of activities that could occur in each program area as a result of a lease sale during the 2017–2022 Program. Estimates of oil and gas resources that could be found in and produced from the areas being considered for leasing provide the basis for the assumption of the broad levels of exploration and development that might occur.

The impact-producing factors (IPFs) related to OCS activities and evaluated in this Programmatic EIS include the following:

- **Noise** from geophysical surveys, ship and aircraft traffic, drilling and production operations, trenching, onshore and offshore construction, and explosive platform removals.
- **Traffic** associated with the movement of ships and aircraft.
- **Routine discharges** associated with the offshore and onshore disposal of liquid wastes, including ballast water and sanitary and gray wastewater generated by OCS-related activities.
- **Drilling, mud cuttings, and debris**, including material removed from the well borehole (i.e., drill cuttings), solids produced with the oil and gas (e.g., sands), cement residue, bentonite, and trash and debris (e.g., equipment or tools) accidentally lost.
- **Bottom/land disturbance** from drilling, infrastructure emplacement (e.g., platforms, pipelines, onshore infrastructures), and structure removal.
- **Air emissions** from offshore and onshore facilities and transportation vessels and aircraft.
- **Lighting/physical presence** associated with onshore and offshore facilities.
- **Visible onshore and offshore facilities** from shore.
- **Space-use conflicts** with onshore and offshore facilities, including oil tankers and barges, supply/support vessels and aircraft, and seismic survey vessels and aircraft.
- **Accidental oil spills**, including those from loss of well control, production accidents, transportation failures (e.g., from tankers, other vessels, seafloor and onshore pipelines, and storage facilities), and low-level spillage from platforms.

Environmental Resources and Conditions

Chapter 4 evaluates 17 environmental, sociocultural, or socioeconomic resources and 2 other environmental conditions that could be affected by oil and gas leasing and activities. The resources and other environmental conditions evaluated are shown in **Figure S-1**.

The Programmatic EIS also considers: (1) the lifecycle greenhouse gas emissions from oil and gas that could be produced under this Program; and (2) the lifecycle greenhouse gas emissions that would result from energy substitutes required to replace foregone production under current demand projections and existing policies in the absence of leasing under the 2017–2022 Program (**Section 4.2.1.2**).

Sensitive Biological and Ecological Resources and Critical Habitats. The program areas constitute diverse marine and coastal environments that support a diversity of habitats and biota, including species and habitats protected by the Endangered Species Act, the Marine Mammal Protection Act, the Magnuson-Stevens Fishery Conservation and Management Act, the Migratory Bird Treaty Act, and other Federal and state laws and regulations. The Programmatic EIS focuses on aspects of marine and coastal resources that are unique, ecologically important, or most susceptible to impacts from OCS oil and gas activities. The Programmatic EIS also concentrates on life stages and habitats that could be most sensitive to moderate and major impacts from routine oil and gas activities. The animal groups evaluated include benthic invertebrates, marine mammals, sea turtles, birds, fish, and Arctic terrestrial mammals. Special attention is given to migratory species, commercially valuable species, species taken for Alaska Native subsistence (including whales, other marine mammals, fish, and birds), and protected species. With respect to habitats, marine (e.g., corals and chemosynthetic communities) and coastal (e.g., estuaries and wetlands/marshes, dunes) areas are identified and evaluated for possible adverse impacts from OCS oil and gas activities.

NATURAL, SOCIAL, CULTURAL, & ECONOMIC RESOURCES	
Air Quality	Fish and Essential Fish Habitat
Water Quality	Arctic Terrestrial Wildlife and Habitat
Marine Benthic Communities	Archaeological and Historical Resources
Coastal and Estuarine Habitats	Population, Employment, and Income
Pelagic Communities	Land Use and Infrastructure
Marine Mammals	Commercial and Recreational Fisheries
Sea Turtles	Tourism and Recreation
Birds	Sociocultural Systems
	Environmental Justice
OTHER ENVIRONMENTAL CONDITIONS	
Climate Change	Human Health

Figure S-1. Resources and other Environmental Conditions Evaluated in this Programmatic EIS

Social, Cultural, and Economic Resources. Key sociocultural, socioeconomic, and archaeological topics analyzed in this Final Programmatic EIS include the following:

- Archaeological resources, including historic shipwrecks and sites inhabited by humans during prehistoric times
- Population, employment, income, and public service issues from the effects of the Program
- Land use and infrastructure, including construction of new onshore facilities
- Commercial and recreational fisheries
- Tourism and recreation
- Sociocultural systems, including potential effects on subsistence resources and activities, loss of cultural identity, health impacts including psychological health, and social cost of oil spills
- Environmental justice (i.e., the potential for disproportionate and high adverse impacts on people of color and/or low-income populations).

Impacts from Routine Activities

The analyses in this Programmatic EIS describe the nature and extent of potential impacts of future oil and gas activities, including direct, indirect, and cumulative impacts that result from routine operations and associated IPFs. Cumulative effects are addressed in the Programmatic EIS in **Section 4.5**. All analyses assume the implementation of all mitigation and other protective measures currently required by statute, regulation, or BOEM policy and practice.

IPFs for routine operations do not change across Alternatives A, B, and C. The primary difference among the alternatives is the level of activity and the need for energy substitutes (**Section 3.5.2**). Alternative D assumes no leasing in any program area, so the direct and indirect impacts would be limited to those from energy substitutes and some potential for socioeconomic impacts (e.g., job losses, out-migration). Alternative C would allow for the removal of one or more program areas from activities, but would always have leasing in at least one program area. Alternative C represents an increase in activity in comparison to the level of activity under Alternative D. Similar to Alternative D, the analysis for Alternative C also considers effects on resources due to energy substitutes to meet energy demand if production from OCS oil and gas leasing is decreased. However, the effects of substitutes under Alternative C are expected to be less than under Alternative D because Alternative C always considers leasing in at least one program area. Alternative B, which would allow for leasing in all program areas but would either include certain mitigation measures or exclude specific areas (EIAs), would result in a probable increase in activity from Alternative C. Alternative A, the Proposed Action, represents the highest level of activity that could occur under the 2017–2022 Program.

Impact levels are summarized in **Table S-4**. The types of impacts would be largely similar regardless of location. Regional differences in impacts are identified and analyzed as needed. **Table S-4** summarizes the direct and indirect impacts expected for the Proposed Action as well as the change from that expected impact for Alternatives B, C, and D. In many cases, potential impacts in **Chapter 4** of the Final Programmatic EIS are expressed as a range, such as "minor to moderate." Where the analysis determines that a range of impacts would be anticipated, **Table S-3** shows only the highest impact level conclusion for that resource.

Impacts from Oil Spills

The greatest concern related to oil and gas development under the action alternatives (A, B, and C) is that of an accidental oil spill. Spills can be associated with loss of well control, production accidents, transportation failures (e.g., tankers, other vessels, seafloor and onshore pipelines, and storage facilities), and platform accidents.

The Programmatic EIS presents analyses of the effects of varying sizes of oil spills on sensitive resources. BOEM estimates the number of small (< 1,000 barrels [bbl]) and large (≥ 1,000 bbl) oil spills that are expected during the 2017–2022 Program given historical spill rates and projected OCS activity levels. Most expected spills would be less than 50 bbl in size, and impacts on most resources from such small spills would be negligible to minor, because weathering, dispersion, and other natural processes would be expected to quickly disperse and degrade the spill, limiting exposure of and effects on resources in the vicinity of the spill. In addition, the farther from the coast a small spill were to occur, the less likely it would be that the spill would adversely affect coastal and nearshore resources. In contrast, a large spill could be expected to affect more resources over a much larger area and for a much longer period of time, and potentially result in major impacts on any or all resources.

In all program areas, the analyses consider the effects of a catastrophic discharge event (CDE) even though the occurrence of such a spill would be statistically unexpected (**Section 3.3**). The effects of a CDE could significantly affect physical, biological, and socioeconomic resources over large areas and for long periods of time. The magnitude and severity of impacts from a spill on any resource would depend on the spill's location, size, depth, and duration as well as the type of spill, meteorological conditions such as wind speed and direction, seasonal and environmental conditions, and the effectiveness of response activities. The aforementioned factors can have a substantial effect on weathering processes such as evaporation, emulsification, dispersion, dissolution, microbial degradation and oxidation, and transport of the spilled products.

The Preferred Alternative

Table S-5 shows the impacts associated with the Preferred Alternative. Exclusion of the Beaufort Sea and Chukchi Sea Program Areas would result in impacts described under Alternative C (**Section 4.4.3**) and Alternative D for those areas (**Section 4.4.4**). Impacts from lease sales conducted in the Cook Inlet and GOM Program Areas are described under the Proposed Action (**Section 4.4.1**). There are no impacts expected for the excluded Arctic program areas because removal of both areas eliminates the potential for cross-boundary impacts, and migratory species impacts are not expected. Impacts from energy substitutes are not expected in the Arctic program areas. See **Section 4.4** for more detailed analysis.

Conclusion

This Programmatic EIS is consistent with the requirements of the OCSLA, NEPA, CEQ regulations implementing NEPA (40 CFR 1500–1508), and Department of the Interior regulations implementing NEPA (43 CFR 46). On the basis of the analyses in this Programmatic EIS, the types of impacts that could occur during routine Program activities would be similar under Alternatives A and B; however, under Alternative B, EIAs would be excluded and thus reduced levels of impacts would occur than would be expected under Alternative A. The exception is the GOM Program Area, where there would be no difference in impacts between Alternatives A and B because no EIAs were considered under Alternative B for the GOM. Under Alternative C, the potential impacts in the area(s) excluded would be similar to those described under Alternative D, whereas impacts in the area(s) that are not excluded would be largely similar to those for the Proposed Action for that area. Under Alternative C, there is also the potential for cross-boundary impacts that does not exist under Alternative D. The alternatives differ principally on the basis of where the impacts could occur and to what extent, which is directly related to the program areas, exclusions, or mitigation measures ultimately selected.

Routine operations are expected to result in impacts ranging from negligible to major, with most impacts being short-term and resolving after completion of the routine activities. Accidental spills also could result in impacts ranging from negligible to major depending on the nature of the spill and spill response. Although statistically unexpected, the greatest effects would occur with a low-probability CDE, but the nature and magnitude of impacts would vary substantially and depend on the location, size, duration, and timing of the spill, the resources affected, meteorological conditions, and the effectiveness of the spill containment and cleanup activities.

BOEM's process for implementing a Program through the various OCSLA stages represents an opportunity for adaptive management and more detailed treatment of both long-standing and developing concerns. The Secretary of the Interior's decision to schedule lease sales with regard to size, timing, and location considerations is only the initial step in a multi-year deliberative process if one of the action alternatives is selected. The actual Program implementation contains numerous subsequent decisions on lease sales, geological and geophysical permit applications, exploration and development plan review and approvals, applications for permits to drill (under authority of the Bureau of Safety and Environmental Enforcement [BSEE]), and, ultimately, decommissioning activities (also under authority of the BSEE). Each of these stages requires a separate environmental review.

Table S-4. Change in Direct and Indirect Impacts across Alternatives relative to the Proposed Action (Alternative A)

Resource	Alternative A Proposed Action				Alternative B[1] Environmentally Important Areas				Area Excluded under Alternative C[2] Reduced Proposed Action with Energy Substitutes				Alternative D No Action with Energy Substitutes			
	Beaufort	Chukchi	Cook Inlet	Gulf of Mexico	Beaufort	Chukchi	Cook Inlet	Gulf of Mexico	Beaufort	Chukchi	Cook Inlet	Gulf of Mexico	Beaufort	Chukchi	Cook Inlet	Gulf of Mexico
Air Quality	🟡	🟡	🟡	🟠	=	=	=	■	↓	↓	↓	↓	↓	↓	↓	↓
Water Quality	🟠	🟠	🟠	🟠	=	=	=	■	↓	↓	↓	↓	↓	↓	↓	↓
Coastal & Estuarine Habitats	🟡	🟠	🟡	🟠	=	=	=	■	↓	↓	↓	↓	↓	↓	↓	↓
Marine Benthic Communities[3]	🟠	🟠	🟠	🟠	↓	↓	=	■	↓	↓	↓	↓	↓	↓	↓	↓
Pelagic Communities	🟡	🟡	🟡	🟡	=	=	=	■	↓	↓	↓	↓	↓	↓	↓	↓
Marine Mammals[4]	🟠	🟠	🟠	🟠	↓	↓	↓	■	↓	↓	↓	↓	↓	↓	↓	↓
Sea Turtles	■	■	■	🟠	■	■	■	■	■	■	■	↓	■	■	■	↓
Birds	🟡	🟡	🟡	🟡	↓	↓	=	■	↓	↓	↓	↓	↓	↓	↓	↓
Fish & EFH	🟡	🟡	🟡	🟡	=	=	=	■	↓	↓	↓	↓	↓	↓	↓	↓
Arctic Terrestrial Wildlife & Habitats	🟠	🟠	■	■	=	=	■	■	↓	↓	■	■	↓	↓	■	■
Archaeological & Historical Resources[5]	🔴	🔴	🔴	🔴	=	=	=	■	↓	↓	↓	↓	↓	↓	↓	↓
Population, Employment, & Income	🟠	🟠	🟡	🟡	=	=	=	■	↓	↓	↓	↑	↓	↓	↓	↑
Land Use & Infrastructure	🟠	🟠	🟠	🟠	=	=	=	■	↓	↓	↓	↓	↓	↓	↓	↑
Commercial & Recreational Fisheries	■	■	🟡	🟡	■	■	=	■	■	■	↓	↓	■	■	↓	↓
Tourism & Recreation	🟠	🟠	🟠	🟠	↓	↓	=	■	↓	↓	↓	↓	↓	↓	↓	↓
Sociocultural Systems	🔴	🔴	🟡	🟡	↓	↓	=	■	↓	↓	↓	↓	↓	↓	↓	↑
Environmental Justice	🔴	🔴	🟡	🟡	↓	↓	=	■	↓	↓	↓	↓	↓	↓	↓	↑

Key: 🟡 = Minor | 🟠 = Moderate | 🔴 = Major | "=" = No Change | ↑ = More impact OR ↓ = Less impact than the Proposed Action | ■ = not applicable

[1]Reduction in impacts under Alternative B is related to the exclusion of these areas and the potential for a localized decrease in impacts within or because of an EIA. It does not necessarily mean a reduction in overall impacts in the program area. See **Section 4.4** for a detailed discussion of potential impacts.

[2] The impact trends shown for Alternative C would occur for the excluded area only.

[3]If sensitive benthic habitats are avoided, impacts under the Proposed Action could be reduced.

[4]The Cook Inlet EIA could result in lesser impacts than those expected under the Proposed Action for beluga whales in Cook Inlet.

[5]If surveys are conducted and resources detected prior to bottom-disturbing activities, adverse impacts are not expected to occur.

Table S-5. Impacts Expected under the Preferred Alternative

Resource	Preferred Alternative Impacts			
	Beaufort Sea	Chukchi Sea	Cook Inlet	Gulf of Mexico
Air Quality	None	None	🟡	🟠
Water Quality	None	None	🟠	🟠
Coastal & Estuarine Habitats	None	None	🟡	🟠
Marine Benthic Communities	None	None	🟠	🟠
Pelagic Communities	None	None	🟡	🟡
Marine Mammals	None	None	🟠	🟠
Sea Turtles	⬛	⬛	⬛	🟠
Birds	None	None	🟡	🟡
Fish & EFH	None	None	🟡	🟡
Arctic Terrestrial Wildlife & Habitats	None	None	⬛	⬛
Archaeological & Historical Resources*	None	None	🔴	🔴
Population, Employment, & Income	None	None	🟡	🟡
Land Use & Infrastructure	None	None	🟠	🟠
Commercial & Recreational Fisheries	⬛	⬛	🟡	🟡
Tourism & Recreation	None	None	🟠	🟠
Sociocultural Systems	None	None	🟡	🟡
Environmental Justice	None	None	🟡	🟡

Key: 🟡 = Minor | 🟠 =Moderate | 🔴 = Major | ⬛ = not applicable
Note:
* If surveys are conducted and resources detected prior to bottom-disturbing activities, adverse impacts are not expected to occur.

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LIST OF ACRONYMS AND ABBREVIATIONS

µPa	micropascals
µPa-m	micropascals at a reference distance of 1 meter
2D	two-dimensional
3D	three-dimensional
ac	acre
ACP	Arctic Coastal Plain
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ANCSA	Alaska Native Claims Settlement Act
APD	Application for Permit to Drill
Bbbl	billion barrels of oil
bbl	barrels of oil
bcf	billion cubic feet
BIA	Biologically Important Area
BLM	Bureau of Land Management
BOE	barrel of oil equivalent
BOEM	Bureau of Ocean Energy Management
BOEM OPA	BOEM’s Office of Public Affairs
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CAH	Central Arctic Herd
CDE	catastrophic discharge event
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
cm^2	square centimeter
cm^3	cubic centimeter
CMP	conflict management plan
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	decibel
DPP	Draft Proposed Program
DPS	Distinct Population Segment
E&D	exploration and development
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIA	Environmentally Important Area
EIS	Environmental Impact Statement
E.O.	Executive Order
EP	Exploration Plan
ESA	Endangered Species Act
ESI	Environmental Sensitivity Index
FAA	Federal Aviation Administration
FCMA	Magnuson-Stevens Fishery Conservation and Management Act
FLM	Federal Land Manager
FMC	Fisheries Management Council
FMP	Fisheries Management Plan
FONSI	Finding of No Significant Impact
FPSO	floating production, storage, and offloading
FR	*Federal Register*
ft	feet
ft^2	square feet
FWCA	Fish and Wildlife Coordination Act
FWPCA	Federal Water Pollution Control Act
G&G	geological and geophysical
GCFMC	Gulf Coast Fishery Management Council

GDP	Gross Domestic Product
GHG	greenhouse gas
GIS	Geographic Information System
GMFMC	Gulf of Mexico Fishery Management Council
GOA	Gulf of Alaska
GOADS	Gulfwide Offshore Activity Data System
GOM	Gulf of Mexico
GOMESA	Gulf of Mexico Energy Security Act
ha	hectares
H_2S	hydrogen sulfide
HAPC	Habitat Area of Particular Concern
HCA	Habitat Conservation Area
HMS	highly migratory species
HPA	Habitat Protection Area
HSWUA	Hanna Shoal Walrus Use Area
Hz	Hertz
IBA	Important Bird Area
IEA	International Energy Agency
IHA	incidental harassment authorization
IPCC	International Panel on Climate Change
IPF	impact-producing factor
INDC	Intended Nationally Determined Contribution
ITS	incidental take statement
km	kilometer
km^2	square kilometer
kn	knot
KPB	Kenai Peninsula Borough
lb	pound
LCI	Lower Cook Inlet
LME	large marine ecosystems
LNG	liquefied natural gas
LOOP	Louisiana Offshore Oil Port
m	meter
m^2	square meters
m^3	cubic meters
MARPOL	International Convention of the Prevention of Pollution from Ships
Mat-Su	Matanuska-Susitna Borough
MBTA	Migratory Bird Treaty Act
MCBI	Marine Conservation Biology Institute
mcf	million cubic feet
mg	milligrams
mg/L	Milligrams per liter
mg/m^3	milligrams per cubic meter
mi	mile
mi^2	square miles
mm	millimeter
MMbbl	million barrels of oil
MMBOE	million barrels of oil equivalent
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MoA	Municipality of Anchorage
MODU	mobile offshore drilling unit
MOU	Memorandum of Understanding
MPA	Marine Protected Areas
MPPRCA	Marine Plastic Pollution Research and Control Act
MPRSA	Marine Protection, Research, and Sanctuaries Act
MRIP	Marine Recreational Information Program
ms	milliseconds
N_20	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
National Register	National Register of Historic Places
NASA	National Aeronautics and Space Administration
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NERR	National Estuarine

	Research Reserves
NETL	National Energy Technology Laboratory
NGO	non-governmental organization
NIC	National Incident Command
nmi	nautical mile
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NMSA	National Marine Sanctuary Act
NO	nitrogen oxide
NO_2	nitrous dioxide
NO_x	nitrogen oxides
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NP	national park
NPDES	National Pollution Discharge Elimination System
NPP	National Park and Preserve
NPR-A	National Petroleum Reserve - Alaska
NPS	National Park Service
NRC	National Research Council
NRDA	Natural Resource Damage Assessment
NRDC	National Resources Defense Council
NSB	North Slope Borough
NTL	Notice to Lessees and Operators
NWAB	Northwest Arctic Borough
NWR	National Wildlife Refuge
O_3	ozone
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OECM	Offshore Environmental Cost Model
ONMS	Office of National Marine Sanctuary
OPA	Oil Pollution Act
OPAREA	Operating Area
ORPC	Ocean Renewable Power Company
OSFR	oil-spill financial responsibility
OSR	oil spill response
OSV	offshore support vessel
P	pressure
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCH	Porcupine Caribou Herd
PFP	Proposed Final Program
pH	potential of hydrogen
PM	particulate matter
$PM_{2.5}$	particulate matter measuring 2.5 microns or less in diameter
PM_{10}	particulate matter measuring 10 microns or less in diameter
Program	2017–2022 OCS Oil and Gas Leasing Program
Programmatic EIS	Programmatic Environmental Impact Statement
PSD	Prevention of Significant Deterioration
PSO	Protected Species Observer
PTS	permanent threshold shift
PTSD	post-traumatic stress disorder
RCRA	Resource Conservation and Recovery Act
RHA	Rivers and Harbors Act
s	seconds
SAFMC	South Atlantic Fisheries Management Council
SAV	submerged aquatic vegetation
SBM	synthetic-based muds
SEL	sound exposure level
SI	International System of Units
SO_2	sulfur dioxide
SO_x	sulfur oxides

SST	sea surface temperature
SVP	sound velocity profiles
TAPS	Trans-Alaska Pipeline System
tcf	trillion cubic feet
TCH	Teshekpuk Lake Caribou Herd
TOC	total organic carbon
TTS	temporary threshold shift
UME	unusual mortality event
UCI	Upper Cook Inlet
U.S.	United States
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDOC	U.S. Department of Commerce
USDOD	U.S. Department of Defense
USDOI	U.S. Department of the Interior
USDOT, FAA	U.S. Department of Transportation, Federal Aviation Administration
USEIA	U.S. Energy Information Administration
USEPA	U.S. Environmental Protection Agency
UERR	undiscovered economically recoverable resources
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
WAH	Western Arctic Herd
WBM	water-based mud

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1. INTRODUCTION

1.1 BACKGROUND

Federal management of oil and gas resources on the Outer Continental Shelf (OCS) of the United States (U.S.) is governed by the Outer Continental Shelf Lands Act (OCSLA) (43 United States Code [U.S.C.] 1331 *et seq*.). OCSLA addresses Federal regulation of oil and gas leasing, exploration, development, production, and decommissioning on the OCS. The OCS is defined to include all submerged lands lying seaward of state coastal waters and subject to U.S. jurisdiction and control.

Section 18 of OCSLA (found at 43 U.S.C. 1344) requires the Secretary of the Interior to prepare, periodically revise, and maintain an OCS oil and gas leasing program. The Bureau of Ocean Energy Management (BOEM) within the U.S. Department of the Interior (USDOI) is responsible for implementing the requirements of OCSLA for the program. The program is a schedule of proposed lease sales that the Secretary of the Interior determines would best meet national energy needs for the five-year period following approval of the program. The program must address, as precisely as possible, the size, timing, and location of leasing activity (43 U.S.C. 1344(a)).

Section 18 (a) of OCSLA requires the Program to be prepared and maintained in a manner consistent with enumerated principles, one of which includes consideration of environmental predictive information. Specifically, management of the OCS is to be conducted in a manner that considers environmental values and the potential impact of activities on the marine, coastal, and human environment. Development of the program must consider the following factors:

1. Existing information concerning the geographical, geological, and ecological characteristics of such regions
2. Equitable sharing of developmental benefits and environmental risks among the various regions
3. The location of such regions with respect to, and the relative needs of, regional and national energy markets
4. The location of oil- and gas-bearing regions in relation to other uses of the sea and seabed (such as fisheries)
5. The interest of potential oil and gas producers in the development of oil and gas resources as indicated by exploration or nomination
6. Laws, goals, and policies of affected states that have been specifically identified by the Governors of such states
7. Relative environmental sensitivity and marine productivity of different areas
8. Relevant environmental and predictive information.

BOEM is currently developing the program for the years 2017 to 2022 (hereinafter the “Program”). BOEM has decided to prepare a Programmatic Environmental Impact Statement (Programmatic EIS) under the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq*.) and it’s implementing regulations as a vehicle for conducting and disclosing the environmental analyses for the Program. The information in this Programmatic EIS addresses factors one, two, and eight above and is intended to inform the Secretary’s Program decision. BOEM’s decision to prepare the Programmatic EIS is discretionary because the U.S. Court of Appeals for the District of Columbia has ruled that the approval of an oil and gas program does not constitute an irreversible and irretrievable commitment of resources, and that, in the context of BOEM’s multiple-stage oil and gas leasing program, the obligation to fully comply with NEPA does not mature until leases are issued (*Center for Biological Diversity v. Department of the Interior*, 385 563 F.3d 466 [D.C. Cir. 2009]; *Center for Sustainable Economy v. Jewell*, 779 F.3d 588 [D.C. Cir. 2015]). Although approval of the Program would not result in an irretrievable and irreversible commitment of resources, BOEM has chosen to analyze potential environmental impacts that could result if leasing, exploration, and development activities eventually occur due to implementation of the 2017-2022 Program. This schedule of lease sales and potentially associated activities constitute the Proposed Action (Alternative A). The Proposed Action and alternatives are described in detail in **Chapter 2**.

The Draft Proposed Program (DPP) lease sale decision eliminated numerous planning areas from potential leasing for the five-year period (BOEM 2015a). The Secretary of the Interior's size, timing, and location decision emphasized avoidance and minimization of impacts at an early stage of the process and eliminated those areas with negligible hydrocarbon resources or industry interest at that time. Subsequently, the Secretary removed the Atlantic Program Area in her Proposed Program decision (BOEM 2016a), eliminating the potential for effects on the environment in that area from activities associated with the Program.

1.2 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

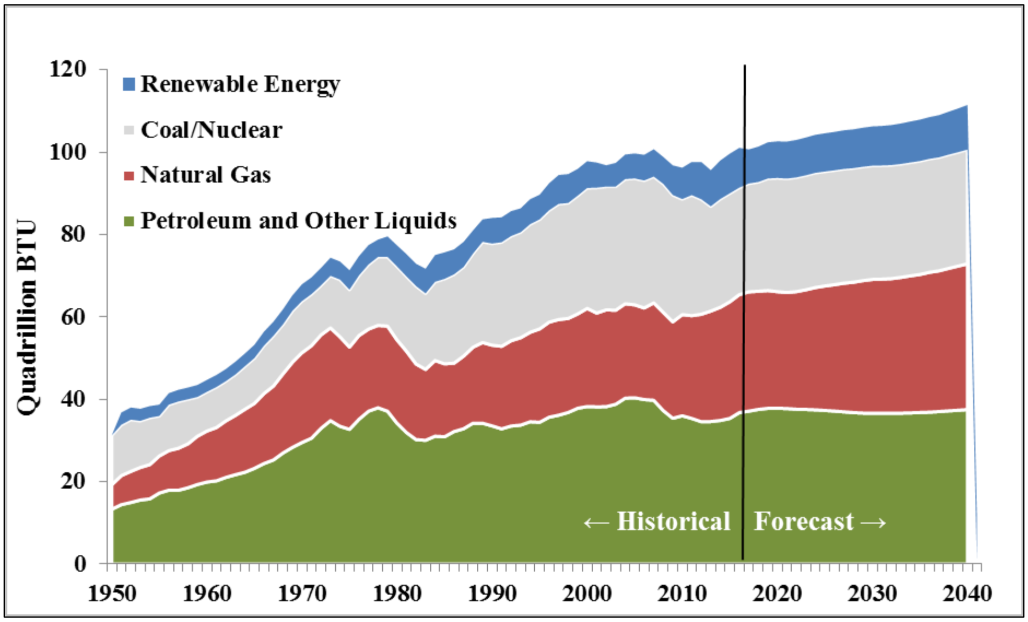
The purpose of the Proposed Action is to implement the requirements of Section 18 of OCSLA for the Secretary of the Interior to schedule size, timing, and location of the 2017–2022 proposed OCS oil and gas lease sales that would "balance the potential for environmental damage, the potential for the discovery of oil and gas, and the potential for adverse impacts on the coastal zone" (OCSLA Section 18(a)(3)).

Oil and natural gas supplies are integral to meeting current national energy demand. The need for oil and gas resources is demonstrated in **Figure 1.2-1**. Oil and gas resources consumption accounted for approximately 64 percent of all energy resources consumed in 2015 (USEIA 2016a). In 2015, OCS production represented approximately 20 percent of the U.S. total for crude oil and approximately 6 percent of the U.S. total for natural gas (USEIA 2016b, USEIA 2016c). Domestic oil and natural gas supplies contribute to meeting domestic energy demand and enhance national economic security. The development of an OCS oil and gas lease sale schedule for 2017–2022 would facilitate domestic oil and gas production to meet this ongoing need.

Any oil and gas production from leases that could be issued under the 2017–2022 Program would not enter the market immediately. Depending on the program area, production might not occur for a decade or longer. Nonetheless, current forecasts from the U.S. Energy Information Administration (USEIA) show that the demand for oil and gas is not expected to drop in the near future (**Figure 1.2-1**). Section 18 of OCSLA requires the Secretary of the Interior to prepare a schedule of OCS oil and gas lease sales for the next five years in consideration of that potential need, even if changes in energy or climate policy, changes in technology, or progress in alternative energy sources could reduce the need for fossil fuel at some point in the future.

1.3 KEY AGENCY RESPONSIBILITIES

BOEM is in charge of managing development of the nation's OCS energy and mineral resources in an environmentally and economically responsible manner. BOEM's principal functions include OCS leasing, resource evaluation, review and administration of oil and gas exploration and development plans, renewable energy development, marine minerals development, environmental assessment, and environmental studies. BOEM regulations related to OCS leasing and oil and gas operations are primarily found in in 30 Code of Federal Regulations (CFR) parts 550, 551, and 556.



Sources: USEIA 2016a, USEIA 2016d

Figure 1.2-1. Energy Use in the United States

The Bureau of Safety and Environmental Enforcement (BSEE), another bureau within the USDOI, is responsible for the safety and environmental compliance oversight of OCS oil and gas operations, including permitting and inspections of OCS oil and gas operations. Principal functions include the development and enforcement of safety and environmental regulations; permitting OCS exploration, development, and production activities; conducting inspections; ensuring industry is prepared to respond to oil spills; and training and environmental compliance programs. BSEE regulations related to OCS oil and gas operations are promulgated primarily in 30 CFR parts 250–254.

The OCSLA leasing and development process for oil and gas includes four major stages, consisting of program planning, specific lease sale planning, Exploration Plan (EP), and Development and Production Plan (**Figure 1.3-1**). The first stage, the subject of this Programmatic EIS, involves the development of a Five-Year Program that establishes a schedule of lease sales. After the Program is approved, the second stage involves the decision of whether to hold individual lease sales included in the program as well as the terms and areas that could be included in the sale. During the third stage, lessees must submit an EP to BOEM for approval before an operator can begin exploratory drilling on a specific lease. The EP establishes how the operator would explore under the lease and includes all exploration activities, the timing of these activities, information concerning drilling, the location of each well, and other relevant information. In the fourth stage, if the lessee discovers oil and gas resources and chooses to develop economically recoverable oil or gas from a specific lease, a Development and Production Plan must be submitted to BOEM for approval. This plan would describe the number of wells to be drilled, well locations, type of structure that would be used, how the operator would transport the oil and natural gas, an analysis of potential OCS and onshore impacts, and a description of decommissioning activities for wells, platforms, pipelines, and other facilities.

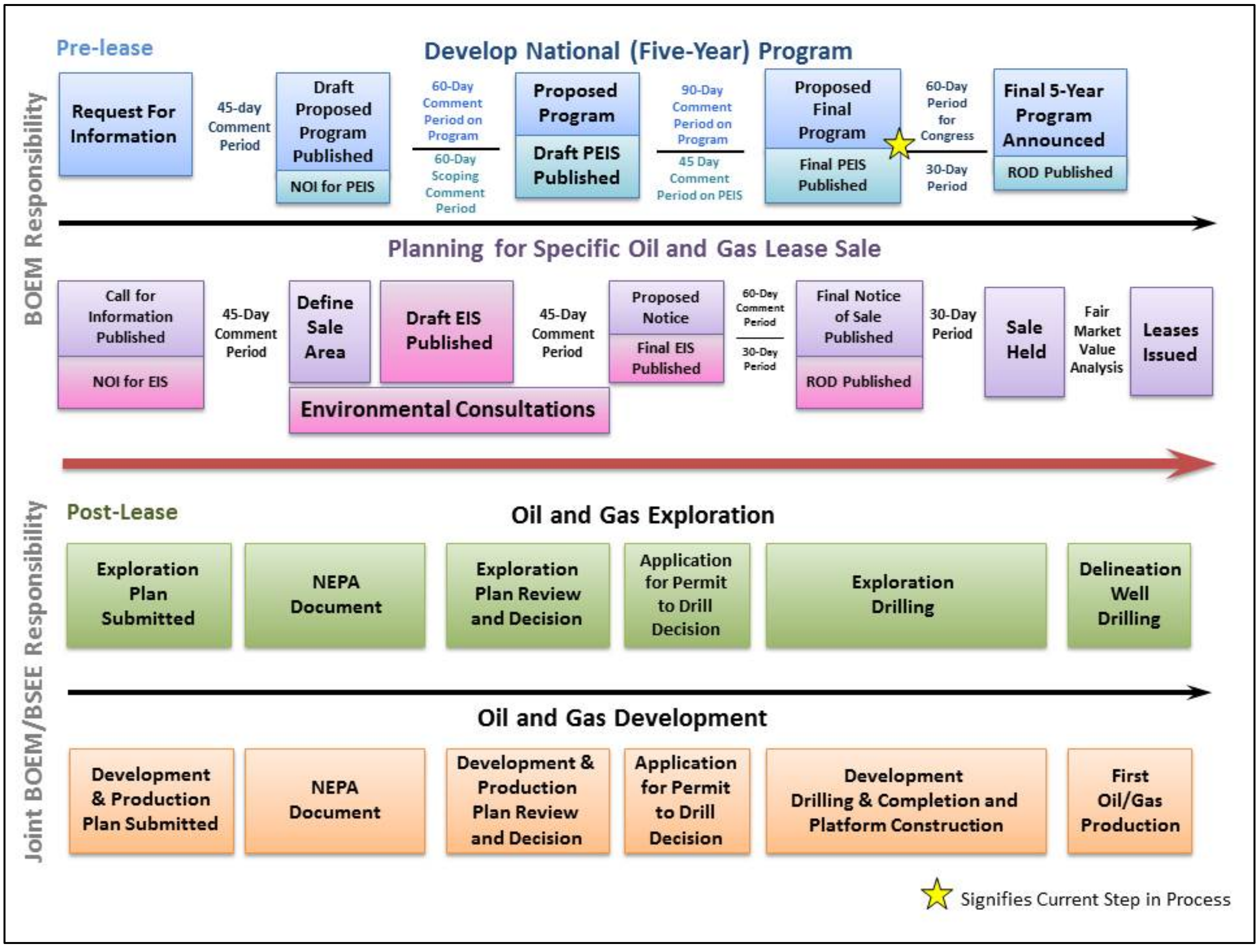


Figure 1.3-1. BOEM's OCS Oil and Gas Leasing, Exploration, and Development Process

Environmental reviews are conducted at each of these four stages so that subsequent decisions can consider information not previously available and address site-specific actions in more detail. These reviews include evaluations under NEPA and coordination with other regulatory requirements, such as the Coastal Zone Management Act (CZMA), Endangered Species Act (ESA), National Historic Preservation Act, and the Marine Mammal Protection Act (MMPA). In addition to the BOEM reviews and approvals listed above, operators must obtain a permit to drill individual wells from BSEE pursuant to a BOEM-approved plan.

1.4 SCOPE AND PARAMETERS OF THE PROGRAMMATIC EIS

Twenty-six OCS planning areas are defined and managed by BOEM offshore the contiguous U.S. and Alaska. All or portions of six OCS planning areas have been identified for leasing consideration as part of the Proposed Program and are evaluated as the Proposed Action in this Programmatic EIS. These six OCS planning areas comprise four program areas: Beaufort Sea, Chukchi Sea, Cook Inlet, and Gulf of Mexico (GOM) (**Figures 2.1-1** and **2.1-2**).

This Programmatic EIS focuses on potential effects that could result in moderate to major impacts from activities that could occur from the Proposed Program (i.e., leasing, exploration, production, decommissioning). Potential impacts that are expected to be negligible to minor are described in **Appendix E**. This approach is consistent with the Council on Environmental Quality's (CEQ) regulations for implementing NEPA (40 CFR 1500–1508) that encourage Federal agencies to de-emphasize insignificant issues and instead focus on those issues most pertinent to the analysis and subsequent decision.

The analyses in this Programmatic EIS focus on national and regional scales (versus impacts of individual lease sales or project-specific actions) consistent with the CEQ's *Final Guidance for Effective Use of Programmatic NEPA Reviews* (CEQ 2014). Programmatic-level analyses and decisions on oil and gas leasing activities are inherently more general and broader than those at the lease sale stage and the even more specific plan stage. This Programmatic EIS and the staged OCSLA process shown in **Figure 1.3-1** are based on the premise that more specific environmental information and review will be considered at later decision stages unless the No Action Alternative is selected, wherein no further reviews are necessary. The level and detail appropriate for this Programmatic EIS is necessary to allow the Secretary of the Interior to make an informed decision on the programmatic alternatives and mitigation measures identified for consideration for the 2017-2022 Program.

1.4.1 Scope of this Programmatic EIS

The purpose of an environmental impact statement is to identify potentially significant environmental impacts and to evaluate and eliminate from detailed analysis the issues that are not expected to be significant (40 CFR §1501.1). The process of identifying potentially significant issues and resources is known as "scoping." This process, which ultimately defines the scope of the document, includes input from the public; local, state, Federal, and Tribal governments; and subject matter experts within BOEM. The public involvement process to help determine the scope of this Programmatic EIS is described in detail in **Chapter 6**.

This Programmatic EIS includes the environmental resources that could be affected by activities resulting from leases issued under the Program (**Section 1.4.2**). It also considers which of these activities could affect those resources and the context, intensity, and duration of potential impacts. Effects on resource areas are evaluated based on impact-producing factors (IPFs). An IPF is an activity or process that could cause impacts on the environmental or socioeconomic setting. Different types of IPFs have been identified for each of the resource areas evaluated in this Programmatic EIS. These IPFs could be relevant at some or all phases of the oil and gas process, including exploration, development, production, and decommissioning. The IPFs are described in **Chapter 3**.

1.4.2 Potentially Affected Resources and Environmental Conditions

The Programmatic EIS considers impacts from the activities associated with the Proposed Action and alternatives on 17 resource areas, described in terms of present conditions and trends. The resource areas analyzed have been identified as those that could be affected by oil and gas activities. The resources evaluated include natural resources (physical and biological) as well as social, cultural, and economic resources. Two environmental conditions, climate change and human health, have also been included as separate discussions to provide additional context and further characterize the affected environment and support the impact analyses. Additional information on the acoustic environment is provided in **Appendix D**. **Figure 1.4.2-1** lists the resources and other environmental conditions evaluated and their associated icons that are used throughout this Programmatic EIS to help readers locate topics of interest.

NATURAL, SOCIAL, CULTURAL, & ECONOMIC RESOURCES			
	Air Quality		Fish and Essential Fish Habitat
	Water Quality		Arctic Terrestrial Wildlife and Habitat
	Marine Benthic Communities		Archaeological and Historical Resources
	Coastal and Estuarine Habitats		Population, Employment, and Income
	Pelagic Communities		Land Use and Infrastructure
	Marine Mammals		Commercial and Recreational Fisheries
	Sea Turtles		Tourism and Recreation
	Birds		Sociocultural Systems
			Environmental Justice
OTHER ENVIRONMENTAL CONDITIONS			
	Climate Change		Human Health

Figure 1.4.2-1. Resources and Other Environmental Conditions Evaluated in the Programmatic EIS

1.4.3 No Action Alternative Considerations

The No Action Alternative in this Programmatic EIS considers both the direct and indirect impacts of having no new leasing during the 2017–2022 Program as well as the changing or evolving condition of environmental and sociocultural resources in the OCS program areas over the same protracted time horizon (40–70 years) considered for the activities associated with the Proposed Action (the "effects baseline"). The No Action Alternative does not represent a static condition, but assumes that there would be ongoing OCS activities in some of the program areas under leases issued up to and through the 2012-2017 Program (43 CFR 46.30). The No Action Alternative allows the decisionmaker to compare the potential future effects of the activities associated with the Proposed Action with the long-term effects of taking no action, or the probable consequence of taking no action. Moreover, present and future actions independent of the Proposed Action could also affect a resource's future condition when compared to the present conditions described in the Affected Environment (**Section 4.3**). The impacts of the activities associated with the Proposed Action would then add to or subtract from the changes or impacts that would occur as part of the effects baseline described in **Section 4.4**. Under the No Action Alternative, BOEM considers the potential for, and, if possible, ascribes other effects or environmental changes that could result from, foregoing OCS oil and gas production and relying on other energy sources to meet national energy demand.

1.4.4 Landscape-scale Approach and Mitigation Hierarchy

On October 31, 2013, the Secretary of the Interior issued Secretarial Order No. 3330, entitled *Improving Mitigation Policies and Practices of the Department of the Interior* (the "Secretarial Order"). In response to the Secretarial Order, the USDOI issued a report in April 2014 entitled *Strategy for Improving the Mitigation Policies and Practices of the Department of the Interior: A Report to the Secretary of the Interior from the Energy and Climate Change Task Force*. Both Order No. 3330 and the report call for a Department-wide mitigation strategy that focuses on using a landscape-scale approach, employing the full mitigation hierarchy of avoidance, minimization, and compensation to protect resources potentially impacted by activities under the USDOI's auspices.

On November 3, 2015, the President issued a memorandum (*Mitigating Impacts on Natural Resources from Development and Encouraging Related Private Investment*) directing Federal agencies responsible for public resources — including the USDOI — to apply mitigation hierarchy at scales appropriate for the country's wide-ranging natural and cultural resources, and, at a minimum, to set a no net loss goal when permitting impacts on key resources. This Presidential memorandum emphasizes the importance of protecting the environment while also providing efficient Federal permitting to American businesses and communities.

The USDOI also issued a new Departmental Policy (Department Manual Release, Landscape-Scale Mitigation Policy [600 DM 6]) that provides goals and guidance for implementing landscape-scale mitigation associated with the management of resources under the jurisdiction of the USDOI. The Department's Mitigation Policy reaffirms the USDOI's authority and commitment to use landscape-level planning to implement the full hierarchy of mitigation, including compensatory mitigation when needed.

OCSLA provides for a four-stage process to lease and develop OCS resources, proceeding from broad-based, landscape-level planning to a narrower focus as leasing is proposed. Considered at the programmatic level, the value of OCS resources and impacts that could result from oil and gas activities on the OCS enables the Secretary of the Interior to use a landscape-level analysis to determine areas more suitable for development. This landscape-level analysis also allows the Secretary of the Interior to consider future impacts on valuable resources that could result from the exploration, development, and production in an area.

This Programmatic EIS takes a landscape-level approach to the analysis of potential impacts by considering and evaluating a mitigation framework that, if selected in whole or in part, could avoid or minimize impacts associated with the Proposed Action. This mitigation framework includes the identification and evaluation of environmentally important areas (EIAs) (**Section 1.4.5**) and the analysis, at the programmatic level, of mitigation measures that would avoid or minimize impacts from the activities associated with the Proposed Action (**Section 2.6**). This landscape-level approach to mitigation is analyzed to allow the Secretary of the Interior to consider whether any of the EIAs should be chosen for exclusion as part of the schedule of lease sales for the 2017–2022 Program. Or, the Secretary of the Interior could identify and commit broadly to certain mitigation measures, such as temporal closures or restrictions on activities that would affect sensitive habitat, at the outset of the Program.

If the Secretary of the Interior identifies certain types of mitigation at the programmatic level, these will be refined and implemented as appropriate throughout the leasing and plan review process. Following the approval of the 2017–2022 Program, BOEM will consider and, where appropriate, employ additional mitigation measures (including the full hierarchy of avoidance, minimization, and compensation) in later stages of the oil and gas development process under OCSLA.

Appropriately scaled analyses for leasing, exploration, development, and production stages can best identify specific mitigation measures, including required compensatory mitigation measures. At all decision points, BOEM coordinates with affected states and conducts government-to-government consultations with federally recognized tribes and Alaska Native Claims Settlement Act (ANCSA) Corporations to help inform appropriate mitigation measures, including avoidance, minimization, and needed compensatory mitigation. Development and implementation of the 2017–2022 Program uses the application of a landscape-scale strategy that promotes the USDOI's Mitigation Policy and the President's Mitigation Memorandum. This approach allows BOEM the opportunity to integrate the mitigation hierarchy into the entire leasing process (i.e., from the Five-Year Program stage, to the lease sale stage, to the exploration stage, to the development and production stage). The landscape-scale approach and OCSLA's integration of the use of the full mitigation hierarchy allows the identification of the best combination of mitigation measures, including compensatory mitigation, to avoid, minimize, and compensate for potential impacts on resources throughout the leasing process. Such an approach considers reasonably foreseeable future impacts and applies the mitigation hierarchy in the context of the needs, conditions, and trends of resources, at all relevant scales.

1.4.5 Consideration of Identified Environmentally Important Areas

The identification of landscape-scale strategies allows for a regionally tailored framework that identifies broad objectives, commitments, and mechanisms to avoid, minimize, or compensate for environmental impacts. Mitigation is defined within this Programmatic EIS as measures to limit impacts in areas where lease activities could occur, as well as the exclusion of areas from leasing activities (per the CEQ NEPA regulations [40 CFR 1508.20] and the *Final Guidance for Effective Use of Programmatic NEPA Reviews* [CEQ 2014]).

In the spirit of USDOI 600 DM 6, this Programmatic EIS considers programmatic mitigation or exclusion of EIAs. EIAs were developed by BOEM during scoping and refined based on public input on the Draft Programmatic EIS. These EIAs represent regions of important environmental value where there is potential for conflict between ecologically important or sensitive habitats; maintenance of social, cultural, and economic resources; and possible oil and gas development. After EIAs were identified, BOEM analyzed and grouped them into three categories: analyzed as an alternative, analyzed as a programmatic mitigation measure that could be applied to any alternative, or not further analyzed. **Figure 1.4.5-1** shows the process for categorization of these EIAs. Each category also indicates where and how these specific EIAs are further discussed within this Programmatic EIS. EIAs have been developed expressly for analysis in this Programmatic EIS and are therefore distinct from any other defined areas for conservation, preservation, or other protection.

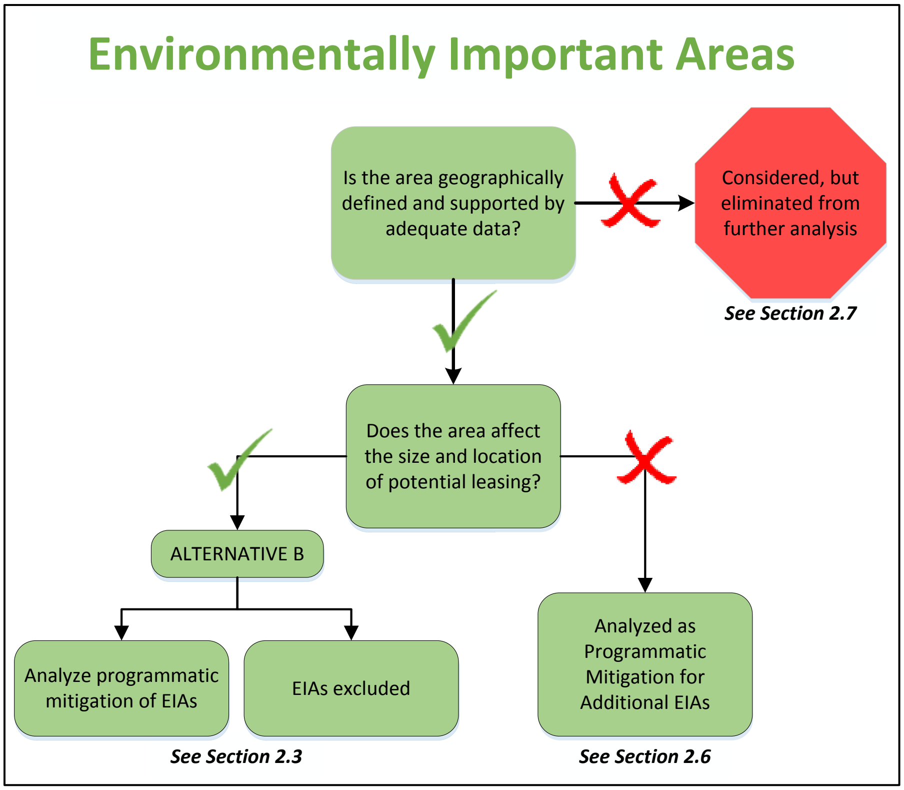


Figure 1.4.5-1. Process of Categorizing EIAs

Analyzed for the Application of Programmatic Mitigation Measures or Exclusions under Alternative B (Section 2.3)

EIAs that could be geographically defined, were supported by adequate data, *and* could affect the size or location of potential leasing include the following:

Beaufort Sea:	Barrow Canyon, Camden Bay, Cross Island, and Kaktovik
Chukchi Sea:	Walrus Foraging Area and Walrus Movement Corridor
Cook Inlet:	Beluga Whale Critical Habitat

Analyzed for the Application of Programmatic Mitigation Measures Separate from any Alternative (Section 2.6)

EIAs that could be geographically defined were supported by adequate data but *would not* affect the size or location of potential leasing include the following:

Beaufort Sea:	Harrison Bay
Chukchi Sea:	Chukchi corridor expansion
Gulf of Mexico:	Biologically sensitive underwater features (topographic and pinnacle trend features) required for lease sales in the current Program, analyzed at the programmatic level

Not Analyzed Further (Section 2.7)

EIAs that lacked adequate scientific support at this point or were not appropriate for programmatic mitigation were eliminated as an alternative but could warrant further analysis at the lease sale stage. These EIAs could still be considered in subsequent NEPA analyses on leasing and include the following:

Beaufort Sea:	Barrow Canyon extension, Smith Bay, Kaktovik extension, Harrison Bay exclusion, Beaufort shelf break, Beluga whale feeding area offshore Kaktovik, and Beaufort Sea deepwater area
Chukchi Sea:	Herald Shoal, Chukchi Sea corridor exclusion, Chukchi Sea deepwater area
Gulf of Mexico:	Buffer offshore Gulf Islands National Seashore, sperm whale high-use area; Loggerhead turtle critical habitat; and Bryde's whale and bottlenose dolphin Biologically Important Areas

The identification of the EIAs are an important step in the regionally tailored framework and help identify areas that warrant exclusion, mitigation, or further analysis in the Proposed Final Program (PFP) or subsequent stages in the Five-Year Program.

1.4.6 Incomplete and Unavailable Information

To conduct analyses, subject matter experts examined existing scientific evidence relevant to evaluating the reasonably foreseeable significant impacts of oil and gas exploration, development, and production activities on the human environment. The subject matter experts that prepared the Programmatic EIS diligently searched for pertinent information, and BOEM's evaluation of such impacts is based on research methods and theory generally accepted in the scientific community. BOEM's subject matter experts acquired and used previously developed and newly available scientifically credible information, and, where gaps remained, exercised their best professional judgment to extrapolate baseline conditions and impact analyses using accepted methodologies based on credible information. This Programmatic EIS was prepared using the best information 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, was either acquired or if it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. For the purposes of this Programmatic EIS, all impacts reasonably foreseeable at later stages of the oil and gas development process have been considered, and the characterization of impact magnitude and duration is supported by scientific evidence. BOEM's assessment of impacts is not based on conjecture, media reports, or public perception; it is based on research methods, scientific findings and concepts, and modeling applications generally accepted by the scientific community. Traditional knowledge is used in corroboration with scientific findings.

1.4.7 Issues not Analyzed in the Programmatic EIS

Several issues were identified during public comment periods but are not appropriate for analysis in the Programmatic EIS. The rationale for their exclusion is described in the following subsections.

1.4.7.1 Implications of Climate Change Policies on Demand for Oil and Natural Gas

Several commenters stated that BOEM's use of the USEIA's projections to characterize future energy demand and energy markets was problematic because USEIA's projections fail to properly account for recently adopted climate change policies, which could necessitate a change in U.S. reliance on fossil fuels to curb greenhouse gas (GHG) emissions. BOEM agrees that the Bureau can enhance its assessment of GHGs and climate change. BOEM's demand assumptions and economic analysis have been revised to reflect the USEIA's 2016 *Annual Energy Outlook*, Reference Case; the Reference Case accounts for the Clean Power Plan, which is designed to limit carbon dioxide (CO2) emissions at existing fossil-fired electric power plants. USEIA's estimates of energy demand, accounting for current law and regulation, are critical to BOEM's estimation of oil and natural gas demand and also inform energy substitutions that could be needed if there was no OCS leasing and production under the No Action Alternative. The USEIA (in the 2016 *Annual Energy Outlook*) and International Energy Agency (IEA) (in the *World Energy Outlook 2015*) indicate that strong climate policies, market changes, or other measures do not obviate future investment in oil and natural gas (IEA 2015a). Even if the U.S. moves decisively towards the demand and emissions trajectory implied by the IEA's climate-friendly 450 Scenario, large-scale investment in oil and natural gas remains an important component of a lower-cost energy bridge to a low-carbon future through the next several decades (IEA 2015a, IEA 2015b). BOEM has not separately modeled future demand or corresponding consumption levels that would correspond to specific emissions reductions targets as that analysis is outside the scope of this Programmatic EIS. However, it is important to note that the U.S. Intended Nationally Determined Contributions (INDC) memorialized in the 2016 Paris Agreement do not assume "zero" oil and gas production or consumption in the future, but rather declining emissions from oil. Both the USEIA and IEA anticipate a long-term need for oil and natural gas, with oil demand eventually declining and continued growth in the demand for natural gas.

The U.S. has made notable progress towards its 2025 emissions reduction target through measures identified in the President's Climate Action Plan. Key measures include reducing methane (CH_4) during oil and gas production, improved fuel economy standards, and improved energy efficiency (Executive Office of the President 2013). BOEM recognizes that the future could also bring new legal and policy, technological, energy efficiency, or other market changes that could ultimately affect supply and demand for oil and natural gas. The Programmatic EIS does not speculate about how different climate policy measures could affect the nature of activities or activity levels under either the Proposed Action or the No Action Alternative if different climate strategies are pursued.

1.4.7.2 Renewable Energy as a National Energy Strategy

Numerous public comments stated support for alternative or renewable energy options as part of a national energy strategy. While many were not specific, some provided supporting materials, literature, and data addressing the feasibility, economic value, or environmental benefits of renewable energy. Some comments provided specific technologies and designs for expanded renewable energy solutions. Other comments explicitly requested that renewable energy be analyzed as an alternative to the Proposed Action in the Programmatic EIS.

Although renewable energy is an important and growing energy source in the U.S., 64 percent of all energy consumption in the U.S. in 2015 came from natural gas and oil (USEIA 2016a; see **Figure 1.2-1**). BOEM is required by law to determine a schedule of oil and gas lease sales for the OCS that would best meet the nation's energy needs. The development of renewable energy sources is strategically important, but the development of these resources in the foreseeable future does not fully or partially satisfy the purpose of and need for the Proposed Action at this time, as described in **Section 1.2**. Therefore, reliance on development of renewable energy as an alternative to OCS oil and gas development is not reasonable and has not been carried forward for analysis in this Programmatic EIS (see also **Section 2.6.5**).

BOEM is working to provide greater opportunities for renewable energy through its OCS Renewable Energy Program, as authorized by the Energy Policy Act of 2005. The OCS Renewable Energy Program is responsible for regulating OCS renewable energy development on the OCS and anticipates future development from three general energy sources: OCS wind, ocean wave, and current wave energy. BOEM's renewable energy regulations provide the framework for issuing leases, easements, and rights-of-way for OCS development activities that support production and transmission of energy from renewable energy sources. The OCS blocks leased as of July 2016 have the potential to support 14,600 megawatts of commercial wind generation if leases are developed. Information on BOEM's Renewable Energy Program, OCS leases, and renewable energy projects proposed or currently in development is available at http://www.boem.gov/Renewable-Energy/.

1.4.7.3 Oil Spill Modeling

Many comments identified the need for better ocean current modeling data to model and consider spill trajectories. Comments also stated that oil spill trajectory analyses should be conducted to support the Programmatic EIS. The potential impacts from oil spills are broadly evaluated in **Chapter 4**. BOEM performs more detailed oil spill modeling during the evaluation of lease sales if the program area is included in the PFP. The oil spill modeling provides a probabilistic assessment of contact with various environmental resource features.

1.5 CHANGES FROM THE DRAFT TO FINAL PROGRAMMATIC EIS

Noteworthy changes from the Draft Programmatic EIS to the Final Programmatic EIS include the following:

1. Reorganization of Alternative B (Reduced Proposed Action) in the Draft Programmatic EIS into two distinct alternatives. Alternative B now considers the exclusion or programmatic mitigation of EIAs, and Alternative C analyzes reductions in leasing from the Proposed Action by excluding one or more individual program areas (**Chapter 2**)
2. Elimination of the Atlantic Program Area from the Proposed Action and range of alternatives analyzed (**Chapter 2**)
3. Revision of the Cross Island EIA in response to deliberative comments and input from the public (**Chapter 2**)
4. Declaration of a Preferred Alternative (**Chapter 2**)
5. Revision of the Chukchi Sea exploration and development (E&D) scenario and corresponding effects analyses, reflecting recent lease relinquishments in the Chukchi Sea Planning Area (**Chapter 3**)
6. Additional analyses to address potential effects on Arctic terrestrial habitat and wildlife given the potential construction of onshore pipeline infrastructure that is now assumed to be part of the Chukchi Sea E&D scenario (**Chapters 3** and **4**)
7. Additional analysis of potential impacts on terrestrial species from large oil spills or catastrophic discharge events (CDEs) (**Chapter 4**)
8. Analysis of downstream effects of GHG emissions related to the processing, distribution, and consumption of OCS oil and gas (**Chapter 4**)
9. Consideration of human health effects (**Chapter 4**)

10. Addition of a programmatic mitigation measure to require a Conflict Management Plan (CMP) for any lease issued in Alaska program areas to mitigate conflicts between subsistence use and oil and gas activities (**Chapter 4**)
11. More rigorous analysis of the No Action Alternative and cumulative impacts (**Chapters 2** and **4**)
12. Inclusion of a comment summary and response to comments (**Appendix G**).

1.6 ORGANIZATION OF THIS DOCUMENT

This Final Programmatic EIS is divided into 6 chapters with accompanying appendices. **Chapter 1** provides an introduction and background information on the scope of the Proposed Action and impact analysis process. **Chapter 2** describes the Proposed Action and alternatives, with a summary of all potential environmental impacts. **Chapter 3** contains information on the E&D scenarios created to provide activities assumptions for the Proposed Action, a description of the IPFs for each of the resource areas analyzed, and characterization of the cumulative actions relevant to the analyses in this document. **Chapter 4** contains a brief description of the Affected Environment (see **Appendix C** for additional information) and detailed analysis for all environmental effects rising to or above the moderate impact level, with negligible to minor impacts disclosed in **Appendix E**. **Chapter 5** provides a discussion on unavoidable adverse impacts and the irreversible and irretrievable commitment of resources, and **Chapter 6** contains information on BOEM's consultation and coordination. **Appendix G** includes summaries of comments provided on the Draft Programmatic EIS and BOEM's responses to those comments.

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2. ALTERNATIVES

This Final Programmatic EIS analyzes four alternatives including the Proposed Action (Alternative A), Exclusion of or Programmatic Mitigation in EIAs (Alternative B), the Reduced Proposed Action (Alternative C), and the No Action Alternative (Alternative D).

2.1 SCREENING PROCESS AND THE RANGE OF ALTERNATIVES

The alternatives analyzed in this document were informed by public input (**Chapter 6**). Additional information available through BOEM's Environmental Studies Program and provided by BOEM subject matter experts was also considered in the development of alternatives. The following five broad screening criteria were applied to all alternative recommendations:

- Does the alternative meet the purpose of and need for the Proposed Action?
- Does the alternative address size, timing, or location factors?
- Is the alternative substantially different from another alternative?
- Is the alternative technically and economically feasible (not remote or speculative)?
- Is the alternative consistent with the requirements of OCSLA?

Subsequently, more detailed screening criteria were applied to determine whether the remaining concepts were suitable for incorporation in Alternative B, as follows:

- Rigor of available data addressing sensitivity, geographic specificity, and ecological importance
- Species or habitat status (e.g., listed or designated under the ESA)
- Whether exclusion or other mitigation measures could reduce impacts on target resource(s).

Table 2.1-1 summarizes the four resulting alternatives across four program areas.

Consistent with the Proposed Program decision, the Proposed Action is a schedule of 13 lease sales in four OCS program areas. This schedule of lease sales was announced in the 2017-2022 Proposed Program, which was published on March 18, 2016. The Programmatic EIS evaluates three alternatives to the Proposed Action that could avoid or minimize potential environmental impacts. Alternative B is the exclusion or programmatic mitigation of EIAs. Alternative C analyzes the exclusion of one or more program area(s) while maintaining the rest of the Proposed Action. Under Alternative D, the No Action Alternative, no new lease sales would be scheduled during the Program in any program area. These represent a reasonable range of alternatives and were developed based on the screening criteria applied to determine appropriate alternatives.

OCSLA requires identification of the size, timing, and location of possible lease sales; however, the alternatives considered in the Programmatic EIS principally address the size and location of proposed lease sales. A change in timing (i.e., year of scheduled lease sale) is expected to have little influence on the context, intensity, and duration of impacts. The number, nature, and timing of activities following a lease sale are not known precisely at the Program stage and vary by program area and other factors. Also, impacts related to lease sales under the Program are expected to occur over a protracted time period (40-70 years), making a 1- or 2-year timing difference in the onset of activities inconsequential. Therefore, alternatives related to timing of the lease sale itself would not constitute a meaningful alternative.

Table 2.1-1. Alternatives Analyzed in Detail in the Programmatic EIS

Program Area	Alternative A*	Alternative B	Alternative C	Alternative D
Beaufort Sea	One sale in 2020 OR advance sale to 2019	B(1): Exclusion of or programmatic mitigation in: a) Barrow Canyon b) Camden Bay c) Cross Island and/or d) Kaktovik	C(1): No new leasing in Beaufort Sea Program Area for 2017–2022	No new leasing in any program area
Chukchi Sea	One sale in 2022	B(2): Exclusion of or programmatic mitigation in Hanna Shoal: a) Walrus Foraging Area and/or b) Walrus Movement Corridor	C(2): No new leasing in Chukchi Sea Program Area for 2017–2022	No new leasing in any program area
Cook Inlet	One sale in 2021	B(3): Exclusion of designated Cook Inlet Beluga Whale Critical Habitat	C(3): No new leasing in Cook Inlet Program Area for 2017-2022	No new leasing in any program area
GOM	Region-wide leasing: 10 sales offering all unleased acreage in the Western, Central, and portions of the Eastern Planning Areas not subject to Congressional moratorium or otherwise excluded. OR Traditional leasing of 10 separate, alternating sales (one sale each year in the Western and another sale in the combined Central and Eastern Planning Areas) for areas not subject to Congressional moratorium or otherwise excluded.	N/A	C(4): No new leasing in entire GOM Program Area for 2017-2022	No new leasing in any program area

Key: * = For the Proposed Action in the GOM, the supplemental 24-km (15-mi) no-leasing buffer south of Baldwin County, Alabama, could be incorporated in either situation.

The Proposed Program considers Options for each program area that would exclude any or all of the EIAs analyzed under Alternative B, as well as consideration of no new leasing in that individual program area (**Table 2.1-1**). It also includes a supplemental Program Option for a 24-kilometer (km) (15-mile [mi]) no-leasing buffer south of Baldwin County, Alabama, as requested by the Governor of Alabama. The environmental impact analysis for Alternative A (Proposed Action) in this Programmatic EIS encompasses this option. The buffer option is not analyzed separately from Alternative A because the area covered is very small compared to the program area and potential activity levels limited when compared to the broader GOM Program Area and, as a result, would not result in significantly different environmental impacts at the scale of interest. The area traditionally has been subject to a lease sale stipulation that requires no new surface structures south and within 24 km (15 mi) of Baldwin County.

This Programmatic EIS assumes continuing implementation of protective measures required by statute, regulation, or current lease sale stipulations that would likely continue to be adopted in the future (see **Appendix I**). It also assumes that BSEE would implement requirements for safe operations and environmental protection, including requiring the use of the best available science and technology and operational practices. Changes to these assumptions, and reconsideration of any related environmental impacts, would be considered in NEPA documents prepared for subsequent lease sales and then possible plan decisions.

2.2 PROPOSED ACTION

This Programmatic EIS analyzes as the Proposed Action ten region-wide sales in the GOM Program Area and one sale each in the Beaufort Sea, Chukchi Sea, and Cook Inlet Program Areas offshore Alaska as well as the activities that could reasonably result from these lease sales. No lease sales are proposed for the Pacific or Atlantic OCS Regions. Additional information on the Program is available at http://www.boem.gov/Five-Year-Program/.

The schedule of sales analyzed as part of the Proposed Action is summarized by program area in **Table 2.2-1** and **Figures 2.2-1** and **2.2-2**. Most sales are proposed for the GOM Program Area where oil and gas resource potential is significant and infrastructure most developed. Fewer lease sales are scheduled for the program areas in Alaska where OCS oil and gas development is comparatively limited. Furthermore, the lease sales in the Arctic and Cook Inlet are scheduled to be late in the Five-Year Program to provide additional opportunity to obtain and evaluate additional information regarding environmental issues, subsistence use needs, infrastructure capabilities, and results from any exploration activity associated with existing leases.

2.2.1 Proposed Action – Beaufort Sea, Chukchi Sea, and Cook Inlet Program Areas

The Proposed Action includes one sale each in the Beaufort Sea (in 2019 or 2020), Cook Inlet (2021), and Chukchi Sea (2022) Program Areas (**Figure 2.2-1**). In 2015, President Obama withdrew several areas in the Arctic from leasing consideration: the Kaktovik Whaling Area, Chukchi Sea Corridor, Barrow Whaling Area, and Hanna Shoal (Office of the Press Secretary 2015). These areas, withdrawn under Section 12 of OCSLA, are referred to as presidential withdrawal areas. Sales in the Alaska program areas are scheduled later in the Five-Year Program to provide additional opportunity to evaluate and obtain information regarding environmental issues, subsistence use needs, infrastructure capabilities, and results from exploration activity associated with existing leases in the Beaufort Sea Program Area. The Proposed Action also considers an option to advance the Beaufort Sea sale to 2019. This option would change the date of the sale by just 1 year and would make no substantive difference in environmental impacts because oil and gas activities could occur over 70 years following any leasing in the Beaufort Sea Program Area.

Table 2.2-1. Schedule of 2017–2022 Lease Sales Analyzed under the Proposed Action

Count	Sale Number	Program Area	Year
1	249	Gulf of Mexico	2017
2	250	Gulf of Mexico	2018
3	251	Gulf of Mexico	2018
4	252	Gulf of Mexico	2019
5	253	Gulf of Mexico	2019
6	254	Gulf of Mexico	2020
7	255	Beaufort Sea	2020
8	256	Gulf of Mexico	2020
9	257	Gulf of Mexico	2021
10	258	Cook Inlet	2021
11	259	Gulf of Mexico	2021
12	261	Gulf of Mexico	2022
13	262	Chukchi Sea	2022

2.2.2 Proposed Action – Gulf of Mexico

The Proposed Action in the GOM entails 10 region-wide sales (two annually) composed of unleased acreage in the Western, Central, and Eastern Planning Areas not subject to statutory moratoria, presidential withdrawal (e.g., Flower Garden Banks National Marine Sanctuary [NMS]), or other exclusions (**Figure 2.2-2**). BOEM traditionally has scheduled two sales annually, alternating between the Western Planning Area and the Central Planning Area, as well as periodic sales in the portion of the Eastern GOM Planning Area not under moratorium. The Proposed Action considers a supplemental Program Option with a minor variation on this traditional schedule with two sales annually, one for the Western Planning Area and one for the combined Central and Eastern Planning Areas (excluding any area under moratorium or otherwise not available for future leasing). Choice of the Proposed Action with or without the supplemental Option would make no substantive difference in environmental impacts because there are no substantive differences expected in activity levels resulting from lease sales (annually or over the long-term) from these slight changes in timing.

2.2.3 Activities Expected to Occur under the Proposed Action

The lifecycle of OCS oil and gas activities generally occurs in phases: (1) exploration to locate viable oil or natural gas deposits; (2) development well drilling, and, assuming favorable outcomes from development drilling, platform construction and pipeline infrastructure placement; (3) oil or gas production and transport; and (4) decommissioning of facilities once a reservoir is no longer productive or profitable. Under the Proposed Action, these activities would occur on OCS leases only after a lease sale is held in the Alaska or GOM program areas. Ensuing activities could extend over a period of 40 to 70 years depending on the program area. This Programmatic EIS does not analyze any activity that occurs before a lease is issued.

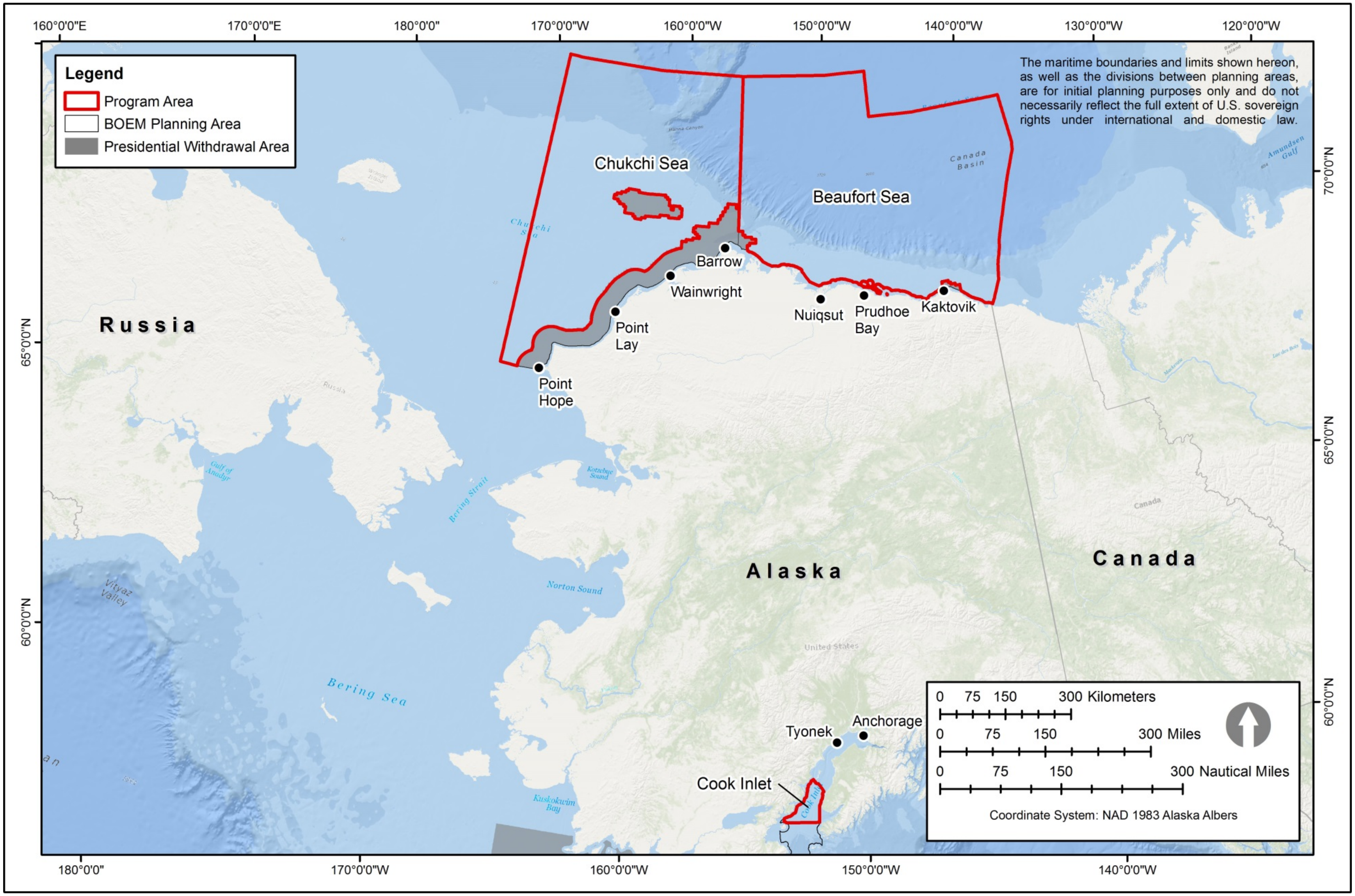

Figure 2.2-1. Location of the Alaska Program Areas

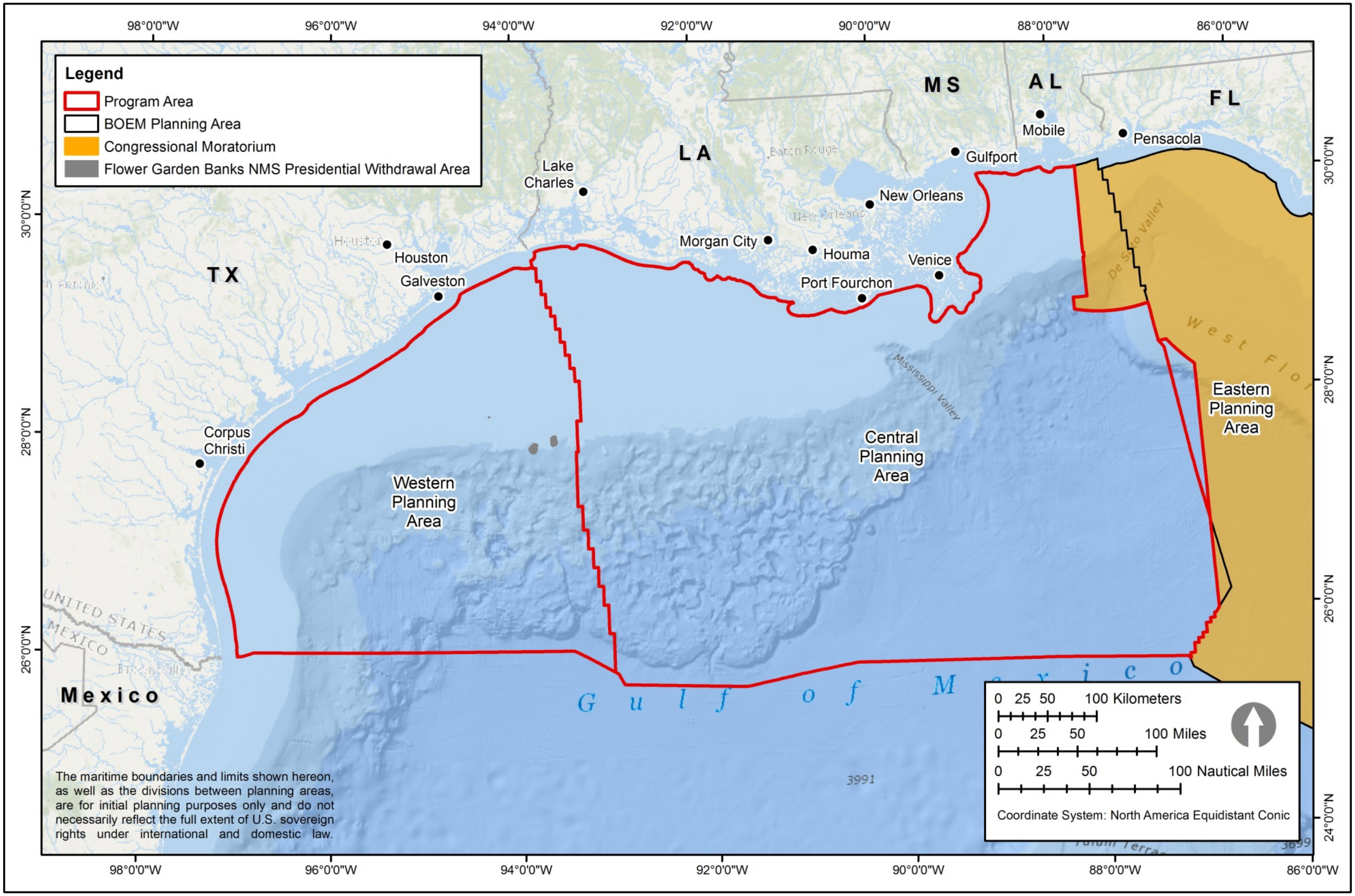

Figure 2.2-2. Location of the Gulf of Mexico Program Area

Exploration could include geophysical surveys and drilling of exploration wells. One or more exploratory wells could be drilled to confirm the presence and determine the viability of potential hydrocarbon reservoirs identified by the geophysical survey. After exploration has confirmed the presence of a commercially viable reservoir, the next phase of activities includes the construction of the production platform and drilling of **development** (or production) wells. Once completion of development wells and platform construction has occurred, oil production and well maintenance are initiated. Additional development wells could be drilled and completed once a platform is constructed and other wells have begun producing. Following completion of the production wells and platform, facilities begin to extract the hydrocarbon resource and transport it to processing facilities. Various types of infrastructure are required to support the production of oil and gas, including ports and support facilities, construction facilities, transportation infrastructure, and processing facilities. After a reservoir is no longer productive or profitable, or upon lease termination or relinquishment, facilities and seafloor obstructions are removed and/or the site is properly abandoned (known as **decommissioning**). Detailed descriptions of the activities that would occur during each of these phases are provided in **Chapter 3**, including specific information on the type, levels, and timing of activity that would be expected for each program area.

2.3 ALTERNATIVE B: EXCLUSION OR MITIGATION OF ENVIRONMENTALLY IMPORTANT AREAS

Alternative B considers the exclusion or programmatic mitigation of EIAs that could affect the size or location of lease sales within the program areas. EIAs represent regions of important environmental value where there is potential for conflict between ecologically important or sensitive habitats; maintenance of social, cultural, and economic resources; and possible oil and gas development.

BOEM considered all EIAs identified during scoping and the comment period of the Draft Programmatic EIS and grouped all recommendations into the following categories:

1. EIAs that could be geographically defined, could affect the size or location of potential leasing, and the basis for protection of the EIA was supported by adequate data (analyzed under Alternative B)
2. EIAs that could be geographically defined, the basis for protection of the EIA was supported by adequate data, but would not affect the size or location of potential leasing (analyzed in **Section 4.4.5** as programmatic mitigation)
3. EIAs that (a) were not spatially discrete; (b) lacked adequate support at this point to include as an alternative, as a component thereof, or as programmatic mitigation; or (c) were unlikely to be leased although included under the Proposed Action. These were eliminated from further analysis within this Programmatic EIS given they are not essential for decisionmaking at this stage (**Section 2.7**). These EIAs could still be considered in subsequent NEPA analyses.

Seven EIAs are analyzed under Alternative B across the Beaufort Sea, Chukchi Sea, and Cook Inlet Program Areas (**Section 4.4.2**). No EIAs are analyzed in detail under Alternative B for the GOM Program Area. There was one EIA identified for analysis in the GOM Program Area. It is discussed under programmatic mitigation (**Sections 2.6** and **4.4.5**) because implementation of the programmatic mitigation in this area would not affect size or location of new leasing under the Proposed Action.

The analysis of Alternative B provides the Secretary of the Interior with information to determine, at her discretion, whether to exclude areas from the Program, adopt programmatic mitigation measures into the Program, or defer application of exclusions or programmatic mitigations to the lease sale decision stage.

2.3.1 Beaufort Sea Program Area EIAs: Alternative B(1)

Alternative B(1) considers new leasing in the Beaufort Sea Program Area but analyzes exclusion or programmatic mitigation of four EIAs [B(1)(a) – B (1)(d)] (see **Figure 2.3-1** and **Chapter 4**).

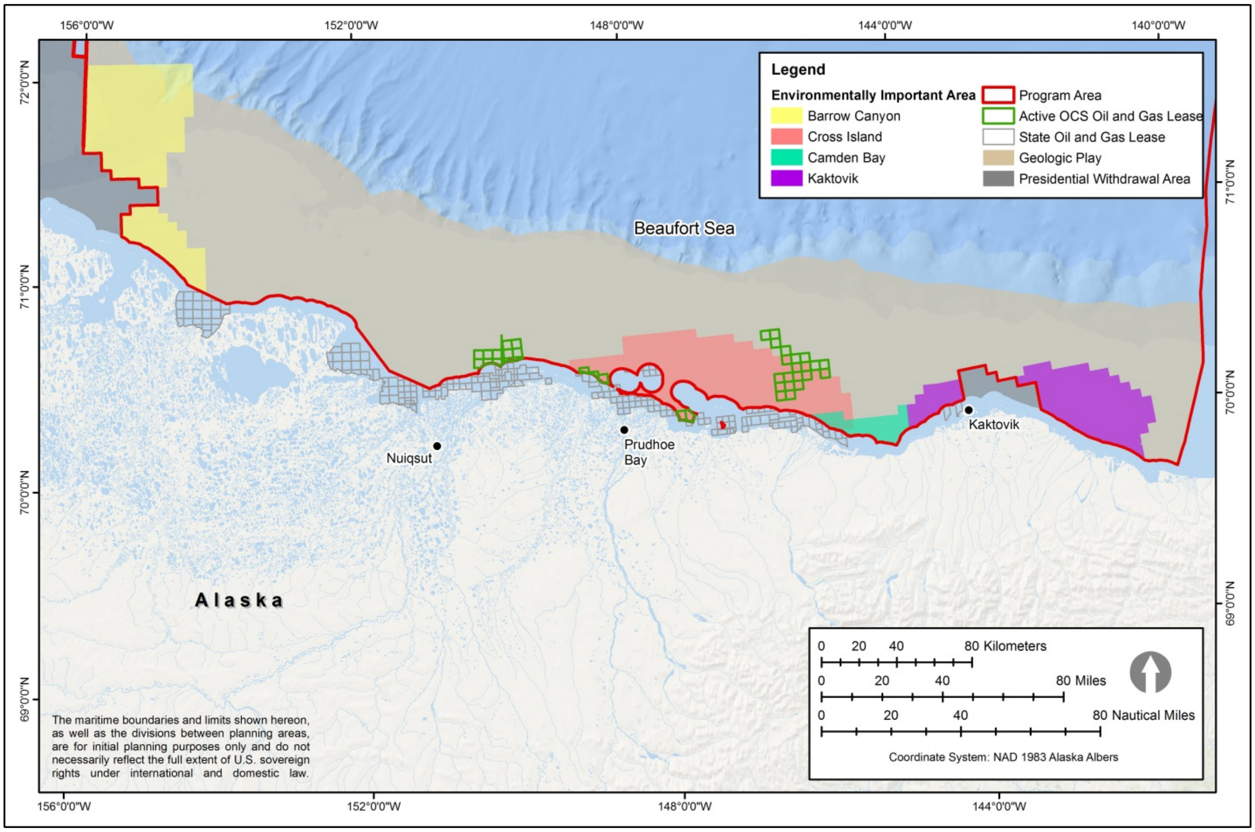

Figure 2.3-1. Beaufort Sea Program Area – Alternative B(1)

Alternative B(1)(a) includes an EIA in waters in the vicinity of Barrow Canyon and the existing Barrow Whaling Area Presidential Withdrawal. This is an important migration and foraging area for beluga whales, bowhead whales, gray whales, and many species of birds (Stafford et al. in review, Clarke et al. 2015a, Clarke et al. 2015b, Kuletz et al. 2015, Hauser et al. 2014, Wong et al. 2014). Several studies show that beluga and bowhead whales use this area preferentially, particularly in the fall; bowhead whales have higher residence times in the area during their westward migration (Stafford et al. in review, Citta et al. 2015, Clarke et al. 2015b, Kuletz et al. 2015, Hauser et al. 2014, NOAA Fisheries 2015). The southern portions of the Barrow Canyon EIA encompass relatively high densities of birds during summer (June to September), including brant geese and king eider (Drew and Piatt 2013, Walker and Smith 2014, Kuletz et al. 2015, USFWS 2016). The EIA encompasses areas of high benthic biomass and high productivity, likely driving the associated occurrence of marine mammals and birds (Grebmeier and Dunton 2000, Dunton et al. 2005, Grebmeier et al. 2006, Citta et al. 2015). The Barrow Canyon EIA lies offshore to the east of Point Barrow at the nexus of the Chukchi and Beaufort Seas. The presence of marine mammals in this area makes it important for subsistence hunting (Stephen R. Braund and Associates 2010). Alternative B(1)(a) considers exclusion (no new leasing) of this area, as well as a temporal closure from June through October of each year to minimize impacts on the species and habitats in the area, and to minimize impacts on the communities that rely upon this area. The temporal closure likely would be tantamount to an exclusion of the area due to the limited time available for exploration during the open water season.

Alternative B(1)(b) includes the Camden Bay EIA. This area is important ecologically and for subsistence use (Huntington 2013). Several stakeholders provided information supporting both aspects during the scoping process for this Programmatic EIS. The Camden Bay area is important to bowhead whales, beluga whales, and seal feeding, and is also an important bowhead whale hunting area in the fall (Wolfe 2013). This area was shown to be a "hotspot" for both marine mammals and seabirds based on analyses in Kuletz et al. (2015). Alternative B(1)(b) considers exclusion (no new leasing) of this area as well as a temporal closure from August through October of each year. The temporal closure likely would be tantamount to an exclusion of the area due to the limited time available for exploration during the open water season.

Alternative B(1)(c) includes an EIA in the vicinity of Cross Island. The area to the north and east of Cross Island is an important and historically significant subsistence hunting area; landed bowhead whales are brought to Cross Island for butchering. This EIA was originally developed from broad stakeholder input during the scoping process and encompassed the full area where subsistence hunting for bowhead whale has occurred over the past couple of decades (Stephen R. Braund and Associates 2010, Galginaitis 2009, Galginaitis 2014). However, comments on the Draft Programmatic EIS from North Slope communities stated that this area was unnecessarily large and that an exclusion was not the preferred method to mitigate potential impacts on subsistence. As a result, the EIA offshore Cross Island has been reduced to recognize the most ecologically sensitive areas to key species, rather than focusing on the broader areal extent within which subsistence has occurred.

The waters around Cross Island are important for bowhead whales, birds, and as a feeding and denning area for polar bears. There is also important seafloor habitat in this region. The EIA captures areas of important habitat for bowhead whales during their fall migration westward when they are travelling near shore (Clarke et al. 2015b). The majority of the EIA overlaps with marine mammal "hotspots" identified by Kuletz et al. (2015). Numerous polar bear dens have been identified in this area between 1910 and 2010, and this area of the Beaufort Sea coast is expected to remain one of several important habitat areas for polar bears during the winter and spring as the sea ice extent continues to change (Durner et al. 2009, Durner et al. 2010).

The nearshore areas to the east of Cross Island within the Cross Island EIA have relatively high annual densities of bird species such as brant, three species of eider, and two species of loon (Audubon Alaska 2014). Boulder Patch in Stefansson Sound is biologically rich and complex relative to the rest of the OCS seafloor (Dunton and Schonberg 2000). Alternative B(1)(c) considers exclusion (no new leasing) of this area as well as a temporal closure from August through October of each year. The temporal closure likely would be tantamount to an exclusion of the area due to the limited time available for exploration during the open water season.

Alternative B(1)(d) includes an EIA offshore of Kaktovik (Barter Island), expanding the area around the presidential withdrawal. The EIA captures areas of important habitat for bowhead whales during their fall migration when they are travelling near shore (Clarke et al. 2015b), and the eastern portion of the EIA overlaps with marine mammal "hotspots" identified by Kuletz et al. (2015). The EIA overlaps with areas where subsistence hunters target bowhead whales during the fall (Wolfe 2013). The portion of this EIA that lies to the west of the presidential withdrawal is important habitat for brant geese, while the eastern side captures habitat for red-throated loon. Both of these areas show persistent higher annual density of bird occurrence between 1979–2010 (Drew and Piatt 2013, Audubon Alaska 2014, Walker and Smith 2014, Smith et al. 2014). Numerous polar bear dens have been identified in this area between 1910 and 2010, and this area of the Beaufort Sea coast is expected to remain one of several important denning and feeding habitat areas for polar bears during the winter as the sea ice extent continues to change

(Durner et al. 2009, Durner et al. 2010). Alternative B(1)d considers exclusion (no new leasing) of this area and a temporal closure from August through October of each year. The temporal closure likely would be tantamount to an exclusion of the area due to the limited time available for exploration during the open water season.

The analysis assumes that exclusions would affect all activities discussed as part of or resulting from the activities associated with the Proposed Action, and, in contrast, that temporal restrictions would apply to certain activities that are expected to impact resources in each area (e.g., geophysical exploration or exploratory drilling) during a particular time. The timing of temporal closures identified in this Programmatic EIS represents the time during which environmental resources within an EIA could be affected by oil and gas activities. Temporal restrictions might apply to facility installation, production, or decommissioning activities; however, because production activities occur year-round, and the specific methods and technology to be used for construction, production, and decommissioning are not yet known, potential environmental effects and specific mitigation requirements or implementation guidelines for these activities could be better analyzed at the lease sale or plan stage when more detailed information becomes available.

BOEM recognizes that temporal closures in the Beaufort Sea can overlap with the open water season, which is the time when geophysical exploration and exploratory drilling activities would be expected to occur. In this scenario, a temporal closure could represent the equivalent of exclusion because there would be limited available, feasible, or safe time periods for industry to conduct these activities. Some exploration activities could occur outside of the open water season (e.g., with seismic surveys using an icebreaker or on-ice, nearshore seismic surveys using tracked vehicles in the Beaufort Sea). For the most part, however, industry generally conducts exploration activities during the open water season in the U.S. Arctic; the sea ice, extreme cold, and lack of daylight increase the difficulty and expense while decreasing the amount of work that can be accomplished in winter. Therefore, a closure from June through October would almost entirely preclude exploration activities, while a closure from August through October would allow only very limited work before the open water season normally begins (i.e., June). If the dynamics of sea ice continue to change under the influence of climate change, the window of feasibility for geophysical exploration and exploratory drilling activities could expand into the months before and after the "typical" open water season (i.e., June to October). Subsequent environmental analyses would consider changes to activity timing as well as any changes to the occurrence or distribution of environmental resources. In recent years, the open water season has increased rapidly, which would increase the length of the time available for exploratory activities, but would not impact the challenge of working in lack of daylight.

2.3.2 Chukchi Sea Program Area EIAs: Alternative B(2)

Alternative B(2) considers new leasing in the Chukchi Sea Program Area but analyzes exclusion or programmatic mitigation (through temporal closure) of two related EIAs: Alternatives B(2)(a) and B(2)(b) (**Figure 2.3-2**).

The EIAs in this area include two interrelated subareas: the Walrus Foraging Area (B(2)(a)) and the Walrus Movement Corridor (B(2)(b)). The Walrus Foraging Area surrounds the current Hanna Shoal Presidential Withdrawal and includes the Hanna Shoal Walrus Use Area (HSWUA); the Walrus Movement Corridor includes an area between the Hanna Shoal Presidential Withdrawal and the existing Chukchi Corridor Presidential Withdrawal and captures portions of the area walruses use to transit from nearshore and onshore haul out areas and feeding areas in and around the existing Hanna Shoal Presidential Withdrawal. The HSWUA has been identified as important walrus foraging habitat by the USFWS in their *Final Incidental Take Regulations for Polar Bears and Pacific Walrus for the Chukchi Sea* issued June 12, 2013. This determination is based on walrus tagging studies conducted by the U.S. Geological Survey (USGS) that have tracked walrus movements and identified foraging and resting habitat (Jay et al. 2012). The Foraging Area includes habitat that is critical for the Pacific walrus, including areas of high benthic biomass within shallow waters where sea ice persists into the summer (Grebmeier et al. 2006, Dunton et al. 2014, Jay et al. 2012). Walruses forage in this area from June to October and can occur in high numbers (Brueggeman et al. 1991, MacCracken 2012, Jay et al. 2012). The Walrus Foraging Area encompasses high use areas of Pacific walrus as defined by foraging and occupancy utilization distributions for June through December (Jay et al. 2012). This area also includes areas of high biological productivity that serves as a foraging area for other marine mammals (Aerts et al. 2013, Kuletz et al. 2015).

Alternative B(2)(a) considers exclusion and temporal closures (June through October) in the Walrus Foraging Area and B(2)(b) considers exclusion and temporal closure (from the time ice moves off the shelf through October) in the Walrus Movement Corridor.

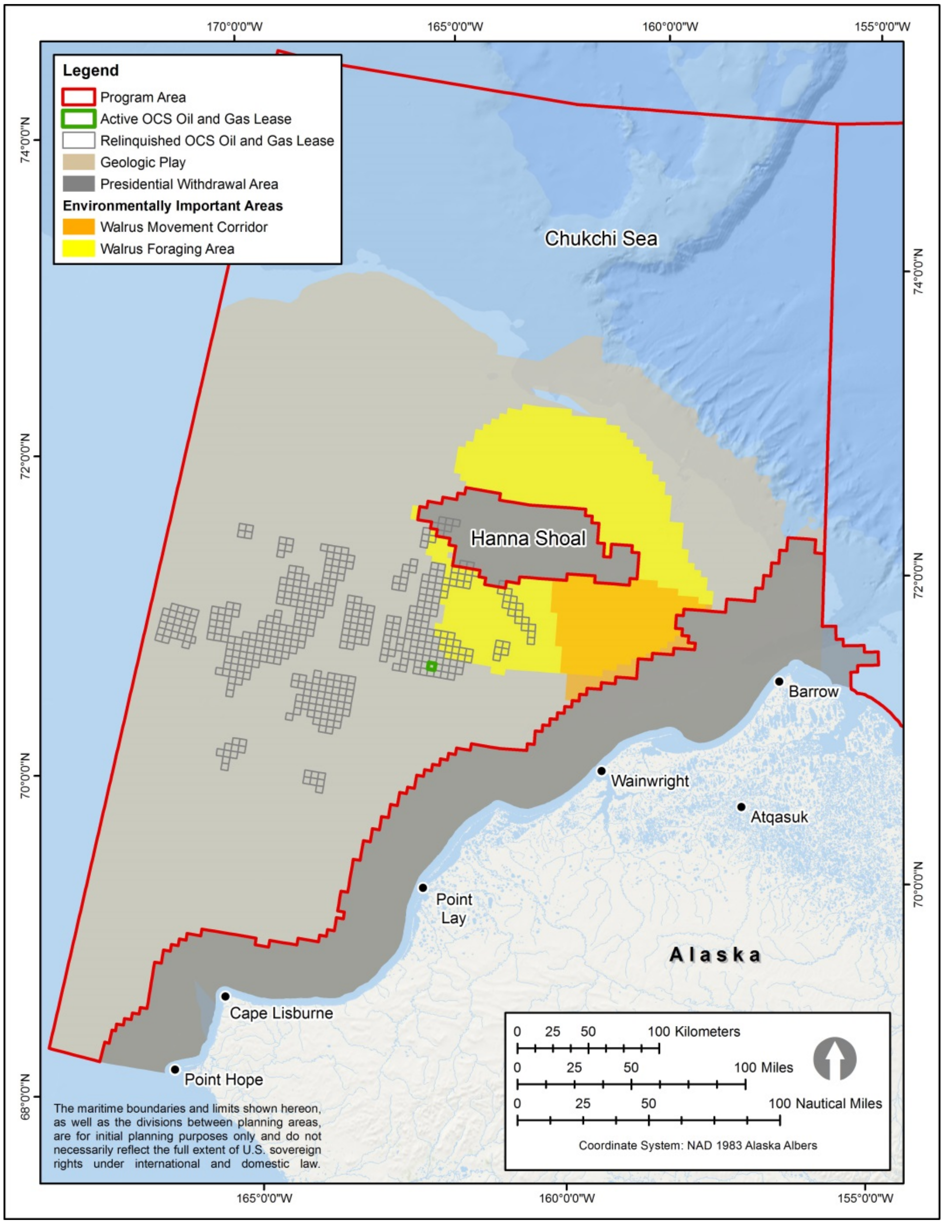

Figure 2.3-2. Chukchi Sea Program Area – Alternative B(2)

This Programmatic EIS analysis assumes (1) exclusions would apply toward all activities discussed as part of or resulting from the activities associated with the Proposed Action; and (2) temporal restrictions would apply to the activities that are expected to impact resources in each area (e.g., geophysical exploration or exploratory drilling). The timing of temporal closures identified in this Programmatic EIS represents the time during which environmental resources within an EIA could be affected by oil and gas activities. Temporal restrictions could apply to construction, production, or decommissioning activities; however, because production activities occur year-round, and the specific methods and technology to be used for construction, production, and decommissioning are not yet known, potential environmental effects and specific mitigation requirements or implementation guidelines for these activities could be better analyzed at the lease sale or plan stage when more detailed information becomes available.

Although there is more open water time in the Chukchi Sea than the Beaufort Sea (e.g., during the months of June and July), BOEM recognizes that temporal closures in the Chukchi Sea can substantially overlap with the open water season necessary for geophysical exploration and exploratory drilling activities. In this scenario, the temporal closure could effectively limit activity to the point of deterring industry interest. If the dynamics of sea ice continue to change under the influence of climate change, the temporal window of feasibility for geophysical exploration and exploratory drilling activities could expand. Subsequent environmental analyses would consider changes to activity timing as well as any changes to the occurrence or distribution of environmental resources.

2.3.3 Cook Inlet Program Area: Alternative B(3)

Alternative B(3) considers new leasing in the Cook Inlet Program Area but analyzes exclusion of one EIA: Beluga Whale Critical Habitat (**Figure 2.3-3**). This is critical habitat for the Cook Inlet Distinct Population Segment (DPS) of beluga whales and is federally designated under the ESA. The Cook Inlet beluga whale DPS, listed as endangered under the ESA, has declined by approximately 74 percent since 1979 and numbers are now in the vicinity of only 300 animals (Muto et al. 2016). Alternative B(3) considers exclusion of the portions of critical habitat that overlap with the Cook Inlet Program Area.

2.4 ALTERNATIVE C: REDUCED PROPOSED ACTION

Alternative C considers the removal of one (or more) program area(s) and associated set of sales while maintaining the remaining complement of sales in the other program area(s) (**Table 2.1-1**). Alternative C(1) considers the exclusion (no new leasing) of the entire Beaufort Sea Program Area. Alternative C(2) considers the exclusion (no new leasing) of the Chukchi Sea Program Area. Alternative C(3) considers the exclusion (no new leasing) of the Cook Inlet Program Area. The Alaska program areas are shown in **Figure 2.2-1**. Alternative C(4) considers the exclusion (no new leasing) of the GOM Program Area (**Figure 2.2-2**). The Secretary can select elements from within the alternative (43 CFR 46.420(c)). In aggregate, Alternative C is distinct from Alternative D (No Action Alternative) because Alternative D considers no leasing in all of the program areas. The exclusion of a program area or combination of program areas under Alternative C would allow some leasing, but would still be less than the area available for leasing under Alternative A and more than the area available for leasing under Alternative D.

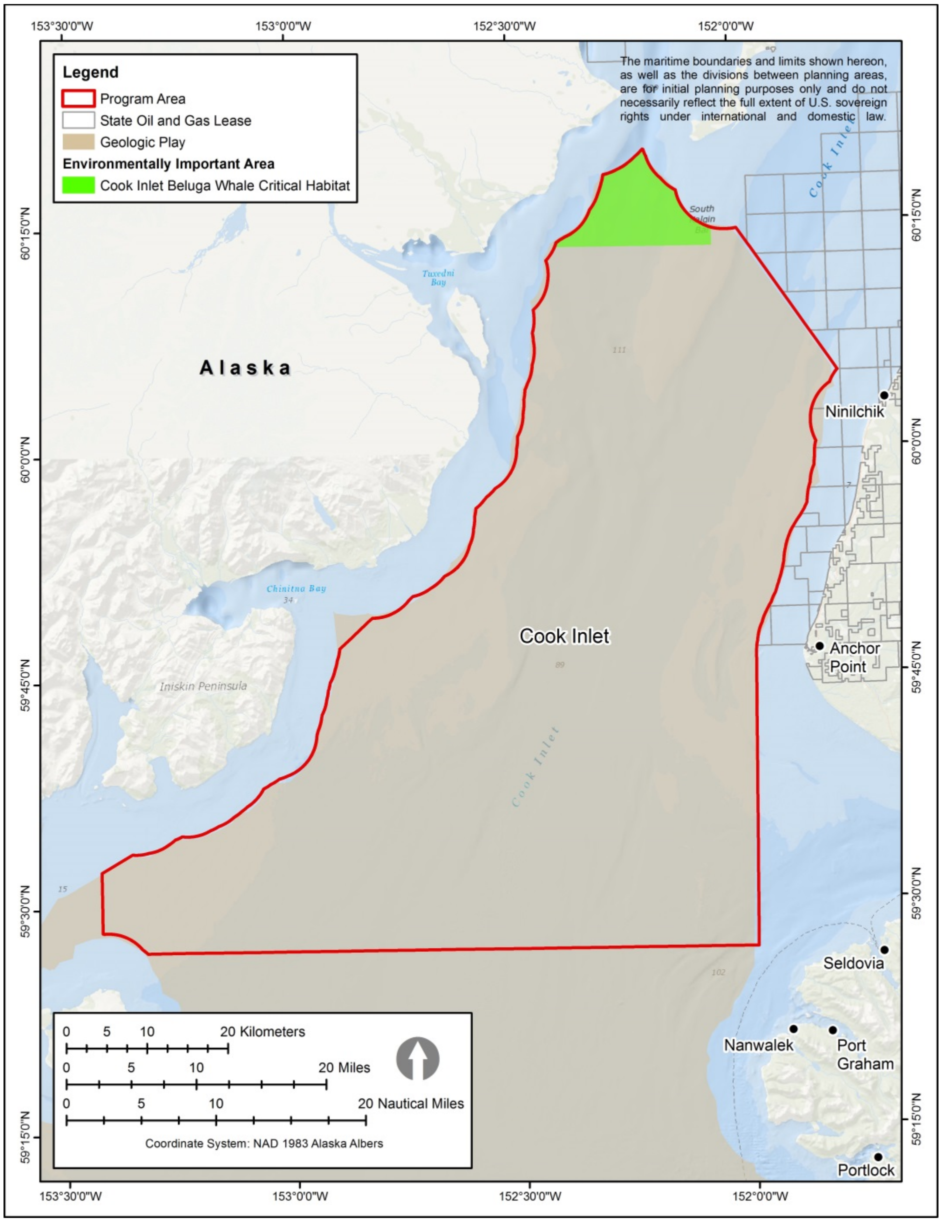

Figure 2.3-3. Cook Inlet Program Area – Alternative B(3)

Alternative C includes the potential for cross-program area impacts. Cross-program area impacts could result from oil spills occurring in one program area but affecting an adjacent program area if spills are carried into the program area through currents/wind action. This could be the case in the Arctic, if one program area is chosen for leasing and another is not. Another example of cross-program area effects under Alternative C could be the impacts on migratory species that traverse from an operational program area to a non-operational program area, or vice versa. It could be surmised that migratory patterns (i.e., timing, pathways) could shift slightly based on species leaving or avoiding areas with OCS oil and gas activities, if sensitive, or not acclimated to, such activities. For example, bowhead whales could avoid noise or structures by altering their migration path along the Beaufort and Chukchi Sea coasts.

Alternative C assumes that OCS oil and gas energy substitutes could be required and that the amount of substitutes required under Alternative C would be less than under Alternative D. Under Alternative C, energy substitutes could be needed to address any unmet energy demand given no leasing in a particular program area(s) between 2017 and 2022 (Industrial Economics, Inc. 2015). Energy substitutes include onshore oil and natural gas production; oil and gas production in state waters; imported oil and natural gas and coal; and electricity generation from other sources, such as nuclear, hydropower, solar energy, and other renewable energy sources. Reduced demand is also considered (**Section 3.5.2**).

The amount of energy substitutes needed would vary substantially depending on the prices of oil and natural gas, the area not included in the Program, and dynamics of energy markets. For example, in the low-price scenario described in **Chapter 3**, no production would occur in the Beaufort Sea or Chukchi Sea Program Areas, so approximately 97 percent of Program production would occur in the GOM Program Area and 3 percent would occur in the Cook Inlet Program Area. In comparison, under the mid-price or high-price scenario, there would be a notable shift in the distribution of production potential across program areas given the high resource potential in the Beaufort Sea and Chukchi Sea Program Areas. **Figure 2.4-1** shows the relative contribution of each program area to the OCS production in barrels of oil equivalent (BOE) that could occur under the Proposed Action for the mid-price scenario. If the Cook Inlet Program Area or the GOM Program Area was not selected, substitute energy sources would be needed for 2 percent and 49 percent, respectively, of OCS BOE that could be produced under the Proposed Action. The types of substitutes that could result from foregone OCS production under this Program would vary (**Section 3.5.2**) and have the potential to introduce environmental impacts (**Section 4.4.4**).

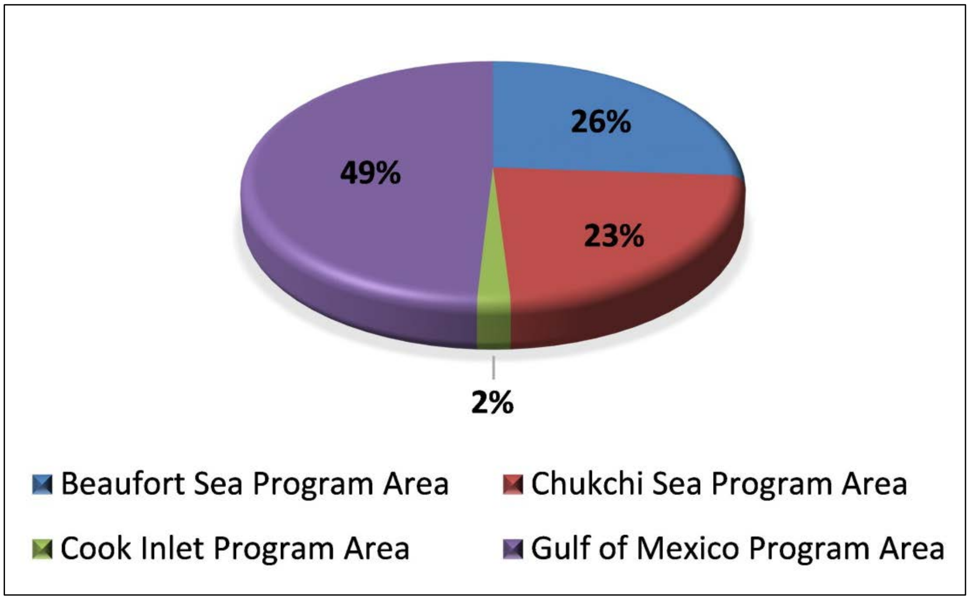

Figure 2.4-1. Relative Energy Production in BOE by Program Area under the Proposed Action, Mid-Price Scenario

Impacts from energy substitutes would only occur in a program area under Alternative C if (1) substitutes would be required to meet demand; and (2) activities associated with energy substitutions would actually occur in a program area considered in Alternative C (likely to occur only in the GOM). Otherwise, impacts from substitutes would occur in other areas (e.g., onshore, in nearshore waters, in OCS Planning Areas not considered in the Programmatic EIS, or on lands or in waters outside U.S. jurisdiction). The amount of energy substitutes required as a result of no leasing in program areas under Alternative C is expected to be less than the substitutes required if all program areas were removed under Alternative D. The need for these substitutes is considered over the life of the Program. The exact timing of when these substitutes would come online or the influence changes in current policy could have on the need for substitutes is not considered because to do so would be largely speculative. **Section 4.4.4** discusses the potential environmental impacts associated with the energy substitutes.

If the Beaufort Sea and Chukchi Sea Program Areas were not selected, different energy sources would be needed for 49 percent of OCS BOE expected to be produced under the Proposed Action for the mid-price scenario (**Figure 2.4-1**). However, at low prices, no production would occur from the Arctic, and thus no substitutions would be needed if either or both Arctic program areas were not selected in the 2017–2022 Program.

2.5 NO ACTION ALTERNATIVE (ALTERNATIVE D)

Under Alternative D (the No Action Alternative), there would be no new leasing in any of the four OCS program areas between 2017 and 2022. The analyses for Alternative D considers two aspects: (1) the direct and indirect impacts expected to occur as a result of no leasing during the 2017-2022 Program; and (2) the changes to the effects baseline that are expected to occur independent of decisions made for the 2017–2022 Program.

Alternative D broadly considers the changing or evolving condition of environmental and sociocultural resources in the program areas over the same protracted time horizon (40–70 years) considered for the Proposed Action (the "effects baseline"). There would be ongoing OCS activities in some of the program areas under leases issued up to and through the 2012–2017 Program that could affect a resource's future condition regardless of decisions made under the 2017–2022 Program (**Section 3.7**). Moreover, other present and future actions independent of the activities associated with the Proposed Action and occurring in the same program area could also affect a resource's future condition when compared to the present condition described in the Affected Environment (**Section 4.3**). These changes would occur *whether or not* new leasing takes place during the 2017–2022 Program or future programs. The impacts of each action alternative (**Sections 4.4.1**, **4.4.2**, and **4.4.3**, respectively) as well as the discussion of direct and indirect impacts of Alternative D in **Section 4.4.4** are considered additive to the effects baseline described under Alternative D.

In comparison, the direct and indirect impacts expected to occur as a result of no leasing are those that would occur *because* no new OCS leases would be offered under Alternative D. Under Alternative D, BOEM considers the potential for, and, if possible, effects or environmental changes that could result from, foregoing OCS oil and gas production and relying on other energy sources. This includes direct and indirect impacts of no new leasing under the 2017–2022 Program and consideration of the energy substitutes that could be required to compensate for foregone production.

In aggregate, Alternative D is distinct from Alternative C because Alternative D considers no leasing in all of the program areas. The exclusion of a program area or combination of program areas under Alternative C would allow some leasing, but would still be less than the area available for leasing under Alternative A and more than the area available for leasing under Alternative D. The substantive difference in effects by program area under Alternatives C and D include the limited potential for adjacent program area or cross-program area effects present in Alternative C (**Section 4.4.3**) that would not exist under Alternative D.

Energy substitutes are introduced in **Section 2.4**; potential energy substitutes and expected proportions of each substitute are discussed in **Section 3.5.2**. Under Alternative D, energy substitutes would be necessary to accommodate national energy needs from forgone OCS oil and gas production. For example, energy production could shift from OCS oil and gas to onshore oil and gas, international oil and gas production, or domestic production of oil and gas alternatives (e.g., renewable energy). The need for these substitutes is considered over the life of the Program. The exact timing of when these substitutes would come online or the influence changes in current policy could have on the need for substitutes is not considered because to do so would be largely speculative. The impacts from energy substitutes are separate and additive to the effects baseline in Alternative D. Impacts from energy substitutes would be greater under Alternative D than under Alternative C, since no new OCS leasing would occur in any program area, and a greater volume of energy substitutes would be required to meet an unchanged demand. The impacts of energy substitutes are described in **Section 4.4.4** and in Industrial Economics, Inc. and SC&A, Inc. (2015).

2.6 PROGRAMMATIC MITIGATION MEASURES

2.6.1 Programmatic Mitigation Considered in Environmentally Important Areas

In addition to the EIAs analyzed under Alternative B (**Section 2.3**), three EIAs have been identified for the potential application of programmatic mitigation measures: Harrison Bay (Beaufort Sea), Chukchi Corridor (Chukchi Sea), and the Biologically Sensitive Underwater Features EIA (GOM). These EIAs could be geographically defined, the basis for protection of the EIA was supported by adequate data, and they *would not* affect the size or location of potential leasing. The analysis of adopting mitigation for these areas at the programmatic level is provided in **Section 4.4.6.**

2.6.1.1 Harrison Bay

The Harrison Bay EIA is in the Beaufort Sea Program Area (**Figure 2.6-1**). This is an important nearshore area that encompasses relatively high productivity and is important to birds and seals during the open water season. Harrison Bay has been identified by the National Audubon Society as an Important Bird Area (IBA) of continental significance for several species of birds. It captures areas of high relative density of birds in the summer (June to September) based on data from 2010 to 2014 and high relative annual density of brant, eiders, and loons based on data from 1979 to 2010 (Audubon Alaska 2014, Audubon Alaska 2016, Drew and Piatt 2013, Walker and Smith 2014, Smith et al. 2014, USFWS 2016). It overlays areas identified as a seabird “hotspot” by analyses in Kuletz et al. (2015). This area serves as a major migration staging area for red-throated and yellow-billed loons in summer and fall and for spectacled and king eiders in spring and fall (Walker and Smith 2014, Smith et al. 2014). Spectacled eiders are an ESA-listed species. Programmatic mitigation such as a temporal closure or activity restrictions for Harrison Bay could minimize impacts on birds, specifically. Other resource areas could also benefit from this mitigation. For example, the Harrison Bay EIA also includes feeding and denning area for polar bears. Polar bear dens have been identified in this area between 1910 and 2010 and this area of the Beaufort Sea coast is expected to remain one of several important denning and feeding habitat areas for polar bears during the winter as the sea ice extent continues to change (Durner et al. 2009, Durner et al. 2010).

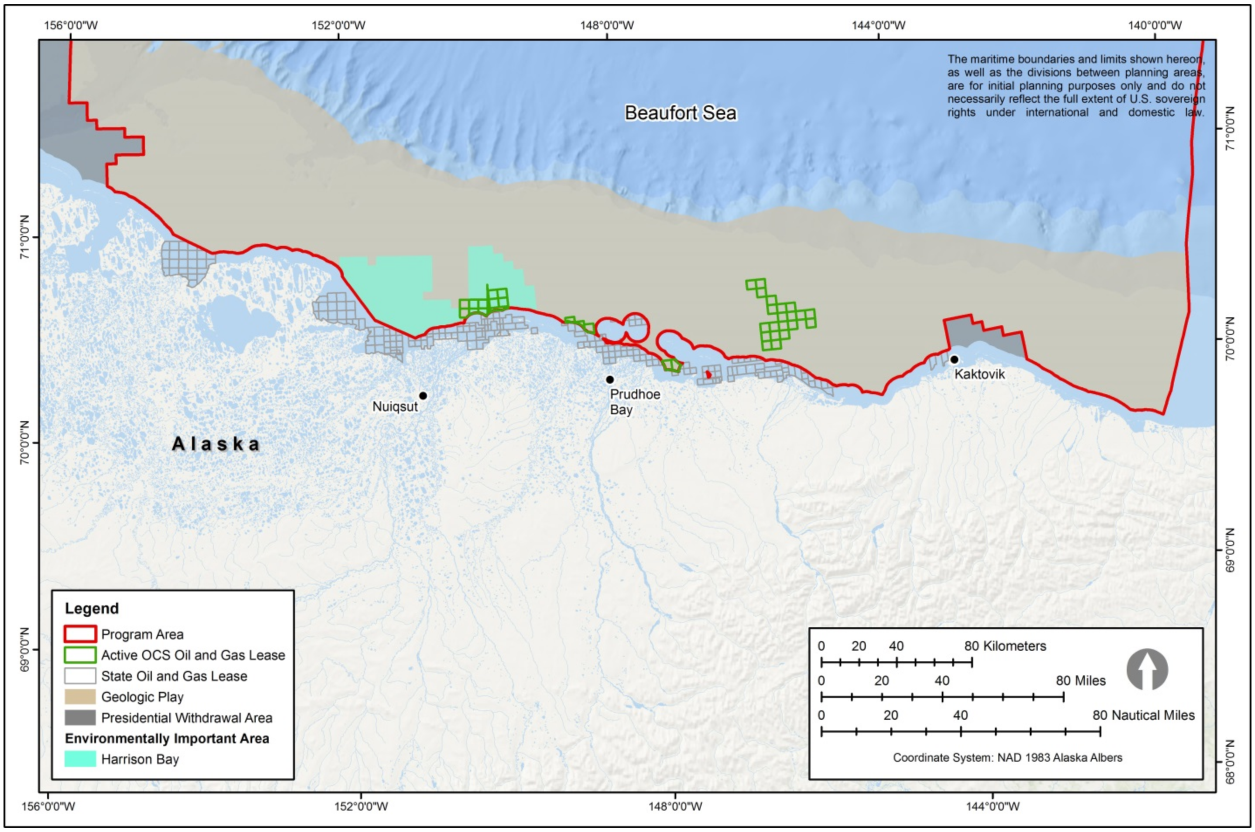

Figure 2.6-1. Harrison Bay EIA

2.6.1.2 Chukchi Corridor

The Chukchi Corridor EIA is in the Chukchi Sea Program Area (**Figure 2.6-2**). This area is a 25 mi-wide corridor extending seaward from and running parallel to the existing Chukchi Corridor Presidential Withdrawal area. The withdrawal area and the EIA contain important seasonal habitat for many species, including marine mammals and birds, as well as important subsistence use areas and spring ice lead systems.

The ecological importance of this area is highlighted by numerous studies. Kuletz et al. (2015) identified “hotspots” for marine mammals and seabirds all along the Chukchi Sea coast. Hauser et al. (2014) identified core areas for the Eastern Chukchi Sea stock of beluga whales using a 50 percent utilization distribution offshore of Point Barrow and off Kasegaluk Lagoon during July and August. The Chukchi Corridor EIA overlaps important feeding habitat for gray whales and the spring migration route for beluga and bowhead whales (Clarke et al. 2015b). Wilson et al. (2014) identified areas of expected preferential use for non-denning polar bears within the southwestern portion of the Chukchi Corridor EIA and expanding slightly beyond it, noting that use is most likely to occur during periods of sea ice retreat and expansion. There are areas of high benthic biomass offshore Point Lay from Ledyard Bay to Kasegaluk Lagoon, offshore Point Barrow and northwest of Wainwright where the Chukchi Corridor EIA abuts the Walrus Movement Corridor EIA (**Section 2.2.2**). Programmatic mitigation for this area would limit or modify activities during migration periods and until after the spring lead system has broken up and the sea ice has retreated.

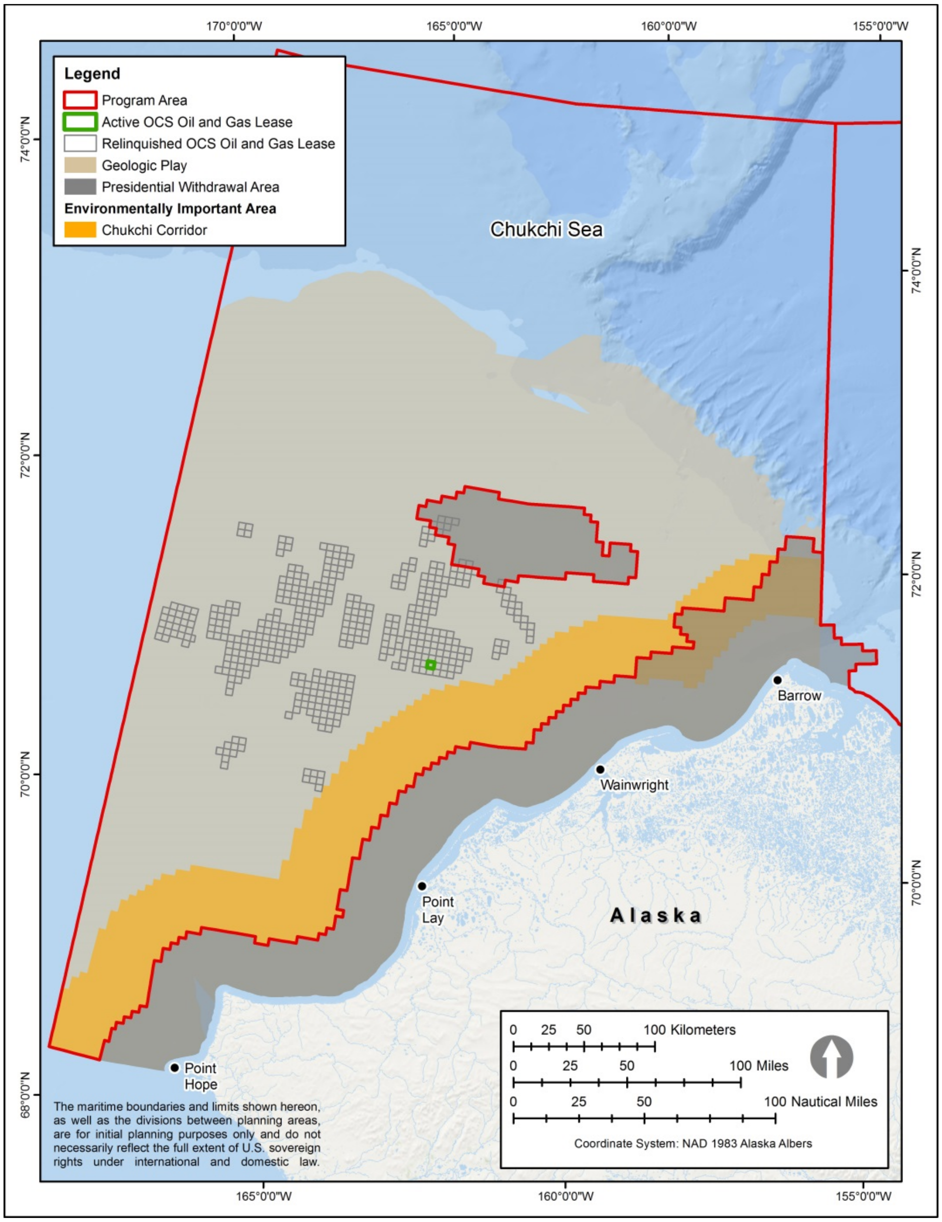

Figure 2.6-2. Chukchi Corridor EIA

2.6.1.3 Biologically Sensitive Underwater Features

The Biologically Sensitive Underwater Features EIA includes GOM lease blocks currently subject to Topographic Features and Live Bottom (Pinnacle Trend) lease stipulations. These existing stipulations require implementation of mitigation measures designed to avoid or minimize harm from seafloor-disturbing activities to sensitive and unique topographic and pinnacle trend features found across the GOM Program Area (**Figure 2.6-3**). None of the blocks with known concentrations of live-bottom, low-relief habitat are expected to be offered for lease; therefore, this stipulation is not being considered at the programmatic level for the 2017-2022 Program. Lease stipulations associated with sensitive underwater features have been implemented in the GOM for decades. This programmatic mitigation would obviate the need for reconsideration at every lease sale. These requirements would apply to all leases issued under the 2017–2022 Program in designated lease blocks.

More detail on the Topographic Features and Live Bottom (Pinnacle Trend) stipulations and the affected blocks can be found in BOEM's Notice to Lessees and Operators (NTL) No. 2009-G39 and **Appendix I**.

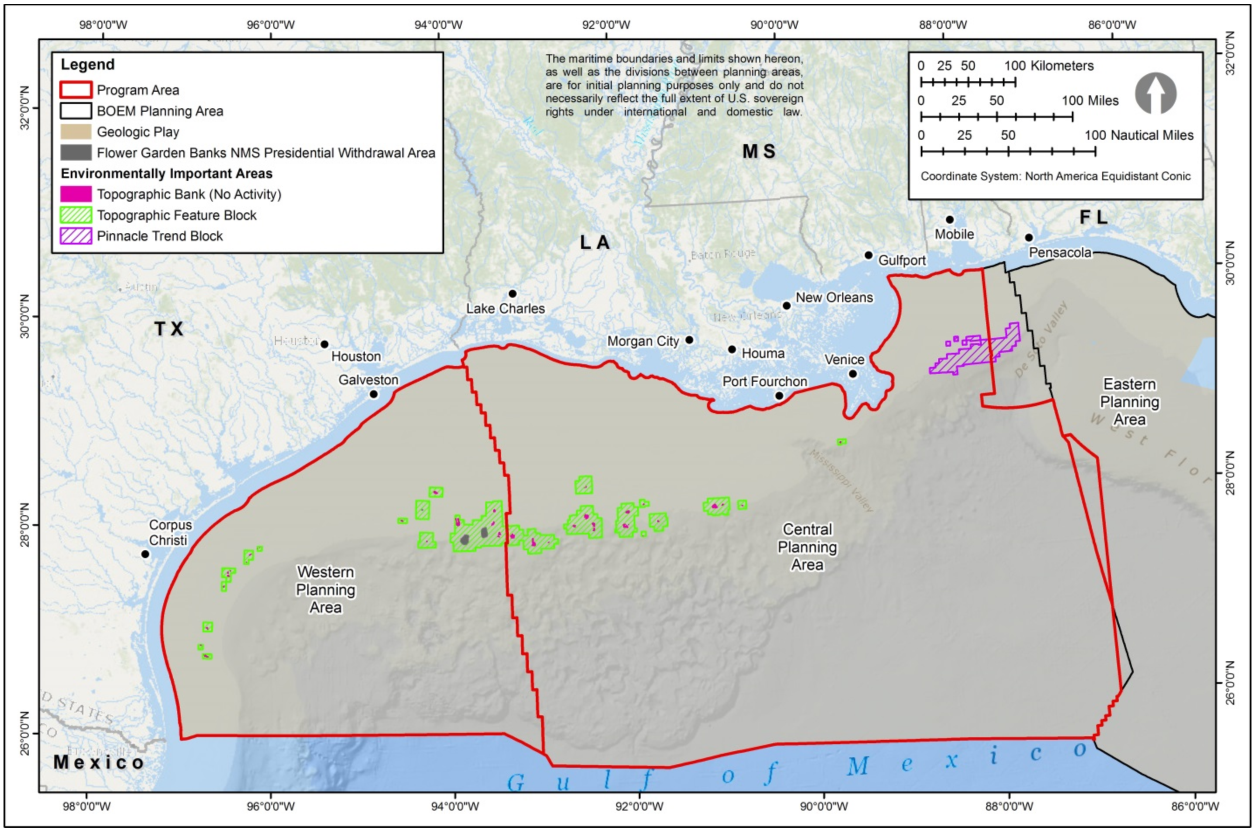

Figure 2.6-3. Biologically Sensitive Underwater Features EIA in the GOM Program Area

2.6.2 Alaska Conflict Management Plan

During the Draft Programmatic EIS comment period, a number of Alaska Native communities and organizations[1] stated a distinct preference to address multi-use conflicts in the Beaufort Sea or Chukchi Sea Program Areas through means other than excluding leasing in conflict-prone or environmentally sensitive areas. Alaska Natives recommended addressing multi-use or space-use conflict related to subsistence or other cultural use needs through an established practice of thoughtful coordination between potentially affected communities and oil and gas operators. The concept of a CMP for leases issued in Alaska program areas is introduced to minimize the potential for conflict between subsistence activities and oil and gas industry operations taking place under BOEM jurisdiction in the Alaska Region OCS.

BOEM would require an oil and gas industry operator to submit a CMP to BOEM as a submittal prior to beginning exploration or development activities. The CMP would document the operator's coordination with Alaska Native communities to determine best practices to prevent unreasonable conflicts with subsistence or other cultural activities, and would outline specific mitigation measures that the operator would implement. The CMP would apply to BOEM-authorized and -permitted activities in

[1] These include the Alaska Eskimo Whaling Commission; Arctic Slope Regional Corporation (ASRC); ASRC Exploration, LLC; Arctic Iñupiat Offshore, LLC; and attendees at the public meetings held in Point Hope, Point Lay, Wainwright, and Nuiqsut, Alaska.

the Alaska Region OCS, as well as support activities (such as aircraft or vessel resupplies or crew transfers), which could occur on the OCS or onshore.

The CMP is not a replacement for the Conflict Avoidance Agreements that industry and Alaska Native communities derive through the MMPA process with National Marine Fisheries Service (NMFS). Conflict Avoidance Agreements are more narrowly focused on impacts on marine mammal subsistence in the OCS and could include compensation for subsistence users through the transfer of benefits. A CMP would not require the transfer of benefits or third-party agreements. It is BOEM's intention to facilitate coordination between industry and Native Alaska communities through a CMP to further minimize the potential for impacts on local communities.

2.7 Alternatives Considered but Eliminated from Programmatic Evaluation

Other alternatives considered but not analyzed in this Programmatic EIS are as follows:

- Add additional sales or re-institute sales from the DPP
- Change frequency or timing of lease sales
- Delay lease sales pending new technologies development or regulatory reform
- Develop alternative or renewable energy sources as a complete or partial substitute for oil and gas leasing on the OCS
- Add additional spatial exclusions within program areas.

2.7.1 Add Additional Sales or Re-institute Sales

Under OCSLA, the Five-Year Program decision process begins by considering the potential for lease sales in all 26 OCS Planning Areas at the DPP stage. As the Section 18 process moves forward, the size, location, and number of lease sales at the subsequent stages of a Five-Year Program process (i.e., Proposed Program and PFP) can be reduced, but cannot be increased. During the development of the 2017–2022 DPP in 2014, the Secretary of the Interior considered all 26 OCS Planning Areas to determine which could be most suitable for oil and gas leasing. Many areas show little to no potential for oil and gas (see Figures 5-6 and 5-8 in the DPP, BOEM 2015a). In other areas, the Secretary considered economic, social, and environmental values of the renewable and nonrenewable OCS resources, and the potential impact of oil and gas exploration on other resource values of the OCS and the marine, coastal, and human environments before deciding the DPP and Proposed Program schedules. The DPP lease sale decision eliminated numerous planning areas from potential leasing from the Five-Year Program and minimized effects on certain areas through the Secretary of the Interior's size, timing, and location decisions. The Secretary of the Interior's 2017–2022 DPP decision included 14 proposed lease sales in five program areas, including a potential Atlantic lease sale.

Certain areas are unavailable for leasing under a variety of authorities and constrain the Secretary's discretion. For example, in December 2014, President Obama withdrew the entire North Aleutian Basin in Alaska from consideration for leasing. In January 2015, President Obama withdrew areas in the Beaufort Sea and Chukchi Sea Planning Areas, as previously discussed (**Section 2.2.1**). In the GOM, most of the Eastern Planning Area and part of the Central Planning Area within 161 km (100 mi) of the Florida coast are under a Congressional moratorium, restricting leasing and development until 2022. Lease sales cannot be held in these areas.

Coincident with the OCSLA Section 18 process, BOEM prepares a Programmatic EIS (**Section 1.1**). The Draft Programmatic EIS analyzed the Secretary's DPP decision as the Proposed Action, which contemplated the 14 proposed lease sales, including a potential Atlantic Program Area lease sale. After consideration of the analysis in the Proposed Program and disclosure of potential impacts from such a sale in the Draft Programmatic EIS, the Secretary of the Interior removed the Atlantic Program Area from the Program in her Proposed Program decision. The Secretary considered a variety of factors, analyzed under OCSLA Section 18, and explained her reasoning for removing the Atlantic Program Area from the Proposed Program (BOEM 2016a). The removal of the Atlantic Program Area from the Proposed Program effectively prevents the Secretary from including an Atlantic lease sale in the Proposed Final Program. Because the Atlantic Program Area was removed from the Proposed Program, an Atlantic lease sale requires no further analysis and is no longer a reasonable alternative. Further analyzing an Atlantic lease sale as an alternative would not inform the PFP decision. Consistent with the Proposed Program, this Final Programmatic EIS does not analyze other sales in OCS planning areas not under consideration, such as a re-instituted sale in the South or Mid-Atlantic Planning Areas or another sale in the Eastern Planning Area.

2.7.2 Change Frequency or Timing of Lease Sales

The approval of a Program establishes a general schedule for potential lease sales, and all scheduled lease sales could be delayed or cancelled at any time during a Program, especially if new conditions or circumstances warrant that course of action. The Program already considers an option in the timing of the Beaufort Sea lease sale and timing options for annual sales in the GOM. In addition, the Program schedules potential lease sales in the Beaufort Sea, Chukchi Sea, and Cook Inlet Program Areas later in the Program to provide a balanced and prudent approach to potential development in frontier areas. The frequency and timing proposed for lease sales reflects careful consideration of the factors set forth in Section 18 of OCSLA. Furthermore, a change in timing (i.e., year of scheduled lease sale), while potentially important for the logistics of Program lease sales, is expected to have little influence on the context and intensity of environmental impacts over the life of the Program. The number, nature, and timing of activities following a sale are not known precisely at the Program stage and vary by program area. Also, any impacts related to lease sales under the Program are expected to occur over 40 to 70 years, making a 1- or 2-year timing difference in the date leased inconsequential to the environmental impact analysis. Therefore, the addition of an alternative that addresses other changes in frequency or timing of lease sales would not represent a meaningfully different alternative than those already considered in this Programmatic EIS.

2.7.3 Delay Lease Sales Pending New Technologies Development or Regulatory Reform

Technologies, safety standards, and industry practices evolve continually, and agency regulations are revised with regularity. OCSLA’s staged decision process allows for adaptive management by providing the opportunity to incorporate new technologies and regulations at each stage of oil and gas development, if warranted (**Figure 1.3-1**). Delaying lease sales is not necessary because, under OCSLA and lease terms, new regulations and best available science and technology determinations apply to existing leases.

2.7.4 Develop Alternative or Renewable Energy Sources as a Complete or Partial Substitute for Oil and Gas Leasing on the OCS

BOEM is required under OCLSA to prepare periodically a schedule of OCS oil and gas lease sales to best meet the nation’s energy needs. As noted in **Section 1.2**, OCS oil and gas production substantially contributes to meeting U.S. energy demand and is expected to supply this demand into the future. BOEM recognizes the importance of decreasing atmospheric GHG emissions and advancing the use of wind and other renewable energy toward that end. BOEM has an OCS Renewable Energy Program currently leasing areas for OCS wind development, which is a subset of its overall regulatory purview for renewable energy. BOEM’s market substitution analysis supports not separately analyzing alternative energy as a reasonable alternative to some or all oil and gas OCS development (BOEM 2016b). Renewable energy would only account for less than three percent of the energy resource produced as a result of no lease sales being held in the 2017-2022 Program (BOEM 2016b).

2.7.5 Add Other Spatial Exclusions in Program Areas

As discussed in **Sections 1.4.4** and **2.3**, EIAs represent regions of important environmental value where there is potential for conflict between ecologically important or sensitive habitats; maintenance of social, cultural, and economic resources; and possible oil and gas development.

EIAs that: (a) were not spatially discrete; (b) lacked adequate support at this point to include as an alternative, as a component thereof, or as programmatic mitigation; or (c) were unlikely to coincide with potential leasing under the Proposed Action were eliminated from further analysis. Spatial exclusions suggested in public comment, but determined not to be ripe for analysis, are described below by program area. Any of these areas could be considered at later stages in the leasing process if determined to be appropriate at that time.

2.7.5.1 Beaufort Sea Program Area

Figure 2.7-1 depicts areas identified during scoping and the Draft Programmatic EIS public comment period that were considered but not carried forward for additional analysis.

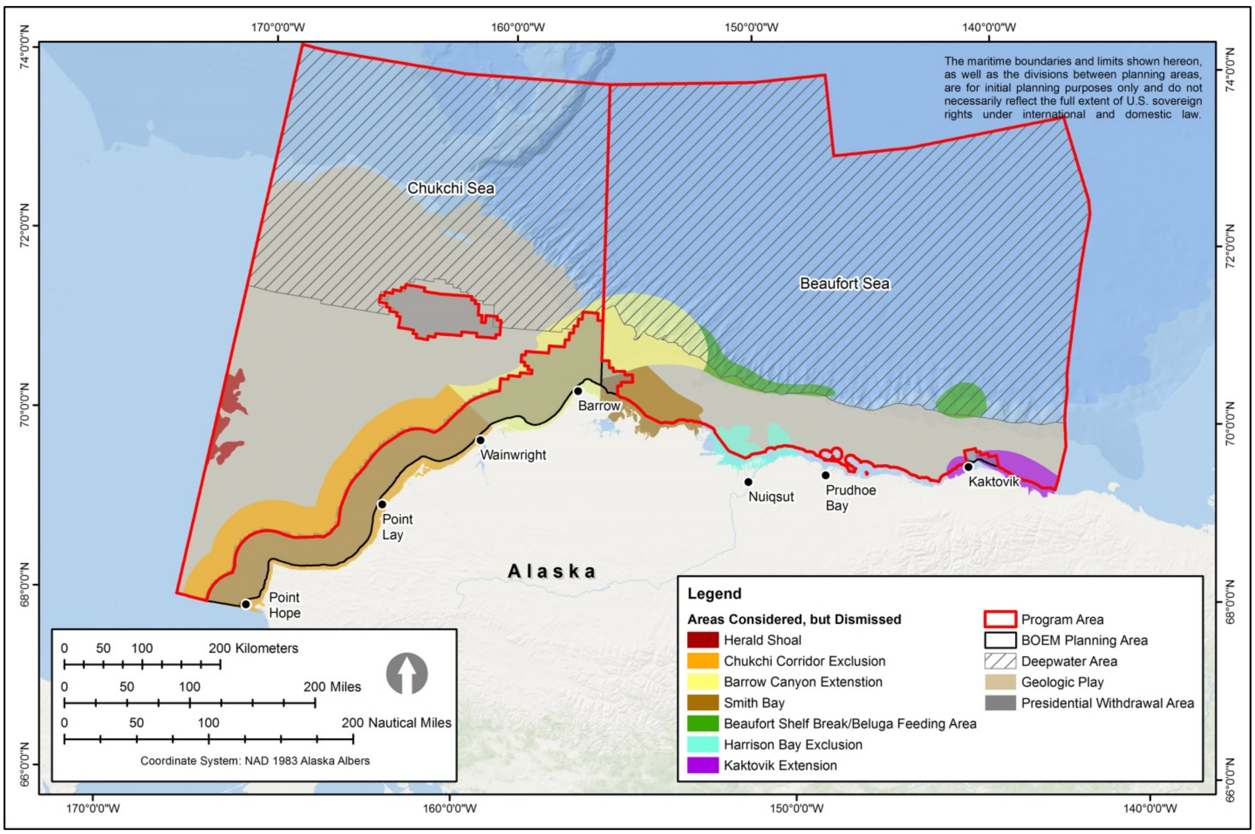

Figure 2.7-1. Areas in the Beaufort Sea and Chukchi Sea Program Areas Considered but not Carried Forward for Analysis

Barrow Canyon Extension: This area was recommended by a consortium of environmental non-governmental organizations (NGOs) and includes waters of the Chukchi Sea Program Area that are almost entirely encompassed by the existing presidential withdrawal area and the Chukchi Corridor EIA analyzed in this Programmatic EIS. The portion of the Barrow Canyon extension considered in this dismissal is the portion that falls within the Beaufort Sea Program Area that would expand the Barrow Canyon EIA analyzed in this Programmatic EIS farther north and east (**Figure 2.7-1**). BOEM does not analyze this as an alternative in this Programmatic EIS for the following two reasons.

First, the information submitted in support of expanding this area was based on BOEM-sponsored aerial survey observations of marine mammals from 2000–2014 (NOAA Fisheries 2015). The information emphasizes an area of relative high density of beluga whales in the fall (September/October) within the vicinity of Barrow Canyon, portions of which overlap with the EIA considered in this Programmatic EIS. There are other studies, using complementary methods such as tagging and acoustics, that confirm beluga whales use this broader area along Barrow Canyon (Stafford et al. in review, Kuletz et al. 2015, Hauser et al. 2014). However, the exact boundaries of the geographic area appear to be sensitive to the data sampling and analytical methods used. Moreover, there is notable inter-annual variability in the geographic extent of the area used by beluga whales that warrants more detailed consideration (NOAA Fisheries 2015). BOEM is funding ongoing research that could provide additional clarity at the lease sale stage on the persistence of beluga whales in this area.

Second, more than 50 percent of the area recommended for expansion is outside of the extent of geologic plays, and therefore, OCS activity is unlikely to occur in this area as a result of this Program. In the portion that does overlap with the geologic plays, there has been limited historical leasing with no exploration (17 lease blocks in Lease Sale 97 in 1988), suggesting that activity would be limited, if any. Adoption of this additional area into the existing EIA would not result in substantially different effects from what was already considered.

Smith Bay: This area was recommended by a consortium of environmental NGOs; the recommendation was to expand the Barrow Canyon EIA analyzed in this Programmatic EIS farther east along the Beaufort Sea coast (**Figure 2.7-1**). BOEM does not analyze this as an alternative in this Programmatic EIS for the following two reasons.

First, this recommendation is similarly based on aerial survey observations from 2000-2014 (NOAA Fisheries 2015); the observations indicate bowhead whales are present in this area during the fall migration (September/October). The existing Barrow Canyon EIA encompasses a portion of this higher density area. It also captures areas of relatively high bird density that occur in summer (June to September) (Drew and Piatt 2013, Walker and Smith 2014, and USFWS 2016). The exact boundaries of the area recommended for expansion appear to be sensitive to the data sampling and analytical methods used. BOEM is funding ongoing research that could provide additional clarity at the lease stage on the persistence of bowhead whales in this area.

Second, the existing Barrow Canyon EIA factors in the geological resource potential consistent with the purpose of and need for the Proposed Action. There is widespread historical leasing in this area, including at least one exploration well, as well as many adjacent state leases. Expanding the exclusion area could deter interest in leasing. The core area deserving environmental protection is already included in the Barrow Canyon EIA analyzed in this Programmatic EIS.

Harrison Bay Exclusion: A consortium of environmental NGOs recommended that Harrison Bay be analyzed for exclusion (**Figure 2.7-1**). Rather than complete exclusion, BOEM analyzes a time-area closure for this area from June through August, which is a substantial part of the open water season. While the time-area closure could be viewed as a major deterrent to industry, and in practice negatively affect leasing, the mitigation does not preclude exploration activities during the entire open water season as would an outright exclusion. The basis to include the EIA for mitigation was the potentially significant resource potential and number of active and historical leases in this area that could encourage development. Since the existing leases could expire by the time the proposed Beaufort Sea lease sale would be held, exclusion of this area could also be considered as an alternative for the lease sale analysis.

Kaktovik Extension: This area, recommended by a consortium of environmental NGOs, would expand the Kaktovik EIA farther east to the border with Canada (**Figure 2.7-1**). The recommendation is similarly based on fall bowhead whale sightings from 2000–2014 aerial surveys (NOAA Fisheries 2015). The data confirm high relative density of bowhead whales during the fall (September/October) in the vicinity of Kaktovik. However, the exact boundaries of the geographic area appear to be sensitive to the data sampling and analytical methods used. There is notable inter-annual variability in the geographic extent of the area used by bowhead whales that also warrants more detailed consideration (NOAA Fisheries 2015). BOEM is funding ongoing research that could provide additional clarity at the lease sale stage on the persistence of bowhead whales in this area.

Beaufort Shelf Break and Offshore Beluga Whale Feeding Area: The recommendation from a consortium of environmental NGOs includes exclusion of a large stretch of the Beaufort Sea shelf break. The Beaufort Sea shelf break runs east of the Barrow Canyon EIA and includes the Offshore Beluga Whale Feeding Area north of Kaktovik along the shelf break (**Figure 2.7-1**). BOEM does not analyze this area as an alternative for two reasons.

First, most of this area is outside of the geologic plays and therefore leasing is unlikely to occur. There has been no historical leasing in the small area that overlaps the plays. Second, the recommendation is based on analyses of aerial survey observations from 2000-2014 (NOAA Fisheries 2015) that show relatively higher density of beluga whales during the fall migration in this area, although this is not as dense as areas farther to the west already covered in the existing Barrow Canyon EIA. However, the exact boundaries of the geographic area appear to be sensitive to the data sampling and analytical methods used. There is notable inter-annual variability in the geographic extent of the area used by beluga whales that warrants more detailed consideration (NOAA Fisheries 2015). BOEM is funding ongoing research in this area that could provide additional clarity at the lease sale stage. Second, there is nominal overlap with the geologic plays and leasing is very unlikely to occur here in these comparatively deeper waters.

The recommendation for excluding the Offshore Beluga Whale Feeding Area also relies on the same observations from 2000–2014 aerial surveys (NOAA Fisheries 2015), showing a relatively higher density of beluga whales during the fall. The exact boundaries of the geographic area appear to be sensitive to the data sampling and analytical methods used. There is notable inter-annual variability in the geographic extent of the area used by beluga whales that also warrants more detailed consideration (NOAA Fisheries 2015). BOEM is funding ongoing research that could provide additional clarity at the lease sale stage on the persistence of beluga whales in this area.

Beaufort Sea Deepwater Area: This area was recommended for exclusion from leasing by the Marine Mammal Commission. The Beaufort Sea deepwater area includes the continental slope and all basin waters deeper than 200 m (656 ft). In general, the area is well north of the geologic plays currently mapped by BOEM. There is no historical leasing north of the shelf break (200 m [656 ft] depth), and this area is not expected to be leased during the Program because of relatively deeper waters and unfavorable economics. Consideration of this additional area would not result in substantially different effects from what is already analyzed.

2.7.5.2 Chukchi Sea Program Area

Exclusion and/or Expansion of Chukchi Corridor: Numerous commenters identified the area along the coast of the Chukchi Sea as vitally important to multiple species of marine mammals and birds; recommendations for the extent of the corridor ranged from 10 to 35 miles beyond the existing 25-mile presidential withdrawal. The Chukchi Corridor EIA analyzed in this Programmatic EIS extends to 50 miles offshore. This captures a reasonable balance among the suggestions, as well as the most important habitat and subsistence use features of this area. The 50-mile buffer encompasses important habitat for gray and bowhead whales, walrus, seals, polar bear, and numerous species of birds (Clarke et al. 2015b, Kuletz et al. 2015). In preparing the Draft Programmatic EIS, BOEM considered this area for both exclusion and mitigation and concluded that closures during migration periods, and until the spring lead system has broken up, would be most appropriate to limit potential impacts on the species that use this area. An incremental expansion of this area out to 60 miles would not result in substantially different effects from what is already analyzed. In addition, areas of principal leasing and activities are expected farther offshore than 50 miles. Reconsideration could be appropriate at the lease sale stage to determine whether exclusion of any subset of the Chukchi Corridor would mitigate site-specific impacts.

Chukchi Sea Deepwater Area: This area includes deep water in the Chukchi Sea north of 72° north latitude. The higher latitude waters have a higher likelihood of persistent sea ice throughout the open water season, even in years of minimal ice cover, potentially making oil and gas operations more challenging. Some of the area also overlaps with the HSWUA that is analyzed under Alternative B. The majority of the deepwater area is north of the geologic plays mapped by BOEM. There is no historical leasing in this area, and this area is not expected to be leased during the Program because of relatively deeper waters and unfavorable economics. Consideration of this additional area would not result in substantially different effects from what is already analyzed.

Herald Shoal: This area was recommended by a consortium of environmental NGOs for exclusion. Herald Shoal is an area of shallow water and elevated productivity where sea ice persists longer into the summer than in other areas of the Chukchi Sea (**Figure 2.7-1**). The habitat Herald Shoal provides is important to species such as walrus, ice seals, and migrating bowhead or gray whales for different life functions based on its similarity to other known high-use areas such as Hanna Shoal. However, this area has been studied less; BOEM is funding research in this area that could help determine the importance and sensitivity of this area. That information could be considered at the lease stage.

2.7.5.3 Gulf of Mexico Program Area

Gulf Islands National Seashore 24-km (15-mi) Buffer: The National Park Service (NPS) requested leasing exclusion of blocks within 24 km (15 mi) of Gulf Islands National Seashore islands along the Mississippi coast. The NPS made the request to minimize potential adverse effects (primarily from visual/lighting effects) on the integrity and experience of wild and scenic places and for the protection of federally designated wilderness. BOEM has carefully considered this request and has decided that it is not appropriate for inclusion as an alternative at the programmatic level. BOEM has already committed to coordination with the NPS at the lease sale and plan stages through the mechanisms described in "Gulf Island National Seashore" Information to Lessees. Furthermore, even if leasing were to occur, existing lease stipulations would mitigate potential environmental impacts. Under the Information to Lessees, BOEM must review any lessee's plans in the area of concern to determine if visual impacts are expected to cause serious harm and if any additional mitigative action is required. Mitigation measures that could be applied at the plan stage could include requested changes in location, modifications to design or direction of proposed structures, pursuing joint use of existing structures on neighboring blocks, changes in color design, or other plan modifications. This is consistent with the NPS proposed management strategy for maintaining optimal night sky viewing conditions, which include cooperating with partners to minimize intrusion of artificial light into the night scene in the national seashore, and evaluating the impacts on the night sky caused by national seashore facilities (NPS 2011). The Programmatic EIS does not separately analyze a no-leasing buffer south of Baldwin County, Alabama, for similar reasons.

Sperm Whale High-Use Area: Sperm whales, protected under the ESA, often concentrate in the deepwater area offshore the Mississippi River Delta, especially in the vicinity of the Mississippi Canyon and adjacent continental slope (Waring et al. 2016). Recent abundance estimates indicate that the sperm whale population appears to be stable despite oil and gas activities in this habitat area. However, NMFS indicates that there are insufficient data to definitively determine population trends in the GOM for this species at this time (Waring et al. 2016). BOEM believes that current long-term biological data do not support additional mitigation measures or exclusion of this area beyond the long-standing mitigation practices already in place to minimize impacts on this species (**Appendix I**). The Mississippi Canyon is a deepwater area that features high oil and gas resource potential. If the area was excluded, it would not be offered for leasing. Many of the most productive leases from current and previous Programs occur in this area. Exclusion of this area, or other deepwater areas, would not be consistent with the purpose of and need for the Proposed Action. Moreover, not offering this area for lease during the 2017–2022 Program would not reduce potential impacts on sperm whales from ongoing activities.

Loggerhead Sea Turtle Critical Habitat: Loggerhead sea turtle critical habitat in the vicinity of the GOM Program Area is shown in **Section 4.3.7**. Critical habitat in the GOM includes onshore nesting areas and nearshore areas used for a variety of life history functions, including breeding, migration, feeding, and overwintering. There is also a large area of the open water GOM designated as critical habitat due to the presence of *Sargassum*, an oceanic species of brown algae that occurs on the surface of the water and provides important habitat for young sea turtles. The area of the GOM in which *Sargassum* occurs is very large and the occurrence of *Sargassum* is highly variable. Therefore, exclusion of this area would preclude any new leasing and the recommendation to exclude it would not be substantively different from Alternative C or Alternative D.

Biologically Important Areas in the Gulf of Mexico: Biologically Important Areas for marine mammals in the GOM were identified based on both scientific information and expert elicitation and developed to inform regulatory and management decisions (Ferguson et al. 2015). They represent areas important to marine mammals for breeding, migration, and reproduction. Biologically Important Areas within the GOM have been identified for bottlenose dolphins (*Tursiops truncatus*) and Bryde's whale (*Balaenoptera edeni*). Bottlenose dolphin areas are in nearshore or estuarine areas along the Gulf coast from Texas to Florida (LaBrecque et al. 2015). The Biologically Important Area identified in the GOM for Bryde's whale includes slope waters off the coast of Florida primarily between 100 and 300 meters (m) deep (LaBrecque et al. 2015). None of these areas overlaps with the GOM Program Area and their exclusion would not constitute a meaningful alternative.

2.8 IDENTIFICATION OF THE PREFERRED ALTERNATIVE

The Secretary of the Interior has identified Alternative C (Reduced Proposed Action) as the Preferred Alternative. Specifically, she has stated a preference for exclusion of the Beaufort Sea Program Area (C[1]) and the Chukchi Sea Program Area (C[2]) from the 2017–2022 Program while maintaining the complement of lease sales for the Cook Inlet and GOM Program Areas. The Preferred Alternative proposes eleven (11) lease sales in the 2017–2022 Program, consisting of ten (10) lease sales in the GOM and one (1) lease sale in the Cook Inlet. The Preferred Alternative reflects the Secretary's consideration and balancing of OCSLA Section 18 factors (including the analysis contained in this Programmatic EIS) as presented in the PFP (BOEM 2016c). **Table 2.8-1** presents the lease sale schedule for the 2017-2022 Program**.**

Table 2.8-1. Schedule of 2017–2022 Lease Sales, Preferred Alternative

Count	Sale Number	Program Area	Year
1	249	Gulf of Mexico	2017
2	250	Gulf of Mexico	2018
3	251	Gulf of Mexico	2018
4	252	Gulf of Mexico	2019
5	253	Gulf of Mexico	2019
6	254	Gulf of Mexico	2020
7	256	Gulf of Mexico	2020
8	257	Gulf of Mexico	2021
9	258	Cook Inlet	2021
10	259	Gulf of Mexico	2021
11	261	Gulf of Mexico	2022

Section 4.4.3 describes the potential impacts associated with Alternative C. **Section 2.9** provides a comparison of the potential impacts across alternatives, including the Preferred Alternative.

2.9 SUMMARY OF IMPACTS ANTICIPATED FROM THE PROPOSED ACTION AND ALTERNATIVES

Figure 2.9-1 is a conceptual illustration of the differences in direct and indirect impacts among Alternatives A, B, C, and D. **Figure 2.9-1** also shows the principal sources influencing the direct and indirect impacts under each alternative. Alternative D, the No Action Alternative, characterizes the direct and indirect effects of not having a Program. This includes potential impacts from energy substitutes and any impacts resulting from not having leasing under the 2017–2022 Program.

Considering the spectrum of direct and indirect impacts from Alternative D to Alternative A (**Figure 2.9-1**), the direct and indirect impacts of each alternative are related to increasing levels of activity in the relevant program areas, and therefore, increasing potential impacts. For example, Alternative D assumes no leasing in any program area, so the direct and indirect impacts would be limited to those from energy substitutes and some potential for socioeconomic impacts (e.g., job losses, out-migration). Alternative C would allow for the removal of one or more program areas from activities, but would always have leasing in at least one program area. Alternative C represents an increase in activity in comparison to the level of activity under Alternative D. Similar to Alternative D, the analysis for Alternative C also considers effects on resources due to energy substitutes to meet energy demand if production from OCS oil and gas leasing is decreased. However, the effects of substitutes under Alternative C are expected to be less than under Alternative D because Alternative C always considers leasing in at least one program area. Alternative B, which would allow for leasing in all program areas but would either include certain mitigation measures or exclude specific areas (EIAs), would result in a probable increase in activity from Alternative C. Alternative A, the Proposed Action, represents the highest level of activity that could occur under the 2017–2022 Program.

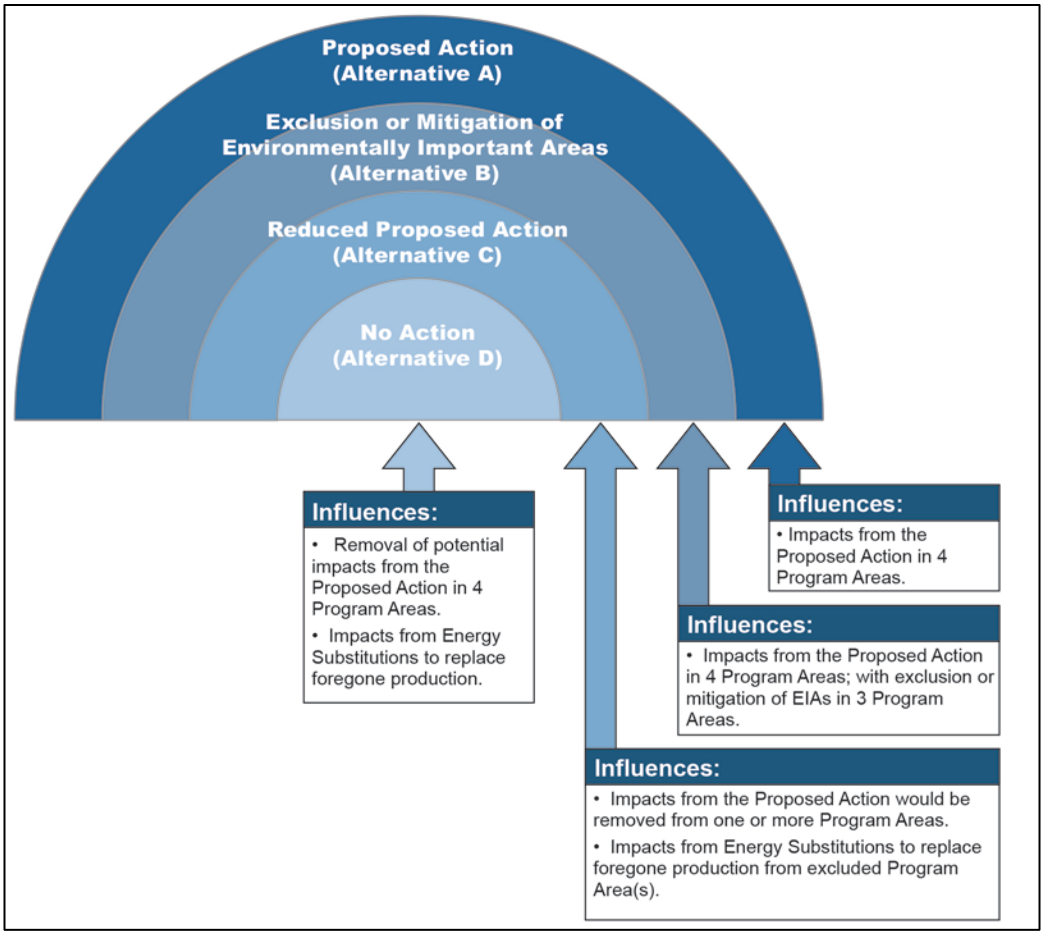

Figure 2.9-1. Relationship among Potential Direct and Indirect Impacts from each Alternative

The impacts expected under Alternative C, the Reduced Proposed Action, are similar to those expected under Alternative D for the excluded program area(s) for activities arising from the 2017-2022 Program. The impacts that could occur in an excluded area include cross-boundary impacts or, for the GOM Program Area, impacts from energy substitutes that could be required and that occur within the excluded area (**Section 4.4.3**). For the program area(s) not excluded, impacts would be the same as under Alternative A. Under the Preferred Alternative, impacts from the Proposed Action in the Beaufort Sea and Chukchi Sea Program Areas would not occur. Any adverse environmental impacts would not manifest and the potential for positive socioeconomic impacts under the Proposed Action would not be realized. In addition, exclusion of both of these program areas eliminates the risk of cross-boundary impacts related to noise, oil spills, or vessel traffic from OCS activities.

Table 2.9-1 presents a relative comparison of the direct and indirect impacts across alternatives for routine operations. It is important to note that impacts from oil spills could be major across all alternatives for all resources, and thus are not presented in the table. The impact level for routine operations is provided for Alternative A. The direct and indirect impacts of Alternatives B, C, and D are presented as trends relative to Alternative A to demonstrate how impacts could manifest as a result of different decisions. It is critical to note that in **Table 2.9-1**, the impact trends shown for Alternative C would occur for the *excluded area only*. The impacts for any area not excluded are expected to be the same as those under the Proposed Action for that area (**Table 4.4.3-1**). The impact trends shown for Alternative D in **Table 2.9-1** would occur in concert for all areas because there would be no new leasing in any program area. A full discussion of the potential direct and indirect impacts associated with the

Proposed Action and alternatives is presented in **Section 4.4**. Cumulative impacts for the Proposed Action are considered in **Section 4.5**. The cumulative impacts analysis considers the incremental contribution of the Proposed Action to all past, present, and reasonably foreseeable future actions including future OCS programs. Cumulative impacts under any of the other alternatives, including the Preferred Alternative, are expected to be less than those contemplated for the Proposed Action (Alternative A) because all other alternatives consider some reduced level of activity.

The impacts associated with the Preferred Alternative are provided in **Table 2.9-2** for each program area – there would be no impacts in the excluded Beaufort Sea and Chukchi Sea Program Areas while the impacts for the Cook Inlet and GOM Program Areas are the same as under the Proposed Action. Cumulative impacts would not occur in any area excluded from the 2017–2022 Program because if there is no activity from the Proposed Action within a given program area, there cannot be an incremental contribution to past, present, or reasonably foreseeable future actions.

There are a number of assumptions built into **Table 2.9-1**. These include the following:

- The table represents the highest impact level on a resource that could occur under the alternative. For example, if one species of marine mammal would experience moderate impacts but the others would only experience minor impacts, the impact level provided for that resource is the higher of the two (i.e., presented as moderate). Please refer to Section 4.4 and Appendix E for more detailed discussion of potential impacts.
- This analysis is based on routine operations and does not take into consideration large or catastrophic oil spills. In the event of a large or catastrophic oil spill, impacts could be **major** across all resources, depending on the size, location, and timing of the spill. See **Sections 3.3** and **4.4.5**.
- The underlying analysis assumes that protective mitigation measures used currently would continue to be applied. See **Appendix I**.
- Increases in employment and income are considered positive impacts. Increases in population generally are positive; however, there could be some negative impacts associated with large-percentage population increases (see resource sections in **Chapter 4** for more detail).

Table 2.9-1. Change in Direct and Indirect Impacts across Alternatives relative to the Proposed Action (Alternative A)

Resource	Alternative A Proposed Action				Alternative B[1] Environmentally Important Areas				Area Excluded under Alternative C[2] Reduced Proposed Action with Energy Substitutes				Alternative D No Action with Energy Substitutes			
	Beaufort	Chukchi	Cook Inlet	Gulf of Mexico	Beaufort	Chukchi	Cook Inlet	Gulf of Mexico	Beaufort	Chukchi	Cook Inlet	Gulf of Mexico	Beaufort	Chukchi	Cook Inlet	Gulf of Mexico
Air Quality	Minor	Minor	Minor	Moderate	=	=	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Water Quality	Moderate	Moderate	Moderate	Moderate	=	=	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Coastal & Estuarine Habitats	Minor	Moderate	Minor	Moderate	=	=	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Marine Benthic Communities[3]	Moderate	Moderate	Moderate	Moderate	↓	↓	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Pelagic Communities	Minor	Minor	Minor	Minor	=	=	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Marine Mammals[4]	Moderate	Moderate	Moderate	Moderate	↓	↓	↓	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Sea Turtles	not applicable	not applicable	not applicable	Moderate	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	↓	not applicable	not applicable	not applicable	↓
Birds	Minor	Minor	Minor	Minor	↓	↓	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Fish & EFH	Minor	Minor	Minor	Minor	=	=	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Arctic Terrestrial Wildlife & Habitats	Moderate	Moderate	not applicable	not applicable	=	=	not applicable	not applicable	↓	↓	not applicable	not applicable	↓	↓	not applicable	not applicable
Archaeological & Historical Resources[5]	Major	Major	Major	Major	=	=	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Population, Employment, & Income	Moderate	Moderate	Minor	Minor	=	=	=	not applicable	↓	↓	↓	↑	↓	↓	↓	↑
Land Use & Infrastructure	Moderate	Moderate	Moderate	Moderate	=	=	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↑
Commercial & Recreational Fisheries	not applicable	not applicable	Minor	Minor	not applicable	not applicable	=	not applicable	not applicable	not applicable	↓	↓	not applicable	not applicable	↓	↓
Tourism & Recreation	Moderate	Moderate	Moderate	Moderate	↓	↓	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↓
Sociocultural Systems	Major	Major	Minor	Minor	↓	↓	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↑
Environmental Justice	Major	Major	Minor	Minor	↓	↓	=	not applicable	↓	↓	↓	↓	↓	↓	↓	↑

Key: ● = Minor | ● = Moderate | ● = Major | "=" = No Change | ↑ = More impact OR ↓ = Less impact than the Proposed Action | ■ = not applicable

[1]Reduction in impacts under Alternative B is related to the exclusion of these areas and the potential for a localized decrease in impacts within or because of an EIA. It does not necessarily mean a reduction in overall impacts in the program area. See **Section 4.4** for a detailed discussion of potential impacts.

[2] The impact trends shown for Alternative C would occur for the excluded area only.

[3]If sensitive benthic habitats are avoided, impacts under the Proposed Action could be reduced.

[4]The Cook Inlet EIA could result in lesser impacts than those expected under the Proposed Action for beluga whales in Cook Inlet.

[5]If surveys are conducted and resources detected prior to bottom-disturbing activities, adverse impacts are not expected to occur.

Table 2.9-2 shows the impacts associated with the Preferred Alternative. Exclusion of the Beaufort Sea and Chukchi Sea Program Areas would result in impacts described under Alternative C (**Section 4.4.3**) and Alternative D for those areas (**Section 4.4.4**). Impacts from lease sales conducted in the Cook Inlet and GOM Program Areas are described under the Proposed Action (**Section 4.4.1**). There are no impacts expected for the excluded Arctic program areas because removal of both areas eliminates the potential for cross-boundary impacts, and migratory species impacts are not expected. Impacts from energy substitutes are not expected in the Arctic program areas. See **Section 4.3** for more detailed analysis.

Table 2.9-2. Impacts Expected under the Preferred Alternative

Resource	Preferred Alternative Impacts			
	Beaufort Sea	Chukchi Sea	Cook Inlet	Gulf of Mexico
Air Quality	None	None	🟡	🟠
Water Quality	None	None	🟠	🟠
Coastal & Estuarine Habitats	None	None	🟡	🟠
Marine Benthic Communities	None	None	🟠	🟠
Pelagic Communities	None	None	🟡	🟡
Marine Mammals	None	None	🟠	🟠
Sea Turtles	■	■	■	🟠
Birds	None	None	🟡	🟡
Fish & EFH	None	None	🟡	🟡
Arctic Terrestrial Wildlife & Habitats	None	None	■	■
Archaeological & Historical Resources*	None	None	🔴	🔴
Population, Employment, & Income	None	None	🟡	🟡
Land Use & Infrastructure	None	None	🟠	🟠
Commercial & Recreational Fisheries	■	■	🟡	🟡
Tourism & Recreation	None	None	🟠	🟠
Sociocultural Systems	None	None	🟡	🟡
Environmental Justice	None	None	🟡	🟡

Key: 🟡 = Minor | 🟠 =Moderate | 🔴 = Major | ■ = not applicable
Note:
* If surveys are conducted and resources detected prior to bottom-disturbing activities, adverse impacts are not expected to occur.

2.10 COST NET-BENEFIT ANALYSIS OF ALTERNATIVES

The 2017–2022 PFP estimates benefits and costs to society from the expected activities from any lease sales held under the Program. The net benefits analysis provides the Secretary of the Interior with an estimate of the impacts of specific Program Options (analyzed in the PFP), so that a fully informed and reasoned decision can be made about the size, timing, and location of lease sales. BOEM's net benefits analysis provides a cost-benefit analysis for each of the Program Options, including the option to not have a sale in a particular program area. Pursuant to CEQ regulations § 1502.23, the net benefits analysis contained in the PFP and accompanying Economic Analysis Methodology document is incorporated by reference into the Programmatic EIS.

The net benefits analysis is composed of three components, each of which considers the impacts of OCS production and the energy substitutes. The first is a calculation of the incremental net economic value, which is the gross revenue of the Program less the private costs of extracting the resources and an estimate of the economic value of substitutes under the No Action Alternative. The second component is a calculation of incremental environmental and social costs. To calculate these costs, BOEM uses the Offshore Environmental Cost Model (OECM), a model designed to focus on capturing the most significant reasonably foreseeable environmental and social costs from the activities associated with the Proposed Action and No Action Alternative. Cost factors that were not expected to contribute significantly to the results or lacked sufficient transferable data are not included. BOEM continuously re-valuates the categories considered in the OECM and incorporates additional data and significant factors as information becomes available. The net benefits analysis currently quantifies and monetizes the impacts associated with OCS production activity and oil spills across six cost categories: (1) recreation; (2) air quality; (3) property values; (4) subsistence harvests; (5) commercial fishing; and (6) ecological impacts. The Programmatic EIS qualitatively addresses the same types of impacts on the same resources. The third component of the net benefits analysis is the calculation of domestic economic surplus, which is the welfare change to producers and consumers from a change in energy prices.

While the net benefits analysis captures most of the stream of economic value, it does not quantify all potential costs and benefits of the Proposed Action or alternatives. CEQ regulations (40 CFR § 1502.23) require that the EIS discuss the "relationship between the [cost-benefit] analysis and any analyses of unquantified environmental impacts, values, and amenities." Unquantified costs and benefits not presently captured in the cost-benefit model are described qualitatively in Industrial Economics, Inc. et al. (2015) and Industrial Economics, Inc. and SC&A, Inc. (2015). The unquantified costs and benefits are discussed in **Chapter 4**. The following summarizes the unquantified costs in the Program's net benefits analysis compared to those described qualitatively in this Programmatic EIS:

1. The net benefits analysis does not incorporate the monetized impacts from catastrophic spills. As that analysis only considers reasonably foreseeable impacts, those from a highly unlikely catastrophic oil spill are not included. Instead, the separate Economic Analysis Methodology paper provides a detailed discussion of the costs and risks of a catastrophic oil spill and includes monetized estimates of a range of catastrophic oil spill sizes (BOEM 2016b). Additional information is also included in **Chapter 4**.

2. The net benefits analysis does not incorporate the social cost of carbon. BOEM has presented the social cost of carbon in a separate technical report on GHG emissions (Wolvovsky and Anderson 2016), and then summarized and referenced that broader analysis as appropriate in BOEM's Economic Methodology report (BOEM 2016b) and PFP (BOEM 2016c).

3. While the net benefits analysis does quantify the costs of animal mortality and lost habitat from an oil spill through a habitat equivalency analysis (where costs are estimated in terms of the anticipated expense to restore or recreate damaged habitat), it does not quantify the values above the restoration cost at which society could value the damaged resource (e.g., it does not monetize the impacts to unique resources). These costs are not monetized in the net benefits analysis, but additional information is provided in Industrial Economics, Inc. et al. (2015) and Industrial Economics, Inc. and SC&A, Inc. (2015). Furthermore, the model does not include ecological costs associated with the use of dispersants or the air quality costs associated with oil spill response vessel and aircraft activity in the event of an oil spill. However, the equivalent environmental effects are addressed in **Chapter 4**.

4. As discussed, the net benefits analysis includes monetized impacts on ecological resources through oil spills, but does not monetize the impacts on these resources from general operations. For example, it does not capture costs to habitats or organisms from waste cuttings and drilling muds deposited on the seafloor near OCS structures during their construction, operation, or removal; auditory impacts and vessel strikes to marine mammals; or water quality impacts associated with produced water discharged from wells or non-oil discharges from platforms and vessels. The equivalent environmental effects from operations are qualitatively addressed by resource category in **Chapter 4**.

5. With one exception, the net benefits analysis does not quantitatively address environmental impacts related to the construction and operation of onshore infrastructure to support OCS activities. The equivalent environmental effects on air and water quality are qualitatively addressed in **Chapter 4**. The net benefits analysis includes air quality impacts from onshore pipeline construction associated with development in the Chukchi Sea Program Area, but does not capture changes in air quality, impacts from reductions in coastal marshland, the value of the ecosystem services lost (e.g., flood protection), or impacts on water quality associated with onshore infrastructure construction.

6. The methodology paper discusses ecosystem services and certain passive-use values such as bequest value, option value, existence value, and altruistic value. Although these values can exist for stakeholders under both alternatives, they are only considered qualitatively. Refer to BOEM (2016c) for a complete discussion of non-use values.

Just as there are non-monetized environmental impacts from the Program analysis, there are also non-monetized impacts associated with Alternative D. These costs not captured relate to increased onshore energy production, including the environmental costs associated with new infrastructure construction. The analysis of the No Action Alternative does not account for the ecological costs associated with increased terrestrial oil spills or pollution from produced water discharges associated with increased onshore oil and gas production; increased emissions and increased oil spill risk associated with transporting onshore oil; air emissions associated with the production of biomass energy sources; or ecosystem and health damages related to releases from coal mines. More information on these costs is included in Industrial Economics, Inc. et al. (2015) and Industrial Economics, Inc. and SC&A, Inc. (2015).

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3. ACTIVITY SCENARIOS AND IMPACT-PRODUCING FACTORS

3.1 ACTIVITIES EXPECTED TO OCCUR UNDER THE PROPOSED ACTION

The lifecycle of OCS oil and gas activities includes the following phases: (1) exploration to locate viable oil or natural gas deposits; (2) development well drilling, and platform construction and pipeline infrastructure placement, assuming favorable outcomes from development drilling; (3) oil or gas production and transport; and (4) decommissioning of facilities once a reservoir is no longer productive or profitable (**Figure 3.1-1**). Geophysical surveys could occur during any one of the phases. Under the Proposed Action, these activities would occur on OCS leases only after a lease sale is held in the Alaska or GOM program areas. Many of the lease blocks offered in a lease sale do not always receive a bid or are sold. If leases are sold and activities are initiated during the primary term (initial period) of the leases, ensuing activities could extend over a period of 40 to 70 years depending on the program area. A number of OCS leases could also be relinquished before activity ever occurs.

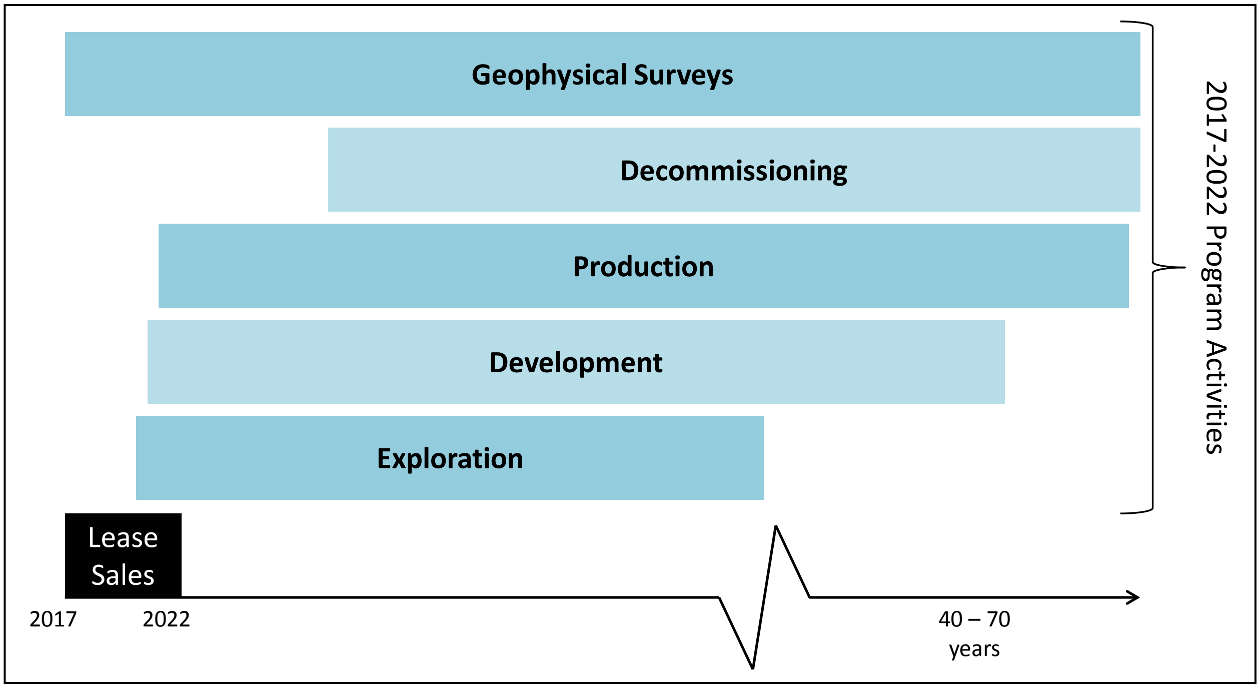
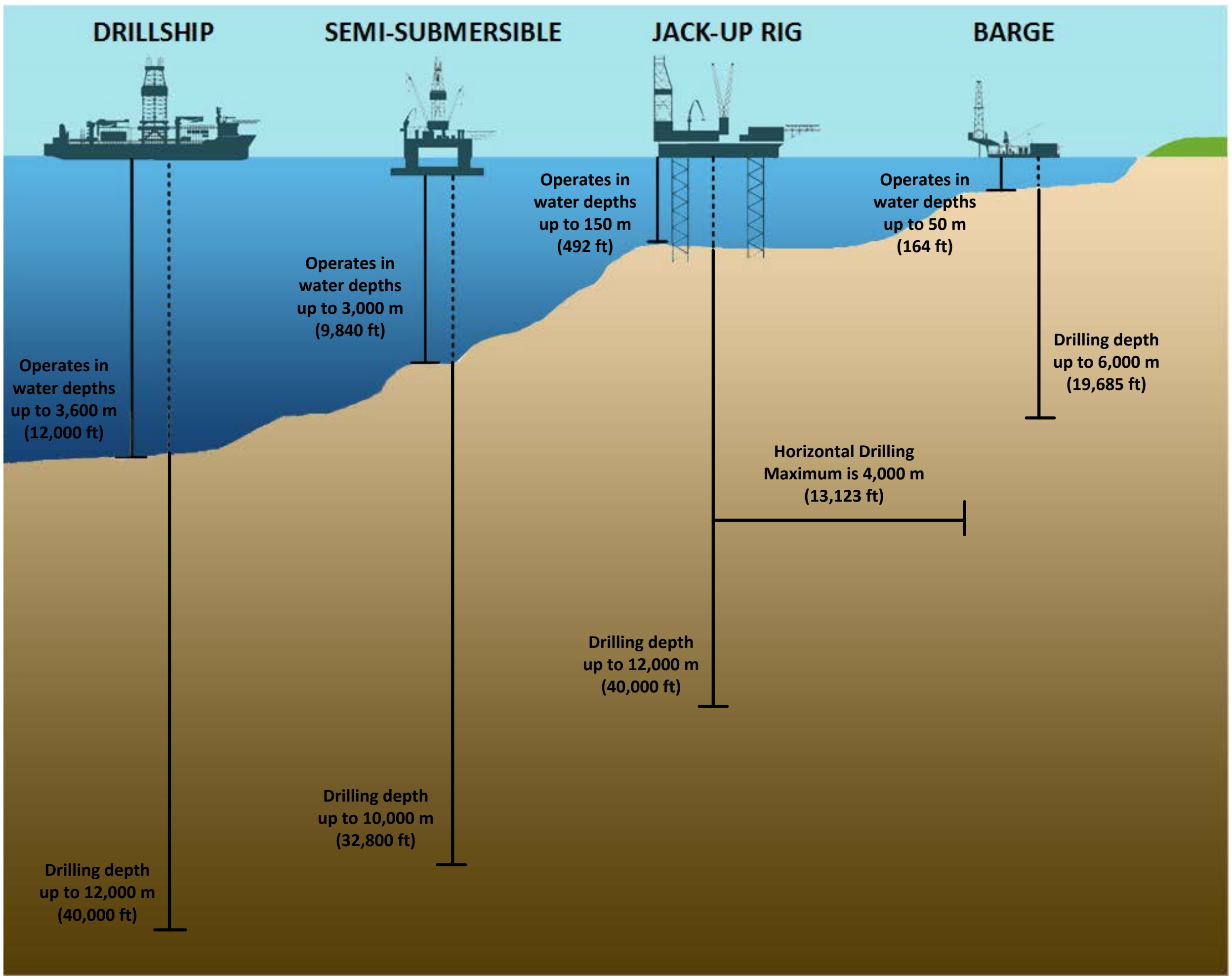


Figure 3.1-1. OCS Activities resulting from the 2017–2022 Program. Geophysical surveys occur during all four phases.

3.1.1 Exploration

Exploration could include geophysical surveys and drilling of exploration wells. During geophysical surveys, typically seismic surveys, one or more airguns (or other sound sources) are towed behind a ship to produce acoustic energy pulses that are directed towards the seafloor. The acoustic signals then reflect off acoustic interfaces, which reflect a change in density in the subsurface and are recorded by hydrophones, which typically are towed behind the survey ship. While most of the energy is focused downward and the short duration of each pulse limits the total energy into the water column, the sound can travel horizontally and vertically for several kilometers depending on water depth, seafloor type, and oceanographic conditions (Greene and Richardson 1988, Hall et al. 1994, BOEM 2014a).

One or more exploratory wells could be drilled to confirm the presence and determine the viability of hydrocarbon prospects identified using G&G data. Exploration drilling operations are likely to employ mobile offshore drilling units (MODUs). Examples of MODUs include drillships, semi-submersibles, and jack-up rigs (**Figure 3.1-2**). Special rigs could be employed for use in the Arctic to better manage different ice states. Drilling operations for a well vary in time length and operational scales at different wellsites but often are between 30 and 60 days, depending on the depth of the well, delays encountered during drilling, and time needed for well logging and testing operations.



Source: Modified from Maersk Drilling 2016

Figure 3.1-2. Representative Rigs used in OCS Exploration Drilling

After a discovery is made with an exploratory well, an operator often drills delineation wells to determine the areal extent of a reservoir. Operators can verify that sufficient volumes of hydrocarbons are present to justify the expense of proceeding to development.

Prior to drilling exploration wells, operators are required to examine the proposed exploration drilling locations for geologic hazards and biological populations, using various techniques such as geohazard seismic surveys and geotechnical studies. Surveys for archaeological features are also typically required. The suite of geophysical equipment used during a typical shallow hazards survey consists of single-beam and multibeam echosounders that provide information on water depths and seafloor morphology; side-scan sonar that provides acoustic images of the seafloor; and a subbottom profiler, boomer, and airgun system that provides for a range of sub-seafloor penetration to detect geologic hazards such as shallow gas. Magnetometers, which detect ferrous items, could also be deployed. Typical acoustic characteristics of these sources are described in Richardson et al. (1995), Hildebrand (2009), and CSLC (2013). Section 3.6 identifies the IPFs associated with exploration.

3.1.2 Development

After exploration has confirmed the presence of a commercially viable reservoir, the next phase of activities includes the construction of the production platform and drilling of development wells. Temporarily abandoned exploration wells also could be re-entered and completed for production. Development wells are drilled using MODUs. Platforms could be fixed, floating, or, in deep water, subsea (**Figure 3.1-3**). Fixed platforms rigidly attached to the seafloor are typical in water depths up to 400 m (1,312 ft), while floating or subsea platforms are typical in waters deeper than 400 m (1,312 ft). Floating platforms are attached to the seafloor using line-mooring systems and anchors. The type and scale of platform installed depends on the water depth of the site, oceanographic and ice conditions, the expected facility lifecycle, the type and quantity of hydrocarbon product expected (e.g., oil or gas), the number of wells to be drilled, and use of subsea tie-backs. In shallower Arctic waters, production platforms can be constructed on reinforced gravel islands or can be a larger bottom-founded structure, such as a concrete gravity base structure.

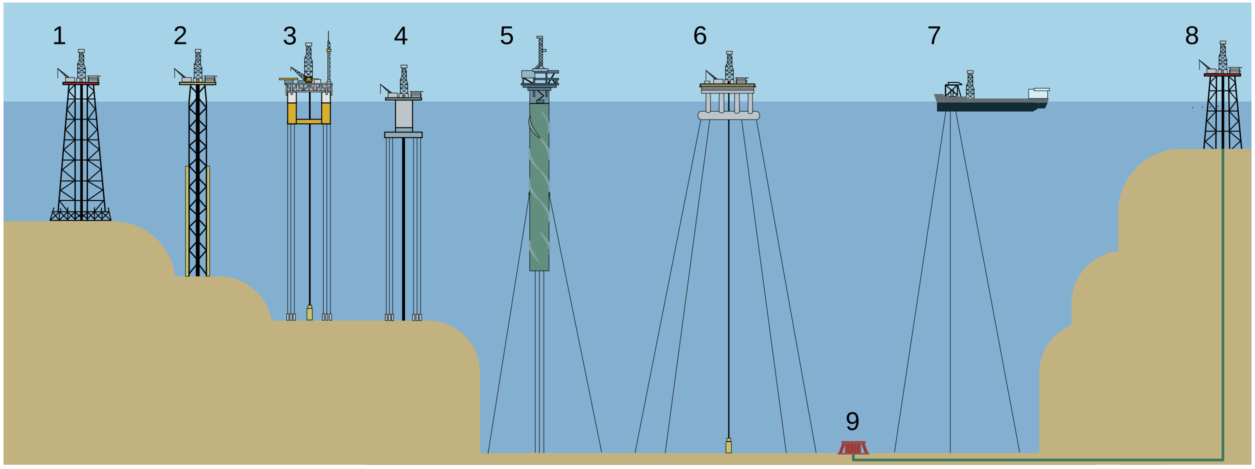
Development includes installation of seafloor pipelines for conveying product to existing pipeline infrastructure or to new onshore production facilities. In shallower waters (< 60 m [200 ft]), pipelines are typically buried to a depth of at least 1 m (3 ft) below the mudline. Pipelines could be buried (trenched) in deeper waters, depending on conditions along the subsea pipeline corridor. Additional requirements are necessary in ice-prone OCS areas to avoid damage from ice gouging and ice keels.

Prior to drilling development wells, constructing platforms, or installing pipelines, operators would be required to examine the proposed locations for site clearance, including geologic hazards, and biological populations, using various techniques such as geohazard seismic surveys and geotechnical studies. Surveys for archaeological features are also typically required. Section 3.6 identifies the IPFs associated with development.

3.1.3 Production

Once completion of development wells and platform construction has occurred, oil production and well maintenance are initiated. Additional development wells could be drilled and completed after a platform is constructed and other wells have begun producing.

Following completion of the production wells and platform, facilities begin operations to extract the hydrocarbon resource and transport it to processing facilities. Historically, the processing facilities have been onshore. In recent years, OCS processing facilities, including floating production, storage, and offloading (FPSO) and liquefied natural gas (LNG) processing facilities, have played a role in storage and processing as well. During this phase, activities focus on the maintenance of production wells (workover operations) and platforms. Pipelines are inspected and cleaned regularly by internal devices (pipeline inspection gauges or “pigs”).



Key: 1 = fixed platform; 2 = compliant tower; 3 = vertically moored tension leg; 4 = mini-tension leg platform; 5 = spar; 6 = semi-submersibles; 7 = floating production, storage, and offloading facility; 8 = subsea completion and tie back to platform.

Note: Special platforms or gravel islands (not shown) could be employed for use in the Arctic to manage different ice states.

Source: Modified from NOAA Ocean Explorer 2010

Figure 3.1-3. Representative OCS Oil and Gas Structures

To maintain reservoir pressure and aid in oil and gas recovery, gas (in the case of oil production) and water would be reinjected into the reservoirs by service wells until the oil is depleted. Operators would continue to re-inject produced water throughout production operations. A well stimulation technique that has been used in the GOM is the “frac pack” completion process. This technique, which is typically used for moderate- to high-permeability reservoirs, is used to reduce the movement of sand and other fine particulate matter within the reservoir, reduce the concentration of sand and silt in the produced fluids, improve the flow of reservoir fluids into the wellbore, increase production rates, and maximize production efficiency. Section 3.6 identifies the IPFs associated with development, including hydraulic fracturing.

3.1.4 Decommissioning

Following lease termination or relinquishment, all facilities and seafloor obstructions are removed below the mudline. Facilities and obstructions could include platforms, production and pipeline risers, umbilicals, anchors, mooring lines, wellheads, well protection devices, subsea trees, and manifolds. Typically, wells would be permanently plugged with cement below the sediment surface and the wellhead equipment removed. Processing modules would be moved off the platforms. The platform is frequently disassembled and removed from the area, and the seafloor would be restored to some practicable pre-development condition. Bottom-founded infrastructure generally is severed at least 5 m (16 ft) below the mudline. Production infrastructure could be removed using explosive or nonexplosive methods.

In the GOM, rigs-to-reefs programs provide alternatives for in-water placement of suitably sized and cleaned platform components. After a pipeline is purged of its contents, it could be decommissioned in place or physically recovered. Pipelines that are out of service for < 1 year must be isolated at each end. When out of service for > 1 year but < 5 years, a pipeline must be flushed and filled with inhibited seawater; the purpose of this is to mitigate internal pipeline corrosion and minimize any residual hydrocarbon leakage. Pipelines out of service for > 5 years could be decommissioned in place, but only if multiple-use conflicts do not limit such a practice, such as oil and gas pipelines within critical sand resource areas on the shallow GOM shelf. Geophysical surveys would be required to confirm that no debris remains and pipelines were decommissioned properly. **Section 3.6** identifies the IPFs associated with decommissioning.

3.1.4.1 Supporting Oil and Gas Infrastructure Facilities

Infrastructure is required to support the production of oil and gas, including ports and support facilities, construction facilities, transportation infrastructure, and processing facilities. This infrastructure is described in more detail below. Coastal oil- and gas-related infrastructure has developed over many decades in the GOM and is not subject to rapid fluctuations because of a new oil and gas leasing program. A mature area like the GOM would not require a significant investment in new infrastructure when compared to the potential build-out, tailoring, or transport of products and wastes necessary in frontier areas like the Arctic (Fugro Consultants, Inc. 2015). A detailed discussion describing supporting oil and gas infrastructure can be found in Dismukes (2011a, 2014).

Ports and Support Facilities

Port Facilities: Ports are major maritime staging areas for movement between onshore industries and infrastructure and OCS leases. Ports play a vital role in supporting the maritime industry, specifically the OCS exploration and production sector. Vehicles that support OCS platforms (notably ships, barges, and helicopters) are based and maintained at ports. Ports act as launching points for delivery and transfer of the necessary structures, equipment, supplies, crew, and other important products to OCS installations. OCS exploration, development, and production operations depend heavily on a readily available supply of these goods and services, making ports an invaluable centralized location for meeting logistical needs. In general, there are two major types of port facilities: (1) deep-draft seaports, and (2) inland river and intracoastal waterway port facilities. Deep-draft seaports are ports that accommodate mostly ocean-going vessels and, for exploration and production activities, are the ones most likely to serve and supply infrastructure.

Support Facilities: Support facilities are multi-varied service providers that support OCS activities, including supply bases, repair and maintenance yards, and crew support services. Transportation facilities such as heliports also support the industry; transportation is discussed later in this section. Support facilities can take many forms, but one common feature is close proximity to or integration with a port. Oil spill response equipment must be strategically and regionally staged at response centers or service bases along the coast, including spill response vessels and aircraft. In the Arctic, oil spill response equipment is regionally staged; however, due to the remoteness of the area, exploration and development drilling programs also necessitate the added precaution and mobilization of specific oil spill containment, response, and cleanup vessels and equipment in case of an incident.

Repair and Maintenance Yards: These support facilities usually are located at platform fabrication facilities or shipyards and are focused on maintaining vessels and equipment for drilling and production activities. These must be situated with access to sufficient channel size to accommodate a given vessel type. Yards with the capacity to handle larger vessels tend to be less common and are often geographically distant from a given exploration and production activity.

Crew Services: These companies provide services to crews living on OCS rigs, including catering, laundry services, and on-site paramedics.

Heliports: Heliports are located throughout the U.S., but those that service the OCS oil and gas industry are more prevalent in the GOM region. OCS helicopter support is most often used for personnel transfer, medical evacuation, and delivery of small parts and supplies. Helicopters used in this way generally have a travel range of 483 to 805 km (300 to 500 mi), depending on their size and configuration. Due to the high hourly cost of helicopter operations, OCS service companies locate their heliports as close to the center of drilling and production as is practical (Fugro Consultants, Inc. 2015).

Construction Facilities

Platform Fabrication Yards: These are facilities where platforms are constructed and assembled for transportation to OCS areas. Such facilities can be used for maintenance and storage. Traditionally, platform fabrication yards are onshore near intracoastal waterways. However, there is some potential to locate certain assembly operations directly offshore to minimize costs and maximize flexibility.

Shipyards and Shipbuilding Yards: Such yards have facilities where ships, drilling platforms, and crew boats are constructed and maintained. These facilities range in size from those that construct or repair small vessels for coastal or inland use to those that focus on construction or maintenance of large ocean-going naval and commercial ships. The repair facilities vary in size, from those with topside capability (i.e., tending to vessels while still afloat) to those that have dry-docking capability for small ships, boats, and barges, and those that have dry-docking capability for large ocean-going vessels, which, like repair yards, are often less abundant than the smaller yards.

Pipe Coating Facilities and Yards: Pipelines that transport oil and natural gas from OCS production locations have exterior coatings to protect against corrosion and other types of physical damage. Pipes can also be treated with interior coatings to protect against corrosion from the fluids moving within them or to improve flow rates. OCS oil and natural gas pipes are often coated with a layer of concrete to increase line weight to ensure stability on and in the seafloor.

Transportation Infrastructure

OCS Support Vessels: OCS support vessels serve exploratory and development drilling rigs and production facilities through OCS and subsea construction support, installation, and decommissioning activities. OCS support vessels are unique in that they are designed for cargo-carrying flexibility and transport of deck cargo (e.g., pipe, equipment, or drummed material), mud, potable water, diesel fuel, dry bulk cement, and personnel. There are seven major types of OCS support vessels: tugs, marine platform supply vessels, anchor handling tug and supply vessels, fast support vessels, lift boats, mini-supply vessels, and FPSOs.

Shuttle Tankers: Before establishing an OCS pipeline network to support development, double-hulled oil tankers could be necessary to transport crude oil to shore. Shuttle tankers are used when economics or site conditions prevent installation of an export pipeline. Shuttle tankers are specialized ships built to transport crude oil and condensate from OCS oil field installations to onshore terminals and refineries and are often referred to as “floating pipelines” (Fugro Consultants, Inc. 2015).

Navigation Channels: Deep and wide navigation channels for accessing ports, yards, and refineries are particularly important for the OCS support industry’s ports, especially as a new generation of larger boats is constructed to service deepwater installations. Dredging, improving, and maintaining navigation channels are critical to sustaining the rapidly growing marine transport industry.

Pipelines: Pipelines transport oil and gas from OCS facilities to onshore processing sites and ultimately to end users. The movement of natural gas and other hydrocarbons from producing regions to consumption regions requires an extensive and elaborate transportation system. In many instances, natural gas produced from a particular well is transported long distances before reaching the location where it is further processed or used.

Processing Facilities

Natural Gas Processing Facilities: These sites process natural gas and separate it into its component parts for the market. All natural gas is processed in some manner to remove unwanted water vapor, solids, and other contaminants that would interfere with its pipeline transportation or sale. The total number of gas processing plants operating in the U.S. has been declining over the past several years as companies merge, exchange assets, and close older, less efficient plants (USEIA 2012).

Natural Gas Storage Facilities: Natural gas storage facilities store processed natural gas for use during peak periods. Generally, underground natural gas storage is filled during low-use (off-peak) periods (April to October) and withdrawn during high-use (peak) periods (winter).

LNG Facilities: Large marine-based LNG terminals have been proposed onshore and on the OCS across different areas of the coastal U.S. Additional information about LNG terminals can be obtained from the Federal Energy Regulatory Commission and U.S. Maritime Administration.

Refineries: Refineries are industrial facilities that process crude oil into numerous intermediate- and end- use products. A refinery is an organized arrangement of manufacturing units designed to produce physical and chemical changes that turn the different varieties of crude oil into final petroleum products. Refineries remove most of the non-hydrocarbon substances from crude oil and break down the remaining hydrocarbons into various components that are blended into useful refined products. Refineries vary in size, sophistication, and cost, depending on their location, crude input types, and the products they manufacture.

Waste Management Facilities: These sites process drilling and production wastes associated with oil and gas activities (Dismukes 2011a, 2014). Several different types of wastes are generated by oil and gas exploration and production activities. Some wastes are common to most commercial-scale operations (e.g., disposal of garbage, sanitary waste [toilets], and domestic waste [sinks, showers]), while other wastes are unique to the oil and gas exploration and production industry (e.g., disposal of different types of drill fluids, cuttings, and produced water). While some wastes can be discharged on site, many others must be transported to shore-based facilities for reclamation, storage, and disposal, or transfer to longer-term storage sites. The most common methods of disposal of oil and gas exploration and production waste include subsurface injection into salt caverns or other subsurface reservoirs, sea discharge, and onshore disposal.

3.2 EXPLORATION AND DEVELOPMENT SCENARIOS

E&D scenarios are estimates of the types, location, and timing of oil- and gas-related activities and production that could result from a Five-Year Program following lease sales. E&D scenarios are inherently uncertain but useful to understand the context and intensity of potential environmental effects that could occur given a range of possible program outcomes.

E&D scenarios describe the way the potential resources available for leasing could be explored and discovered, developed, and produced if found. The anticipated production estimates reflected in E&D scenarios typically represent only a portion of undiscovered economically recoverable oil and gas resources (UERR) available on unleased blocks in each of the program areas (BOEM 2016c). UERR refers to that portion of the undiscovered technically recoverable resources that could be explored, developed, and commercially produced at given cost and price considerations using present or reasonably foreseeable technology. For the GOM, the E&D scenarios describe the potential outcome of ten proposed lease sales, whereas the E&D describes a single sale in the Alaska program areas. Factors such as oil and gas resource potential, price volatility, industry interest and economic viability, historical activity, existing infrastructure, and regulatory processes are considered during preparation of E&D scenarios and affect the range and likelihood of outcomes.

The Programmatic EIS considers the potential range of effects of OCS activities that could be possible over the protracted life of a program. E&D scenarios were prepared for three different possible real, or inflation-adjusted, price scenarios for the Program: low, mid-, and high (**Table 3.2-1**). The three price scenarios represent a reasonable range of prices that can be expected over the development and life of the program (BOEM 2016b, BOEM 2016c).

Table 3.2-1. Oil and Natural Gas Price Scenarios

Price Scenario	Price per bbl	Price per mcf of Natural Gas
Low	$40	$2.14
Mid-	$100	$5.34
High	$160	$8.54

The flat-price scenarios are not intended to imply or represent price expectations, or be an exact forecast of oil or gas prices at the time of the Program decision. Oil and gas prices can fluctuate considerably during both development and implementation of a program; price expectations and price volatility are important factors in estimating the anticipated activity levels and production that could occur with a program. Future prices and long-term profitability are important considerations when making decisions on whether or not to lease, explore, and develop OCS blocks since ensuing activities can last decades. The three price scenarios are determined following careful consideration of short- and long-term price forecasts by the USEIA as well as historical price trends (USEIA 2016b, USEIA 2016c). The reference case and low oil price and high oil price side cases described in the 2016 *Annual Energy Outlook* corroborate these three price scenarios as reasonable and representative of the wide array of possible future prices. USEIA anticipates that current oil and natural gas prices will rebound from present low levels over the next decade, making it critically important to consider a wider range of prices and commensurate levels of activity. For example, the 2016 *Annual Energy Outlook* reference case estimates that oil prices will rebound to near mid-price scenario levels by 2028, within the envelope of primary terms on leases that could be issued if lease sales are held. Nonetheless, historical price data show that unanticipated market and political events, new technologies, weather, geopolitical unrest, economic changes, or other factors can cause energy prices to deviate considerably from even the most respected forecasts. Thus, these price cases do not represent absolute lower and upper bounds.

BOEM prepares the E&D scenarios to provide a framework for describing and analyzing a range of potential effects that could be possible. It is imperative to realize that the E&D scenarios, or underlying price assumptions, do not constitute predictions or forecasts. Moreover, BOEM does not assign a given likelihood to a particular outcome. Considerable uncertainty surrounds future activity levels and production given geologic risk, economic risk, and regulatory processes, especially in frontier areas like the Alaska program areas where there is currently limited OCS activity.

3.2.1 Alaska Program Areas

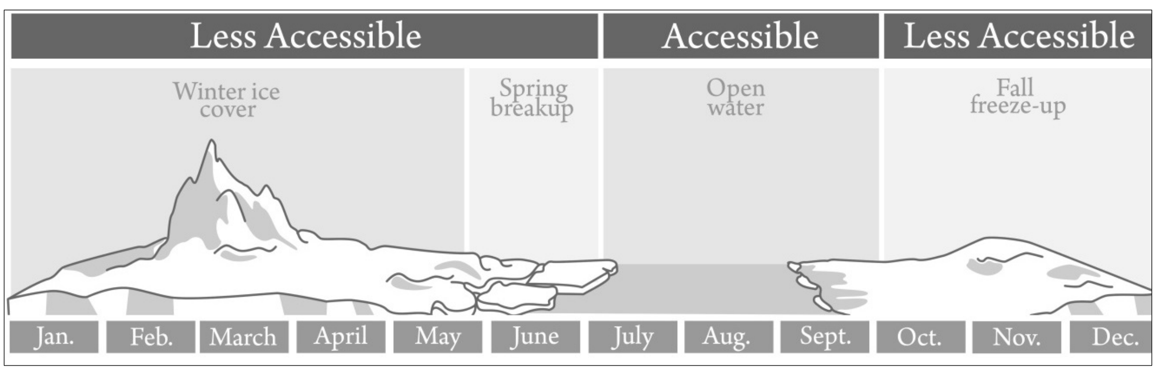
Single lease sales are considered in each of the following program areas:

- Beaufort Sea Program Area
- Chukchi Sea Program Area
- Cook Inlet Program Area.

The E&D scenarios for the Alaska program areas represent a wide range, from a more probable exploration-only scenario in the Arctic to a more optimistic, but less probable build-out scenario. The full range is considered in the Programmatic EIS so as not to understate potential environmental impacts; however, BOEM does not necessarily expect a particular E&D scenario to occur. In a frontier area, it is possible that because of geologic risk, economic risk, regulatory processes, and litigation, no activities would occur. In the Beaufort Sea and Chukchi Sea Program Areas, only 43 wells have been drilled in the past 30 years, and the only existing OCS Federal production is from the Northstar Field in the Beaufort Sea.

Oil and gas exploration, development, and production activities proceed quite differently in mature areas versus frontier areas. Mature areas are characterized by a history of development and production, existing infrastructure, lower costs of doing business, and established access to markets. In contrast, frontier areas are characterized by their remoteness, comparatively high costs of doing business, and lack or scarcity of existing infrastructure. It is extremely costly to develop the infrastructure required to extract resources and transport them to market. Successful development and production of resources from frontier areas is therefore contingent upon successful exploration of an “anchor field” — a large discovery that justifies the substantial capital investments required for an initial commercial development. Absent the discovery of an economically viable anchor field, zero development and production is likely to occur.

Ice state and open water accessibility largely dictate the window of time for exploration and development drilling, platform and structure construction, and pipeline installation in the Arctic (**Figure 3.2-1**). The open water season, although variable, generally runs from June/July through October when the ice pack recedes. Operational restrictions related to the Chukchi Sea ice leads, well containment capability, and spill response measures generally constrain vessel-based access to July through October. Once a production facility is operational, operations would occur year-round, but access would be limited to transport over ice or by helicopter. The nearshore region of the Beaufort Sea could become more accessible in January through April, and, if conditions permit, driving on landfast ice could become possible. Operations at remote locations require transportation of supplies and personnel by different means, depending on seasonal constraints and phase of the operations. During winter months, ice conditions could prevent the use of vessels (including supply or service vessels) for production activities. Under these conditions, helicopters would be used for basic re-supply and crew rotation operations. While Cook Inlet experiences broken ice in winter, winter weather conditions could limit operations due to logistical issues or because of the additional expense required to conduct winter operations.



Source: Modified from Pew Charitable Trusts 2013

Figure 3.2-1. Simplified Illustration of Timing and Variability of Arctic Ice and Sea State

A critical factor in the Arctic is how to transport oil and gas produced to markets. Oil produced at the platforms generally is delivered via trenched subsea pipelines to existing or new onshore facilities. The Chukchi Sea Planning Area and area immediately onshore has a very limited existing oil and gas infrastructure or transportation system for oil and gas. Not only would all the OCS platforms, wells, and pipelines have to be constructed, but Arctic onshore support facilities such as airfields, docks, storage, and processing facilities must be constructed if development and production are to occur. Unlike the Chukchi Sea, the Beaufort Sea has an existing network of onshore oil and gas infrastructure and a transportation system for oil based out of Prudhoe Bay, Alaska. This allows for potential sharing of existing support facilities. In both areas, elevated onshore pipelines would convey the oil and gas from the landfall facilities to production facilities at Prudhoe Bay for ultimate entry to the TAPS.

Natural gas produced from Alaska's North Slope is currently separated from the oil and reinjected into the producing reservoirs, minus the gas used to operate facilities. Gas would be transported by new subsea and overland pipelines that would be constructed through as much of the same corridor as the existing oil pipeline. A natural gas pipeline from Prudhoe Bay to south-central Alaska would need to be constructed, similar to the one currently under review by the State of Alaska. BOEM assumes that a pipeline would be built and capacity would be available to transport natural gas from the Chukchi and Beaufort Seas after an initial period of gas reinjection. Gas from the Beaufort Sea would be transported to the main hub at Prudhoe Bay by connecting to the existing network of overland pipelines. A new 300-mile overland gas pipeline from the shore of the Chukchi Sea to the Prudhoe Bay facilities would be required to transport natural gas from the Chukchi Sea.

Beaufort Sea Program Area

The Proposed Action in the Beaufort Sea Program Area focuses on exploration and development of two prospects, each associated with a separate geologic play. **Table 3.2-2** provides an overview of exploration, development, and production activities that could occur. Note that under the low-price scenario, only exploration would be anticipated to occur because development would not be economic at lower prices.

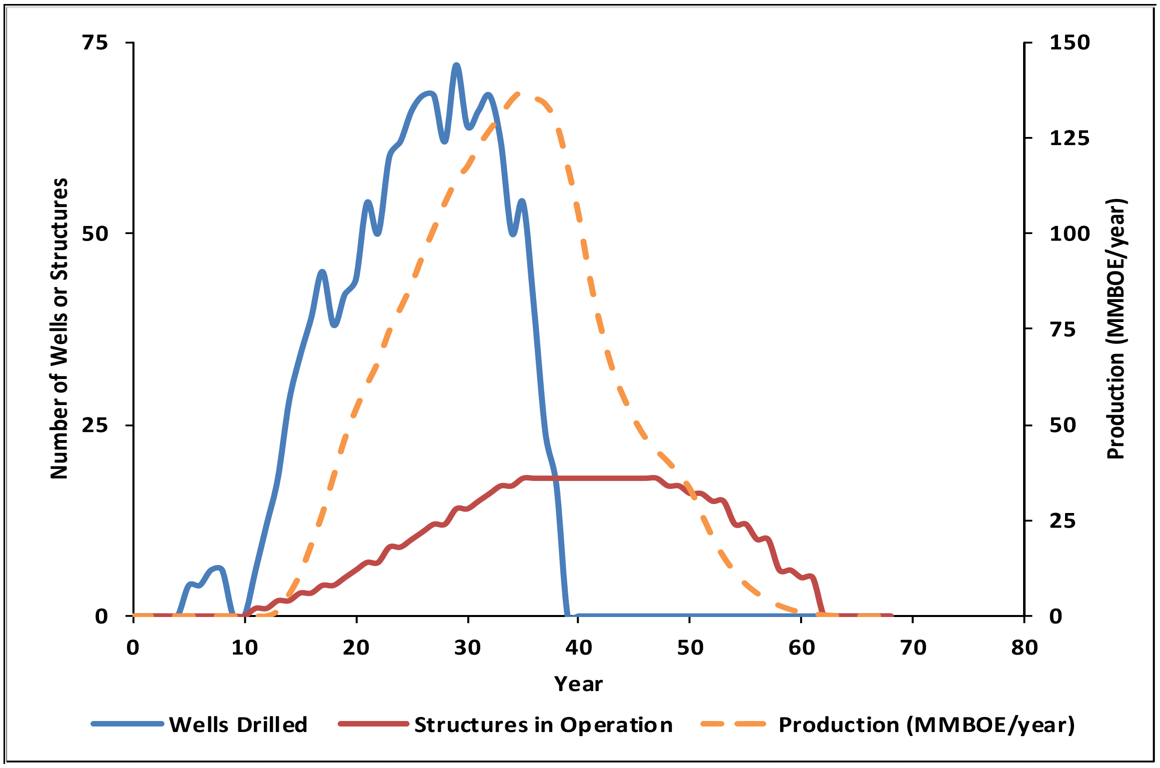
Table 3.2-2. E&D Scenario Summary for the Beaufort Sea Program Area

Scenario Element	Estimated Value
Number of sales	1
Years of activity	15 to < 70
Oil (Bbbl)	0 to 3.7
Natural gas (tcf)	0 to 6.4
Exploration and delineation wells	25 to 90
Development and production wells	0 to 1,840
Platforms/structures	0 to 25
New offshore pipeline miles	0 to 410 oil, 0 to 410 gas
New onshore pipeline miles	0 to < 10
Vessel trips	Varies with phase of activity
Helicopter operations	Varies with phase of activity
New pipeline landfalls	0 to < 10

Notes: Range reflects low to high price scenarios. Values have been rounded.
Key: Bbbl = billion barrels; tcf = trillion cubic feet.

Exploration

Two-dimensional (2D) and three-dimensional (3D) seismic surveys would begin 2 to 3 years prior to a lease sale, enabling operators to determine which offered OCS lease blocks are of greatest interest. Approximately 5 to 12 different geophysical surveys would occur over a period of 10 to 25 years. The typical 2D exploration survey would collect approximately 9,656 km (6,000 line mi), whereas a 3D exploration survey would cover approximately 100 OCS lease blocks. Thereafter, operators would conduct smaller-scale geohazard surveys and geotechnical studies in advance of exploration drilling or site-specific operations. Similar smaller-scale surveys typically are required for development drilling, platform and pipeline installation, and decommissioning. Approximately 7 to 70 geohazard and geotechnical surveys (in total) would be conducted in the Beaufort Sea Program Area within 30 years after the lease sale. Exploration drilling (up to 90 wells) would begin within a few years after the lease sale and extend for approximately 15 years assuming primary lease terms on some leases are extended (**Figure 3.2-2**). Exploration drilling operations are most likely to employ MODUs, such as jack-up rigs or drillships, but it is possible that artificial gravel islands could be used as a cost-effective alternative in the shallowest water depths. **Figure 3.2-3** shows where exploration activities could occur under a mid-price scenario. Because of severe winter ice conditions, it is generally assumed that exploration drilling would be limited to the shelf and would occur in the open water season, unless gravel islands were in use. Most exploration and development operations would involve mobilization of operation-specific oil spill containment and response equipment given the remote nature and challenging operating environment of the Arctic.

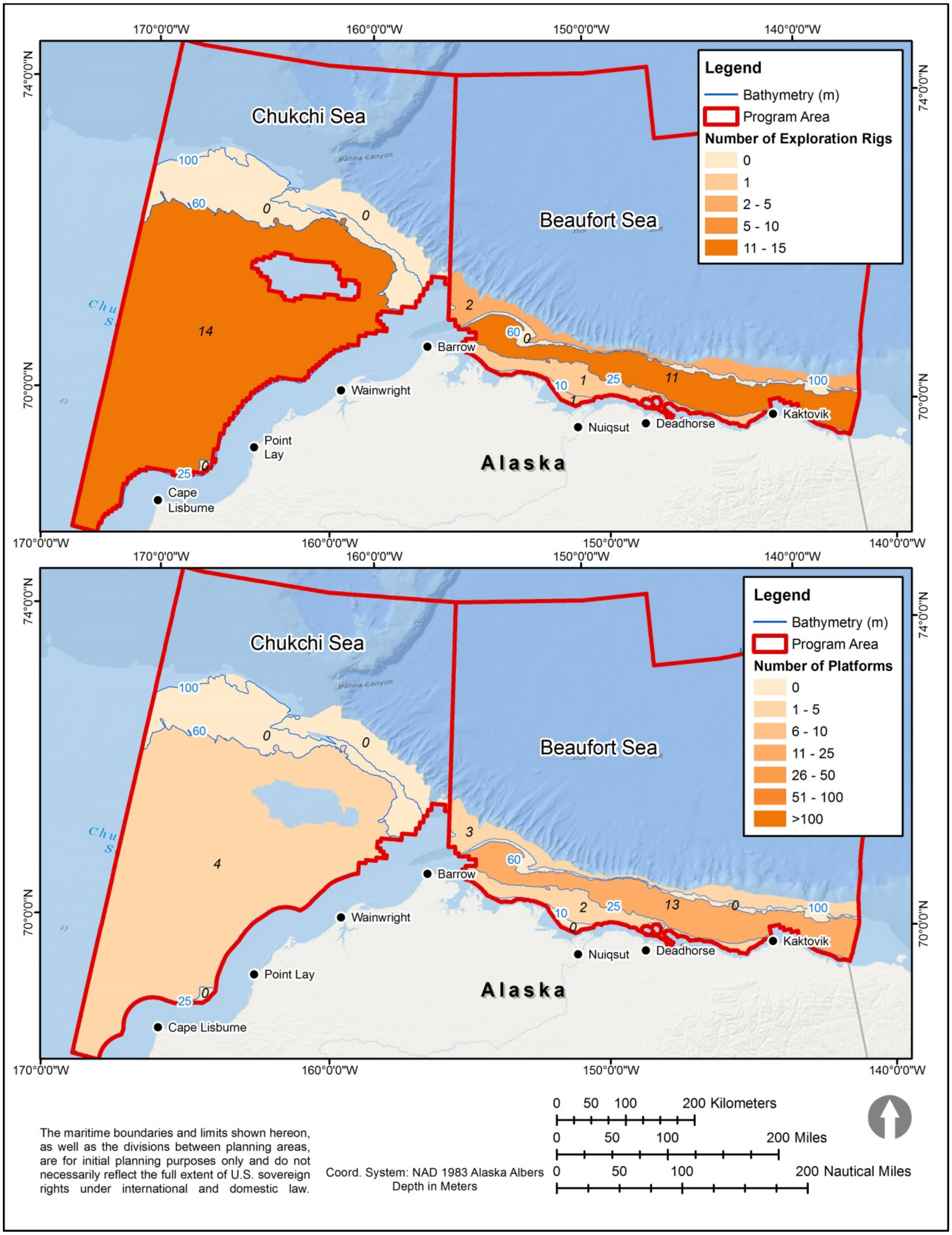


Key: MMBOE = million barrels of oil equivalent

Figure 3.2-2. Estimated Timing and Magnitude of Wells, Structures in Operation, and Production in the Beaufort Sea Program Area (Mid-Price Scenario, Year 0 = 2017)

Development

Compared to OCS development in the Chukchi Sea OCS, development in the Beaufort Sea OCS is expected to require more wells. This is related to distribution and characteristics of the reservoirs and geologic formations. Although highly dependent on various factors, such as seasonality, market conditions, regulatory processes, and future state of infrastructure, up to 1,840 development wells could be drilled within 35 years of the lease sale (**Table 3.2-2**). Water depth, sea conditions, and ice conditions are important factors in development drilling and selecting a platform type. In waters shallower than 10 m or 33 ft, the most likely production platform would be a reinforced gravel island. For water depths up to 100 m (330 ft), a larger bottom-founded structure, such as a gravity base structure, or a platform type rated for dynamic ice loading, would likely be used. There are no subsea wells identified in the scenario due to the lower well yields expected and relatively shallow water depths where leasing is most likely to occur. In addition, maintenance or repair work on subsea wells requires a vessel, which would be unavailable except during the open water season.



Note: To highlight differences in activity levels between program areas, the same scale and symbology is used to display the number of platforms in **Figures 3.2-3** and **3.2-7** (number of platforms in the GOM).

Figure 3.2-3. Estimated Distribution of OCS Exploration Rigs (*Top)* and Development/Production Platforms (*Bottom*) by Depth Range in the Beaufort and Chukchi Seas Program Areas for the Mid-Price Scenario

Production

Hydrocarbon production in the Beaufort Sea would begin around 2030 and end almost 50 years later. Hydrocarbon production would gradually increase during the first 20 years and decrease thereafter (**Figure 3.2-2**). **Figure 3.2-3** shows the estimated number of structures in operation for the mid-price scenario. Gas and water would be reinjected into the reservoirs by service wells until the oil is depleted. After each oil well becomes depleted, it would be re-completed as a gas well. Gas production would be assumed to start around 2045 to 2050.

Pipelines

Subsea pipelines would connect the platforms to existing nearshore facilities. The existing facilities at Prudhoe Bay connect with TAPS; any gas pipelines would connect with the proposed gas pipeline to carry gas from Prudhoe Bay to south-central Alaska. New offshore and onshore pipelines are described in **Table 3.2-2**.

Decommissioning

Removal of infrastructure would occur within approximately 60 years of the lease sale (around year 2080). Gravity-based structures would be disassembled and moved offsite, and subsea pipelines would be decommissioned by cleaning the pipeline, plugging both ends, and leaving them buried in the seafloor. Geophysical surveys would be required to confirm that no debris remained and pipelines were decommissioned properly.

Chukchi Sea Program Area

The Chukchi Sea Program Area scenario has been revised since publication of the Draft Programmatic EIS to reflect the recent relinquishment of lease holdings in the Chukchi Sea. The *Final Second Supplemental Environmental Impact Statement, Chukchi Sea Planning Area Oil and Gas Lease Sale 193 in the Chukchi Sea, Alaska* (BOEM 2015b) described the development of a large anchor field (i.e., principal field that would allow for scalable and economic development of adjacent fields) and two additional satellite fields that would utilize the infrastructure installed for the large anchor field. Because these fields would not be developed under Lease Sale 193 leases, BOEM assumes that some of those fields would be explored and developed as a part of the 2017-2022 Program. The revised scenario for the 2017–2022 Program principally considers the development of the same large anchor field; this results in changes in the E&D scenario relative to the Draft Programmatic EIS. The cumulative scenario highlighted in **Section 3.7.3** describes the exploration and development of all related fields (originally considered in context of Lease Sale 193) that would be developed as satellites to the anchor field and leverage a pipeline to shore and onshore facilities.

Because there is no existing oil and gas infrastructure in the Chukchi Sea Planning Area, all exploration and development assumed to stem from this Program would necessitate the installation of new OCS infrastructure, OCS and overland pipeline, and new shore-based infrastructure to explore and develop the anchor field. **Table 3.2-3** provides an overview of exploration, development, and production activities that could occur. Note that under the low-price scenario, only exploration would be anticipated to occur because development would not be economical at lower prices.

Exploration

Seismic surveys (2D and 3D) would begin several years prior to a lease sale. Approximately one to two different seismic surveys would occur over a period of 10 to 20 years. The typical 2D survey would collect approximately 9,656 km (6,000 line mi), whereas a 3D survey would cover approximately 100 OCS lease blocks.

Table 3.2-3. E&D Scenario Summary for the Chukchi Sea Program Area

Scenario Element	Estimated Value
Number of sales	1
Years of activity	5 to < 75
Oil (Bbbl)	0 to 4.2
Natural gas (tcf)	0 to 1.8
Exploration and delineation wells	4 to 30
Development and production wells	0 to 565
Platforms/structures	0 to 7
New offshore pipeline miles	0 to 190 oil, 0 to 190 gas
New onshore pipeline miles	0 to 300 oil, 0 to 300 gas
Vessel trips	Varies with phase of activity
Helicopter operations	Varies with phase of activity
New pipeline landfalls	0 to 2

Notes: Range reflects low to high price scenarios. Values have been rounded.
Key: Bbbl = billion barrels; tcf = trillion cubic feet.

Prior to exploration drilling, operators would conduct geohazard surveys and geotechnical studies. Similar surveys typically are required for development drilling, platform and pipeline installation, and decommissioning. Approximately 2 to 27 geohazard and geotechnical surveys (in total) would be conducted in the Chukchi Sea Program Area within 20 years of the lease sale. Exploration drilling (up to 30 wells) would begin around 2025 with exploratory drilling extending approximately 15 to 20 years assuming primary lease terms on some leases are extended (see **Figure 3.2-4** for a timeline with mid-price scenario). Exploration drilling operations are most likely to employ drillships or jack-up rigs. Because of severe winter ice conditions, it is assumed that exploration and development drilling would be limited to the shelf and would occur only during the open water season. Similar to the Beaufort Sea, most exploration and development operations would involve mobilization of operation-specific oil spill containment and response equipment, given the remote nature of the area and challenging operating environment.

Development

Compared to OCS development in the Beaufort Sea OCS, development in the Chukchi Sea OCS is expected to require fewer wells. This is related to distribution and characteristics of the reservoirs and geologic formations expected to be explored. Although highly dependent on various factors, such as seasonality, market conditions, regulatory processes, and future state of infrastructure, up to 565 development wells could be drilled within 30 years of the lease sale (**Table 3.2-3**). There are no subsea wells identified in the scenario. All platforms are expected to be constructed in water depths < 60 m (200 ft) (**Figure 3.2-3**). Production operations would use large, gravity-based structures with trenched subsea pipelines to transport the oil to landfalls.

Production

Hydrocarbon production in the Chukchi Sea would begin around 2030 and end almost 35 to 50 years later. Hydrocarbon production gradually would increase during the first 15 years and would decrease thereafter (**Figure 3.2-4**). **Figure 3.2-3** shows the total number of structures estimated to be in operation and anticipated annual production for the mid-price scenario. Gas and water would be re-injected into the reservoirs by service wells until the oil is depleted. As each oil well becomes depleted, it would be re-completed as a gas well. Gas production would be assumed to start around 2045 to 2050.

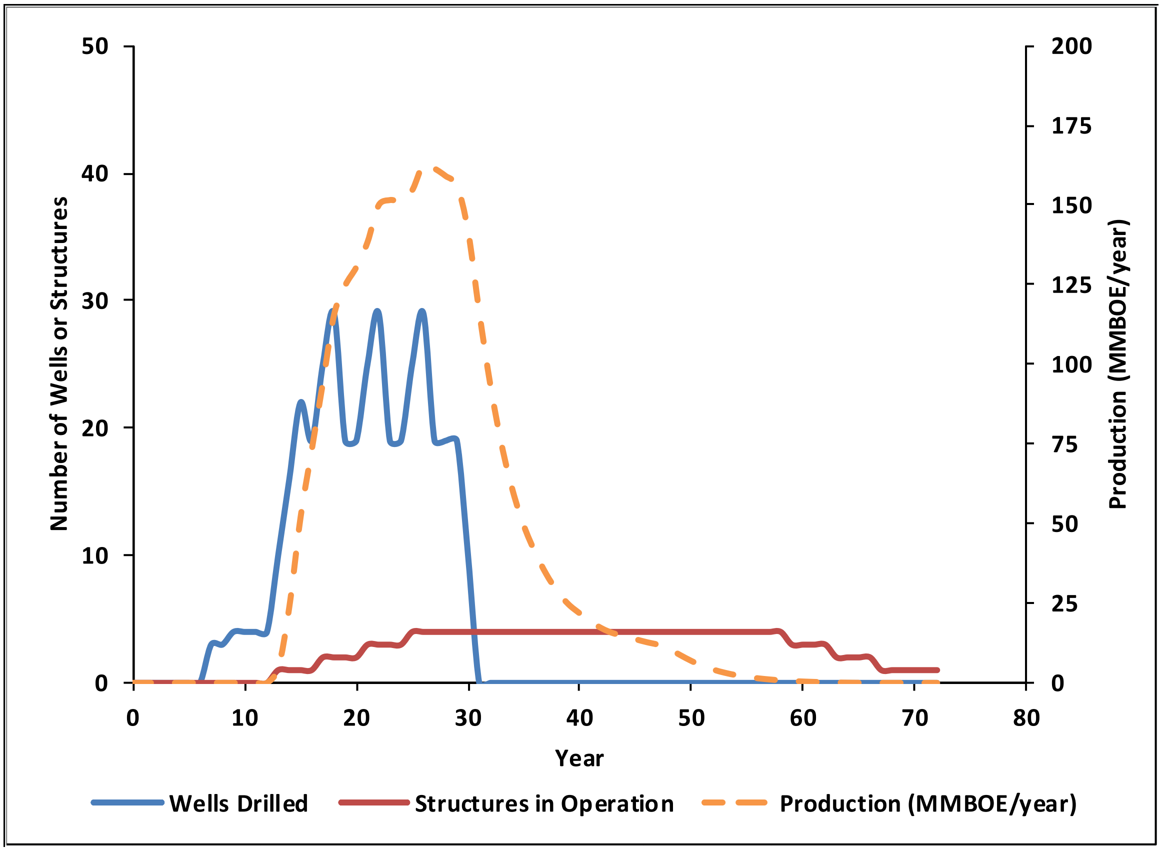


Figure 3.2-4. Estimated Timing and Magnitude of Wells, Structures in Operation, and Production in the Chukchi Sea Program Area (Mid-Price Scenario, Year 0 = 2017)

Pipelines

Subsea pipelines would connect the platforms to new nearshore facilities along the Chukchi Sea coast. An additional 483 km (300 mi) of overland oil pipeline would have to be constructed to connect the Chukchi Sea OCS to TAPS at Prudhoe Bay. Gas production from the Chukchi Sea Program Area would have to be transported via a 483-km (300-mi) overland gas pipeline to Prudhoe Bay to connect with the proposed gas pipeline to south-central Alaska. The existing facilities at Prudhoe Bay connect with TAPS; any gas pipelines would connect with the proposed gas pipeline to carry gas from Prudhoe Bay to south-central Alaska. New offshore and onshore pipeline lengths are displayed in **Table 3.2-3**.

Decommissioning

Removal of infrastructure would occur within approximately 60 to 75 years of the lease sale. Gravity-based structures would be disassembled and moved offsite; subsea pipelines would be decommissioned by cleaning the pipeline, plugging both ends, and leaving them buried in the seafloor. Geophysical surveys would be required to confirm that no debris remained and pipelines were decommissioned properly.

Cook Inlet

One sale would be held in 2021 in the Cook Inlet Program Area. Although there has been no oil and gas activity in the Cook Inlet OCS, there is an available market nearby for oil and gas. Cook Inlet has had oil and gas operations in state waters since the late 1950s and currently possesses a well-established oil and gas infrastructure. OCS activities could occur in the Cook Inlet Planning Area related to Lease Sale 244, which is scheduled to be held in 2017 under the 2012-2017 Program.

Unlike Arctic OCS areas with limited infrastructure, the gas associated with oil production in Cook Inlet can be brought to market at the same time as the oil production. **Table 3.2-4** provides an overview of exploration, development, and production activities that could occur.

Table 3.2-4. E&D Scenario Summary for the Cook Inlet Program Area

Scenario Element	Estimated Value
Number of sales	1
Years of activity	< 35
Oil (Bbbl)	0.08 to 0.34
Natural gas (tcf)	0.04 to 0.15
Exploration and delineation wells	5 to 15
Development and production wells	30 to 100
Platforms/structures	2 to 5
New offshore pipeline miles	90 to 190
New onshore pipeline miles	0
Vessel trips	Varies with phase of activity
Helicopter operations	Varies with phase of activity
New pipeline landfalls	1 to 5

Notes: Range reflects low to high price scenarios. Values have been rounded.
Key: Bbbl = billion barrels; tcf = trillion cubic feet.

Exploration

Several years prior to the lease sale, 3D seismic surveys would be initiated. Approximately two to three different seismic surveys would occur coincident with the lease sale. A 3D survey would cover approximately 30 to 60 OCS lease blocks.

Prior to exploration drilling, operators would conduct geohazard surveys and geotechnical studies. Similar surveys typically are required for development drilling, platform and pipeline installation, and decommissioning. Approximately 6 to 15 geohazard and geotechnical surveys (in total) would be conducted in the Cook Inlet Program Area within 10 years after the lease sale. Exploration drilling (up to 15 wells) would begin around 2025 with exploratory drilling extending for < 10 years assuming primary lease terms on some leases are extended (**Figure 3.2-5**). Exploration drilling operations would most likely employ jack-up rigs.

Development

Although highly dependent on various factors such as seasonality, market conditions, regulatory processes, and availability of supporting infrastructure, up to 100 development wells could be drilled within 20 years of the lease sale (**Table 3.2-4**). There would be no subsea wells anticipated due to strong tides. Only two to five platforms would be constructed in water depths < 100 m (330 ft) (**Table 3.2-4**). Production operations would use fixed, jacketed platforms with trenched subsea pipelines to transport the oil to landfalls.

Production

Hydrocarbon production in the Cook Inlet would begin before 2030 and end almost 20 years later. **Figure 3.2-5** shows the total number of estimated structures in operation and annual production for the mid-price scenario.

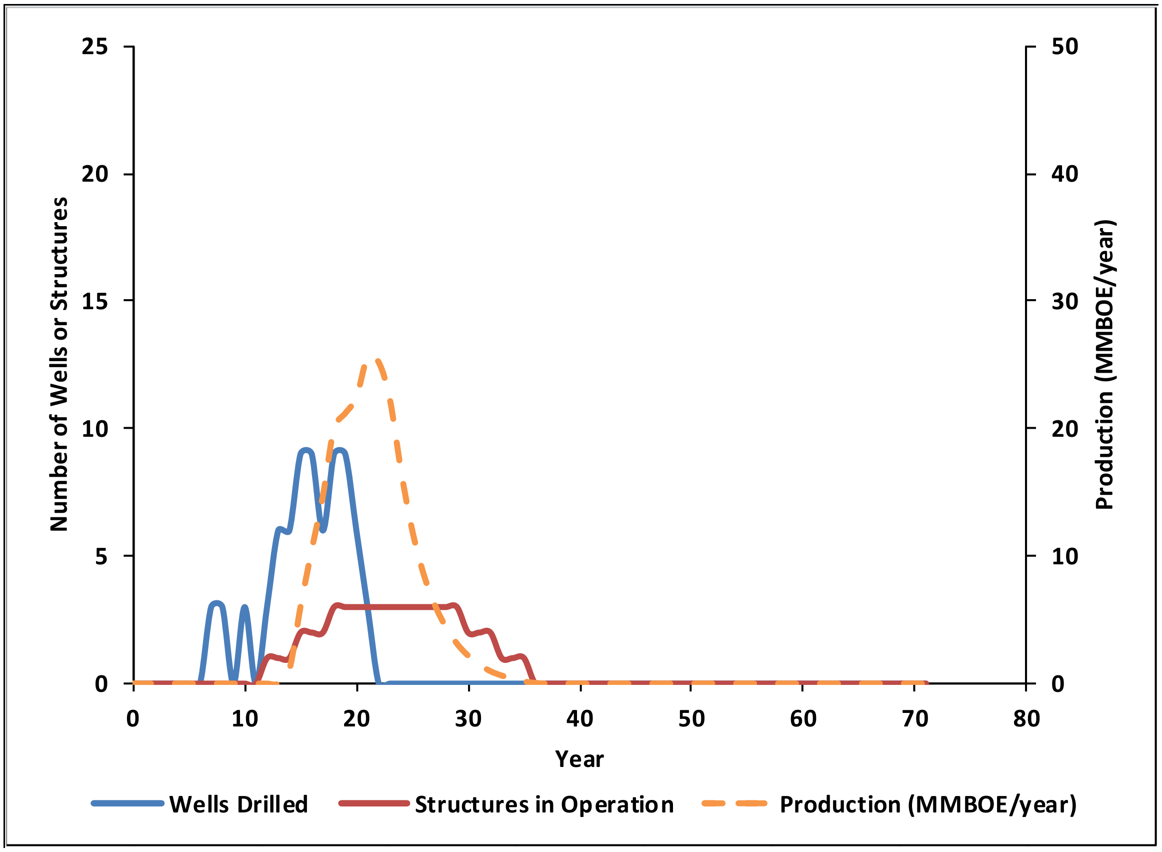


Figure 3.2-5. Estimated Timing and Magnitude of Wells, Structures in Operation, and Production in the Cook Inlet Program Area (Mid-Price Scenario, Year 0 = 2017)

Pipelines

The preferred method to transport oil and gas from the platform would be subsea pipelines to the nearest landfall location, probably on the southern Kenai Peninsula near Homer or Nikiski, depending on the location of the first commercial oil discovery. It is not anticipated that any of the production facilities would be able to use any existing pipelines. Approximately 72 to 152 km (45 to 95 mi) of oil and gas OCS pipeline would need to be installed.

Decommissioning

Removal of infrastructure would occur within approximately 35 years of the lease sale. Fixed structures would be disassembled and moved offsite, and subsea pipelines would be decommissioned by cleaning the pipeline, plugging both ends, and leaving them buried in the seafloor. Geophysical surveys would be required to confirm that no debris remained and pipelines were decommissioned properly.

3.2.2 Gulf of Mexico Program Area

The GOM Program Area being considered for leasing largely includes the Western and Central Planning Areas and a small number of OCS lease blocks in the Eastern Planning Area. The area not included in the GOM Program Area is the portion of the Eastern Planning Area within 201 km (125 mi) of Florida, all areas in the GOM east of the Military Mission Line (86°41’ west longitude), and the area within the Central Planning Area within 161 km (100 mi) of Florida. Ten regionwide sales are proposed in the GOM Program Area. **Table 3.2-5** provides an overview of exploration, development, and production activities that could occur.

Table 3.2-5. E&D Scenario Summary for the GOM Program Area

Scenario Element	Estimated Value
Number of sales	10
Years of activity	< 50
Oil (Bbbl)	2.1 to 5.6
Natural gas (tcf)	5.5 to 22
Exploration and delineation wells	375 to 4275
Development and production wells	425 to 3750
Platforms/structures	90 to 1350
Subsea structures	50 to 165
Floating, production, storage, and offloading	0 to 2
New pipeline miles	1,800 to 6,500
Vessel trips (thousands of round trips)	200 to 2,500
Helicopter operations (1,000 operations)	600 to 18,000
New pipeline landfalls	0 to 10
New onshore facilities	0
New natural gas processing facilities	0 to 3

Notes: Range reflects low to high price scenarios. Values have been rounded.
Key: Bbbl = billion barrels; tcf = trillion cubic feet.

In the GOM, substantially more E&D activity would occur in the Central Planning Area compared to the Western Planning Area (**Figures 3.2-6a** and **3.2-6b**). Oil and natural gas production is distributed across the shelf and slope in the GOM. Relatively more exploration and development drilling and structure installation (not including subsea structures) would occur on the shelf (in depths < 200 m [660 ft]) than in deep water. In comparison, most oil production (> 90 percent) would come from deepwater areas (> 200 m [660 ft]) (**Table 3.2-6**). A combination of factors such as the availability of leasing acreage, hydrocarbon resource potential, scalability of operations, economic viability, and diverse business strategies drive these trends. In general, deepwater reservoirs and fields tend to have greater oil and natural gas potential; the cost to explore and develop those resources is substantially greater. This results in relatively few wells and platforms targeted on high oil and gas producers.

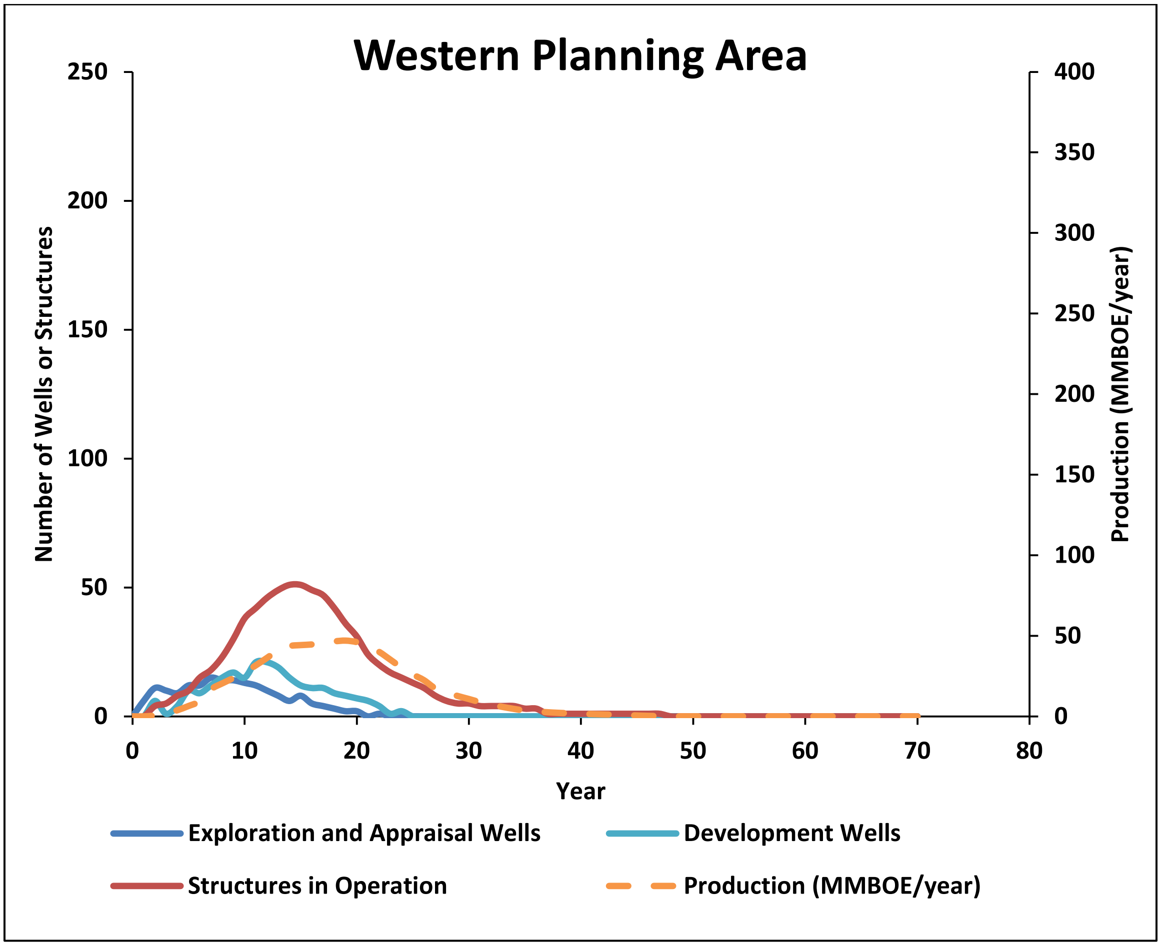
Exploration

Geophysical surveys generally would be the first activities to occur within the GOM Program Area. **Table 3.2.7** presents estimated levels of seismic survey activity in the GOM Program Area.

High-resolution geophysical surveys generally occur before exploration drilling, but also before development drilling, platform and pipeline installation, and decommissioning activities. High-resolution geophysical survey activities are not included in the activities listed in **Table 3.2-7**.

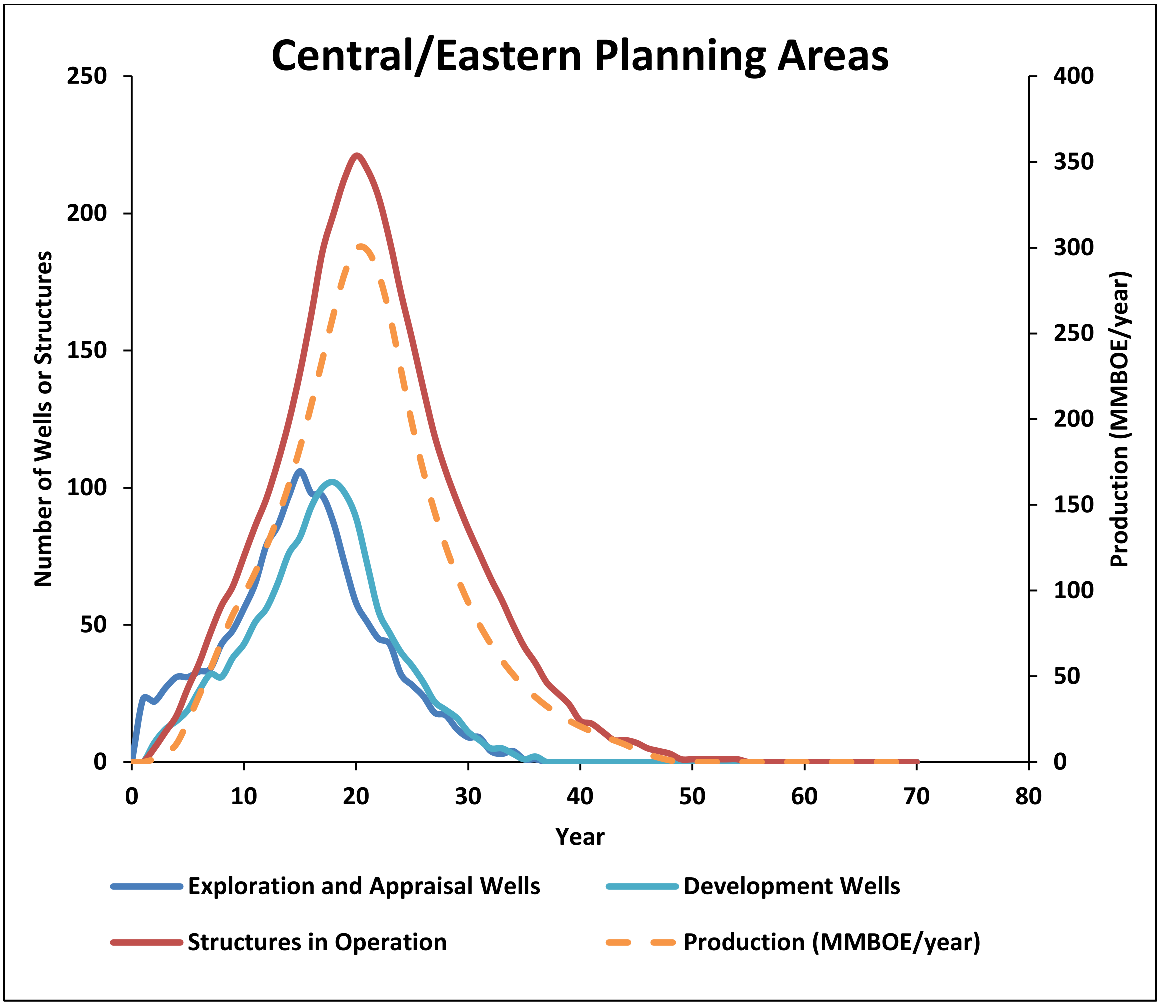
Exploration drilling, development drilling, and platform installation would begin within a few years after the first lease sale. Peak exploration drilling is expected to occur within 15 years, although a

decreasing number of exploration wells would be drilled over the entire Program window.
Figures 3.2-6a and **3.2-6b** shows estimated timing and magnitude of OCS activities under a mid-price scenario. Shallow-water exploration drilling generally occurs before deepwater drilling.
Figure 3.2-**7** shows the exploratory drilling activity (up to 4275 wells) by depth range in the GOM for the Proposed Action.



Notes: Development wells could include some exploration wells re-entered and completed; structures do not include subsea structures. Vertical scale is consistent across similar figures to illustrate the relative differences within and across program areas.

Figure 3.2-6a. Timing and Magnitude of Exploration and Appraisal Wells, Development Wells, Structures in Operation, and Production in the Western Planning Area (Mid-Price Scenario, Year 0 = 2017)



Notes: Development wells could include some exploration wells re-entered and completed; structures do not include subsea structures. Vertical scale is consistent across similar figures to illustrate the relative differences within and across program areas.

Figure 3.2-6b. Timing and Magnitude of Exploration and Appraisal Wells, Development Wells, Structures in Operation, and Production in the Central/Eastern Planning Area (Mid-Price Scenario, Year 0 = 2017)

Table 3.2-6. Depth Distribution within the GOM Program Area, Mid-Price Scenario

OCS Depth Zone	Location	Percent Wells		Percent Platforms		Percent Gas Production		Percent Oil Production	
		Shelf or Slope Area	Depth Zone Area	Shelf or Slope Area	Depth Zone Area	Shelf or Slope Area	Depth Zone Area	Shelf or Slope Area	Depth Zone Area
0 to 60 m (0 to 197 ft)	Shelf	76	51	95	68	31	20	3	2
60 to 200 m (197 to 656 ft)			25		27		11		1
200 to 800 m (656 to 2,625 ft)	Slope	24	8	5	1	69	7	97	10
800 to 1,600 m (2,625 to 5,249 ft)			7		1		26		28
1,600 to 2,400 m (5,249 to 7,874 ft)			4		1		15		27
> 2,400 m (> 7,874 ft)			5		1		20		30

Table 3.2-7. Estimated Exploration Seismic Survey Activity for the GOM Program Area

Location	2D Surveys	2D Permits	3D Lease Blocks	3D Permits	Ancillary Permits
Western	4,989 to 15,128 km (3,100 to 9,400 mi)	10 to 20	18,600 to 56,800	15 to 40	10 to 115
Central/ Eastern	576,145 to 1,657,624 km (358,000 to 1,030,000 mi)	170 to 485	102,700 to 292,500	65 to 190	60 to 1,000

Development

The peak in development drilling and platform installation would lag behind the peak in exploration drilling (**Figures 3.2-6a** and **3.2-6b**). The distribution and number of development wells to be drilled and completed in the Western Planning Area and in the Central/Eastern Planning Areas under the mid-price scenario are illustrated in **Figure 3.2-8**.

Production

Figure 3.2-9 depicts the estimated distribution and number of structures to be in operation in the GOM, with the exception of subsea systems, over the life of the Program. **Figure 3.2-9** also shows the depth distribution of estimated platforms and structures in the GOM. Various single well to multi-well structures would be installed and commissioned depending on the water depth. There would be a slight temporal lag between peak development drilling and platform installation. The final remaining platforms would be operated in the last 10 to 20 years to maximize production from remaining production wells. Subsea structures would only be installed and operated on the slope in water depths > 200 m (660 ft). The potential range in total and annual production is presented in **Table 3.2-5** and **Figures 3.2-6a** and **3.2-6b** for the mid-price scenario.

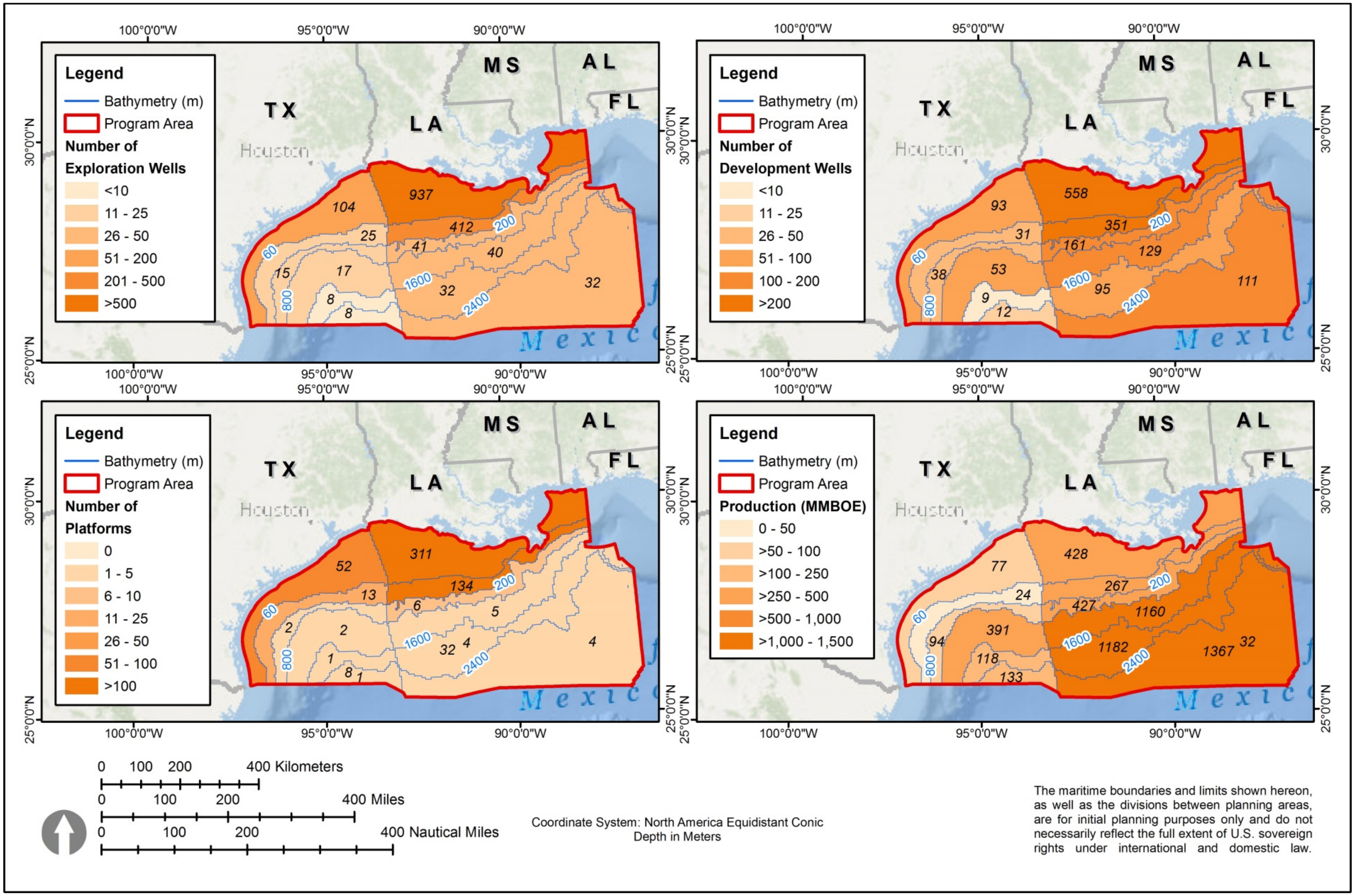


Figure 3.2-7. OCS Exploration (*Top Left*: Exploration Wells), Development (*Top Right*: Development Wells), and Production (*Bottom Left*: Platforms; *Bottom Right*: Oil and Gas Production) in MMBOE by Depth Range in the GOM Program Area (Mid-Price Scenario)

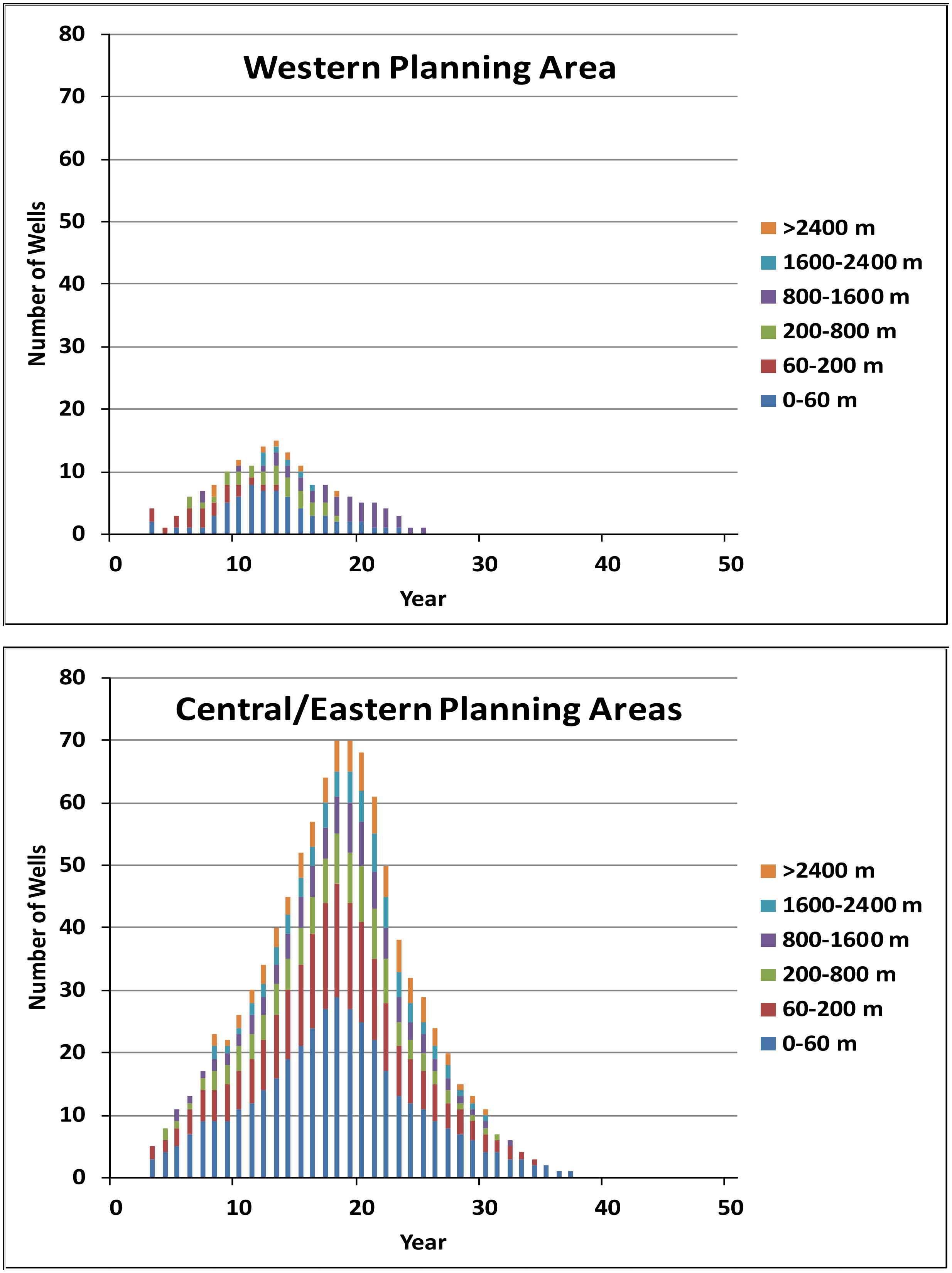
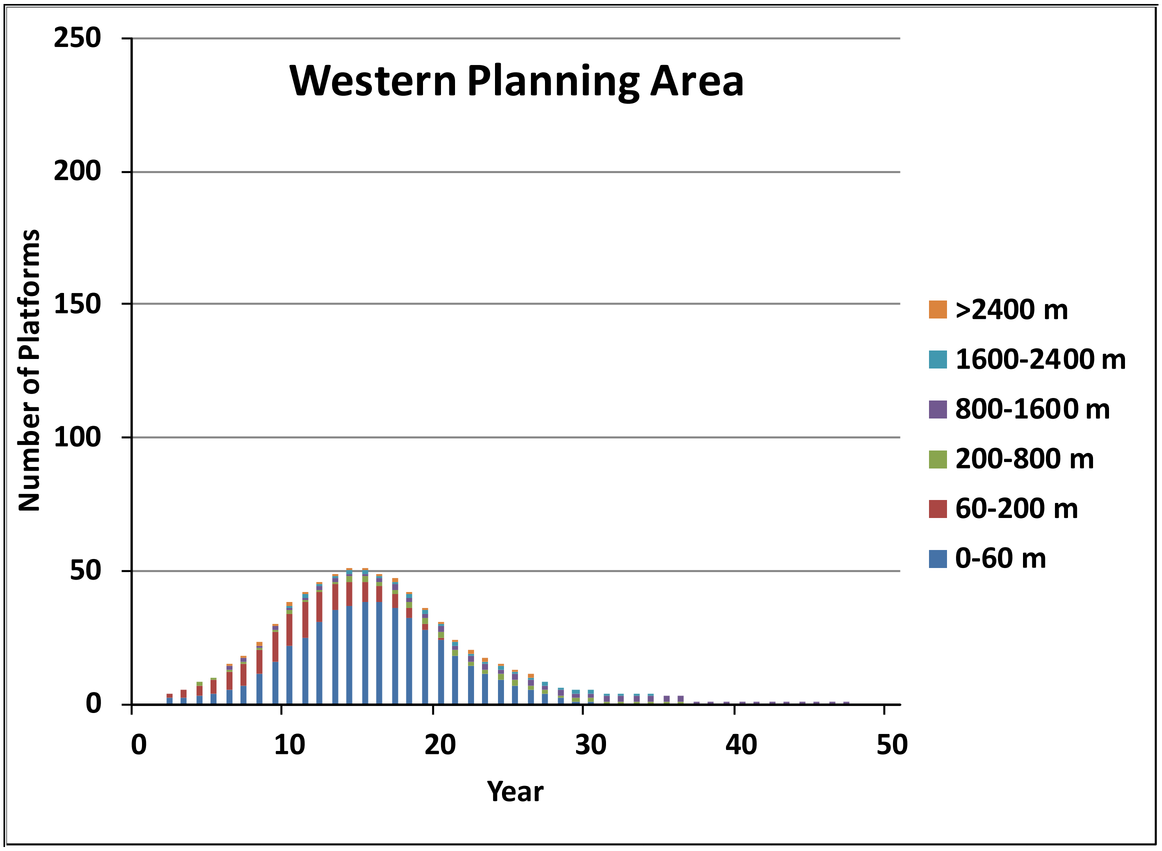


Figure 3.2-8. Distribution and Number of Development Wells Drilled and Completed in the GOM Program Area (Mid-Price Scenario, Year 0 = 2017)



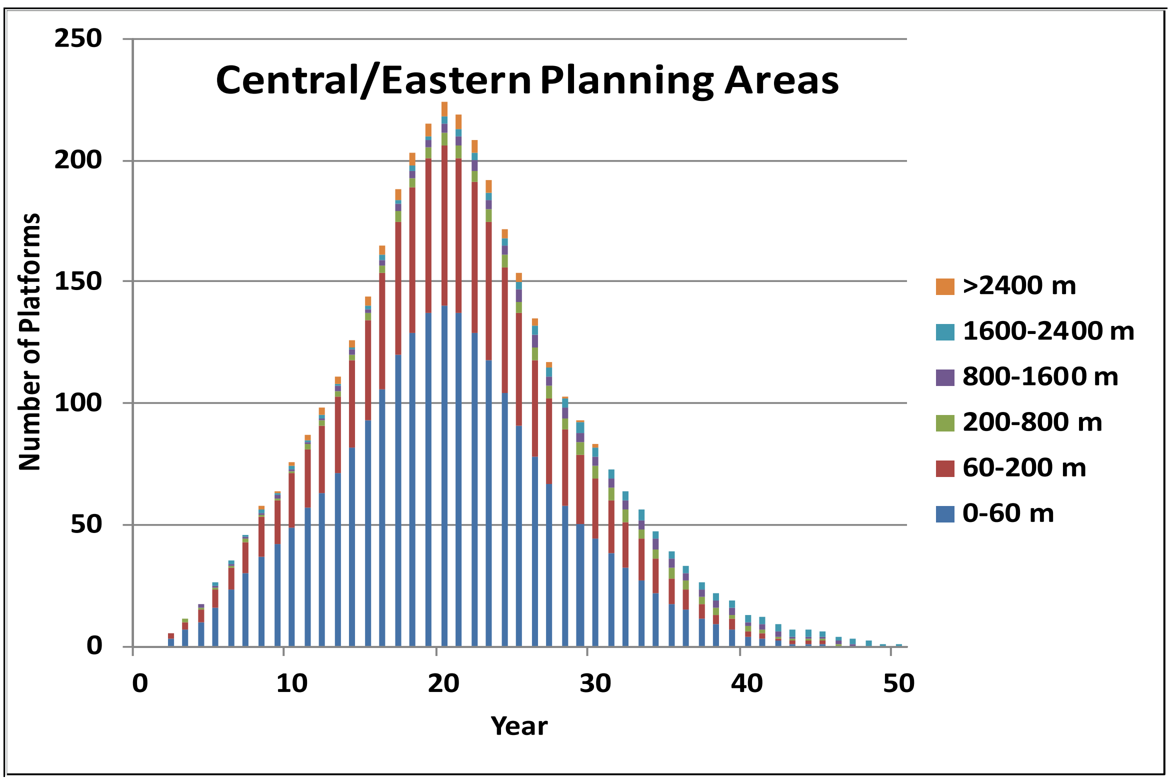


Figure 3.2-9. Platforms in Operation in the GOM Program Area (Mid-Price Scenario, Year 0 = 2017)

Pipelines

The preferred method of transporting oil and gas from fixed or floating production structures in the GOM would be subsea pipelines to the nearest interconnection with existing OCS pipeline infrastructure or to a landfall location (**Tables 3.2-5** and **3.2-8**). Relatively few new pipeline landfalls are anticipated because of the extensive nature of the existing pipeline network in the GOM. **Figure 3.2-10** shows the line-miles of pipeline to be installed under the Program for the mid-price scenario.

Table 3.2-8. Method of Oil Transportation in the GOM

Method of Oil Transportation	Offshore Depth Ranges						Total GOM
	0 to 60 m (0 to 197 ft)	60 to 200 m (197 to 656 ft)	200 to 800 m (656 to 2,625 ft)	800 to 1,600 m (2,625 to 5,249 ft)	1,600 to 2,400 m (5,249 to 7,874 ft)	< 2,400 m (< 7,874 ft)	
Percent Piped	72 to 93.5	100	100	100	100 to 83.8	100 to 85.7	99.8 to 89.9
Percent Barged	28 to 6.5	0	0	0	0	0	0.2
Percent Tankered	0	0	0	0	0 to 16.2	0 to 14.3	0 to 9.9

Notes: Range reflects low- to high-price scenarios. All natural gas is assumed to be transported by pipeline. Values of percent piped is presented according to the price range. The volume of oil transported by pipe decreases in a higher price scenario.

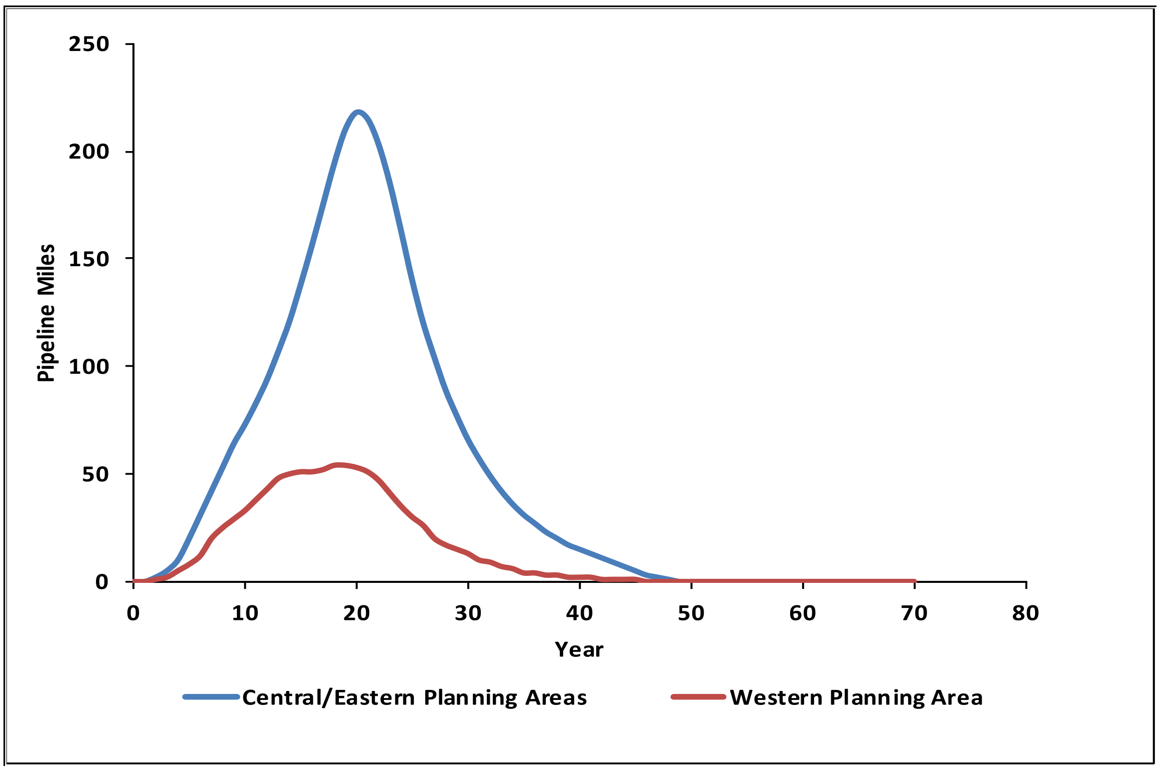


Figure 3.2-10. Pipeline Miles installed in the GOM Program Area (Mid-Price Scenario, Year 0 = 2017)

Decommissioning

After oil and gas resources are depleted and income from production no longer meets operating expenses, operators would begin to shut down their facilities. In a typical situation, wells would be permanently plugged with cement and wellhead equipment removed. Processing modules would be moved off the platforms. Subsea pipelines would be decommissioned by cleaning the pipelines, plugging pipelines at both ends, and removing them or leaving them buried beneath the seafloor, as permitted. The platform could be disassembled and removed from the area and the seafloor site would be restored to some practicable pre-development condition. In the GOM, state-managed rigs-to-reef programs provide alternatives to decommissioning through in-water placement of suitably sized and cleaned platforms. **Table 3.2-9** summarizes the number of platforms that would need removal with or without explosives in the GOM planning areas. Approximately 97 percent of removals occur on the GOM shelf in water depths < 200 m (656 ft).

Table 3.2-9. Platforms to be Decommissioned in the GOM Program Area

Platforms Removed		
Western Planning Area	With Explosives	Without Explosives
	10 to 100	4 to 45
Central/Eastern Planning Areas	With Explosives	Without Explosives
	45 to 850	30 to 360

Note: Range reflects low- to high-price scenario.

3.3 ACCIDENTAL EVENTS

Impacts associated with accidental events are considered in terms of accidental events that occur with enough frequency that such events are statistically expected to occur, and those that are statistically unexpected to occur but would still be possible (catastrophic discharge events [CDEs]). Expected (i.e., occurring with regular frequency) accidental events include spills anticipated to occur during routine operations (e.g., a diesel spill or oil spills of varying size from a platform, pipeline, or tanker). In comparison, CDEs are rare, very low-probability events arising from equipment failure such as a loss of well control or a blowout. Small and large oil spills and CDEs are evaluated separately, but quantitatively. Small spills (≥ 1 to < 50 bbl; ≥ 50 to < 1,000 bbl) and large spills (≥ 1,000 bbl) from platforms and pipelines are considered.

BOEM estimates the source and number of accidental spills (small and large) based on the estimated volume of oil production for each program area and the assumed mode of transportation (Anderson et al. 2012, ABS 2016). Spills from platforms are assumed to occur within the lease sale areas. Spills from pipelines are assumed to occur within their respective routes from production platform to destination. The number of small and large oil spills was estimated for the Proposed Action and the cumulative scenario of OCS oil and gas activities in each program area (**Table 3.3-1**).

From 1985 to 2013, eight crude oil spills ≥ 500 bbls were documented along the Alaska North Slope, one of which was ≥ 1,000 bbl (Johnson et al. 2000, Robertson et al. 2013). For that same time period, the total North Slope production was 12.80 Bbbl of crude oil and condensate (Alyeska Pipeline Service Company 2013). From June 1971 to September 2011, the highest mean volume of North Slope spills were from pipelines (Robertson et al. 2013). The mean spill size for pipelines was 145 bbl. The spill rate for crude oil spills ≥ 500 bbl from pipelines (1985 to 2013) is 0.23 pipeline spills per Bbbl of oil produced.

Table 3.3-1. Estimated Number of Accidental Spills during the 2017–2022 Program

Spill Size (and *Type*)	Assumed Spill Volume (bbl)	Estimated Number of Spills[1]				
		Gulf of Mexico Program Area		Arctic Program Areas		Cook Inlet Program Area
		Western	Central/ Eastern	Beaufort Sea	Chukchi Sea	
Large[2]						
Platform[3]	3,283[5]	0 to 1	1 to 2	0 to 1	0 to 1	0 to 1
Pipeline[4]	3,750[5]	0 to 1	2 to 5	0 to 4	0 to 4	0 to 1
Small[6]	≥ 1 to < 50	20 to 57	140 to 367	0 to 278	0 to 320	7 to 26
	≥ 50 to < 1,000	4 to 11	27 to 69	0 to 52	0 to 60	1 to 5

Notes: Range reflects low- to high-price scenarios.

[1] The number of spills is estimated using the 1974 to 2015 spill rates found in ABS (2016). The estimated number of spills is rounded up to a whole number. For example, the estimated number of platform and pipeline spills could each be less than 1 spill, but reported as 1 spill in each category; when summed, the combined number of platforms and pipeline spills is less than 1 spill.

[2] A large spill is defined as ≥ 1,000 bbl (ABS 2016). Large spills are reported separately for platforms and pipelines. Spills from tankers were not included in this table due to the low number of expected events (< 1) given the small volume potentially tankered.

[3] The ≥ 1,000 bbl spill rate for platforms is 0.22 spills/Bbbl handled.

[4] The ≥ 1,000 bbl spill rate for pipelines is 0.89 spills/Bbbl handled.

[5] The assumed spill volume for platforms and pipelines is the median oil spill size from 1974 to 2015 for spills ≥ 1,000 bbl. There were four platform spills ≥ 1,000 bbl from 1974 to 2015, including the *Deepwater Horizon* oil spill. There were 16 pipeline spills ≥ 1,000 bbl from 1974 to 2015.

[6] The number of spills < 1,000 bbl is estimated using the total spill rate for pipeline and platform spills. The ≥ 50 to < 1,000 bbl spill rate for pipelines and platforms combined is 14.13 spills/Bbbl handled. The ≥ 1 to < 50 bbl spill rate for pipelines and platforms combined is 75.64 spills/Bbbl handled.

3.4 RISK OF A LOW-PROBABILITY CATASTROPHIC DISCHARGE EVENT

The term CDE means a very large spill that is not expected to result from the Program's activities and would be considered outside of the normal range of probability, despite the inherent risks of oil E&D-related activities (Bercha Group 2014, Ji et al. 2014). However, the risk of such a CDE is not zero. These spills could result from OCS exploration; development and production activities involving rigs, facilities, pipelines, tankers, and/or support vessels; and other causes (e.g., hurricanes, human error, acts of terrorism).

Incidents with the greatest potential for catastrophic consequences are likely to be losses of well control where primary and secondary barriers fail, wells do not bridge (when the wellbore collapses and seals the flow path), and discharge is of long duration and/or occurs in an environmentally sensitive area and/or at a sensitive time. Recently implemented safeguards, including additional subsea blowout preventer testing, required downhole mechanical barriers, well containment systems, and additional regulatory oversight make such an event less likely than in the past.

Although a CDE is not expected to result from activities associated with the 2017–2022 Program, the consequences of a low-probability incident, if it were to occur, could be catastrophic. Past oil spills that are considered relevant include the *Exxon Valdez* oil spill in the Prince William Sound in south-central Alaska (262,000 bbl); the *Ixtoc* oil spill (3,500,000 bbl) in the GOM offshore Bahia de Campeche, Mexico; and the *Deepwater Horizon* event that occurred on the OCS in 2010 in the northern GOM (4,900,000 bbl; 800,000 bbl captured) (McNutt et al. 2011). The *Exxon Valdez* and *Ixtoc* oil spills were not expressly related to OCS activities.

A quantitative approach has been developed to demonstrate the relative unlikelihood of such low-probability spill incidents, wherein spill size is one of many factors that could determine the severity of effects (BOEM 2012a). First, BOEM defined a reasonable range of potentially catastrophic OCS spill sizes by applying extreme value statistics to historical OCS spill data (Ji et al. 2014). Then, extreme value statistical methods and complementary risk assessment methods (Bercha Group 2014) were used to characterize the potential frequency of different size spills.

Actual risk can be highly variable depending on the characteristics of a given reservoir, well, operation, and an operator's approach to risk management; however, treatment here is programmatic and considers broadly the activities that would result from the Program. It is important to note that the full range of spill sizes considered might not actually be possible in a given program area due to the individual undiscovered reservoir sizes or other geologic constraints in that program area.

Table 3.4-1 presents BOEM's estimates of the following elements for CDEs:

1. Spill size return levels (i.e., the spill size that occurs with a certain frequency, or alternatively, the spill size that is expected to be exceeded by the annual maximum in a particular year with a given probability)
2. Spill size return periods (i.e., the OCS-wide spill recurrence interval corresponding to certain sizes)
3. A per-well probability that an OCS spill would exceed given sizes.

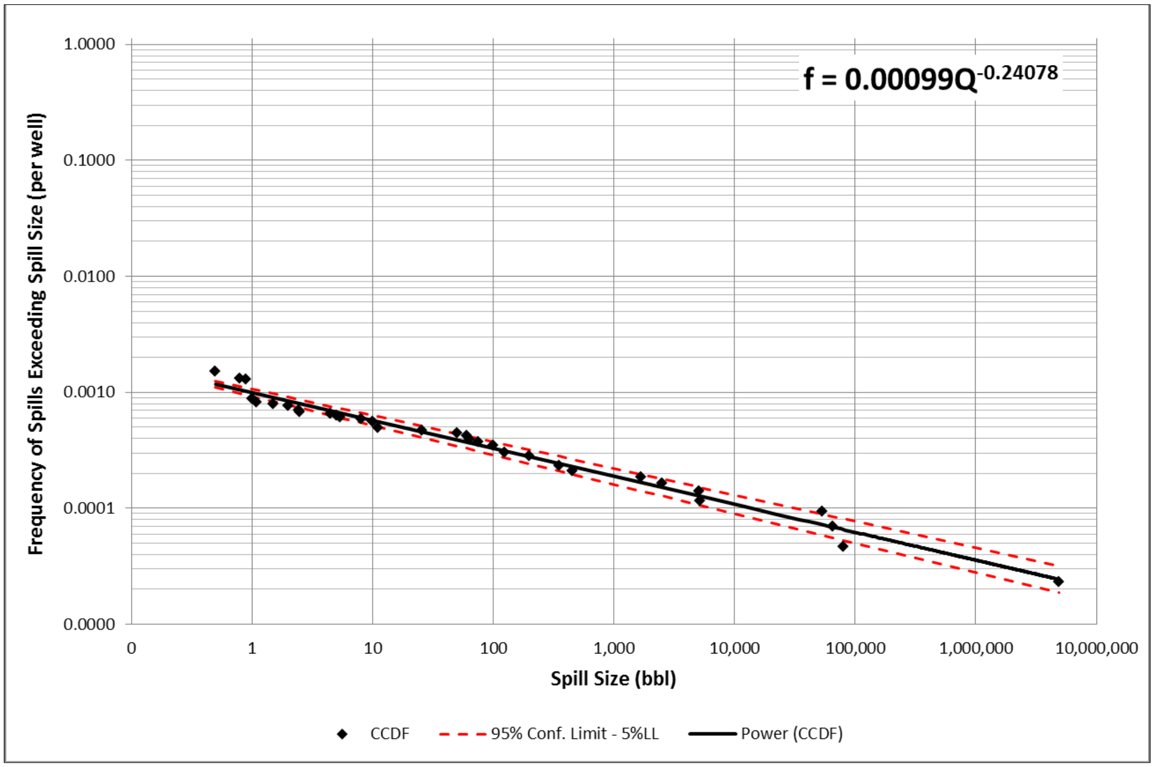
The estimated per-well frequency for a given spill size assumes a spill occurred following loss of well control. The per-well spill size frequency estimates consider OCS-wide loss of well control data from 1964 through 2014 and corresponding OCS-wide well exposure data (only original well boreholes and sidetracks are summed to determine well exposure; bypasses are excluded) (**Figure 3.4-1**).

Table 3.4-1. Annual Maximum OCS Spill Sizes for all Ongoing OCS Activities and OCS Planning Areas Combined

Spill Size (bbl) (rounded to nearest thousand)	Percent Spills Expected to be Less than or Equal to Given Spill Size	Return Period (years)	Frequency (per well)
150,000	97.4	39	0.0000564
500,000	98.8	86	0.0000422
1,000,000	99.3	139	0.0000357
2,000,000	99.6	229	0.0000302
5,000,000	99.8	451	0.0000242
10,000,000	99.87	770	0.0000205

Extreme value results show that 90 percent of any "annual maximum" oil spills are expected to be less than approximately16,000 bbl; 95 percent of any "annual maximum" oil spills are expected to be less than approximately 50,000 bbl. Spill sizes corresponding to a range of larger sizes and statistically useful benchmarks were also considered.

Table 3.4-1 shows the return period and estimated frequency for sizes from 150,000 bbl to 10 million barrels of oil (MMbbl). The return period estimated is independent of any Five-Year Program timing or activity level. Estimated return periods demonstrate that most very large spills are not expected to occur on a time frame relevant to the Proposed Action.



Notes: The variable f is equal to a per-well occurrence, whereas the variable Q refers to spill size. Note log scales. A cumulative distribution function of the probability is the probability that Q will be a value less than or equal to q. The complementary cumulative distribution function, or CCDF (CDF), is equal to 1 – CDF (BOEM 2012a).

Figure 3.4-1. Estimated Frequency of Spills Resulting from Loss of Well Control on the OCS

The number of CDEs equal to or greater than a given size in a given Five-Year Program can also be estimated using the aggregate number of E&D wells expected to be drilled in that same program. In combining the per-well spill frequency with estimates of the aggregate number of wells in the 2017-2022 Program, no spills ≥ 150,000 bbl would be expected to occur despite the volume of Program activities previously described.

3.5 CONSIDERATIONS FOR OTHER ALTERNATIVES

3.5.1 Alternative B: Leasing and Resource Potential Considerations for EIAs

Alternative B describes several EIAs in the Proposed Action area. Potentially excluding these areas from leasing would impact leasing viability as well as levels of exploration, development, production, and decommissioning activities. **Tables 3.5-1** and **3.5-2** contrast the acreage of the EIAs with the acreage of the associated program area, as well as the combined footprint of the all geologic plays within the respective program area. Geological plays are used to assess the potential for undiscovered oil and natural gas development in an OCS planning area. An individual play is identified and mapped based on common geologic characteristics and a common history of hydrocarbon generation, migration, reservoir development, and entrapment. In many of the planning areas, geologic plays are often stacked in the vertical dimension.

Potential exclusions in the Beaufort Sea and Chukchi Sea Program Areas are likely to have the largest impact on activity levels given their relative size and location coincident with high hydrocarbon resource potential.

Table 3.5-1. Area Available for Leasing and Area of Combined Geologic Plays

Program Area	Acreage of Program Area (including existing leases)	Acreage of all Geologic Plays
Beaufort Sea	64,721,992	11,950,174
Chukchi Sea	53,159,584	34,266,636
Cook Inlet	1,093,532	1,093,451

Note: Acreage only reflects areal extent of geologic plays.

Table 3.5-2. Areas of EIAs Compared to Program Areas and Combined Footprint of Geologic Plays

Program Area	EIA	No. of Geologic Plays overlapping EIAs	Acreage of EIA	Percent of Program Area Acreage	Percent of Geologic Plays Acreage
Beaufort Sea	Kaktovik	4	599,530	0.9	5.0
	Camden Bay	5	127,574	0.2	1.1
	Cross Island	9	925,641	1.4	7.8
	Overlap of Camden Bay and Cross Island EIAs	*4*	*32,567*	*0.05*	*0.3*
	Barrow Canyon	8	1,014,392	1.6	8.3
Chukchi Sea	Walrus Foraging Area	15	5,348,051	10.1	15.6
	Walrus Movement Corridor	6	1,487,070	2.8	4.3
	Overlap of Walrus Foraging Area and Movement Corridor EIAs	*5*	*1,280,994*	*2.4*	*3.7*
Cook Inlet	Beluga Whale Critical Habitat	4	29,372	2.7	2.7

3.5.2 Alternatives C and D: Energy Substitutes Considerations

Assuming demand for energy would not decrease commensurately with the decrease in production that would result from no leasing under the 2017–2022 Program, Alternatives C and D could require energy substitutes and/or conservation to replace the oil and gas production that would not occur as a result of excluding one or more program areas (Alternative C) or having no leasing at all under the 2017-2022 Program (Alternative D) (**Sections 2.4** and **2.5**; **Table 3.5-3**).

Energy production could shift from OCS oil and gas to onshore oil and gas, international oil and gas production, or domestic production of oil and gas alternatives (e.g., renewable energy). The process for calculating these impacts begins with the application of MarketSim, a multi-market equilibrium model that simulates the energy supply, demand, and price effects of OCS oil and gas production compared with baseline projections from the USEIA (2016b). In addition to simulating oil and natural gas markets, MarketSim addresses substitution effects across coal and electricity segments of the energy market. Modeling each of these sectors, MarketSim produces an estimate of the energy market's response to the absence of OCS production. **Table 4.4.4-1** presents the changes in energy markets estimated by MarketSim. The table shows the percent of foregone OCS oil and gas production that would be substituted by each energy sector.

Table 3.5-3. Energy Substitutions under Alternatives C and D

Energy Sector	Replacement Percent (Low-Price Scenario)	Replacement Percent (Mid-Price Scenario)	Replacement Percent (High-Price Scenario)
Domestic onshore oil and gas	28	24	26
Existing OCS or state waters oil and gas	1	1	1
Oil imports	60	65	63
Gas imports	< 1	< 1	< 1
Other	3	3	3
Coal	< 1	< 1	< 1
Electricity from sources other than coal, oil, and natural gas	1	1	1
Reduced demand	7	7	7

Source: BOEM 2016b

To ensure that national demands for oil and gas are met, a sharp increase in oil imports via tanker and pipeline would be likely. The quantities of domestic onshore production of oil and natural gas also are anticipated to increase, accounting for approximately 24 percent of foregone OCS production in the mid-price scenario. The reduction in OCS oil and gas production related to excluding any or all of the program areas would be replaced by an increase in electricity production and reduced demand or energy conservation measures. Conservation could take the form of increased fuel economy (e.g., driving more fuel efficient vehicles, driving smaller and lighter cars, driving at slower speeds, replacing gasoline engines with hybrids and diesel engines) or reducing miles traveled by private vehicles through use of public transportation and eliminating some trips.

Potential impacts from substitute energy sources (e.g., more tankers bringing imported oil) are quite variable and would be determined by the type and location of substitution (e.g., increase in foreign oil imports, renewable energy, onshore drilling). An exception could be made when increased energy efficiency or conservation are the effective substitutes, as those actions often result in decreased use of the energy resources that give rise to adverse environmental consequences. Impacts of energy substitutes are discussed in **Section 4.4.4**.

3.6 IMPACT-PRODUCING FACTORS

Impact assessment considers impacting activities, processes, and pathways, known as IPFs, to determine the context and intensity of effects on environmental resources. At the Five-Year Program stage, it is not possible to perfectly identify the nature, magnitude, and timing of IPFs for OCS future activities. Each phase of OCS activity has a set of IPFs (some unique to a particular phase) that could affect physical or environmental conditions and one or more natural, cultural, or socioeconomic resources.

Table 3.6-1 outlines IPFs for OCS spills from initial exploration to decommissioning, differentiating between routine activities and accidental events. **Table 3.6-2** provides a general description of each IPF. **Table 3.6-3** presents a preliminary determination of the stressor-receptor relationship for oil and gas development activities considered within the current impact analysis, including routine activities and non-routine events.

Table 3.6-1. Summary of IPFs associated with OCS Oil and Gas Activities

Impact-Producing Factor	Exploration		Development	Production	Decommissioning
	Geophysical/ Geologic Survey	Exploration Drilling			
Routine Activities					
Noise	X	X	X	X	X
Geophysical Noise (including seismic)	X	X	X	X	X
Ship Noise	X	X	X	X	X
Aircraft Noise	X	X	X	X	X
Drilling Noise	–	X	X	–	–
Trenching Noise	–	–	X	–	–
Production Noise	–	–	-	X	–
Offshore Construction	–	–	X	–	–
Onshore Construction	–	–	X	–	–
Platform Removal (includes explosives use)	–	–	–	–	X
Traffic	X	X	X	X	X
Aircraft Traffic	–	X	X	X	X
Ship/Vessel Traffic	X	X	X	X	X
Routine Discharges	X	X	X	X	X
Sanitary Wastes	X	X	X	X	X
Gray Water, Misc. Discharges	X	X	X	X	X
Drilling Mud/Cuttings/Debris	X	X	X	–	X
Produced Water	–	X	X	X	–
Bottom/Land Disturbance	X	X	X	X	X
Drilling	–	X	X	–	–
Infrastructure Emplacement	X	–	X	–	–
Pipeline Trenching	–	–	X	–	–
Onshore Construction	–	–	X	–	–
Structure Removal Activities	–	–	–	–	X
Anchoring	X	X	X	X	X
Air Emissions	X	X	X	X	X
Offshore	X	X	X	X	X
Onshore	–	–	X	X	X
Lighting/Physical Presence	X	X	X	X	X
OCS Facilities	X	X	X	X	X
Onshore Facilities	–	–	X	X	–
Visible Infrastructure	–	X	X	X	–
Offshore	–	X	X	X	–
Onshore	–	–	X	X	–
Space Use Conflicts	X	X	X	X	–
OCS Facilities	X	X	X	X	–
Onshore Facilities	–	–	X	X	–
Non-Routine Events					
Accidental Spills	X	X	X	X	X

Key: "X" = the activity includes coincident IPFs; "–" = the activity does not include coincident IPFs.

Table 3.6-2. General Description of IPFs

IPF and Specific Sources	General Description
Noise	
Geophysical Noise	The E&D scenario considers two main types of geophysical surveys: (1) marine seismic surveys, which generally cover a large area of leased and/or unleased acreage; and (2) geohazard surveys, which include side-scan sonar and shallow-penetrating, reflection seismic profiling to detect archaeological resources or seafloor features that could be problematic for operations, such as drilling a well or installing a platform or pipeline on a more specific site. Geohazard surveys often are accompanied by geotechnical surveys, which involve sampling or measuring mechanical properties or stability of near-seafloor sediments. Sound source levels depend on equipment type and size. Airgun arrays can have source levels of 216 to 259 dB (decibels) re 1 µPa-m (micropascals at reference distance of 1 m), with frequencies < 120 Hertz (Hz). Other techniques (e.g., sparkers, boomers) are in the range of 212 to 221 dB re 1 µPa m, with frequencies in the 800 to 1,200 Hz range (Richardson et al. 1995, NOAA and MCBI 2000).
Ship Noise	Ship noise is a combination of narrow-band (tonal) and broadband sound. The primary sources of ship noise are propeller cavitation, propeller singing, and propulsion; other sources include auxiliaries, flow noise from water dragging along the hull, and bubbles breaking in the wake (Richardson et al. 1995). Sound source levels depend on vessel size. Small vessels (e.g., crew boats, tugs, self-propelled ships) have source levels of 145 to 170 dB re 1 µPa-m, with frequencies of 37 to 6,300 Hz. Larger vessels (e.g., commercial vessels, supertankers) have source levels of 169 to 198 dB re 1 µPa-m, with frequencies of 6.8 to 428 Hz (Richardson et al. 1995, Greene and Moore 1995).
Aircraft Noise	Penetration of aircraft noise into the water is greatest directly below the aircraft; much of the sound is reflected and does not penetrate into the water at angles > 13° from vertical (Richardson et al. 1995). The duration of underwater sound from passing aircraft is much shorter in water than air. For example, a helicopter passing at an altitude of 152 m (500 ft) that is audible in air for 4 minutes could be detectable underwater for only 38 seconds at 3 m (10 ft) depth and for 11 seconds at 18 m (59 ft) depth (Richardson et al. 1995). Sound source levels of fixed-wing aircraft and helicopters are 156 to 175 dB re 1 µPa-m, with frequencies of 47 to 7,070 Hz.
Drilling Noise	Noise from drilling operations contains strong tonal components at low frequencies (< 500 Hz), including infrasonic frequencies (Richardson et al. 1995). Machinery noise can be continuous or transient and can vary in intensity. Noise levels vary with the type of drilling rig and water depth. Drillships produce the highest levels of underwater noise because the hull containing the rig generators and drilling machinery is well coupled to the water. In addition, dynamically positioned drillships use thrusters to maintain position and are constantly emitting engine and propeller noise. Jack-up rigs are at the other end of the spectrum because they are supported by metal legs with only a small surface area in contact with the water. The drilling machinery is on decks well above the water, and there is no propulsion noise. Semi-submersibles are intermediate in noise level because the machinery is well above the water but pontoons supporting the structure have a large surface area in contact with the water. Sound source levels vary depending on the drilling structure: drilling from islands and caissons generates sound source levels of 140 to 160 dB re 1 µPa-m, with frequencies of 20 to 1,000 Hz; drilling from bottom-founded platforms generates received sound levels of 119 to 127 dB re 1 µPa-m, with frequencies of 5 to 1,200 Hz; drilling from vessels generates sound source levels of 154 to 191 dB re 1 µPa-m, with frequencies of 10 to 10,000 Hz (Greene and Moore 1995, Richardson et al. 1995).
Production Noise	Production noise is generally low frequency and similar to drilling noise.
Trenching Noise	Pipeline trenching is conducted by using plow and jet burial and generates continuous, transient, and variable sound levels.

IPF and Specific Sources	General Description
OCS Construction	Construction noise is expected to be composed of vessel noise (e.g., support vessels, heavy lift vessels) and equipment noise. Construction noise would tend to be limited to the vicinity of the activity, except for drilling, dredging, and pile driving, which can be detected over fairly wide areas. Dredging sound source levels are 150 to 180 dB re 1 μPa-m with peak frequencies of 20 to 1,000 Hz; pile driving generates a sound source level of 228 dB re 1 μPa-m with a broadband frequency range peaking in the 100 to 500 Hz range.
Onshore Construction	Onshore construction includes construction of new landfalls; possible new infrastructure; and expansion of existing ports, docks, and other infrastructure. Onshore construction could include the use of vehicles (e.g., trucks, earthmoving equipment) or vessels (e.g., dredges, pile-driving equipment, barges).
Platform Removal (includes explosives use)	Explosive severance uses specially designed bulk or shaped charges with specific properties to produce enough stress upon detonation to completely sever the bottom-founded components of a platform. Explosive charges generally are placed inside the platform legs or conductors at a depth of 4.6 to 7.6 m (15 to 25 ft) below the seafloor. Platform removal using explosives generates sound source levels of 267 to 279 dB re 1 μPa-m (Barkaszi et al. 2016; Saint-Arnaud et al. 2004; CSA 2004a). Frequency content is broadband.
Traffic	
Aircraft Traffic	All aircraft would be expected to follow Federal Aviation Administration guidance over land, which recommends a minimum altitude of 610 m (2,000 ft) when flying over noise-sensitive areas such as national parks, national wildlife refuges, and wilderness areas (FAA 2004). When in transit on the OCS, helicopters generally maintain a minimum altitude of 213 m (700 ft). Guidelines and regulations have been implemented by the NMFS under the authority of the MMPA that require operational altitudes of 305 m (1,000 ft) within 91 m (300 ft) of marine mammals (50 CFR Ch. II). During normal production operations, the frequency of helicopter flights on the OCS would remain the same (one to three per platform per day).
Ship/Vessel Traffic	Support-vessel traffic is estimated to consist of one to three trips per platform per week from the shore base. If barges are used to transport the drill cuttings and spent mud from production wells during drilling operations, a dedicated barge could make one to two trips per week to an onshore disposal facility. Oil spill response vessels could operate near the shore or in the vicinity of a platform to serve as immediate response assets during operations or to periodically conduct exercises.
Routine Discharges	
Sanitary Wastes	Sanitary waste consists of human body wastes from toilets and urinals. Sanitary waste is routinely treated by means of a marine sanitation device that produces an effluent with a maximum residual chlorine concentration of 1.0 mg/L and no visible floating solids or oil and grease. Wastewater treatment sludge is normally transported to shore for disposal at an approved facility.
Gray Water and other Miscellaneous Discharges	Miscellaneous discharges include deck drainage; desalination unit brine; and uncontaminated cooling water, bilge, fire, and ballast water. Domestic waste, or gray water, includes water from showers, sinks, laundries, galleys, safety showers, and eye wash stations. Aside from screening to remove solids, domestic waste does not require treatment before discharge. Food waste, a type of domestic waste, is routinely ground prior to discharge.

IPF and Specific Sources	General Description
Produced Water / Well Completion or Enhanced Recovery Fluids	Produced water is water that is brought to the surface from an oil-bearing formation during oil and gas extraction (Neff et al. 2011). It is the largest individual discharge produced by normal operations. Small amounts of effluents and oil are routinely discharged in produced water during OCS operations. Produced water discharges must meet a daily maximum of 42 mg/l and a monthly average of 29 mg/l for oil and grease per National Pollution Discharge Elimination System (NPDES) permits issued by the U.S. Environmental Protection Agency (USEPA)((40 CFR 435). Completion and workover fluids and various inhibitors can be discharged with produced water but according to NPDES permits requirements. Well treatment and enhanced recovery operations can improve the flow of reservoir fluids into the wellbore. The fracture pack or "frac pack" completion process uses pressurized fluids, typically seawater, brine, or gelled brine, to create small fractures in the reservoir rock within a zone near the wellbore where the reservoir's permeability was damaged by the drilling process. The pressurized high-density, gelatin-like fluid also serves as the carrier for the mechanical agent or proppant that is mixed with the completion fluids. The mechanical agents, typically sand, manmade ceramics, or small microspheres (tiny glass beads), are injected into the small fractures and remain lodged in the fractures when the process is completed. The proppant serves to hold the fractures open, allowing them to perform as conduits to assist the flow of hydrocarbons from the reservoir formation to the wellbore. Well-treatment chemicals are also commonly used to improve well productivity. Boehm et al. (2001) identifies additives and proppants used offshore for fracturing. In general, discharges of any fluids, including those associated with well completion activities, are subject to the terms of NPDES permits issued by the USEPA. These permits place limitations on the toxicity of all effluents and other requirements for monitoring and reporting.
Exploratory and Development Drilling Muds and Cuttings	During deep stratigraphic test well operations, geologic boring, and drilling, drilling muds are circulated down a hollow drill pipe, through the drill bit, and up the annulus between the drill pipe and the borehole. Drilling muds are used for the lubrication and cooling of the drill bit and pipe. The muds also remove the cuttings that come from the bottom of the oil well and help prevent loss of well control by acting as a sealant. The drilling muds carry drill cuttings (i.e., crushed rock produced by the drill bit) to the surface. The drilling muds are then processed on the platform to remove the cuttings and are recycled back down the well. The separated cuttings are, in most cases, discharged to the ocean. There are two classes of drilling muds used in the industry in the United States: water-based muds (WBMs) and synthetic-based muds (SBMs) (Neff 2010). Several field studies have shown that the highest concentrations of cuttings are usually in sediments within approximately 100 m (328 ft) of the platform. However, cuttings could be deposited 1 to 2 km (0.6 to 1.2 mi) from the discharge point. The potential impacts of accumulated drilling muds and cuttings are expected to be localized and short-term.
Loss of Debris (all phases)	Debris includes accidental loss of tools or equipment and trash overboard, and allowable seafloor components remaining after decommissioning. In deep water, the probability that components would be left on the seafloor is higher.
Bottom/Land Disturbance	
Drilling	Physical disturbance of the seafloor would be limited to the proximal area where the well infrastructure and borehole penetrates the substrate and where mud and drill cuttings would be deposited.
Infrastructure Emplacement	Bottom disturbance from structure emplacement operations would disturb bottom habitat and produce localized, temporary increases in suspended sediment. This would result in decreased water clarity and little reintroduction of pollutants. Structure emplacements can act as fish-attracting devices and result in the aggregation of migratory and reef fish species.

IPF and Specific Sources	General Description
Anchoring	Drilling, platform, mooring, and pipeline laying operations on the OCS require anchors to hold the rig, topside structures, pipeline laying barges, support vessels, or other equipment in place. Anchoring can disturb the seafloor and sediments in the area where emplaced, or damage sensitive habitat or sensitive cultural resources. Anchoring can cause physical compaction beneath the anchor and chains or lines, as well as resuspended sediment. The greatest potential physical disturbance is from anchor chains and cables; areal extent and severity of the impacts are related to the size of the mooring anchor and the length of chain resting on the bottom.A disturbed area on the sea bottom forms by the swing arc formed by anchor lines scraping across bottom within the range of the anchoring system configuration.
Pipeline Trenching	Trenching for pipeline burial causes displacement or resuspension of seafloor sediments. Areas adjacent to the trench would be covered by excavated sediments, and organisms could be affected by sedimentation and turbidity associated with the disturbance of bottom sediments during trench excavation and backfilling. Impacts could be reduced by implementing measures to restrict the dispersal of sediments. If anchors are used, the cable sweep inherent in the progression of the barge would affect more area than any other seafloor disturbance.
Onshore Construction	Typical infrastructure (new or currently existing that would be expanded or retrofitted) that would support OCS activity and would affect biological, physical, and socioeconomic resources include construction of the following: • Ports and support facilities (repair and maintenance yards, crew services, support sectors) • Construction facilities (platform fabrication yards, shipyards and shipbuilding yards, pipe coating facilities and yards) • Transportation (pipelines, railroads) • Processing facilities (natural gas processing, natural gas storage, LNG facilities, refineries, petrochemical plants, waste management).
Structure Removal	Structure removal that could result in impacts is defined as the removal of OCS platforms by the use of explosives or by cutting the structure below the sediment line; also includes the removal of pipelines, which causes seafloor disturbance and sediment displacement.
Air Emissions	
Offshore	Activities affecting air quality include vessel operations during geophysical surveys and oil spill response exercises, drilling activities, platform construction and emplacement, pipeline laying and burial operations, platform operations, flaring, fugitive emissions, support vessel and helicopter operations, and evaporation of volatile organic compounds (VOCs) during transfers and spills.
Onshore	Activities affecting air quality onshore include emissions from new infrastructure constructed onshore and OCS activities that occur within 40 km (25 mi) of a state's boundary.
Lighting/Physical Presence	
OCS Facilities	Physical presence and lighting from structures on the OCS include platform lighting, construction lighting, MODU lighting, and/or vessel lighting. OCS facilities are routinely equipped with mandatory navigation lighting and special use lighting for work areas, outside passageways, machinery spaces, control stations, alleyways, stairways, and exits. Navigation lights are operated to ensure that the facility is visible to other vessels and aircraft. Special use lighting is intended to ensure the safety of vessel personnel. As a result, navigation lighting must be visible to specified distances, while special use lighting could be shielded or other alternative techniques employed to minimize projection into the environment (e.g., alteration of color; flashing).

IPF and Specific Sources	General Description
Onshore Facilities	Presence of and lighting from: • Ports and support facilities (repair and maintenance yards, crew services, support sectors) • Construction facilities (platform fabrication yards, shipyards and shipbuilding yards, pipe coating facilities and yards) • Transportation infrastructure (pipelines, roads, railroads, gravel pads) • Processing facilities (natural gas processing, natural gas storage, LNG facilities, refineries, petrochemical plants, waste management).
Visible Infrastructure and Activities	
OCS	Visual or aesthetic experience related to facilities or activities on the OCS.
Onshore	Visual or aesthetic experience related to support facilities or activities onshore.
Space-Use Conflicts	
OCS Facilities	Time/area conflicts among military/National Aeronautics and Space Administration (NASA) use, fishing, subsistence use, renewable energy (e.g., Wind Energy Areas, and LNG facilities).
Onshore Facilities	Planning and siting of onshore facilities, ports, construction facilities, transportation, and processing facilities.
Non-Routine Events	
Expected Accidental Events	Fuel, crude oil, or other spills resulting from accidents, weather events, and collisions.
Unexpected CDE	Well blowout. Low-probability, very large volume, longer-duration spills with the potential for catastrophic effects.

Table 3.6-3. Resources potentially affected by OCS Impact-Producing Factors

Impact Producing Factor	Air Quality	Water Quality	Coastal and Estuarine Habitats	Marine Benthic Communities	Pelagic Communities	Marine Mammals	Sea Turtles	Birds	Fishes and EFH	Arctic Terrestrial Wildlife & Habitat	Archaeological & Historical Resources	Population, Employment, & Income	Land Use and Infrastructure	Commercial & Recreational Fisheries	Tourism and Recreation	Sociocultural Systems	Environmental Justice
Routine Project-Related Activities																	
Noise				•	•	•	•	•	•	•				•	•	•	•
Traffic		•	•		•	•	•	•		•					•	•	
Routine Discharges		•		•	•	•	•	•	•					•	•	•	•
Drilling Muds/Cuttings/Debris		•		•	•	•	•	•	•					•	•	•	•
Bottom/Land Disturbance		•	•	•	•	•	•	•	•	•	•	*	•	•		•	•
Emissions	•					•	•	•		•					•	•	•
Lighting/Physical Presence					•	•	•	•	•	•				•	•	•	•
Visible Infrastructure											•		•		•	•	•
Space-Use Conflicts													•		•	•	•
Non-Routine or Accidental Events																	
Oil Spills	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Other Spills or Discharges	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Key: * = The IPFs do not apply to Population, Employment, and Income impacts. Rather, the Proposed Action could catalyze population, employment, or income changes.

Notes: Climate change and human health effects are considered as issues of programmatic concern in **Section 4.2**. Acoustics are discussed in **Appendix D**.

3.7 CUMULATIVE ACTIVITIES SCENARIO

A cumulative impact under the NEPA “results from the incremental impact of [an] action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions” (40 CFR 1508.7). It is important to consider the lease sales that might be held under the Program in a broader context that accounts for the full range of actions and associated impacts taking place within each of the four program areas, currently and in the foreseeable future (**Section 3.7.3**). Repeated actions, even minor ones, could produce significant impacts over time. Impacts in a programmatic NEPA review typically focus on environmental effects over a large geographic or time scale. Consequently, the depth and detail in a programmatic analysis reflects the major broad and general impacts that could result from making programmatic decisions (CEQ 2014).

An understanding of the protracted time frame and large spatial domain related to cumulative actions is important for contextualizing cumulative impacts. This section outlines the framework of cumulative actions. **Section 4.5** provides the analysis of cumulative effects, focusing on the incremental contribution to cumulative effects from the Proposed Action. **Figure 3.7-1** shows the incremental contribution from the Proposed Action as the difference in the effects and trends relative to the future condition that would likely occur under the No Action Alternative.

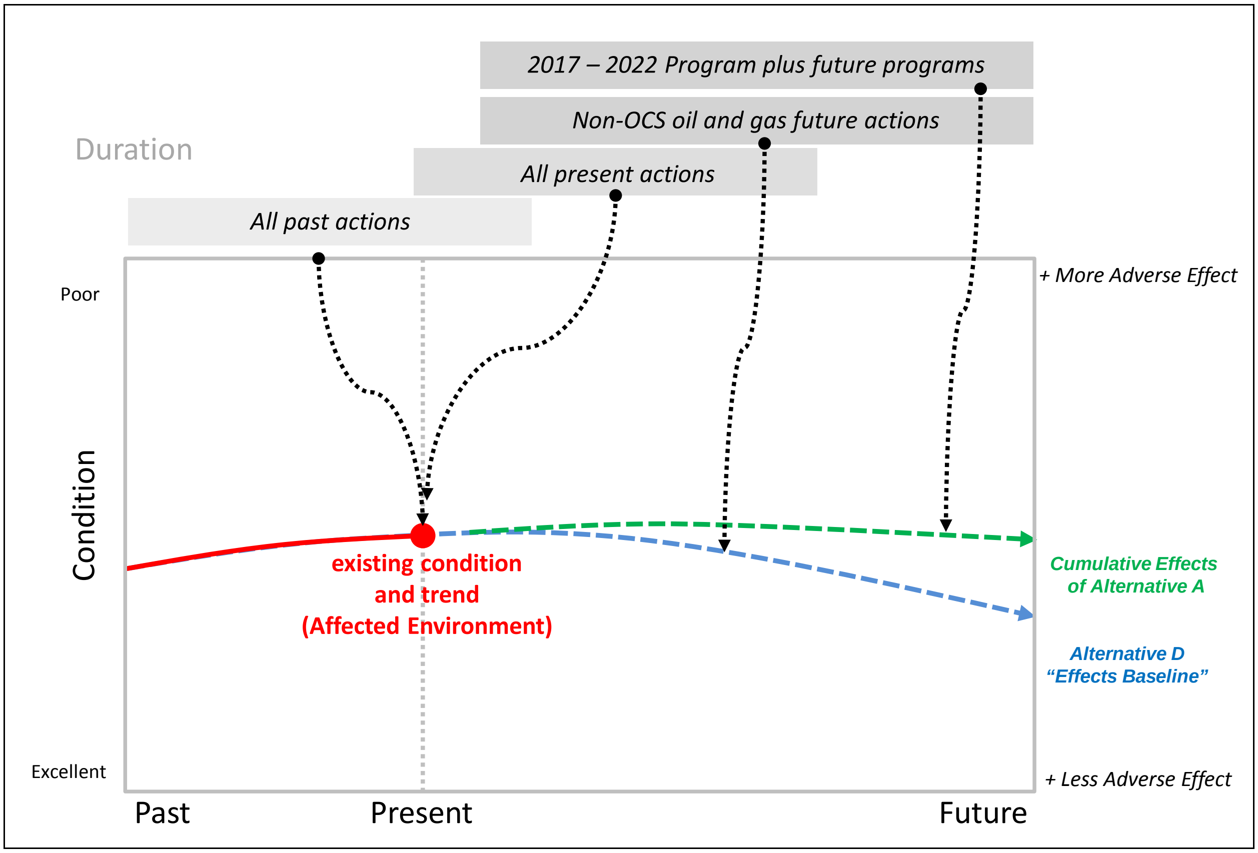


Figure 3.7-1. Conceptual Framework for Cumulative Effects

3.7.1 Methodology for Assessing Cumulative Impacts

The general approach for the cumulative impacts assessment follows the principles outlined by Eccleston (2011), Magee and Nesbitt (2008), CEQ (1997a), and guidance developed by the USEPA (1999). It also considers the findings and recommendations of the NEPA task force and the CEQ as they pertain to programmatic assessments and environmental management systems (The NEPA Task Force 2003, CEQ 2014).

The cumulative impacts assessment focuses on the resources, ecosystems, and human communities that would be affected by the incremental impacts associated with the Program, in combination with other past, present, and reasonably foreseeable future actions. Cumulative impacts on a given resource, ecosystem, or human community could result from single actions or a combination of multiple actions over the protracted time frame considered. They could be additive, less than additive (counteracting), or more than additive (synergistic).

The baseline analysis for the No Action Alternative is used to describe the change to the future condition of the Affected Environment (the "effects baseline") that could happen even in the absence of the Proposed Action or action alternatives (Magee and Nesbitt 2008). The No Action Alternative describes these changes that could occur to the environmental baseline described in the Affected Environment (**Section 4.3**), especially considering the protracted time frame under consideration (the "effects baseline"). This allows the decisionmaker to compare future impacts from the Proposed Action and alternatives with the long-term effect of taking no action.

The cumulative impacts assessment considers the incremental contribution of the Proposed Action to impacts from past, ongoing and future actions, and consider the possibility of future OCS leasing as described in **Section 3.7.3.2** (**Figure 3.7-1**). Impacts from ongoing and non-OCS oil and gas future actions are described in the effects baseline for Alternative D. The cumulative impacts discussion in **Section 4.6** considers the incremental contribution of the Proposed Action to the overall impacts that could occur over the same time frame.

3.7.2 Spatial and Temporal Boundaries for the Cumulative Impacts Assessment

Spatial Boundaries: The spatial boundaries (i.e., regions of interest) for the cumulative impacts assessment encompass the geographic areas of affected resources and the distances at which impacts associated with past, present, and reasonably foreseeable future actions would occur. For the cumulative impacts analysis, marine and coastal ecoregions are used as the spatial framework for most resources because they encompass the areas potentially affected by the Proposed Action, future Programs, and other non-Program actions, within and beyond the administrative planning area boundaries in which such activities would be occurring. Marine regions are ecosystem-based regions defined according to the boundaries of large marine ecosystems (LMEs) developed by the National Oceanic and Atmospheric Administration (NOAA). The geographic scope of the cumulative analysis varies depending on the resources being evaluated and their geographic distribution (**Table 3.7-1**).

Table 3.7-1. Regions of Interest for the Cumulative Impacts Analysis

Resource	Arctic Region	Cook Inlet	Gulf of Mexico
Water Quality	Coastal waters (bays); marine (state offshore and Federal OCS) and deep waters in the Chukchi and Beaufort Seas	All waters of Cook Inlet	Coastal waters (bays and estuaries), marine waters (state offshore and Federal OCS), and deep water (depths >305 m [1,000 ft])
Air Quality	Shelf waters (marine), North Slope Borough	Kenai Peninsula, Alaska Peninsula, and Kodiak Island Boroughs	Northern GOM waters (marine). Coastal counties in Texas, Louisiana, Mississippi, Alabama, and Florida
Coastal and Estuarine Habitats	Coastal and nearshore habitats within estuarine watersheds along the coastline and around bays, lagoons, and river mouths; includes barrier islands, beaches, low tundra, marshes, tidal flats, scarps, peat shorelines, and seagrass	Coastal and nearshore habitats within estuarine watersheds of the coastline and around bays, lagoons, and river mouths; includes beaches, marshes, tidal flats, scarps, river mouths/deltas, and seagrass	Estuarine drainage areas (NOAA); coastal and nearshore habitats, including barrier islands, beaches, wetlands, mangroves and seagrasses

Resource	Arctic Region	Cook Inlet	Gulf of Mexico
Marine Benthic Habitats	Seafloor of the Beaufort/Chukchi Shelf Marine Ecoregion and the Arctic Slope and Arctic Plains Marine Ecoregions	Seafloor of the Alaska Fjordland Shelf Ecoregion; includes Kachemak Bay, Shelikof Strait, lower Cook Inlet, and Gulf of Alaska (oil spills)	Seafloor of the OCS and slope/deep sea; includes soft sediments, hard bottom areas, chemosynthetic communities, warm water coral reefs, and deepwater coral reefs
Pelagic Habitats	Water column and water surface of the Beaufort/Chukchi Shelf Marine Ecoregion	Water column and water surface of the Cook Inlet and Shelikof Strait	Water column and water surface of the Mississippi and Texas Estuarine Areas
Marine and Terrestrial Mammals (ESA- and non-ESA species)	Beaufort/Chukchi Shelf Level II Ecoregion, including the Chukchi Neritic and Beaufort Neritic Level III Ecoregions (marine) and coastal habitats of the Arctic region (terrestrial)	Cook Inlet Level III Coastal Region; Gulf of Alaska Level III Coastal Region (marine) and coastal habitats in the Cook Inlet Planning Area and nearby coastal habitats in the Gulf of Alaska	Northern GOM waters (marine) and coastal habitats of northern GOM waters (terrestrial)
Marine and Terrestrial Reptiles (ESA- and non-ESA species)	N/A	N/A	Coastal habitats and OCS waters of the Western, Central, and Eastern Planning Areas
Marine and Coastal Birds (ESA- and non-ESA species)	Beaufort and Chukchi Seas, including coastal habitats	Cook Inlet Planning Area, including coastal habitats (wetlands and bays) used by migratory species; includes mudflats, beaches, lagoons, and islands	Northern GOM coastline, including coastal habitats used by migratory species from northern latitudes; includes coastal wetlands and marshes, mud flats, and beaches. Trans-Gulf flyways
Fish	Waters and seafloor of the Beaufort and Chukchi Seas and associated bays, estuaries, and rivers	Cook Inlet waters and seafloor and associated rivers and bays	Northern GOM waters and seafloor (continental shelf to abyssal plain) and associated rivers, bays, lakes, and estuaries
Essential Fish Habitat	Water and substrate of the Arctic Management Area	Water and substrate from the lower Cook Inlet to the Gulf of Alaska shelf; includes estuaries, bays, kelp forests, and reefs identified by the Gulf of Alaska Fisheries Management Area of the North Pacific Fisheries Management Council	Water and substrate of coastal, estuarine, and marine environments; includes submerged aquatic vegetation, emergent intertidal wetlands (marshes and mangroves), soft-bottom (mud, sand, or clay), live/hard bottom, oyster reefs, coral reefs, marine sediment, continental slope, chemosynthetic cold seeps, *Sargassum*, and man-made structures identified by the GOM Fishery Management Council

Resource	Arctic Region	Cook Inlet	Gulf of Mexico
Terrestrial Wildlife	North Slope Region (Chukchi Sea coastline northeast towards Prudhoe Bay and TAPS)	Cook Inlet region, including coastal habitats (wetlands and bays) used by migratory species; includes mudflats, beaches, lagoons, and islands (oil spills)	Northern GOM coastline, including coastal habitats used by migratory species from northern latitudes; includes coastal wetlands and marshes, mud flats, and beaches (oil spills)
Archaeological and Historical Resources	Beaufort and Chukchi Seas Planning Areas, including adjacent onshore areas	Cook Inlet Planning Area, including adjacent onshore areas	Western, Central, and Eastern Planning Areas, including adjacent onshore areas (e.g., river channels, floodplains, terraces, levees)
Population, Employment, and Income	North Slope and Northwest Arctic Boroughs	Anchorage municipality, Kenai Peninsula, Kodiak Island, and Matanuska-Susitna Boroughs	Relevant counties and Economic Impact Areas in Texas, Louisiana, Mississippi, Alabama, and Florida along the GOM coast
Land Use and Infrastructure	Land in the vicinity of the Beaufort and Chukchi Seas Planning Areas	Lands in the vicinity of the Cook Inlet Planning Area	Coastal counties along the northern GOM
Commercial and Recreational Fisheries	Arctic Management Area	Upper and Lower Cook Inlet Management Areas; Gulf of Alaska	GOM coastal states
Tourism and Recreation	North Slope Borough (mainly Barrow and Deadhorse)	Cook Inlet area (including Anchorage), Kenai Peninsula, and Prince William Sound	Coasts of Florida, Alabama, Mississippi, Louisiana, and Texas
Sociocultural Systems	North Slope and Northwest Arctic Boroughs	South-central Alaska (including Anchorage, Kenai, Soldotna, Nikiski, Port Lions, Nawlek, Port Graham, and coastal communities)	Coastal counties along the northern GOM
Environmental Justice	North Slope and Northwest Arctic Boroughs	Anchorage municipality, Kenai Peninsula, Kodiak Island, and Matanuska-Susitna Boroughs	Relevant counties and Economic Impact Areas in Texas, Louisiana, Mississippi, Alabama, and Florida along the GOM coast
Climate Change	Coastal communities inshore of the Beaufort and Chukchi Sea Planning Areas	Coastal communities inshore of the Cook Inlet Planning Area	Coastal states, counties, and communities of the northern GOM
Acoustic Environment (Noise)	Chukchi Sea and Beaufort Sea LMEs	Gulf of Alaska LME	GOM LME

Key: GOM = Gulf of Mexico; ESA = Endangered Species Act; LME = large marine ecosystem; MMPA = Marine Mammal Protection Act; N/A = not applicable; OCS = Outer Continental Shelf.

Setting the spatial boundaries for the cumulative effects analysis based on the No Action Alternative over the 40- to 70-year time frame of the cumulative impacts analysis is speculative. This is because under Alternative D, there would be no OCS oil and gas lease sales held during the 2017-2022 period, and, as a result, energy demand would likely be met using other energy sources. Some of the lost OCS oil and gas production would be replaced by tanker imports into existing terminals, but some would be made up by onshore production (transported via pipelines) and domestic production of oil and gas alternatives (**Section 2.5**). Therefore the mix of non-OCS sources of energy and the locations of resource or energy development are unknown, but could occur throughout the U.S. or the world, both on land or at sea, rendering a spatial boundary to be speculative.

Temporal Boundaries: The cumulative impacts assessment incorporates the sum of the effects of the Proposed Action in combination with other past, present, and reasonably foreseeable future actions because impacts could accumulate or develop over time. The future actions described in this analysis are those that are "reasonably foreseeable;" that is, they are ongoing and are expected to continue into the future, are funded for future implementation, or are included in firm near-term plans. The reasonably foreseeable time frame for future actions evaluated in this analysis is approximately 40 to 70 years from the time the Program takes effect in each particular program area. The time frame represents the temporal boundaries for all alternatives.

3.7.3 Past, Present, and Reasonably Foreseeable Future Actions

Impacts and stressors that contribute to the current and future condition of a resource result from impacts caused by both OCS and non-OCS actions. The ongoing and reasonably foreseeable future actions are summarized below and in **Appendix B**. They provide context for the analysis of direct and indirect impacts from the Proposed Action and alternatives (**Sections 4.4.1**, **4.4.2**, **4.4.3**, and **4.4.4**), as well as for the analysis of cumulative impacts associated with implementation of the Proposed Action (**Section 4.4.5**).

3.7.3.1 Existing OCS Activities

In the Arctic, activities from past OCS leasing would be expected to continue. Active leases remain in the Beaufort Sea from the following lease sales: Beaufort Sea Lease Sale (1979), 124 (1991), 144 (1996), 186 (2003), 195 (2005) and 202 (2007). With the exception of leases in the Northstar and Liberty units, no activities are currently occurring on these active leases. In the Chukchi Sea, all leases are from Lease Sale 193 held on February 6, 2008; all but one of these leases has been relinquished. In Cook Inlet, there are no existing OCS oil and gas leases, although there is a lease sale scheduled for June 2017. G&G activities could also occur in Cook Inlet. In the GOM, OCS oil and gas activities would be expected to continue from leasing through the end the existing (2012–2017) Program. .

3.7.3.2 Cumulative OCS Cases

The following summarizes the E&D scenarios for the cumulative OCS activities for Alaska (Arctic [Beaufort and Chukchi Seas] and Cook Inlet) and the GOM for approximately 40 to 70 years after each initial regional sale.

Figures 3.7-2 through **3.7-6** provide estimated magnitude and timing of cumulative OCS oil and gas activity levels in the Beaufort Sea, Chukchi Sea, Cook Inlet, and GOM, respectively, for a mid-price scenario. The structures in operation refer to all production structures that would be operating in a given planning area over the time frame specified. In all price scenarios, the Proposed Action contributes a relative proportion towards the cumulative case, contributing least in the GOM where there are already high levels of activities. For example, peak production in the GOM from the 2017–2022 Program occurs approximately 20 years after the first lease sale in 2017 (**Figures 3.2-6a** and **3.2-6b**). Twenty years after the first lease sale, under the mid-price scenario, production from the Program is expected to contribute approximately half of the production in the GOM. As time passes, the relative greater contribution of total GOM production would come from leases issued under future Five-Year Programs. Different price scenarios would result in different magnitudes of activity and production; despite the influence of price, coherent trends persist. IPFs for cumulative OCS activities are similar to those described for the Proposed Action. Estimates of the assumed numbers of large and small expected oil spills that could result from all OCS activities over the 40- to 70-year time frame are presented in **Table 3.7-2**.

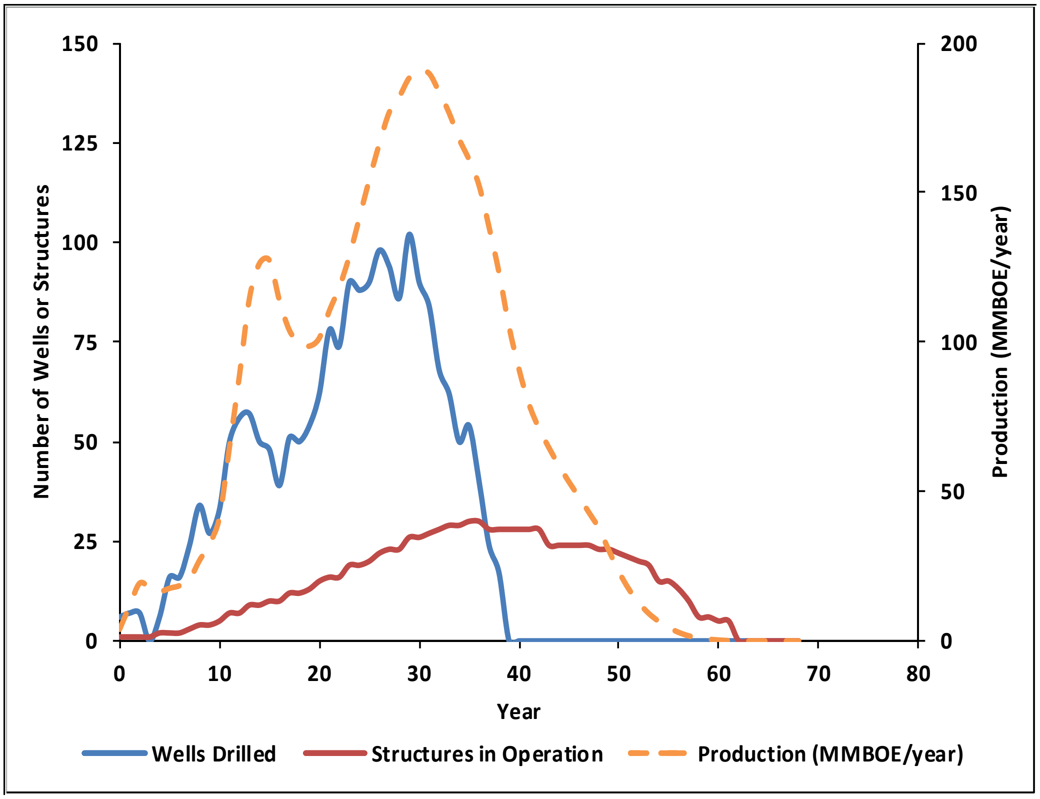


Figure 3.7-2. Estimated Cumulative E&D Activity in the Beaufort Sea Planning Area (Year 0 = 2017)

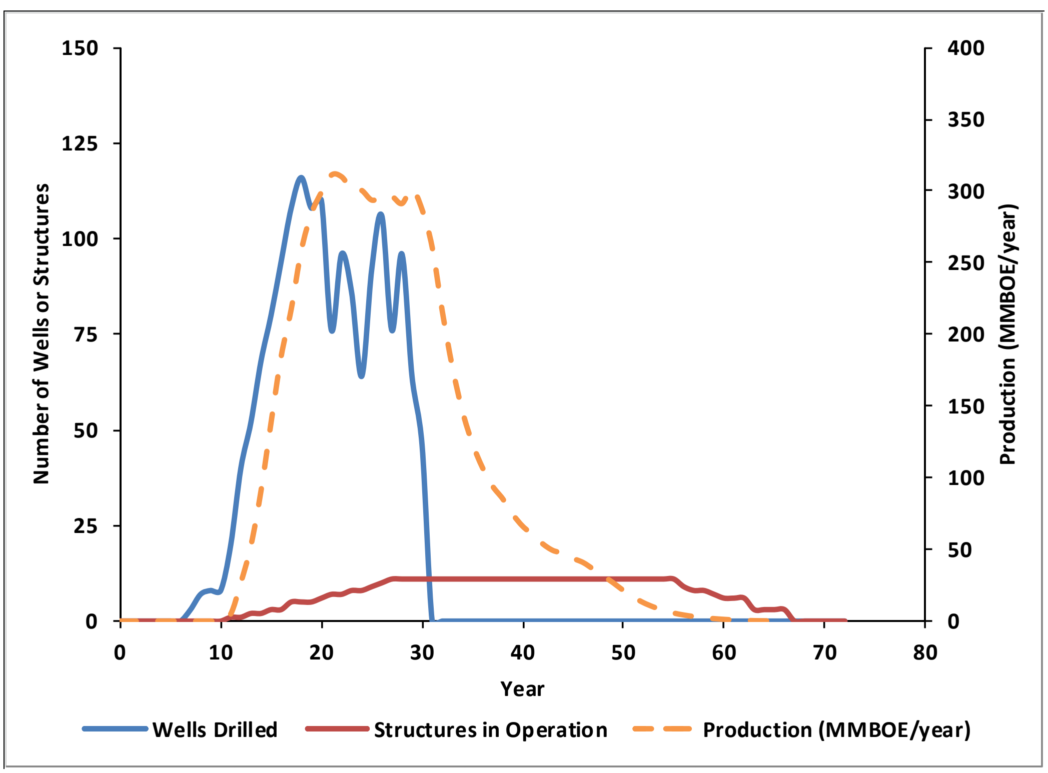


Figure 3.7-3. Estimated Cumulative E&D Activity in the Chukchi Sea Planning Area (Year 0 = 2017)

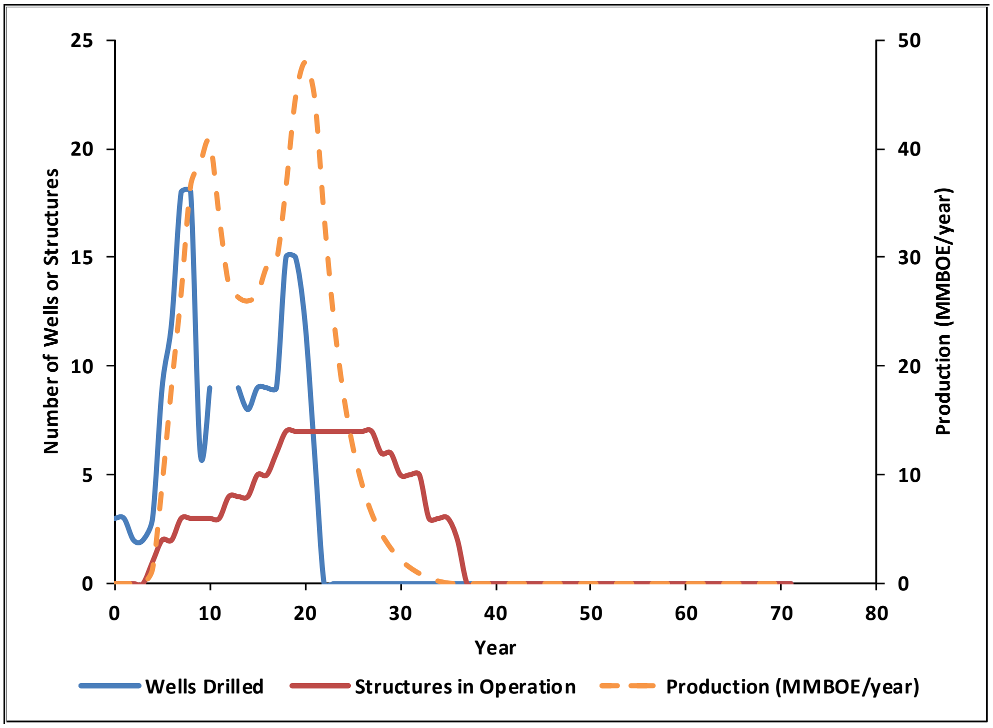


Figure 3.7-4. Estimated Cumulative E&D Activity in the Cook Inlet Planning Area (Year 0 = 2017)

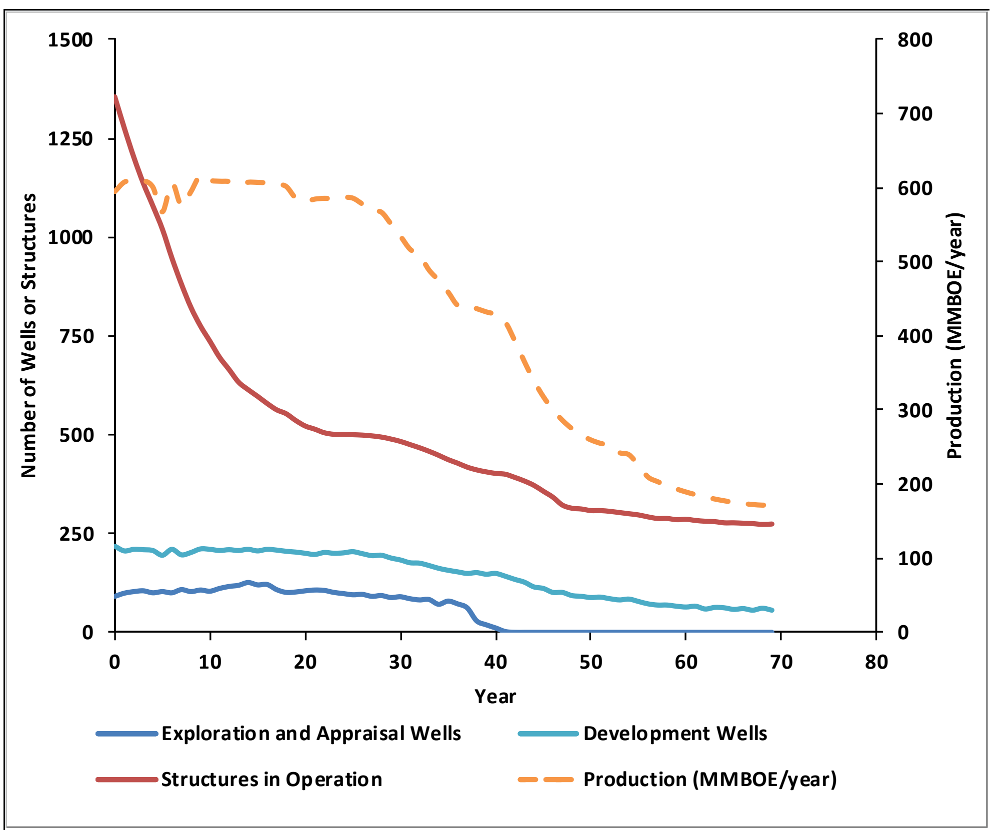


Figure 3.7-5. Estimated Cumulative E&D Activity in the Eastern/Central Planning Area (Structures do not include Subsea Structures, Year 0 = 2017)

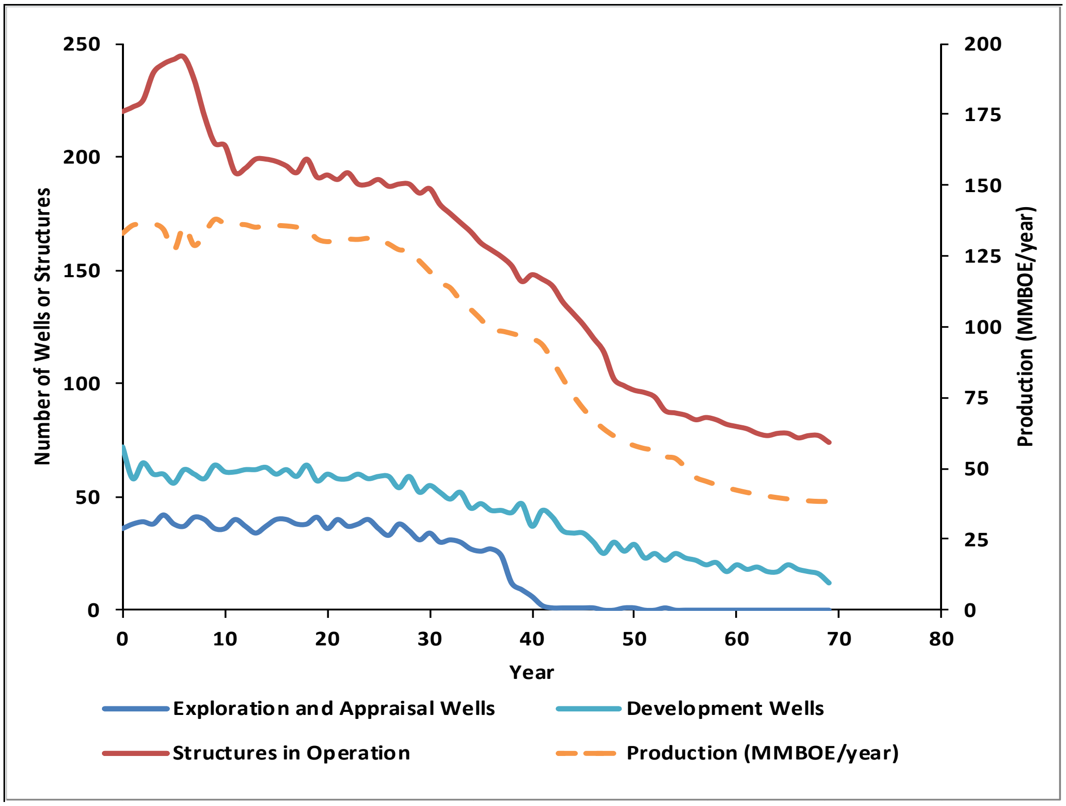


Figure 3.7-6. Estimated Cumulative E&D Activity in the Western Planning Area (Structures do not include Subsea Structures, Year 0 = 2017)

Table 3.7-2. Estimated Number of Accidental Spills in the Cumulative Case

Spill Size (and *Type*)	Assumed Spill Volume (bbl)	Estimated Number of Spills[1]				
		GOM Program Area		Arctic Program Areas		Cook Inlet Program Area
		Western	Central/ Eastern	Beaufort Sea	Chukchi Sea	
Large[2]						
Platform[3]	3,283[5]	0 to 1	4 to 5	0 to 2	0 to 2	0 to 1
Pipeline[4]	3,750[5]	2 to 4	13 to 20	0 to 6	0 to 6	0 to 1
Small[6]	≥ 1 to < 50	135 to 277	1,037 to 1,676	0 to 470	0 to 484	16 to 65
	≥ 50 to < 1,000	26 to 52	194 to 313	0 to 88	0 to 91	3 to 12

Notes:
[1] The number of spills is estimated using the 1974 to 2015 spill rates found in ABS (2016). The estimated number of spills is rounded up to a whole number. For example, the estimated number of platform and pipeline spills could each be less than 1 spill, but reported as 1 spill in each category; when summed, the combined number of platforms and pipeline spills is less than 1 spill.
[2] A large spill is defined as ≥ 1,000 bbl (ABS 2016). Large spills are reported for platforms and pipelines separately. Spills from tankers were not included in this table due to the low number of expected events (< 1) given the small volume potentially tankered.
[3] The ≥ 1,000 bbl spill rate for platforms is 0.22 spills/Bbbl handled.
[4] The ≥ 1,000 bbl spill rate for pipelines is 0.89 spills/Bbbl handled.
[5] The assumed spill volume for platforms and pipelines is the median oil spill size from 1974 to 2015 for spills ≥ 1,000 bbl.
[6] The number of spills < 1,000 bbl is estimated using the total spill rate for pipeline and platform spills. The ≥ 50 to < 1,000 bbl spill rate for pipelines and platforms combined is 14.13 spills/Bbbl handled. The ≥ 1 to < 50 bbl spill rate for pipelines and platforms combined is 75.64 spills/Bbbl handled.

3.7.3.3 Non-OCS Oil and Gas Program Actions and Trends

Other cumulative actions and uses in the OCS regions include renewable energy; dredging and beach nourishment and coastal restoration activities; commercial fishing; state oil and gas activities; national defense activities; tourism and recreation; commercial shipping and transport; coastal recreation, including recreational fishing and diving; and subsistence use. This section summarizes the information at the regional level, while highlighting important distinctions between the different planning areas in a region for ongoing activities, oil and gas activities, and other uses. **Appendix B** summarizes ongoing cumulative actions and describes reasonably foreseeable future actions and trends affecting resources and systems that are analyzed in **Chapter 4**. The principal source of information on the economic and public uses of the OCS and the surrounding coastal region for the different planning areas is BOEM's report, *Economic Inventory of Environmental and Social Resources Potentially Impacted by a Catastrophic Discharge Event within OCS Regions* (BOEM 2014b).

3.7.3.3.1 Alaska OCS Region

The 15 planning areas in the Alaska OCS Region are grouped into three subregions: (1) the Arctic (Beaufort Sea, Chukchi Sea, and Hope Basin); (2) the Bering Shelf (Navarin Basin, North Aleutian Basin, St. George Basin, Norton Basin, St. Matthew-Hall, and Bowers Basin); and (3) the Pacific Margin (Cook Inlet, Gulf of Alaska, Shumagin, Kodiak, and Aleutian Arc).

Arctic Region

Table B-1 in **Appendix B** summarizes ongoing and reasonably foreseeable future actions and trends affecting resources and systems in the Arctic Region. Reasonably foreseeable future actions/trends considered include oil and gas activities, subsistence activities, marine vessel traffic (including circum-Arctic traffic), scientific research, wastewater discharge, contaminant and debris persistence, military operations, mining, dredging, recreation and tourism, and climate change. Drastic changes in and variable levels of activities are possible across this wide range of cumulative actions considered over the 70-year timeframe.

Ongoing Oil and Gas Exploration, Development, and Production Activities and Existing Infrastructure

Onshore and in-State or International Waters: Oil and gas exploration in the Arctic Region of Alaska began in the late 1950s when federally sponsored geological studies found that the region had significant hydrocarbon potential. The first State of Alaska lease sale on the North Slope took place in 1964, and by 1968, the Prudhoe Bay oil field, the largest oil field in North America, was in production and the TAPS was completed in 1977 with a peak flow of more than 2 million barrels of oil per day in 1988. By 2001, oil development on the North Slope consisted of 19 producing fields and related infrastructure, including roads, pipelines, power lines, production facilities, and transportation hubs. Due to the high cost of building infrastructure and the remoteness and harsh weather of the region, many Arctic fields remain undeveloped including parts of the Prudhoe Bay oil field.

As of August 4, 2016, the ADNR indicates that there are 1,360 active oil and gas leases in the North Slope, covering a total of 1.14 million hectares (ha) (2.84 million acres [ac]) onshore, and 41,000 ha (101,415 ac) offshore in the Beaufort Sea region (ADNR 2016a). Currently, there are more than 30 producing oil fields and satellites on the North Slope and nearshore areas of the Beaufort Sea. Oil fields are distributed among the various unit pools: Prudhoe Bay (12), Duck Island (3), Northstar (1), Badami (1), Kuparak (5), Milne Point (3), Colville River (8), Ooogaruk (1), and Nakiatchuq (1) (NETL 2009, ADNR 2016b). Industrial development centers on Prudhoe Bay and National Petroleum Reserve in Alaska (NPR-A) (BLM 2016); infrastructure includes artificial gravel islands, roadways, pipelines, production and processing facilities, gravel mines, and docks. In recent years, oil production from the North Slope has declined to less than 200 million barrels a year. The State of Alaska plans to hold areawide oil and gas lease sales along the North Slope and Beaufort Sea through 2019 as part of the Alaska State Five-Year Program (ADNR 2015a). Currently, there are no leases held or lease sales planned in the state waters of the Chukchi Sea, and no oil and gas production along its coast (BOEM 2015b).

It is possible that offshore oil and gas activities in other countries could affect U.S. waters. Ongoing activities in Russian or Canadian waters could result in an oil spill that spreads into the Alaska OCS.

Important IPFs associated with oil and gas development include noise and vibrations, platform lighting, engine emissions and fuel spills from transport vehicles, oil spills from storage tanks and vessel casualties, hazardous spills and releases, oil and chemical releases from wells and produced water, disturbance or injury of fish and wildlife, and habitat displacement or degradation. These activities contribute to cumulative effects on air and water quality, the acoustic environment, coastal habitats, coastal fauna (fish, marine and terrestrial mammals, and birds), commercial and recreational fisheries, sociocultural systems (local economies and subsistence), and, if present, cultural resources.

Ongoing Other Uses in the Arctic

Commercial activity in the Arctic subregion is limited. There is oil and gas production in state waters adjacent to the Beaufort Sea Planning Area (BOEM 2015b). Since the late 1960s, NASA, other Government agencies, and educational institutions have carried out scientific research using suborbital rockets launched from the Poker Flat Research Range (PFRR), outside of Fairbanks, Alaska. The PFRR is the only high-latitude, auroral-zone rocket launching facility in the U.S. where a sounding rocket can readily study the aurora borealis and the sun-earth connection. Over the past 10 years, launch frequency has averaged approximately four rocket flights per year, with all launches occurring during the winter months when scientific conditions are optimal. Several configurations of PFRR-launched sounding rockets, including spent stages and payloads, have the potential to land within the boundaries of the Beaufort Sea Program Area (**Figure 3.7.7**). NASA estimates that at least 70 PFRR-launched rocket motors and payloads have landed within the Beaufort Sea since the range's inception (NASA 2013). The potential for space-use conflict in the Beaufort Sea Program Area is considered low due to limited temporal and spatial interactions. The vast majority of sounding rocket launches occur from October–April when the presence of sea ice would preclude use of vessels farther offshore. Jettisoned sounding rocket items typically land more than 300 km (186 mi) offshore.

Fishing activity is limited to subsistence and recreational fishing, since commercial fishing is prohibited in U.S. waters north of the Bering Strait. Among native communities (such as the Iñupiat along the Chukchi and Beaufort Seas), subsistence fishing and hunting activities have significant cultural value and provide a substantial portion of many communities' annual diets. The harsh Arctic climate and the difficulty of physically accessing the area limit most recreational activity in the Arctic. Some recreational fishers are non-residents, who visit primarily in the summer, but Arctic oilfield workers account for most recreational fishing in the area.

The patterns and amount of vessel traffic in the Arctic are highly affected by seasonal variability and ice cover. There is limited travel infrastructure in the region, so transportation by water and, during the winter, via over-ice roads, are important means of moving fuel and supplies for area residents. In addition to military activities in OCS waters, the U.S. Coast Guard conducts search and rescue missions and coordinates with the U.S. Navy to conduct ice thickness and acoustic surveys in the Arctic OCS. Scientific research, focusing on wildlife, oceanography, and ice dynamics, is also common in the Chukchi and Beaufort Seas.

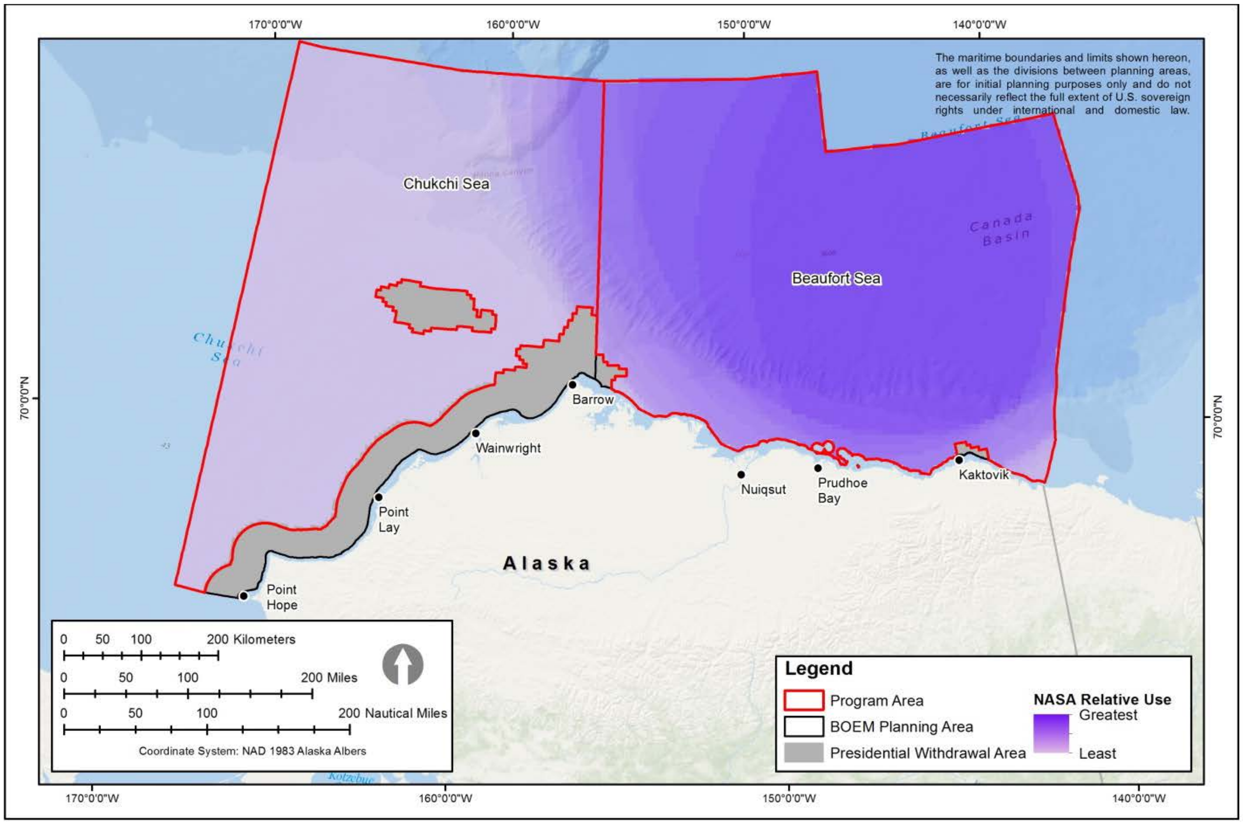


Figure 3.7-7. Estimated Recovery Area for Spent Stages or Payloads of Sounding Rockets in the Poker Flat Research Range Flight Corridor in the Beaufort Sea Program Area

Cook Inlet

Table B-2 in **Appendix B** summarizes ongoing and enumerates reasonably foreseeable future actions and trends affecting resources and systems in Cook Inlet. Reasonably foreseeable future actions/trends considered include oil and gas activities, commercial fishing, harbor and port development, marine vessel traffic, renewable energy production, wastewater discharge, contaminant and debris persistence, military operations, mining, dredging, recreation and tourism, and climate change.

Ongoing Oil and Gas Exploration, Development, and Production

Oil and gas discoveries in the upper Cook Inlet cover an estimated 11,400 square kilometers (km^2) (4,400 mi^2), and extend from the Kachemak Bay area north to the Susitna River. The area includes fields in the Cook Inlet OCS, the western shore of the Cook Inlet, and the western half of the Kenai Peninsula.

As of August 4, 2016, the ADNR estimates that there are 358 active oil and gas leases in the Cook Inlet region, covering a total of 149,127 ha (368,500 ac) onshore, and 248,073 ha (613,000 ac) offshore (ADNR 2016c, ADNR 2016d). Currently, there are 17 production platforms in Cook Inlet, all of which are in state waters. Oil production has fluctuated between 3–7 million barrels per year over the past 10 years. Crude oil production is handled through the Trading Bay Production Facility on the western side of Cook Inlet, which pipes the crude oil received to the Drift River Oil Terminal. Almost all Drift River crude oil, most of which is consumed within Alaska, is transported to the Tesoro Refinery in Nikiski on the eastern shore of Cook Inlet; natural gas is also processed through several plants in Nikiski and consumed locally. The State of Alaska plans to hold areawide oil and gas sales along the Cook Inlet through 2019 as part of the Alaska State Five-Year Program (ADNR 2015a).

Important IPFs associated with oil and gas development include subaerial and subsea noise and vibrations, platform lighting, engine emissions and fuel spills, oil spills from storage tanks and vessel casualties, hazardous spills and releases, oil and chemical releases from wells and produced water, disturbance or injury of fish and wildlife, habitat displacement or degradation, seafloor disturbance by anchors and mooring lines, and bottom disturbance increasing turbidity and resuspended contaminants. These activities contribute to cumulative effects on air and water quality, the acoustic environment, marine and coastal habitats, marine and coastal fauna (fish, marine and terrestrial mammals, and birds), commercial and recreational fisheries, sociocultural systems (local economies and subsistence), and, if present, cultural resources.

Ongoing Other Uses of the Pacific Margin

Commercial fishing, harvesting and processing seafood, tourism and recreation, and commercial shipping are all important industries in and adjacent to the Pacific Margin subregion. Particularly important industries along the Gulf of Alaska, Aleutian Arc, Kodiak, and Shumagin include commercial fishing and seafood harvesting/processing. While these are somewhat less important along Cook Inlet, they are still economically important.

Tourism is a critical component for the economies of Cook Inlet and the Gulf of Alaska, but is limited in and near the Kodiak, Shumagin, and Aleutian Arc Planning Areas. Visitor industry-related employment accounts for more than 10 percent of all employment in Juneau (Gulf of Alaska area) and approximately 20 percent of all sales tax revenue collected by the city.

Commercial shipping is also important in the Pacific Margin subregion. The Port of Valdez in the Gulf of Alaska is the largest Alaskan port and 1 of the 20 largest in the U.S. as defined by total traffic, largely due to oil shipments. The Port of Anchorage on the eastern end of Cook Inlet is essential for many Alaskans with a large percentage of goods moving through the port. In addition, thousands of commercial vessels pass through the Gulf of Alaska, Kodiak, Shumagin, and the Aleutian Arc annually along the "Great Circle" shipping route from the Pacific Northwest to Asia. Oil and gas production in state waters adjacent to the Pacific Margin subregion is currently limited to the Cook Inlet Planning Area.

Important public uses in and along the Pacific Margin subregion include coastal recreation as well as recreational and subsistence fishing and hunting. Cook Inlet is a popular destination for outdoor recreational activities, particularly fishing, hiking, boating, hunting, and wildlife viewing. The majority of sportfishing in Alaska takes place along the south-central coast. Subsistence fishing and hunting is a critically important public use of coastal and marine resources across the four planning areas in the subregion. Communities engage in subsistence hunting and fishing for their economic, social, cultural, and spiritual value and to meet basic nutritional needs. While species of salmon are the primary subsistence source, halibut and shellfish, particularly crab, are also important. Subsistence fishing and hunting make up a substantial portion of many communities' annual diets. This includes residents on the Kenai Peninsula, villages on the western side of Cook Inlet (e.g. Tyonek) and in Anchorage (all of which are adjacent to Cook Inlet).

3.7.3.3.2 Gulf of Mexico Region

Table B-3 in **Appendix B** summarizes ongoing and enumerates reasonably foreseeable future actions and trends affecting resources and systems in the GOM. Reasonably foreseeable future actions/trends considered include oil and gas activities, commercial fishing, harbor and port development, marine vessel traffic, renewable energy development and production, scientific research, LNG facilities and oil imports, wastewater discharge, contaminant and debris persistence, military operations, mining, dredging, recreation and tourism, hypoxia, and climate change.

Ongoing Oil and Gas Exploration, Development, and Production

Oil and gas development is the main industrial activity in the GOM region, including the coastal waters of the GOM states and in Mexico's waters. All the GOM states except Florida have active oil and/or natural gas programs in state waters and/or on adjacent coastal lands. Mississippi does not have oil and gas activities occurring in state waters, although the State of Mississippi can explore oil and gas development in state waters in the future. In 2014, oil and natural gas produced in GOM state waters totaled more than 10 MMbbl and 140,000 mcf, respectively (USEIA 2015a, USEIA 2015b). Production is generally in decline because producing fields are mature. It is possible that activities in Mexico and Cuba could result in a spill that could reach the waters of the U.S. GOM.

Important IPFs associated with oil and gas development include subaerial and subsea noise and vibrations, platform lighting, engine emissions and fuel spills from marine vessels, oil spills from storage tanks and vessel casualties, hazardous spills and releases, oil and chemical releases from wells and produced water, disturbance or injury of fish and wildlife, habitat displacement or degradation, chronic seafloor disturbance by anchors and mooring lines, bottom sediment disturbance increasing turbidity and resuspended contaminants, and wildlife collisions with marine vessels. These activities contribute to cumulative effects on air and water quality, the acoustic environment, marine and coastal habitats, marine and coastal fauna (fish, marine and terrestrial mammals, and birds), commercial and recreational fisheries, sociocultural systems (local economies and subsistence), and, if present, cultural resources.

Renewable Energy and Non-energy Marine Minerals

BOEM has not received nominations for renewable energy leasing in the Western, Central, or Eastern Planning Areas in the GOM. Therefore, it appears unlikely that commercial leasing for renewable energy resources will proceed in the 2017–2022 timeframe. Noting that leases with discoveries of oil or gas can be held for as long as commercial production continues, any renewable energy leasing that occurs during the approximately 50-year lifespan of the producing leases issued during the 2017–2022 Program would need to be coordinated during the later stages of BOEM's oil and gas leasing process (e.g., lease sale, EP, and Development and Production Plan stages).

BOEM has issued, or plans to issue, leases and agreements for sand and gravel projects along the GOM, specifically offshore the western coast of Florida, Mississippi, and Louisiana. BOEM's Gulf of Mexico Region Marine Minerals Program expects to be a substantial resource to the GOM coastal region as funds from the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies Act (RESTORE Act) are used for restoration projects by coastal states. Typically, the sand/gravel borrow areas are in 9 to 18 m (30 to 60 ft) of water in close proximity to the coast.

Military Uses

The U.S. Department of Defense (USDOD) conducts training, testing, and operations in offshore operating and warning areas, at undersea warfare training ranges, and in special use or restricted airspace on the OCS. These activities are critical to military readiness and national security. The U.S. Navy uses the airspace, sea surface, subsurface, and seafloor of the OCS for events ranging from instrument and equipment testing to live-fire exercises. The U.S. Air Force conducts flight training and systems testing over extensive areas on the OCS. The U.S. Marine Corps conducts amphibious warfare training extending from offshore waters to the beach and inland.

Some of the most extensive offshore areas used by the USDOD include Navy at-sea training areas. Training and testing can occur throughout the U.S. GOM OCS waters, but is concentrated in operating areas and testing ranges. These activities vary, depending on where they occur (e.g., open water versus nearshore). Major testing and training areas in the GOM include the Gulf of Mexico Range Complex; the

Naval Surface Warfare Center, Panama City Division; and the Key West Complex off the southwestern tip of Florida.

The USDOD and USDOI will continue to coordinate extensively under the 1983 Memorandum of Agreement, which states that the two parties shall reach mutually acceptable solutions when the requirements for mineral E&D and defense-related activities conflict.

Other Uses

The most notable "other uses" in terms of economic contribution in the GOM are tourism and recreation (including recreational fishing), commercial fishing and harvesting seafood with over $1 billion in value for 2014 (NOAA 2016a), and commercial shipping. Millions of individuals participate in a variety of recreational activities in the region's coastal environment each year, including recreational fishing, boating, beach visitation, wildlife viewing, and swimming. Texas, Louisiana, and Florida have significantly more coastline and more coastal population centers than Alabama or Mississippi. However, while tourism and recreation contribute more to the gross domestic product (GDP) in states with more coastline and more coastal population centers, the tourism and recreation industries in Alabama and Mississippi still make up sizable portions of the states' GDPs and sizeable percentages of each state's total employment.

On an annual basis, coastal tourism and recreation industries contribute more than $1 billion in GDP along the Western and Central Planning Areas and more than $10 billion in GDP along the Eastern Planning Area. Commercial fishing and seafood industries also contribute billions to state GDP on an annual basis, most notably in and along the Eastern Planning Area, contributing more than $4 billion to Florida's GDP. The commercial fishery sector is the largest in Louisiana, followed by Texas and Florida. However, Florida's commercial fishery sector contributes most to the GDP because of its contributions further along the seafood supply chain (e.g., processors, retailers).

Commercial shipping also is economically important. As measured by the amount of cargo flowing through the ports on an annual basis, more than half of the 20 largest U.S. ports are along the Gulf coast, mostly along the Western and Central Planning Areas. While very little data exist to track its economic contribution, subsistence fishing and harvesting seafood also are an important public use of coastal and marine resources along the three GOM planning areas, particularly in rural communities. Subsistence harvesting, including fishing and hunting, continues among some ethnic and low-income groups (Hemmerling and Colten 2004) but also occurs recreationally with higher-income groups.

4. AFFECTED ENVIRONMENT AND IMPACT ASSESSMENT

4.1 INTRODUCTION

This chapter contains a programmatic description of the affected environment and the impact assessment on a regional scale for each alternative across the full range of potential effects in each of the four program areas. Alternatives A (the Proposed Action), B (exclusion or mitigation of EIAs), C (Reduced Proposed Action), and D (the No Action Alternative) are described in detail in **Chapter 2**. Some impacts involve features specific to particular program areas, and these are identified as warranted. However, most impact conclusions involve considerations that are common throughout a program area, and some cross all program areas. For this reason, the discussion of impacts for Alternative A, the Proposed Action, is not structured by program area. Furthermore, the discussion does not address specific OCS planning areas, which either encompass an entire program area (Beaufort Sea, Chukchi Sea, Cook Inlet) or are adjacent areas in the GOM Program Area (Western and Central/Eastern Planning Areas) because their separate consideration would not lead to different impacts conclusions.

BOEM actively solicited the most recently available science/data necessary to effectively describe all potential impact pathways relevant to the Proposed Action during the scoping process. The level of analysis in this Programmatic EIS is in compliance with recent CEQ guidance on programmatic reviews (CEQ 2014) and is an appropriate level of detail for the decision at hand. The analysis is at a national level, and the scope of impacts is described broadly. The anticipated context and intensity of impacts from proposed activities associated with OCS oil and gas exploration, development, production, and decommissioning are discussed herein. If a decision is made to move forward with any of the proposed lease sales in the proposed Five-Year Program, additional environmental reviews would take place that would be more site-specific and analyze impacts on ESA-listed and non-listed species in greater detail. Subsequent NEPA documents would be written at the individual lease sale level.

For each resource, IPFs identified in **Section 3.6** were carefully considered and refined to identify aspects specific to the environmental, sociocultural, and socioeconomic resources under evaluation. Analyses identified, as applicable, the sensitivities of each resource to further refine the relationship between impacting factors and the resource, establishing a clearer stressor-receptor relationship.

This Programmatic EIS incorporates by reference the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (DWHNRT 2016). The analysis was prepared by Federal and state natural resource agencies (identified as the Trustees), as authorized under the Oil Pollution Act of 1990. The document presents the Trustees' injury assessment and proposed restoration plan, and considers the environmental impacts of the proposed restoration and alternatives to that restoration in accordance with NEPA. The Trustees concluded that the injuries caused by the *Deepwater Horizon* oil spill affected a wide array of linked resources over an enormous area, and that the effects must be described as an ecosystem-level injury. Therefore, a comprehensive, integrated ecosystem restoration plan was proposed, with a portfolio of restoration types to address the diverse suite of injuries that occurred at both regional and local scales.

4.1.1 Impact Assessment Methodology

Impact analysis considers direct effects, indirect effects, and cumulative effects. Direct effects are those that could be caused by the activities associated with the Proposed Action and occur at the identical location and time of the action (40 CFR § 1508.8). Indirect effects are those that could be caused by the activities associated with the Proposed Action at a later time or are farther removed from the location of the action, but would still be reasonably foreseeable (40 CFR § 1508.8). Cumulative effects are additive, countervailing, or synergistic, and would result from incremental impact of the activities associated with the Proposed Action when compared or added to other past, present, or reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR § 1508.7; CEQ 1997a).

Based on comments received through the scoping or public comment process for this Programmatic EIS as well as a review of previous environmental analysis documents, BOEM has identified resources that could be impacted by activities associated with the 2017–2022 Program and the most likely IPFs (see **Section 3.6**). The CEQ has directed Federal agencies to focus environmental analysis on what is significant and de-emphasize what is not. Therefore, BOEM has undertaken a screening exercise to identify what stressor-receptor relationships could result in impacts and the level of those impacts (**Section 4.1.2**). **Appendix E** includes a structured presentation of each resource area, the IPFs that could impact each resource area, and a determination of the level of impact for each IPF. Impacts that are expected to be negligible or minor are disclosed and addressed in **Appendix E** to help focus the analysis in this chapter. Impacts that could rise to a moderate or major level are discussed in **Section 4.4**.

4.1.2 Impact Levels

Impact levels and associated terminology in this Programmatic EIS follow a prescribed set of impact definitions following a four-level classification scheme established by BOEM. The impact evaluation process considers potential impacts in terms of their temporal context (i.e., short- vs. long-term) and intensity (severity), guided by CEQ regulations implementing NEPA regarding the significance of impacts (40 CFR § 1508.27). This approach was also used to characterize impacts that could result from routine operations and expected accidental events and spills during OCS oil and gas activities. Although CDE-level accidents are not expected to occur under any of the alternatives, this Programmatic EIS discusses the types of effects that could arise if such an unexpected accident were to occur.

The following impact categories and definitions apply to **biological**, **physical**, and **archaeological resources**. For most biota, determinations are based on population-level impacts rather than impacts on individuals. For species listed under the ESA, impact levels consider impacts on individuals, when appropriate, as well as populations. While archaeological and historic resources are valuable for providing insights into past cultures and lifeways, they are physically present on or under the seafloor as well as onshore, and thus are affected in similar ways to biological and physical resources. Many shipwrecks also provide benefits to the marine ecosystem by providing stable structures for habitats in areas of the ocean that are devoid of such features. Impact levels and definitions include the following:

- **Negligible:** No measurable impact(s). See **Appendix E** for a discussion of anticipated negligible impacts per resource area.
- **Minor:** Most impacts on the affected resource could be avoided with proper mitigation; if impacts occur, the affected resource would recover completely without mitigation once the impacting stressor was eliminated, or there would be no loss of archaeological and historic information and a site would not require *in situ* stabilization. See **Appendix E** for a discussion of anticipated minor impacts per resource area.

- **Moderate:** Impacts on the affected resource are unavoidable. Viability or integrity of the affected resource is not threatened, although some impacts could be irreversible, or the affected resource would recover completely if proper mitigation is applied or proper remedial action was taken once the impacting stressor was eliminated, or some archaeological and historic information would be irretrievably lost, requiring *in situ* stabilization, and limited data recovery could be necessary to preserve some archaeological and historic information.
- **Major:** Impacts on the affected resource are unavoidable. Viability or integrity of the affected resource could be threatened and some impacts could be irreversible. The affected resource would not recover fully even if proper mitigation is applied or remedial action was implemented once the impacting stressor was eliminated, or the resource would have been damaged to such an extent that most of the archaeological and historic information that could have been gathered from the resource would have been irretrievably lost. *In situ* stabilization would not be a viable mitigation measure, and data recovery would be necessary to preserve remaining archaeological and historic information.

The following impact categories and definitions apply to **socioeconomic** and **societal** issues, including population, employment, and income; land use and infrastructure; commercial and recreational fisheries; tourism and recreation; sociocultural systems; and environmental justice. Impact levels and definitions include the following:

- **Negligible**: No measurable impacts. See Appendix E for a discussion of anticipated negligible impacts per resource area.
- **Minor**: Impacts on the affected activity, community, or resource could be avoided with proper mitigation. Impacts would not disrupt the normal or routine functions of the affected activity or community. Once the impacting stressor was eliminated, the affected activity or community would, without mitigation, return to a condition with no measurable effects. See Appendix E for a discussion of anticipated minor impacts per resource area.
- **Moderate**: Impacts on the affected activity, community, or resource would be unavoidable. Proper mitigation would reduce impacts substantially during the life of the project. A portion of the affected resource would be damaged or destroyed. The affected activity or community would have to adjust somewhat to account for disruption due to impacts of the project, or once the impacting stressor was eliminated; the affected activity or community would return to a condition with measurable effects if proper remedial action is taken.
- **Major**: Impacts on the affected activity, community, or resource would be unavoidable. Proper mitigation would reduce impacts substantially during the life of the project. For other socioeconomic and cultural resources, impacts could incur long-term effects. The affected activity or community would experience unavoidable disruptions to a degree beyond what is normally acceptable, and once the impacting stressor was eliminated, the affected activity or community could retain measurable effects for a significant period of time or indefinitely, even if remedial action was taken.

4.2 ISSUES OF PROGRAMMATIC CONCERN

4.2.1 Climate Change

The Earth's climate system is driven by solar radiation, which provides heat to the planet. Increasingly, anthropogenic changes to the Earth's atmosphere have slowed the rate at which this incoming solar radiation is re-radiated back into space, resulting in a net increase of energy in the Earth system (Solomon et al. 2007). The climate's subsequent response is complicated by a number of positive and negative feedback processes among atmospheric, terrestrial, and oceanic systems, but the overall result is climatic warming, as is evident by observed increases in air and ocean temperatures, melting snow and ice, and rising sea levels (IPCC 2007, IPCC 2014). These planet-wide chemical and physical changes are collectively referred to as climate change, and the changes can be directly attributed to the release of GHGs and other climate forcers, primarily as a byproduct of combustion (USEPA 2016a).

Chief among drivers of climate change are increasing atmospheric concentrations of CO_2 and other GHGs, such as CH_4 and nitrous oxide (N_2O). These GHGs reduce the ability for solar radiation to re-radiate out of Earth's atmosphere and into space. Although all three have natural sources, these three GHGs comprise the majority of GHGs released from anthropogenic sources; CO_2 and N_2O are released in association with combustion, and CH_4 and N_2O are both released as a byproduct of agriculture and also oil and gas production.

Other climate forcers, such as black carbon, which is a specific kind of fine particulate matter ($PM_{2.5}$ [particulate matter with a diameter equal to or less than 2.5 microns]), also contribute to Earth's rising surface temperature. Black carbon is a byproduct of combustion, and is dark relative to most surfaces, meaning that it has a low surface albedo that absorbs more solar energy than lighter surfaces. If black carbon lands on something with a high surface albedo that normally would reflect energy, like snow or ice, the black carbon can greatly lower the surface albedo. When the surface albedo decreases, the surface absorbs more solar radiation. In the case of snow and ice, the decrease in the surface albedo results in melting. This can expose a larger area of the ground, further lowering the surface albedo, and spreading the energy absorption effect over a wider area, contributing to overall climate change.

There are other GHGs, such as: hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride, and sulfur hexafluoride. These four GHGs, known collectively as fluorinated gases, are released in trace amounts, but are far more efficient at preventing solar radiation from being re-radiated back into space, and have a longer lifespan than CO_2, CH_4, and N_2O. Fluorinated gases have no natural sources and are either a product or a byproduct of certain manufacturing processes. Hydrofluorocarbons are used as refrigerants, in aerosols, and as a fire retardant. Perfluorocarbons are a byproduct of aluminum and semiconductor manufacturing. Nitrogen trifluoride is used as a cleaner in electronics manufacturing, and sulfur hexafluoride is used in electrical transmission equipment, such as circuit breakers and in magnesium processing and semiconductor manufacturing.

Average temperature in the continental United States has increased approximately 0.3°C (0.5°F) since 1895, and most of this increase has occurred since 1970. The most recent decade was the nation's and the world's hottest on record, and 2012 was the hottest year on record in the continental United States (IPCC 2014). The rate of warming for the past 50 years has roughly doubled the rate of the past 100 years (Trenberth et al. 2007). Across the United States, temperatures are generally projected to rise another 1.1 to 2.2°C (2 to 4°F) over the next few decades. During the 21st century, average global atmospheric temperature is projected to rise 1.65 to 2.75°C (3 to 5°F), under the lowest emissions scenarios (IPCC 2014). Meanwhile, the majority of heat energy associated with climate change is being absorbed by the oceans (Levitus et al. 2012), warding off what would otherwise be a more rapid rise in atmospheric temperatures. Although there are annual and decadal shifts in ocean heat content

(Levitus et al. 2012), temperatures in the upper 2,000 meters (6,562 ft) of the water column has increased dramatically since the 1950s.

Rising temperatures result in rising sea levels, leading to land submergence as a result of reduced sea ice areal extent and temporal duration, oceanic thermal expansion, and loss of permafrost. Globally, mean sea level has risen at a rate of 1.8 millimeters (mm)/year (± 0.5 mm/year) from 1961 to 2003, with considerable spatial and decadal-scale variability (Bindoff et al. 2007). Further, increasingly extreme weather such as severe droughts, flooding, and stronger hurricanes are expected to significantly alter habitats. The rate of climate change is expected to continue and possibly accelerate, although consequences would be felt unevenly across different ecosystems (Doney et al. 2014).

Climate change is also recognized to have consequences for national security by changing food and water availability, which could trigger domestic and international humanitarian crises, and increase the frequency of climate-driven emergencies. Recent reports describing the cascading effects of climate change on national security have been published by the White House (2015) and U.S. Navy through the National Academy of Sciences (NRC 2011).

Climate change will affect resources in OCS regions included in the Proposed Action. However, the pace and consequences of change are most acute in the Arctic (IPCC 2014), where temperatures have increased twice as much as those at lower latitudes (Symon et al. 2005, Jefferies and Richter-Menge 2014). These changes to the physical framework (e.g., sea level rise, shrinking ice caps), chemical framework (e.g., ocean acidification), and biological framework (e.g., changing habitats) of these areas could be compounded by the activities associated with the Proposed Action; some examples include the following:

1. Fertilization is expected to increase vegetative growth in certain areas, which releases VOCs. VOCs interact with NO_x released from oil and gas operations to produce haze and O_3, degrading air quality.
2. Ocean acidification, a byproduct of increasing atmospheric CO_2 concentrations, affects marine benthic and plankton communities, especially organisms that form hard shells.
3. Rising sea levels and warmer ocean water increase hurricane intensity and frequency, which are expected to damage or reduce coastal and estuarine habitats.
4. Melting sea ice is reducing polar bear habitat in the Arctic.
5. Changing ocean and coastal environments will affect marine and coastal bird habitats.
6. Shifting fisheries populations as a result of changing habitats are affecting commercial and recreational fishing.

Additional information on how climate change can exacerbate the Proposed Action's impacts on OCS resources is discussed in the relevant resource sections throughout **Chapter 4**.

4.2.1.1 Contribution from the Proposed Action

The activities associated with the Proposed Action would increase global GHG emissions from the use of vessels, drilling equipment, and other activities that burn fossil fuels. In addition, CH_4, also known as natural gas, is removed from wells and brought onto OCS facilities along with oil being produced. Sometimes CH_4 is released as a fugitive gas that can escape unintentionally from leaks in equipment used by operators. Operators have the four following methods of managing natural gas removed from wells:

- Production: selling the natural gas, provided there is a sufficient quantity, favorable market conditions, and infrastructure (e.g., natural gas pipelines) to justify production
- Reinjection: the natural gas is directed back into the reservoir to aid in oil extraction
- Venting: the deliberate release of natural gas into the atmosphere
- Flaring: burning the natural gas, converting it to CO_2 and water, and in some cases, also releasing N_2O and black carbon. This practice is rare on the OCS.

Of the fluorinated GHGs, only two are used on the OCS: hydrofluorocarbons and sulfur hexafluoride, which are used in trace amounts and are at no time deliberately emitted into the atmosphere. Because each GHG impacts the atmosphere at a different strength and for a different period of time, for analytical purposes, they typically are converted to what the strength would be if emissions were exclusively CO_2; this is referred to as the CO_2-equivelent (CO_2e) to facilitate comparison. CH_4 and N_2O are much more effective climate forcers than CO_2, meaning one ton of CH_4 or N_2O has a greater impact on climate change than one ton of CO_2. However, CH_4 and N_2O are removed from the atmosphere through natural processes more efficiently than CO_2. Accounting for these factors, CO_2e conversion for CH_4 and N_2O are 25 and 298, respectively (USEPA 2016b). This means one ton of CH_4 is estimated to have the same warming potential as 25 tons of CO_2, and one ton of N_2O would have the same impact as 298 tons of CO_2. Because black carbon is not a GHG and functions differently, it is not possible to convert it using the CO_2e method. However, because black carbon is a specific kind of $PM_{2.5}$, it is possible to use the $PM_{2.5}$ concentration to estimate the maximum amount of black carbon released. BOEM has regulatory authority on the OCS for $PM_{2.5}$, along with several other air quality pollutants. See **Section 4.3.1** for more information.

As a result of exploration, development, and production of oil and gas on the OCS, the activities associated with the Proposed Action are expected to release GHGs and black carbon from the use of combustion engines in vessels, construction, drilling, and other equipment as well as through deliberate or accidental release of CH_4. Emissions estimates for the activities associated with the Proposed Action, and for cumulative BOEM-related OCS emissions, were calculated using the OECM. These estimates are provided in **Table 4.2-1** for the high-price scenario, which would likely result in the highest level of potential emissions for the Proposed Action. Cumulative numbers include current operations, the activities associated with the Proposed Action, and expected future development beyond the Proposed Action. Unlike the GHGs, which warm the planet generally, black carbon's potential to contribute to climate change has a spatial component. As a result, black carbon emitted in the Arctic would have a greater impact than black carbon emitted in the GOM. Cook Inlet, with shorter periods of seasonal ice and snow than the Artic, would have less impact than the Artic, but more than the GOM.

Table 4.2-2 compares emissions under the Proposed Action (high-price scenario) to the current Program (2012–2017). Compared to the current Program, the activities associated with the Proposed Action would result in an overall increase in the rate of CO_2e emissions from OCS oil and gas activities.

4.2.1.2 Lifecycle Contribution

In addition to the direct emissions from OCS oil and gas operations presented above, BOEM has evaluated GHG emissions covering the lifecycle of OCS oil and gas production and consumption. This includes both the "downstream" consumption and onshore processing of oil and gas products as well as the "upstream" emissions from offshore exploration, development, and production.

Table 4.2-1. Estimated Offshore Emissions in Thousands of Metric Tons per Year from the Proposed Action and Cumulative Emissions from OCS Activities, High-Price Scenario

Climate Forcer	Proposed Action		Cumulative	
	Total Emissions	CO2e	Total Emissions	CO2e
Western Planning Area				
CO_2	16,419.13	16,419.13	154,552.84	154,552.84
CH_4	30.99	774.74	359.15	8,978.86
N_2O	0.43	127.06	3.74	1,113.81
$PM_{2.5}$	6.46	N/A	48.17	N/A
CO_2e Total		**17,320.93**		**154,552.84**
Central and Eastern Planning Areas				
CO_2	104,904.82	104,904.82	644,224.24	644,224.24
CH_4	140.61	3,515.34	1,940.69	48,517.16
N_2O	2.01	600.16	17.17	5,117.56
$PM_{2.5}$	35.53	N/A	214.48	N/A
CO_2e Total		**109,020.32**		**697,858.96**
Beaufort Sea				
CO_2	29,443.88	29,443.88	48,974.85	48,974.85
CH_4	119.59	2,989.85	210.35	5,258.72
N_2O	0.81	240.60	1.40	416.33
$PM_{2.5}$	106.67	N/A	183.48	N/A
CO_2e Total		**32,674.34**		**54,649.90**
Chukchi Sea				
CO_2	13,965.20	13,965.20	31,345.70	31,345.70
CH_4	55.10	1,377.56	126.75	3,168.80
N_2O	0.47	140.58	1.05	313.60
$PM_{2.5}$	83.94	N/A	83.94	N/A
CO_2e Total		**15,483.33**		**34,828.09**
Cook Inlet				
CO_2	3,355.71	3,355.71	9,241.53	9,241.53
CH_4	12.57	314.34	34.23	855.70
N_2O	0.10	29.74	0.28	83.81
$PM_{2.5}$	1.04	N/A	1.80	N/A
CO_2e Total		**3,699.79**		**10,181.04**

Source: Industrial Economics, Inc. and SC&A, Inc 2015

Note: The high-price scenario would likely result in the highest level of emissions for the Proposed Action.

Key: CH_4 = methane; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; N/A = not applicable; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter with a diameter equal to or less than 2.5 microns

Table 4.2-2. Comparison of Offshore Estimated CO_2e Emissions in Thousands of Metric Tons per Year from 2012–2017 Program and the Proposed Action, High-Price Scenario

Region	2012–2017 Program CO_2e	2017–2022 Proposed Action, CO_2e
GOM	120,500.03	126,341.25
Arctic (Beaufort and Chukchi Seas)	0.00	44,425.71
Cook Inlet	10,660.00	3,699.79
CO_2e Total	**131,160.04**	**174,466.75**

Sources: BOEM 2012b, Industrial Economics, Inc. and SC&A, Inc 2015

Notes: The high-price scenario would likely result in the highest level of emissions for the Proposed Action. Scheduled Arctic lease sales under the 2012–2017 Program were cancelled.

Key: CO_2e = carbon dioxide equivalent

Table 4.2-3 shows the expected GHG emissions for the low- and high-price scenarios as described in **Section 3.2**. These calculations include numerous assumptions (Wolvovsky and Anderson 2016); therefore, while being a reasonable approximation, these numbers are an estimate and not a forecast. However, because the methodology used to compare the two price scenarios and the No Action Alternative are the same, the analysis can be assumed to provide a relative comparison. There is a significant degree of uncertainty in these numbers, and they do not take into account future Federal, state, and/or local economic, social, policy, regulatory, and legislative changes that could affect the amount of GHGs released. In addition, this analysis is bounded by U.S. consumption and the upstream domestic and overseas production supporting American consumption. This means that the likely overseas reduction in consumption under the No Action Alternative is not calculated in this analysis.

Table 4.2-3. Estimated Future Lifecycle GHG Emissions from the Proposed Action in Thousands of Metric Tons of CO_2e

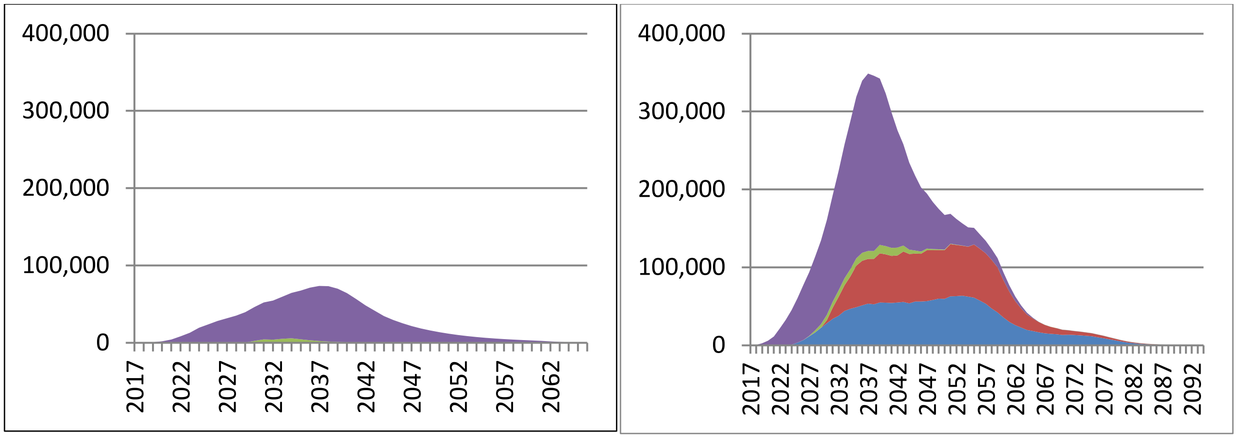
Program Area	Proposed Action (Low-Price Scenario)	No Action Alternative (Low-Price Scenario)	Proposed Action (High-Price Scenario)	No Action Alternative (High-Price Scenario)
Beaufort Sea	120	0	1,985,070	2,019,670
Chukchi Sea	20	0	1,943,310	2,043,210
Cook Inlet	39,480	40,620	156,820	240,930
GOM	1,245,920	1,258,110	3,801,480	3,719,880
Total	**1,285,540**	**1,298,730**	**7,886,680**	**8,020,550**

Source: Wolvovsky and Anderson 2016
Key: CO_2e = carbon dioxide equivalent

On April 22, 2016, the United States joined the Paris Agreement, a United Nations-brokered agreement to keep global temperatures within 2°C of the pre-industrial climate, and preferably within 1.5°C (UN 2015). A recent study (McGlade and Ekins 2015) states that to prevent the planet from warming beyond 2°C, emissions of GHGs must be kept below 1,100 billion tons of CO_2e between 2011 and 2050. McGlade and Elkins (2015) also discuss the need to greatly reduce the amount of oil and gas extraction to stay under this threshold, with particular emphasis on not drilling in the Arctic. It should be noted that the 2°C warming threshold would still result in significant impacts on the world's ecosystems and to humanity (Hansen et al. 2016).

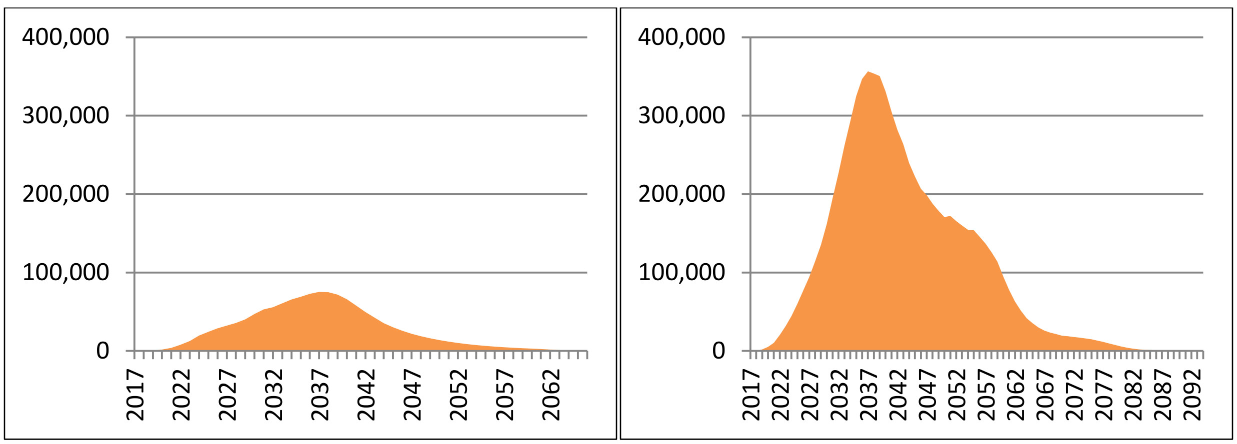
The United States has pledged to reduce emissions by filing an INDC with the United Nations. The American INDC commitment is to reduce net GHG emissions by 17 percent below 2005 levels by 2020, and by 26-28 percent by 2025 (UN 2016). In addition, the Obama Administration has set a target to reduce U.S. GHG emissions by at least 80 percent by 2050 (White House 2015). In 2005, the United States had net emissions of 6,680,300,000 metric tons of CO_2e (USEPA 2016b).

The activities associated with the Proposed Action's lifecycle emissions fluctuate over the course of the Program, with early emissions largely coming from OCS sources. GHG emissions would peak in the 2030s and 2040s, at the same time as production peaks (see **Figures 4.2-1** and **4.2-2**). **Table 4.2 4** displays a comparison of GHG reduction commitments and the percentage of the annualized contribution of OCS oil and gas lifecycle emissions to those emissions targets. Overall, the GHGs from the activities associated with the Proposed Action would be similar to but slightly lower than the No Action Alternative in both low- and high-price scenarios. This similarity is due to the economic substitution effects from onshore and overseas sources expected under the No Action Alternative.



Key: Purple = Gulf of Mexico; Green = Cook Inlet; Red = Chukchi Sea; Blue = Beaufort Sea

Figure 4.2-1. Proposed Action Low- (*left*) and High- (*right*) Price Scenario Lifecycle Emissions by Year showing Emissions in Thousands of Metric Tons



Key: Orange = non-OCS oil and gas sources

Figure 4.2-2. No Action Alternative Low- (*left*) and High- (*right*) Price Scenario Lifecycle Emissions by Year showing Emissions in Thousands of Metric Tons

Additional sector-specific goals, such as the United States' commitment with Canada and Mexico to achieve 50 percent of electricity from non-carbon sources (White House 2016) and other yet-to-be determined measures, could significantly affect how oil and gas products are used and the emissions resulting from that consumption. Policies already determined and implemented have been included in the lifecycle analysis. The high- and low-price scenarios are intended to provide the upper and lower bounds of possible emissions scenarios. Overall, implementation of U.S. climate goals through future policies and regulations would be expected to reduce overall oil and gas demand, making it unlikely that the estimated emissions presented for the high-price scenario would be realized.

Table 4.2-4. United States' GHG Emissions Reduction Commitments in Thousands of Metric Tons and the Proposed Action's Lifecycle Annualized Contribution

Year	U.S. INDC Commitment in CO_2e[1]	Low-Price Scenario				High-Price Scenario			
		Proposed Action		No Action Alternative		Proposed Action		No Action Alternative	
		CO_2e	%	CO_2e	%	CO_2e	%	CO_2e	%
2020	5,544,649	5,880	0.11	5,040	0.09	2,020	0.04	1,660	0.03
2025	4,943,422	60,240	1.22	59,890	1.21	23,930	0.48	24,180	0.49
	4,809,816		1.25		1.25		0.50		0.50
2050[2]	1,336,060	167,210	12.52	170,700	12.78	13,820	1.03	13,808	1.03

Notes:

[1] U.S. commitments in later years assume many changes in policy, many of which have not yet been fully formulated; in contrast, the 2017–2022 Program emissions estimates do not take into account any unimplemented future policy or other changes that could assist the U.S. in achieving those commitments.

[2] Meeting these commitments are expected to require substantial changes in the U.S. oil and gas market. These changes would likely reduce the amount of oil and gas being produced on the OCS, and consequently reduce the amount of CO_2e emissions released from the consumption of OCS resources. This table does not account for such changes, as BOEM lacks the necessary information about specific policies not yet fully formulated.

Key: % = percent of U.S. INDC Commitment; CO_2e = carbon dioxide equivalent in metric tons; INDC = Intended Nationally Determined Contribution

4.2.2 Human Health Effects

OCS oil and gas activities have the potential to adversely and/or beneficially impact human health. This important issue is considered programmatically in this Programmatic EIS. Adverse effects could be toxicological effects and mental health effects from oil spills, and impacts on communities that rely on subsistence resources (Aguilera et al. 2010). However, OCS oil and gas activities can be beneficial because they require a large and diverse labor force, can promote economic development and infrastructure, public works, and health care improvements (Luton and Cluck 2003, Berner 2011). See also **Section 4.4.1.12**, Population, Employment, and Income; and **Section 4.4.1.13**, Land Use and Infrastructure.

4.2.2.1 Potential Human Health Effects of a Catastrophic Discharge Event

Effects on mental health could be similar to the *Exxon Valdez* oil spill event, which caused an increase in mental health and sociocultural disorders, such as domestic violence, substance abuse, and suicide in affected communities. Similar to the *Exxon Valdez* oil spill, it is likely that the *Deepwater Horizon* event could lead to higher levels of depression, generalized anxiety disorder, post-traumatic stress disorder (PTSD), violence, and other psychological problems (Goldstein et al. 2011, Grattan et al. 2011).

Negative impacts on the human environment vary based on whether they are the result of routine events or the result of the threat or event of an oil spill. However, the principal threat to human health would be from oil spills, including: (a) toxicological effects; and (b) mental health effects emanating from social and economic disruption (Goldstein et al. 2011, McCoy and Salerno 2010). These effects could be incurred by oil spill response workers, fishermen, local communities, recreationalists, and others. It is possible that low-income and minority populations could be affected to a greater extent than the general population because of their dietary reliance on wild coastal resources, reliance on these resources for other subsistence purposes such as sharing and bartering, the limited flexibility in substituting wild resources with those purchased, and the likelihood of participating in cleanup efforts and other mitigating activities (BOEM 2012a). Impacts on low-income populations and communities of color from OCS oil and gas activities are discussed further in **Section 4.4** under Environmental Justice.

Workers responding to the *Deepwater Horizon* event reported a number of toxicological symptoms: chemically induced upper respiratory illnesses; mucous membrane, throat, and eye irritation; headaches, dizziness, nausea, and vomiting (Goldstein et al. 2011, BOEM 2012b); pulmonary abnormalities (Meo et al. 2008, BOEM 2012b); bronchial hyper-responsiveness; acute and persistent genotoxic effects; and endocrine effects (Aguilera et al. 2010, Goldstein et al. 2011, BOEM 2012b , Peres et al. 2015). Toxicological effects can be through contact with the contaminants, such as through inhalation and skin contact.

4.2.2.2 Health Status of U.S. Arctic Iñupiat

OCS oil and gas operations could have disproportionately higher health or environmental impacts on Alaska Natives because they rely on subsistence resources from the marine and terrestrial environment. Research in the North Slope Borough (NSB) of Alaska indicates that the most important dimensions of human health for sociocultural impact analysis are psychological, social pathologies, and sociocultural systems. These include: alcohol and drug abuse, tobacco use, injury (both intentional and unintentional), depression, anxiety, assault, domestic violence, child abuse, and suicide. Effects on these psychological and social pathologies could have secondary effects on physical health dimensions. These include cancer, diabetes and metabolic diseases, cardiovascular disease, and chronic pulmonary disease (NSB 2014a, NSB 2015a). Also, Iñupiat of the North Slope face a combination of offshore and cumulative onshore oil and gas activities, which constitute a new threat to subsistence on the North Slope (Stephen R. Braund and Associates 2009).

Research in circumpolar Inuit societies suggests that social pathology and related health problems relate directly to the rapid sociocultural changes that have occurred over the past 50 years (AMAP 2009). It should be recognized that social change can be positive as well as negative, and the society can be impacted while remaining resilient. These changes in the U.S. Arctic include the following:

- Oil and gas development at Prudhoe Bay and surrounding fields
- Increase in cash jobs and wealth spread across the socioeconomic strata
- Greater ownership of personal vehicles, snow machines, and small and large aircraft
- Greater viewing of television, use of improved telecommunications and computers, including the web and social media
- Improved public facilities, schools, health care, social services, and housing
- Improved and expanded structure of local government
- Transfer of ownership of Federal lands to local entities

The Iñupiat are Alaska Natives who reside in the Arctic in communities bordering the Beaufort Sea and Chukchi Sea Program Areas. They have deep cultural traditions that form complex, multi-layered sociocultural systems. Subsistence food is essential for their physical health and spiritual well-being, and protecting subsistence resources is necessary for food security. The Iñupiat have practiced this traditional subsistence way of life for millennia. Subsistence hunting for and consumption of marine mammals, particularly bowhead and beluga whale, walrus, seals, and fish, is at the core of their culture (NSB 2011b, NSB 2015a, Ahtuangaruak 2015, BOEM 2015b, NWAB 2016). Traditional Iñupiat cultural values focus on close family relations, kinship, cooperation, and sharing, particularly sharing subsistence foods with near family, extended family, and with those in other communities.

4.2.2.3 Potential Human Health Effects in Alaska

Oil and gas activities in general and a CDE specifically could have impacts on the culture and well-being of Iñupiat overall health, including these aspects: physiological, toxicological, nutritional, psychological, mental, sociocultural, and spiritual (BOEM 2015b, Greiner et al. 2013). As one North

Slope resident has stated: "[all of] our villages…have expressed concern about threats to traditional and cultural activities from oil and gas exploration and development. We value the land and water and what they mean to our culture and traditions [and we] are concerned about threats of social change" (Ahtuangaruak 2015). A CDE could cause toxicological effects on clean-up workers in Alaska as the *Deepwater Horizon* event did in the GOM (see **Section 4.2.2.1**).

Oil and gas activities could cause *nutritional* impacts. Oil spill contamination of subsistence resources could diminish their availability and impact human health directly, and this is a central concern of Alaska Natives (Stephen R. Braund and Associates 2010, Stephen R. Braund and Associates 2013, BOEMRE 2011, BOEM 2015c). A CDE could contaminate habitat, resulting in perception of or the consequence of actual species contamination and thereby diminishing consumption. Persistent contaminants (e.g., organic chemicals, metals) could bio-accumulate through the food chain rising to concentrating at the apex of the food chain-subsistence food; the Iñupiat inadvertently consuming these contaminated foods could suffer physiological health impacts (AMAP 2009, BOEM 2012b). A CDE can produce contaminants with well-characterized toxicological profiles such as benzene and specific PAHs (BOEM 2015b). A CDE could also lead to contaminant related health problems such as cancers, respiratory disease, birth defects, and chemical exposures (BLM 2012).

Lack of traditional foods in the daily diet has been linked to increased morbidity and mortality (e.g., diabetes, heart disease). Reductions in overall caloric input from subsistence foods have been documented to have negative impacts on the physical and mental health of Arctic indigenous communities (Wernham 2007). Impacts on the subsistence harvest could threaten food security, nutritional status, and the risk of nutritionally based chronic medical problems such as high blood pressure, obesity, diabetes, and cardiovascular disease.

A CDE could contaminate essential whaling areas, subsistence species, and shorelines. Tainting of subsistence resources can result in a disruption of subsistence food gathering and is a serious concern to Alaska Natives. Subsistence foods could be tainted or perceived to be tainted and harvests could be curtailed for a short or long periods. Also, a CDE could cause subsistence hunters to travel farther to harvest uncontaminated resources. This could result in increased community stress, and safety risks, including accidents, injuries, and even death. These potential impacts could diminish basic physiological and psychological needs for a vital, productive life (Shepard and Rode 1996, Hicks and Bjerregaard 2006, Poppel et al. 2007, BOEM 2015b). There could be real and perceived contamination of environmental resources, which in turn can lead to decreased hunting and use of traditional food sources, food insecurity, and nutritional and metabolic disorder (Stephen R. Braund and Associates 2009, NSB 2014a, Ahtuangaruak 2015). A CDE could lead to reductions and displacement of marine subsistence resources and fear of contamination, which could combine to substantially reduce traditional, "wild" subsistence food consumption. Potentially it could lead to increases in cardiovascular, cerebrovascular, metabolic diseases, and diabetes. A negative change of subsistence-harvest patterns also could result in food insecurity and nutritional deficit (BLM 2012).

Noise associated with routine operations, including vessel traffic, could cause bowhead whale to change their migration and make hunting more difficult and lessen the amount harvested (see **Figure 4.3.16-1** in **Section 4.3.16**) (Richardson et al. 1990, Ahtuangaruak 2015, BOEM 2015c). The Iñupiat rely on these whales for subsistence and nutrition (University of Arkansas 2016). Whales migrating farther offshore could make hunting more difficult, dangerous, or impossible. This in turn could reduce availability of this subsistence resource (see **Section 4.3.17**). Noise could also disrupt and displace caribou from normal habitat and migration paths resulting in hunters traveling longer distances to hunt, which in turn could lead to diminished harvest. Natives have observed that noise from helicopter and small aircraft disrupts caribou (Stephen R. Braund and Associates 2009, NSB 2014a, Ahtuangaruak 2015). There could also be respiratory problems from natural gas flaring, as at the Alpine field; diminished fish quantities because of altered riverine fish pathways, and fish illnesses and abnormalities diminishing usable fish subsistence resources (Stephen R. Braund and Associates 2009, Ahtuangaruak 2015)

A CDE can cause *psychological* and *mental health* impacts including increased emotional stress, depression, anxiety, fears, and PTSD. Changes in the traditional way of life can lead to deteriorating physical well-being as well as increased domestic violence and substance abuse (University of Arkansas 2016, BOEM 2012b, NSB 2014a, Ahtuangaruak 2015). This could be directly related to the loss of marine subsistence resources and the general sense of violence on their environment. Research has shown that after the *Deepwater Horizon* oil spill, communities that were indirectly impacted (as opposed to workers who were directly oiled) displayed clinically significant levels of anxiety and depression (BOEM 2015b), and this could occur in Alaska.

Research regarding the *Exxon Valdez* oil spill indicates that the spill caused dramatic psychological and mental health impacts on local residents who relied on commercial fishing. These impacts were within the psychosocial, cultural, and economic context. They incurred psychological, intrusive recollections, avoidance behavior, and PTSD. There were also patterns of social disruption in general and disruption of future plans and work activities more specifically. Individuals reported diminished responsiveness and “numbness.” Because the respondents to the study depended on fisheries resources, the extreme ecosystem stress produced high levels of PTSD. The shorter-term PTSD effect lasted five to eight months after the spill, but it will likely lead to longer-term stress or PTSD based on earlier research (Picou et al. 1990).

Of primary importance is that the Iñupiat rely on subsistence foods, which is a cornerstone of their physical health and general wellbeing (BOEM 2015c). Research indicates that strong community attachment can cause stress in the event of a technological disaster and tend to generate worry about community well-being and threats to it (Lee and Blanchard 2012). A CDE could cause considerable stress and anxiety over the loss of subsistence harvest patterns, contamination of habitat, and fear of the health effects from eating contaminated wild foods (Fall 1992). Effects could be similar to the *Exxon Valdez* oil spill event, which caused an increase in mental health and sociocultural disorders, such as domestic violence, substance abuse, and suicide in affected communities (e.g., Tatitlik and Chenega) (Picou et al. 1990).

A rapid influx of non-resident oil-spill cleanup workers to a community could lead to increased social and psychological problems. Impacts could occur via social interactions and commerce-related factors, such as the local economy and inflation. In general, the larger the spill, the more dramatic the impact on social upheaval and the more deleterious the effects are on human health (IAI 1990a, IAI 1990b). Recovery from impacts on individuals, families, and communities can be long-term. Adults could experience symptoms of depression, anxiety, and PTSD, often compounded by substance abuse and economic hardship resulting in physiological disease. Adolescents are more likely to exhibit behavioral and mental health problems and gender-specific responses. Young children are more likely to show regression and dysregulation or impairment of immune response and organ function (WHO 2016).

Similar impacts can occur among populations that are heavily dependent on fishing along the GOM coast (Picou 2011, BOEM 2012b). The *Exxon Valdez* oil spill in 1989 occurred in Prince William Sound and spread more thinly into Cook Inlet; the much smaller Glacier Bay oil spill occurred in Cook Inlet in 1987. Both impacted the commercial fishing industry (MMS 1995); this in turn resulted in increases in depression, suicide, and other pathological behavior (BOEM 2012b).

4.3 AFFECTED ENVIRONMENT

4.3.1 Air Quality

The Clean Air Act (CAA) requires the USEPA to establish National Ambient Air Quality Standards (NAAQS) (**Appendix C**, Section 2.0) for criteria pollutants to provide protection from adverse effects of poor air quality on human health and public welfare. These pollutants are:

- Nitrogen Dioxide (NO_2)
- Carbon monoxide (CO)
- Sulfur dioxide (SO_2)
- O_3
- PM (particulate matter); $PM_{2.5}$ and PM_{10} (particulate matter with a diameter equal to or less than 10 microns)
- Lead (Pb).

The CAA established two types of air quality standards under the NAAQS. Primary standards set limits to protect public health, including the health of sensitive populations, such as people with asthma, children, and older populations. Secondary standards set limits to protect public welfare, including protection against decreased visibility and harm to animals, crops, vegetation, and buildings. Primary and secondary NAAQS are identical for four of the six criteria pollutants (NO_2, PM, O_3, and Pb). The secondary NAAQS is less strict than the primary standards for SO_2, and there is no secondary NAAQS for CO.

When an area does not meet the NAAQS for one or more criteria pollutants, the USEPA designates the location as a nonattainment area. The CAA Amendments of 1990 sets forth the regulatory process to bring a nonattainment area into compliance with the NAAQS. Some areas near the Program are currently in nonattainment for pollutants expected to be released as part of the activities associated with the Proposed Action, specifically O_3, SO_2, and $PM_{2.5}$ (**Figure 4.3.1-1**) (USEPA 2015a). The atmosphere above the OCS is unclassified. The USEPA defines unclassified areas as “any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant” (USEPA 2015b).

In addition to the air quality standards, the USEPA splits the country into Class I and Class II Areas (**Appendix C**, Section 2.0). Class I Areas are defined in the CAA Amendments of 1977 as federally owned land for which air quality-related values are highly prized and no diminution of air quality, including visibility, can be tolerated (USEPA 2015c). Incremental increases in NAAQS criteria are more strictly regulated for Class I Areas compared to the remainder of the country, known as Class II Areas. There are several Class I Areas close to the OCS, two of which are the most likely to be impacted by oil and gas development. The USEPA recommends BOEM notify the Federal Land Manager (FLM) when a proposed source would be within 100 km (62 mi) of a Class I Area because proposed sources could have an effect within this distance. In general, FLMs request notification of any large facility up to 300 km (186 mi) from a Class I Area. Both Class I Areas within 100 km (62 mi) of the program area are managed by the U.S. Fish and Wildlife Service (USFWS). The NPS and USFWS have identified several Sensitive Class II Areas that do not receive the same protections as Class I Areas, but still receive more scrutiny by these agencies than other Class II Areas. The NPS and USFWS consider these areas more environmentally sensitive, but the ‘sensitive’ designation is not bound by any additional regulation. USEPA makes no distinction between Class II and Sensitive Class II Areas. Five Sensitive Class II Areas fall within 100 km (62 mi) of regions that could be impacted by the activities associated with the Proposed Action. See **Figures 4.3.1-1** and **4.3.1-2** for the relevant Class I and Sensitive Class II Areas.

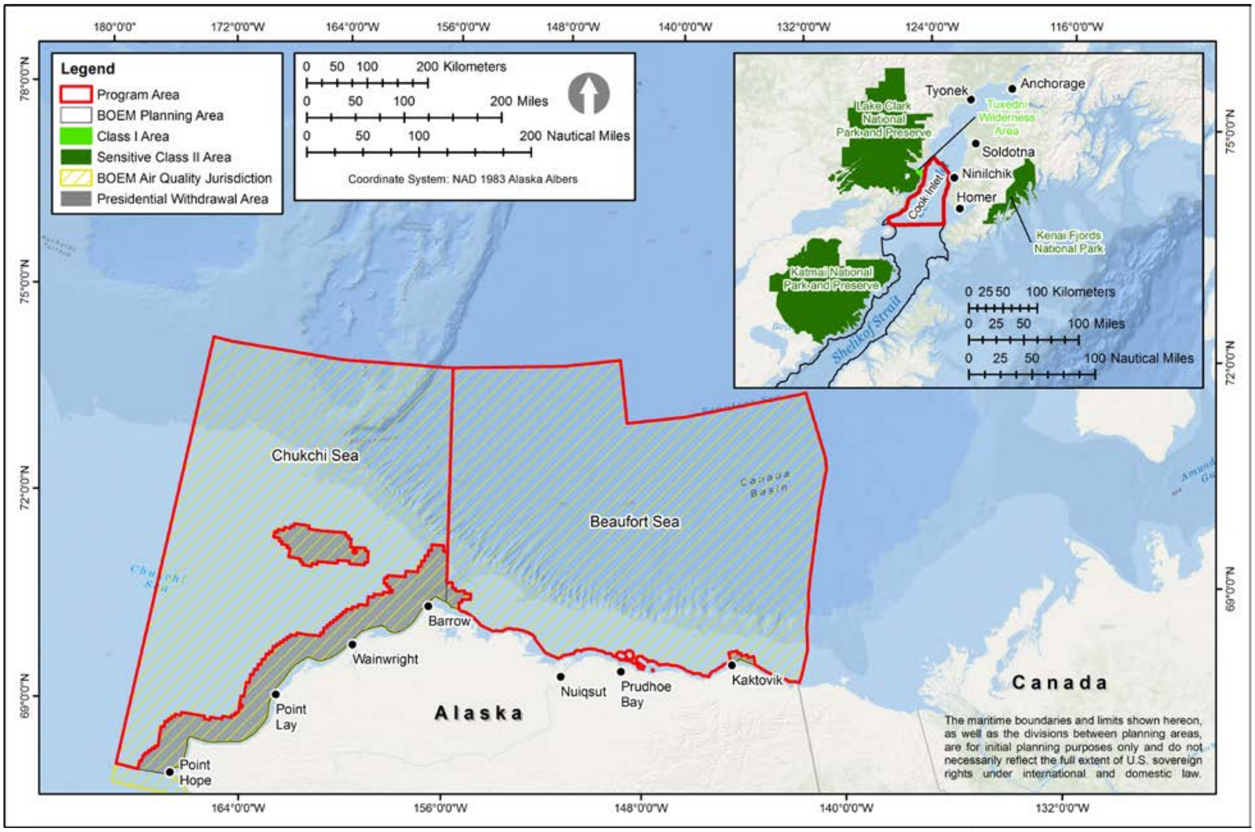


Figure 4.3.1-1. BOEM Air Quality Jurisdiction and Class I and Sensitive Class II Areas near the Alaska Program Areas

In the GOM west of 87.5° W, and offshore the NSB, Alaska, OCS air emissions are regulated by BOEM under 30 CFR part 550, Sections 302–304 (see **Figures 4.3.1-1** and **4.3.1-2**). Lease-specific plans submitted for exploration or development activities must include emissions information for BOEM review. If the emissions exceed certain thresholds, which are determined by distance from shore, a modeling analysis is required to assess air quality impacts on onshore areas. Should modeling show concentrations exceeding significance levels, emission reduction measures are required at the facility. Mitigation is required for each pollutant to ensure no net increase in the pollutant's onshore concentration. Onshore concentrations also are subject to the USDOI maximum allowable increases above a baseline level.

The rest of the OCS, as directed in CAA Section 328, falls under the USEPA's jurisdiction, which regulates air emissions under 40 CFR part 55. Facilities within 40 km (25 mi) of a state's seaward boundary are subject to the corresponding onshore air regulations and would include state and local requirements for emission controls, emission limitations, offsets, permitting, monitoring, testing, and modeling. For facilities beyond 40 km (25 mi) of a state's seaward boundary, only Federal air regulations apply, including Prevention of Significant Deterioration (PSD) regulations, Title V permits, and new source emissions standards. PSD regulations apply to sources with the potential to emit more than 100 or 250 tons per year of a criteria pollutant or precursor, depending on the source type. Title V permits are required for sources emitting > 100 tons per year of any regulated pollutant. See **Appendix C**, Section 2.0 for more information on PSD.

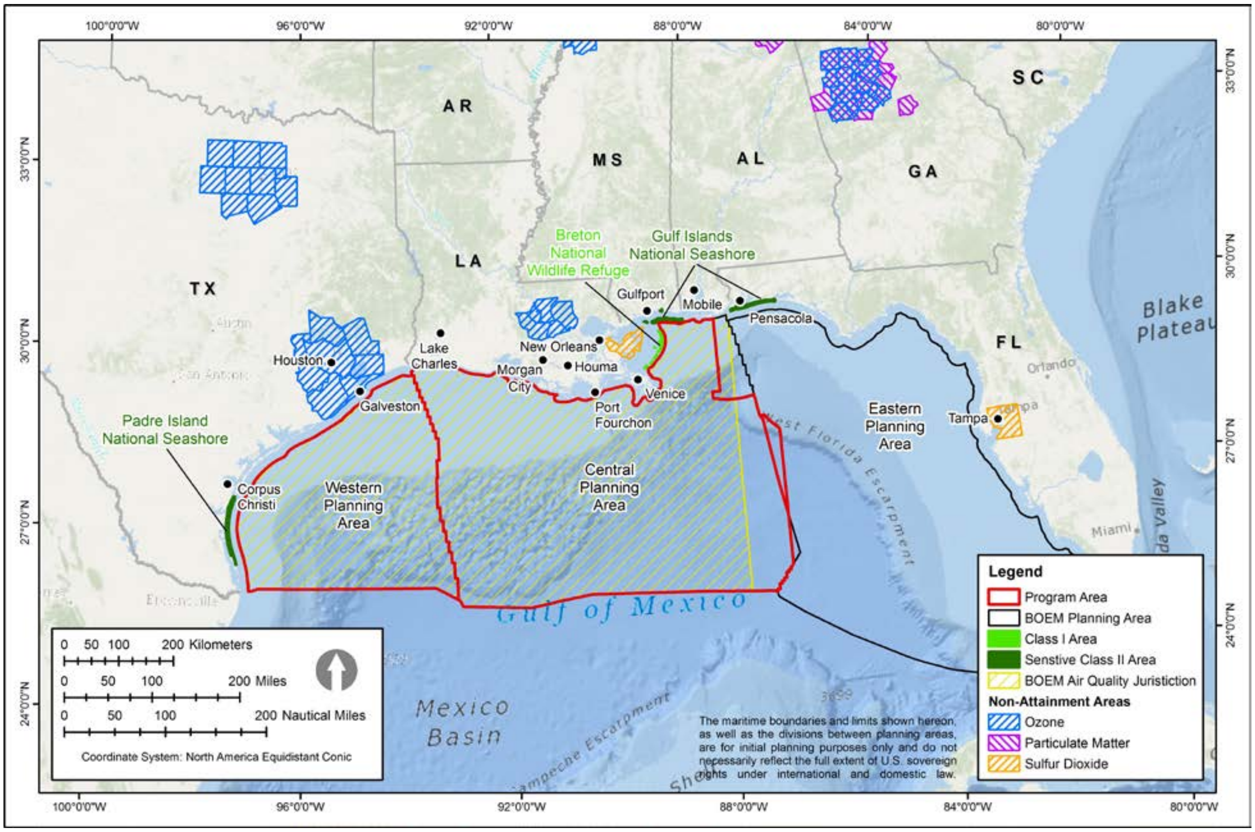


Figure 4.3.1-2. BOEM Air Quality Jurisdiction and Nonattainment, Class I, and Sensitive Class II Areas near the GOM Program Area

4.3.2 Water Quality

Water quality is a term used to describe the condition or environmental health of a water body or resource, reflecting its particular biological, chemical, and physical characteristics and the ability of the waterbody to maintain the ecosystems it supports and influences. It is an important measure for ecological and human health and is defined in detail in **Appendix C**, Section 3.0.

Water quality is evaluated by measuring factors that are considered important to the health of an ecosystem. Primary factors influencing coastal and marine environments are temperature, salinity, dissolved oxygen, chlorophyll content, nutrients, potential of hydrogen (pH), oxidation reduction potential, pathogens, transparency (i.e., water clarity, turbidity, or suspended matter), and contaminant concentrations (heavy metals and hydrocarbons). Moreover, concentrations of trace constituents such as metals and organic compounds also can affect water quality. The 2012 USEPA *National Coastal Condition Report* (USEPA 2012) categorizes coastal waters of the U.S. based on an evaluation of five indices: water quality, sediment quality, benthic community condition, coastal habitat, and fish tissue contaminants.

Water quality is affected by many factors, including urbanization, forestry practices, mining, municipal waste discharges, and agriculture. Non-OCS program activities likely to contribute to water quality impacts include ongoing and future oil and gas exploration, development, and production onshore and in state, Mexican, Canadian, and Russian waters; marine vessel traffic related discharges; wastewater; persistent contaminants and marine debris; natural oil seepage; dredging and marine disposal; bridge and coastal road construction; commercial fishing; recreation and tourism military operations; harbor, port, and terminal operations; marine mineral mining; military and NASA operations; and renewable energy development (**Appendix B**).

Natural events also contribute to impacts on water quality resulting from oil seeps and turbidity caused by suspended sediment load from rivers and erosion from currents, storms, and downslope sediment transport. Hurricanes can increase the potential for spills and cause short-term turbidity. Oil seeps present the same potential impacts as an accidental oil spill, except that the seeps can persist over the long-term. Natural turbidity persists in coastal waters due to river outflow and can be intermittent in response to currents, storms, and downslope sediment transport. The effects from the elevated turbidity on water quality would be short-term, localized, and reversible.

Climate change is an ongoing threat to ocean water quality. Global alterations include decreased oxygen (Long et al. 2016), changing nutrient loads, and altered ocean circulation (Brierley and Kingsford 2009). Ocean acidification (Feely et al. 2009, Doney et al. 2009) is a specific continual threat to water quality. The leading cause of ocean acidification is the increased concentrations of CO_2 into the atmosphere. Seawater chemistry is directly altered with the addition of CO_2, ultimately lowering seawater pH and leading towards more acidic conditions. This chemical alteration leads to a decrease in carbonate ions, which are used in the formation of calcium carbonate. These ionic concentrations are critical to marine organisms that use calcium carbonate in their skeleton and shell formation. Overall, there is a trend towards increased nutrient loading, decreased oxygen, and increased ocean acidification that would continue absent further regulatory measures. Within the Arctic, ocean acidification is accelerated for a multitude of reasons such as upwelling, increased sea ice loss, respiration of organic matter, and riverine inputs (Mathis et al. 2015).

4.3.2.1 Beaufort Sea and Chukchi Sea Program Areas

Water quality in the Beaufort and Chukchi Seas varies naturally throughout the year. This variation is related to seasonal biological activity and naturally occurring processes such as seasonal plankton blooms, hydrocarbon seeps, seasonal changes in turbidity due to terrestrial runoff and storms, localized upwelling of cold water, and formation of surface ice. Rivers and streams that flow into the seas contribute substantial freshwater to the marine system, which affects salinity, temperature, and other aspects of water quality such as productivity, particularly within a band of water that runs along the seacoast. McClelland et al. (2014) found that annual river discharge to the Beaufort Sea is strongly dominated by runoff during the spring melt, which contributes nitrogen that influences productivity along the Beaufort Sea coast.

Overall, the rivers that flow into the Chukchi and Beaufort Seas are relatively unpolluted by anthropogenic sources (ADEC 2013). Studies in the region have shown that the flow and the concentration of constituents such as suspended sediment, dissolved chemicals, and land-borne contaminants carried by rivers vary seasonally and generally are higher in the spring melt (Alkire and Trefry 2006, Townsend-Small et al. 2006).

In both seas, water quality is relatively pristine because there is limited municipal and industrial activity along the coast. Currently, the water quality within the Arctic meets the qualitative criteria for protection of marine life described in Section 403 of the Clean Water Act (CWA). As of the most recent listing by the State of Alaska Department of Environmental Conservation (ADEC 2013), no waterbodies are identified as impaired, as defined by the Section 303d of the CWA, within the Arctic Region. Degradation of water quality, where it occurs in the Arctic, is largely related to aerosol deposition and localized anthropogenic pollution from onshore and OCS oil and gas exploration and production, mining activities, urban runoff/development, and seafood processing (ADEC 2013). Water quality is also affected by erosion of organic material along the shorelines. The Chukchi Sea has a high-energy shore that contributes to erosion and flooding during fall and spring storms, and periods of ice movement

(BOEM 2015b). Water quality is altered by sea ice cover as well. During fall, the formation of sea ice reduces shoreline erosion and storm wave action. In addition, lower temperatures reduce river discharges. All of these factors result in low turbidity levels during the winter (BOEM 2015b).

Studies by Naidu et al. (2001), Trefry et al. (2004, 2012, 2014), Neff (2010), MMS (2010), and Cai et al. (2011) have examined hydrocarbon and trace metal concentrations in the water and sediments of the Beaufort and Chukchi Seas, finding concentrations at natural background values except in areas around drilling sites.

4.3.2.2 Cook Inlet Program Area

The Cook Inlet watershed contains approximately two-thirds of Alaska's population and, thus, provides the potential for non-point source pollution runoff. Additional influences on water quality include onshore and OCS oil and gas exploration and production, municipal discharges including fecal pathogens (Norman et al. 2013), mining wastes, vessel traffic, fish processing discharges, and numerous smaller industries (BOEM 2012b). Point source pollution is rapidly diluted by the energetic tidal currents in the Cook Inlet; it is estimated that 90 percent of the water in the Cook Inlet is flushed every 10 months (MMS 2003).

The Alaska Department of Environmental Conservation (ADEC 2013) rated the overall condition of south central Alaska's coastal waters (water quality, sediment quality, and fish tissue contaminants indices) as good. Glass et al. (2004) reported that water quality in the Cook Inlet Basin was good, but that quality was affected by natural geologic and climatic features, including the presence or absence of glaciers as well as human activities.

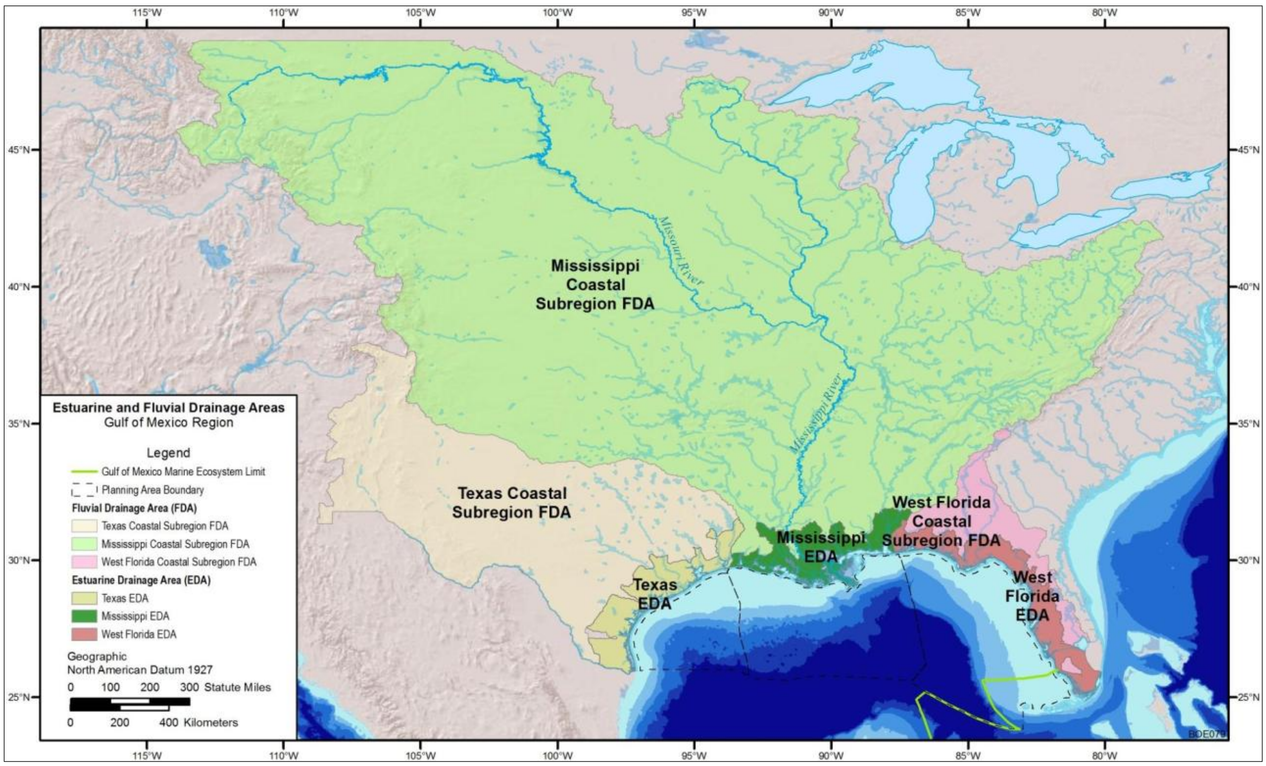
Studies by Boehm (2001), Saupe et al. (2005), Driskell and Payne (2011), and Trefry et al. (2012) have examined hydrocarbon and trace metal concentrations in the water and sediments of Cook Inlet and determined that there does not appear to be any identifiable addition of hydrocarbon or metals contaminants from anthropogenic activities, including oil and gas production in upper Cook Inlet, with no detectable enrichment from oil and gas activities.

4.3.2.3 Gulf of Mexico Program Area

GOM coastal waters include all bays and estuaries from the Rio Grande River to Florida Bay. The U.S. portion of the GOM coast extends across five states, from the southern tip of Texas east through Louisiana, Mississippi, Alabama, and the Florida Keys. Including the shorelines of all barrier islands, wetlands, inland bays, and inland bodies of water, the combined coastlines of these states total more than 75,639 km (47,000 mi) (NOAA 2012). The GOM coastal areas comprise more than 750 bays, estuaries, and sub-estuary systems that are associated with larger estuaries (USEPA 2012).

Water quality in the GOM has two primary influences: (1) configuration of the basin, which controls the influx of water from the Caribbean Sea and the output of water through the Straits of Florida; and (2) runoff from the land masses, which controls the quantity of freshwater input into the GOM from the estuarine and fluvial drainage areas. More than 60 percent of U.S. drainage flows into the GOM, including outlets from 33 major river systems and 207 estuaries (Gulf of Mexico Foundation 2016). Three major estuarine drainage areas (EDA) and three fluvial drainage areas (FDA) in Texas, Mississippi, and western Florida have a large influence on water quality in the GOM (**Figure 4.3.2-1**). Additional freshwater inputs into the GOM originate in Mexico, the Yucatán Peninsula, and Cuba. Because drainage from > 60 percent of the U.S. enters the GOM, much of the country contributes to coastal water quality conditions there.

Population growth in coastal areas can impact water quality. Since 1960, the population of the GOM's coastal U.S. counties has increased by > 100 percent. From 2000 to 2004, the population expanded by 6.7 percent. Population growth results in additional land clearing, excavation, construction, and expansion of paved surface areas, and demands further drainage controls (U.S. Commission on Ocean Policy 2004). These activities alter the quantity, quality, and timing of freshwater runoff. Stormwater runoff, which flows across impervious surfaces like parking lots, is more likely to be warmer than non-stormwater runoff, and to transport contaminants associated with urbanization, including suspended solids, heavy metals and pesticides, oil and grease, and nutrients. The USEPA (2012) *National Coastal Condition Report* rates the overall condition of coastal waters within the Gulf coast as fair. With increasing distance from shore, oceanic circulation patterns play an increasingly large role in dispersing and diluting anthropogenic contaminants and determining water quality.



Source: BOEM 2012b

Figure 4.3.2-1. Estuarine and Fluvial Drainage Areas of the Northern GOM

Water quality on the continental shelf west of the Mississippi River is predominantly influenced by the input of sediment, nutrients, and pollutants from the Mississippi and Atchafalaya Rivers (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force 2008). There is a surface turbidity layer associated with the freshwater plume from the two rivers. During summer months, shelf stratification results in a large hypoxic zone (having a low concentration of dissolved oxygen) on the Louisiana-Texas shelf in bottom waters (Turner et al. 2005). Hypoxia therefore is a widespread seasonal phenomenon on the continental shelf of the northern GOM (**Figure 4.3.2-2**) (Rabalais et al. 2002, Turner et al. 2005, Turner et al. 2012, Obenour et al. 2013). The hypoxic zone is influenced by the timing of the Mississippi and Atchafalaya River discharge; formation of the zone is attributed to nutrient influxes and shelf stratification, and the zone persists until wind-driven circulation mixes the water column.

Turner et al. (2003) found trace organic pollutants, including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls, and trace inorganic metals, in shelf sediments offshore Louisiana that were attributed to river discharge. Additional input of hydrocarbons associated with natural seeps and oil and gas activity of the region were found farther offshore (Turner et al. 2003). Discharges of drilling wastes, produced water, and other industrial wastewater streams from OCS oil and gas platforms in the area also contribute to the water quality of the region.

Water quality on the continental shelf east of the Mississippi River is influenced by river discharge, coastal runoff, and the Loop Current and its associated eddies. The Loop Current and its associated eddies intrude on the shelf at irregular intervals and mix the water column. Warm-core eddies bring clear, low-nutrient water onto the shelf and entrain and transport high-turbidity shelf waters farther offshore into deeper waters while cold-core eddies introduce nutrient-rich waters onto the shelf through upwelling. Waters in the area generally are turbid from the input of fine sediments discharged from the Mississippi River, but water clarity improves closer to Florida, and out of the influence of riverine outflow.

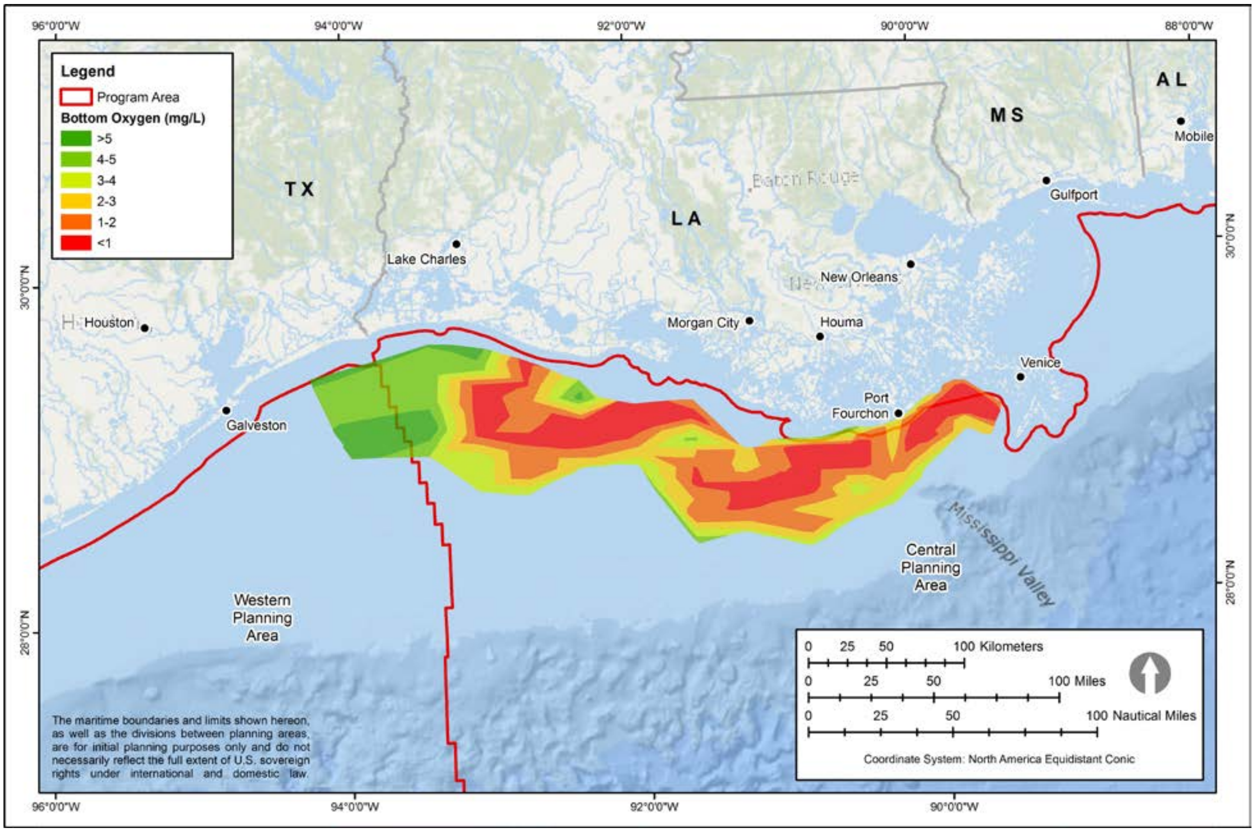


Figure 4.3.2-2. Bottom Oxygen Concentrations along the Louisiana and Texas Coast measured July 28 to August 3, 2015

Water and sediment quality in deepwater areas is most directly impacted by natural hydrocarbon seeps estimated to input from 1 to 1.4 million bbl yr^{-1} into the GOM (Kvenvolden and Cooper 2003, NRC 2003a). Natural seeps are extensive along the continental slope of the GOM and are the largest source of petroleum hydrocarbons to the marine environment. Pelagic tar is a common form of hydrocarbon contamination present in the OCS environment of the GOM (BOEM 2016d). Higher tar concentrations were closely correlated with proximity to the Loop Current. Van Vleet et al. (1983) estimated that that approximately 7,000 tons (7,112,323 kg) of pelagic tar are discharged annually from the GOM into the North Atlantic Ocean and that roughly half of the oil could be brought into the Gulf from the Caribbean Sea via the Loop Current, while the remainder appears to originate in the GOM.

Storm events have had a substantial impact on the quality of coastal waters in the program area. Hurricanes Katrina and Rita impacted water quality in the GOM by damaging pipelines, refineries, manufacturing and storage facilities, sewage treatment facilities, and other infrastructure, resulting in hundreds of minor pollution reports, and millions of gallons of spilled oil (Pine 2006, MMS 2006).

Deepwater Horizon

The *Deepwater Horizon* explosion, oil spill, and response event had an impact on the coastal and marine water quality of the GOM. The explosion and resultant spill released an estimated 4.93 MMbbl of oil (OSAT 2010), an unknown volume (up to 30,000 barrels) of synthetic-based drilling mud, and a range between 200,000 and 500,000 tons of hydrocarbon gases (Joye et al. 2011a, Reddy et al. 2012) (**Figure 4.3.2-3**). This natural gas contained more than 80 percent CH_4, with decreasing amounts of ethane, propane, butane, and pentane (Reddy et al. 2012). In addition, estimates of dispersants applied to the spill have ranged from 1.8 to 2.2 million gallons (combined for surface and depth) (OSAT 2010, National Commission 2011, Allan et al. 2012, Joung and Shiller 2013, Paul et al. 2013, Spier et al. 2013). The Federal Interagency Solutions Group (2010) and the National Incident Command (NIC) (Lubchenco et al. 2010) estimated the fate of the oil, and determined that 26 percent of spilled oil was estimated to remain, as oil on or near the water surface, onshore oil that remains or has been collected, and oil that is buried in sand and sediments (**Appendix C**, Figure C-13).

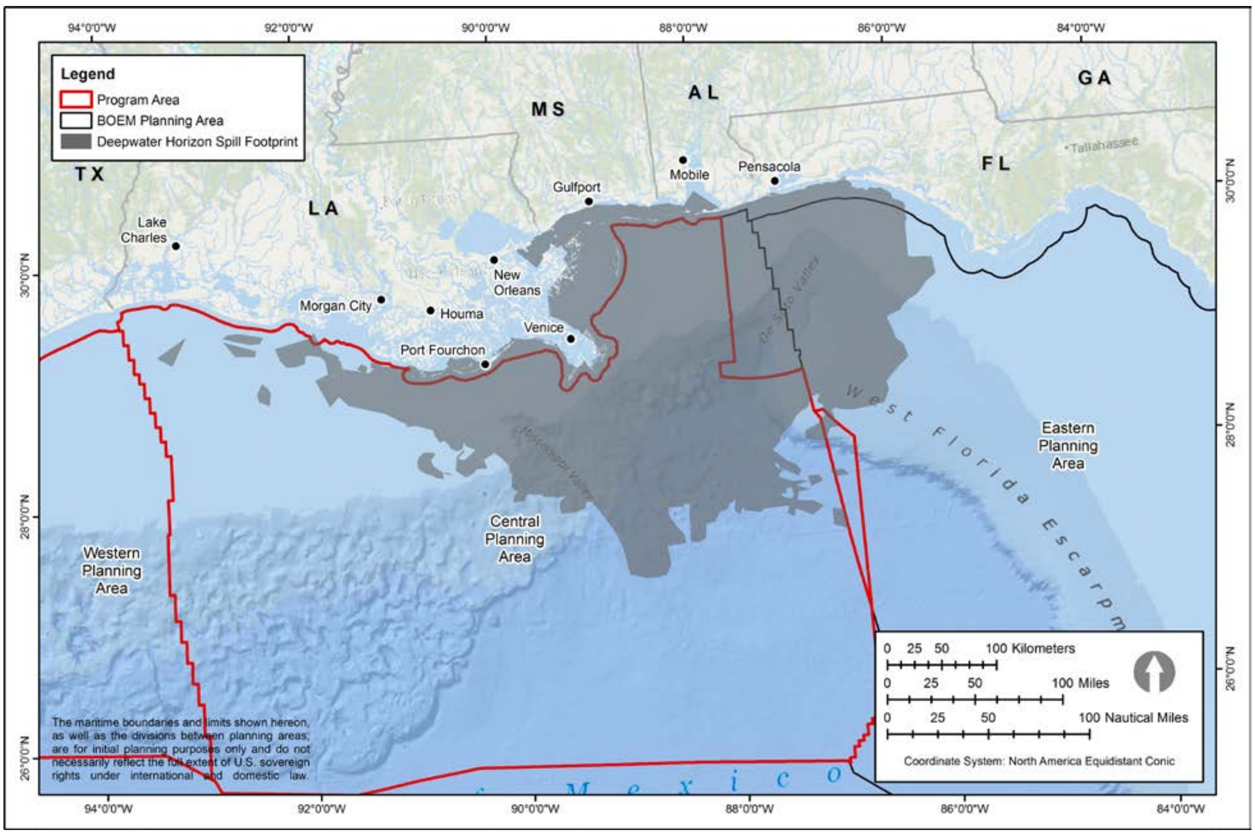


Figure 4.3.2-3. Cumulative *Deepwater Horizon* Oil Spill Footprint over Time

Valentine et al. (2010) reported that after the spill, gases such as CH_4, ethane, propane, and butane were driving rapid respiration by bacteria. However, the extent to which the bacteria consumed these gases is disputed (Joye et al. 2011b, Kessler et al. 2011b). Fate of the remaining oil from the spill is still being studied, but work by Valentine et al. (2014) identified a fallout plume of hydrocarbons on the seafloor over an area of 3,200 km^2 (1,236 mi^2) around the wellsite. Valentine et al. (2014) suggests that the oil was initially suspended in deep waters around the wellsite and then settled to the underlying seafloor at a distance up to 300 km (186 mi) from the wellhead. Similarly, Chanton et al. (2015) estimated that 3.0 to 4.9 percent of the oil spilled was deposited in a 2.4×10^{10} square meters (m^2) (2.6×10^{11} square feet [ft^2]) region surrounding the wellhead.

Kujawinski et al. (2011) investigated the fate of the chemical dispersants injected at depth and found that dispersant ingredients were concentrated in hydrocarbon plumes at 1,000 to 1,200 m (3,281 to 3,937 ft) depths up to 300 km (186 mi) from the wellsite, and that the dispersants underwent slow rates of biodegradation. In addition, White et al. (2014) indicated that under certain conditions (formation of oil and dispersant-soaked sand patties), dispersants can persist for up to 4 years in the environment. DeLeo et al. (2015) provided direct evidence for the toxicity of dispersants on deepwater corals and indicated that dispersant additions during the cleanup efforts following the *Deepwater Horizon* event could have caused more damage to coldwater corals than the initial release of oil into the deep sea.

Following the spill, multiple additional studies evaluated concentrations of oil and dispersant-related chemicals in water and sediment samples collected regionally throughout the GOM; these studies are summarized in **Appendix C**, Section 3.0 (Camilli et al. 2010, Diercks et al. 2010, OSAT 2010, Boehm et al. 2011, Allan et al. 2012, Joung and Shiller 2013, Paul et al. 2013, Sammarco et al. 2013, Spier et al. 2013).

4.3.3 Marine Benthic Communities

4.3.3.1 Beaufort Sea and Chukchi Sea Program Areas

Shallow continental shelves of the U.S. Chukchi Sea and Beaufort Sea are among the largest in the world (Grebmeier et al. 2006). These seas have some of the highest primary productivity found in the Arctic regions due to advective processes, which drive warm, nutrient-rich Pacific Ocean waters northward to meet deep Arctic Ocean water upwelling from abyssal depths in the Chukchi and Beaufort Seas (Codispoti et al. 2005). The Chukchi and Beaufort Seas are also strongly influenced by organic nutrients from freshwater discharges of numerous coastal rivers (Dunton et al. 2006). Most of the North Slope seafloor consists of a soft-bottom, featureless plain composed of silt, clay, and sand. Deposits of flocculated particles from plankton blooms, epontic (under-ice) organisms, and ice algae from ice retreat all contribute to the seafloor sediments in these regions. Disturbance from sea ice scour is a dominant process affecting the seafloor of the Beaufort and Chukchi Sea shelves. Deep keels of icebergs moving across the shelf scour sediments, causing chronic disturbance to benthic communities (Barnes 1999).

High primary productivity of the Chukchi Sea and Beaufort Sea Program Areas fuels high benthic faunal biomass (Grebmeier and Dunton 2000, Dunton et al. 2005) composed of a diverse array of invertebrates, primarily cnidarians, echinoderms, mollusks, polychaetes, copepods, and amphipods (Darnis et al. 2008). Gouging of the seafloor by ice keels creates a habitat for opportunistic infauna (e.g., *Macoma* spp., *Mya truncata*, amphipods, other small invertebrates) (Conlan and Kvitek 2005) that are fed on by seabirds, fishes, walrus, and other marine mammals (Bogoslovskaya et al. 1981, Bluhm and Gradinger 2008). Common fish in areas of soft sediment include Arctic cod (*Boreogadus saida*), Pacific herring (*Clupea pallasii*), sculpins, and pollock (*Gadus chalcogramma*) (NPFMC 2009).

Hard-bottom seafloor habitat is also present, primarily in the form of cobblestone and boulders distributed sporadically along the inner Beaufort and Chukchi Sea shelves and in Barrow Canyon, including in Stefansson Sound and western Camden Bay in the Beaufort Sea, and in Peard Bay in the Chukchi Sea (MMS 2007). The Boulder Patch in Stefansson Sound is biologically rich and complex relative to the rest of the OCS seafloor; total biomass of organisms is approximately an order of magnitude higher than for most of the Beaufort OCS seafloor (Dunton and Schonberg 2000). Hard-bottom habitats in the Beaufort and Chukchi Sea shelves typically are dominated by kelp beds (communities dominated by the kelp *Laminaria solidungula*). These unique biological communities exist on bottom substrates dominated by cobblestone or rock that support highly diverse and abundant epifaunal communities dominated in numbers by amphipods, polychaetes, cumaceans, corals (including the soft coral *Gersemia rubiformis*), and sponges (Dunton and Schonberg 2000). Kelp communities spread very slowly, taking almost a decade to recolonize denuded boulders (Martin and Gallaway 1994).

4.3.3.2 Cook Inlet Program Area

Intertidal and shallow subtidal habitats of lower Cook Inlet support infaunal and epifaunal organisms as well as floral communities. Western lower Cook Inlet is influenced by seasonal ice cover while eastern lower Cook Inlet remains ice-free. These physical differences create somewhat distinct benthic communities. Seafloor substrate types include rock, sand, silt, and shell debris.

The floral community of southeastern Cook Inlet is dominated by various species of brown algae in the rocky intertidal zones and by kelps in the subtidal areas to a depth of approximately 20 m (66 ft) (Lees et al. 1986). Dominant faunal species include echinoderms (sea urchins and sea stars), mollusks (clams, chitons), crustaceans (crabs), fish, gastropods, polychaetes, bryozoans, and sponges. Southwestern intertidal zones of Cook Inlet are dominated by *Fucus* (a brown algae) and red algae. Kelps are also present, but at shallow subtidal depths (< 5 m [16.5 ft]). Fauna in this zone of winter ice are smaller and less diverse compared to the shallow areas of southeastern Cook Inlet. In deeper waters beyond the kelp beds, the dominant fauna include suspension feeders (e.g., barnacles, bryozoans, ascidians, polychaetes) and predator/scavengers (e.g., sea stars, snails, crabs). In non-rock substrate areas (mud and sand), the invertebrate community is dominated by polychaetes, amphipods, clams, and crabs (BOEM 2016j).

4.3.3.3 Gulf of Mexico Program Area

Marine benthic communities of the northern GOM inhabit continental shelf and slope/deepsea environments, including soft sediments, hard bottom areas, deepwater coral areas, pinnacles (including warm-water coral reefs), artificial reefs, and chemosynthetic communities. The continental shelf, present in all three GOM planning areas, extends from the coastline to water depths of approximately 200 m (660 ft). The continental slope is a complex transitional zone that includes varying ranges of productivity and faunal assemblages.

The seafloor of the northern GOM is composed primarily of muddy and sandy sediments. Faunal assemblages of the continental slope and abyssal zone were described in BOEM's EIS covering multiple GOM lease sales (BOEM 2012a) as follows:

- Shelf-Slope Transition Zone (150 to 450 m [492 to 1,476 ft]): A highly productive zone that is dominated by demersal fishes, asteroids, gastropods, and polychaetes.
- Archibenthal Zone Horizon A (475 to 740 m [1,558 to 2,428 ft]): Sea cucumbers become more abundant in this zone, and demersal fishes become less abundant. Gastropods and polychaetes are also numerous.
- Archibenthal Zone Horizon B (775 to 950 m [2,543 to 3,117 ft]): Demersal fishes, asteroids, and echinoids are found in large numbers. Gastropods and polychaetes are also common.
- Upper Abyssal Zone (1,000 to 2,000 m [3,281 to 6,562 ft]): This zone has fewer fishes than shallower depths. The number and types of invertebrate species increase, especially sea cucumbers and galatheid crabs.
- Mesoabyssal Zone (2,300 to 3,000 m [7,546 to 9,843 ft]): Few fish species are found in this deepwater zone. Echinoderms dominate the fauna.
- Lower Abyssal Zone (3,200 to 3,800 m [10,499 to 12,468 ft]): The large asteroid Dytaster insignis is the dominant megafaunal species.

Hard-bottom communities, though far less common than soft-bottom environments, are scattered across the GOM. GOM hard-bottom communities include shallow corals, deepwater corals, pinnacles, topographic features, artificial reefs, and chemosynthetic communities.

Deepwater coral habitats are known to exist throughout the northern GOM. To help identify potential areas where chemosynthetic communities and deepwater coral habitats could exist, BOEM has examined decades of industry-collected seismic data to identify areas of anomalously high reflectivity at or near the seafloor that could indicate hard-bottom areas. As of January 2016, the database included > 20,000 areas of anomalously high reflectivity that indicate possible hard bottom where deepwater coral or chemosynthetic communities could exist (Shedd et al. 2012). Colonies of the deepwater *Lophelia pertusa* coral have been found as deep as 3,000 m (9,842 ft) worldwide (BOEM 2012a), but the deepest record for the GOM is 801 m (2,627 ft) seen on an artificial substrate created by an offshore energy platform in 2012 (Brooks et al. 2016). Other high-density coral habitats also have been described on deeper areas of the slope with one notable example of *Madrepora* at a depth of 1,440 m (4,593 ft) (Brooks et al. 2016). These findings suggest that hard-bottom areas throughout the entire GOM Program Area could harbor deepwater coral communities.

Benthic resources within the program area managed under a fisheries management plan (FMP) include corals, although collection is prohibited except for limited circumstances regarding live rock and octocorals. Essential Fish Habitat (EFH) for the coral management unit includes the total distribution of coral species and life stages throughout the GOM. Four banks in the GOM are considered Coral Habitat Areas of Particular Concern (HAPCs), a subset of EFH, including Stetson, McGrail, and the East and West Flower Garden Banks. A total of seven species of shallow-water coral in the Atlantic/Caribbean region, which includes the GOM, are classified as threatened under the ESA: elkhorn coral (*Acropora palmata*), staghorn coral (*A. cervicornis*), pillar coral (*Dendrogyra cylindrus*), lobed star coral (*Orbicella* [previously *Montastraea*] *annularis*), mountainous star coral (*O. faveolata*), boulder star coral (*O. franksi*), and rough cactus coral (*Mycetophyllia ferox*). Four of the threatened coral species (elkhorn, lobed star, mountainous star, and boulder star) were documented on the Flower Garden Banks National Marine Sanctuary (NMS) (NOAA 2013a, NOAA 2013b) and on the 18 Fathom and Bright Bank reefs in the northwestern GOM (Rezak et al. 1983, Rezak et al. 1990). Two very small elkhorn coral colonies also were documented at the West and East Flower Garden Banks NMS in 2003 and 2005, respectively (Zimmer et al. 2006).

Pinnacles are hard-bottom features with vertical extensions up to 15 m (49 ft) above the seafloor. Pinnacles, which consist of rock outcrops heavily encrusted with sessile invertebrates and harboring subtropical and tropical fishes, are known to exist in at least 47 OCS lease blocks, encompassing > 2,652 km^2 (1,024 mi^2) of the northeastern Central Planning Area (**Figure 4.3.3-1**). Relatively steep sides and tops of the pinnacles provide prime hard-bottom habitat for coralline algae, sponges, octocorals (sea fans and sea whips), crinoids (sea lilies), bryozoans, and demersal fishes. The biological diversity of the fauna on the pinnacles has been found to be directly related to the height of the pinnacle feature (Gittings et al. 1992, Thompson et al. 1999). Biological diversity also increases with greater distance from the Mississippi River Delta as water turbidity decreases (Gittings et al. 1992).

The term "topographic features" refers to submerged banks in the GOM; many of these features are protected from oil and gas activities. They are defined in NTL No. 2009-G39 as "isolated areas of moderate- to high-relief that provide habitat for hard-bottom communities of high biomass and diversity and large numbers of plant and animal species, and support, either as shelter or food, large numbers of commercially and recreationally important fisheries." These banks are in the Western and Central Planning Areas, and include the Flower Garden Banks NMS, which are also hermatypic coral reefs. BOEM has mandated "No Activity Zones" around major topographic features in the GOM (BOEM 2012a) to protect these submerged banks from anchoring and other disturbances that could occur during oil and gas exploration and production activities. Topographic features in the GOM include shelf edge banks (e.g., East and West Flower Garden Banks), mid-shelf banks (e.g., Stetson Bank and Sonnier Bank), and the South Texas banks (e.g., Southern and Baker Bank).

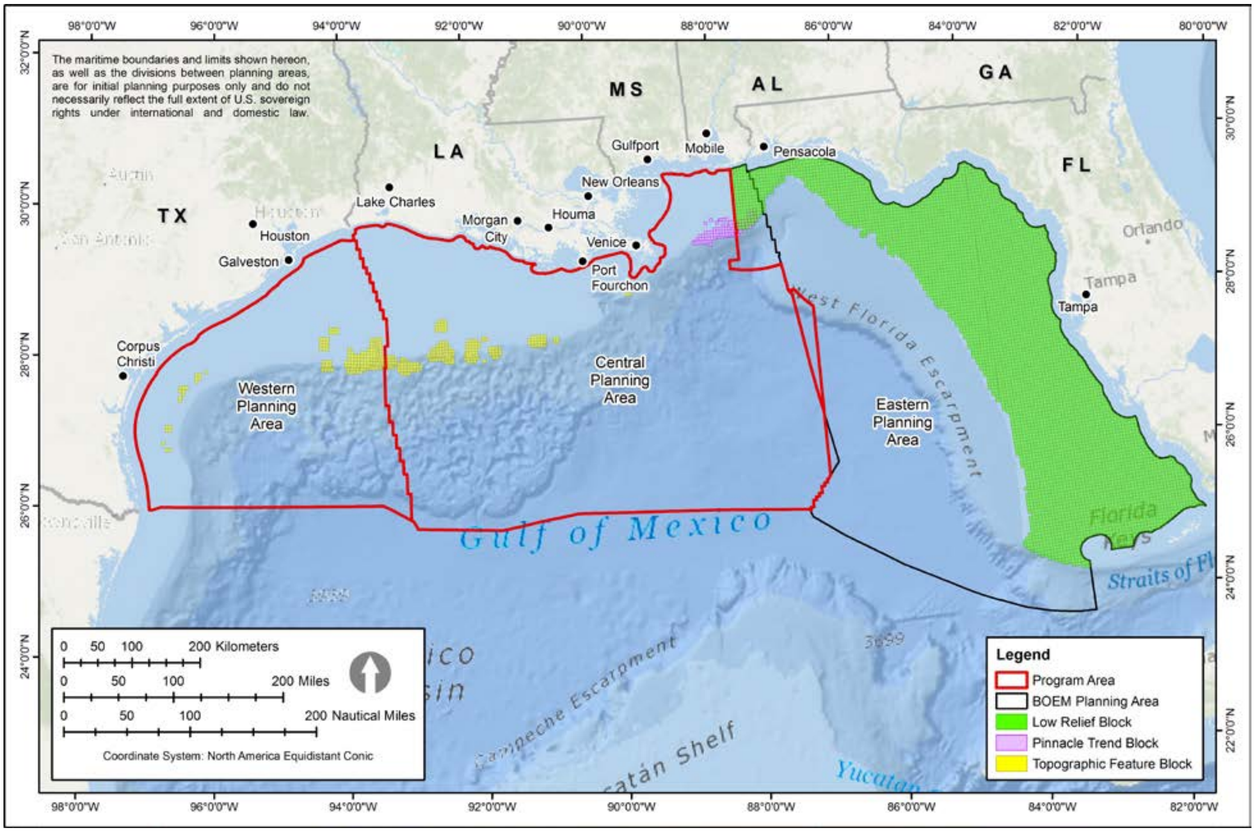


Figure 4.3.3-1. Lease Blocks subject to Mitigation Measures for Topographic Features, Live-Bottom Pinnacle Trend, and Live-Bottom, Low-Relief Areas

Two entire lease blocks were withdrawn from leasing in 1973 representing the central portions of the East Flower Garden Banks and West Flower Garden Banks along with portions of other blocks overlapping the designated No Activity Zones. Flower Garden Banks NMS (East and West Flower Garden Banks) was initially created in 1992 and Stetson Bank was added in 1996. Leasing exclusion areas were expanded with the designation of Sanctuary boundaries, particularly for Stetson Bank, after its inclusion in the NMS. NOAA is in the process of considering expansion of the sanctuary boundaries; the preferred alternative in the Draft EIS for this expansion includes 15 additional banks and expansion of current boundaries for the existing three (NOAA Office of National Marine Sanctuaries 2016). This alternative would increase the sanctuary area from 56 to 383 mi^2. BOEM is a cooperating agency on the EIS that identifies sanctuary expansion alternatives.

In addition to natural features, artificial reefs created by decommissioned GOM oil and gas platforms and sunken vessels can provide suitable substrate for supporting vibrant live-bottom communities (SAFMC 2009) and associated fish assemblages. As of July 2015, approximately 470 platforms, or 10 percent of all platforms decommissioned in the GOM, had been converted into artificial reefs (BSEE 2016), many through the USDOI Rigs-to-Reefs policy (BSEE 2013). Platforms are prepared for decommissioning to become an artificial reef and can be toppled in place, partially removed near the surface, or the entire structure towed to existing reef sites with proper permits obtained by the state from the U.S. Army Corps of Engineers (USACE) and in accordance with applicable guidelines to ensure navigational safety, infrastructure security, and environmental protection.

At least 356 deepwater benthic communities have been found in the GOM that constitute a combination of chemosynthetic and coral assemblages (BOEM 2015d). Chemosynthetic organisms are unique in that they use a carbon source other than the photosynthesis-based food webs that support most all other life on earth. Chemosynthetic bacteria have the ability to oxidize the chemicals present in seafloor vents, including oil, methane, hydrogen sulfide, hydrogen gas, or ammonia into organic molecules used to produce biomass (often sugars). Growth rates of many organisms in these communities are extremely slow, averaging approximately 2.5 mm per year for tubeworms of the genus *Lamellibrachia* (Fisher 1995). However, mytilid mussels have been found to reach reproductive age relatively quickly, with growth rates slowing in adulthood (Fisher 1995). These factors lead to long-lived individuals and communities; Powell (1995) estimated that some clam and mussel communities at chemosynthetic sites have been present in the same location for between 500 and 4,000 years. Individual tubeworms can be > 400 years old. Results from a deep (16-m) piston core at one of the largest GOM *Lophelia pertusa* habitats in lease block VK906 showed coral growth throughout the core dated by a variety of methods to span approximately 300,000 years (Brooks et al. 2016).

4.3.4 Coastal and Estuarine Habitats

Coastal and estuarine habitat supporting information is discussed in **Appendix C**, Section 4.0. The type of coastal and estuarine habitat usually is determined by the local geology and climate. Habitats associated with estuaries include salt and brackish marshes, bays, lagoons, mangrove forests, mud flats, tidal rivers and deltas, rocky intertidal shores, reefs, submerged aquatic vegetation, barrier islands, and beaches. Coastal and estuarine habitats are present in all program areas.

4.3.4.1 Beaufort Sea and Chukchi Sea Program Areas

Arctic coastal habitats are greatly influenced by a short growing season, extremely cold winters, and the dynamics of sea ice. In the Arctic, wet tundra and moist tundra dominate the Arctic Coastal Plain (ACP) (**Figure 4.3.4-1**; see **Section 4.3.10.1** for additional information on the ACP). The ACP is a physiographic province is low relief and dominated by periglacial features such as thaw lakes and marshes (BLM 2012). It is a smooth plain rising imperceptibly inland between roughly 15 to 100 miles from the coast of the Arctic Ocean (Wahrhaftig 1965). Wet tundra is a saturated or inundated wetland in wetter environments such as drained lake basins and poorly drained river terraces, while moist tundra is a saturated wetland in broad expanses of tundra above shallow water tables; both have similar emergent and scrub-shrub vegetation (USACE 2012). Moist and wet tundra are composed of wetlands and marshes over permafrost soils (Wahrhaftig 1965, Walker et al. 1980, Walker 1983). Coastal and nearshore habitats along the shorelines of the Beaufort and Chukchi Seas include barrier islands and beaches, wetlands, tidal flats, and seagrasses. These habitats occur within estuarine watersheds in and around bays, lagoons, and river mouths where marine and freshwaters mix (Wilkinson et al. 2009). Sea ice is more extensive and lasts longer in the Beaufort Sea than in the Chukchi Sea (Hopcroft et al. 2008, Forbes et al. 2011). The Arctic coastline is highly disturbed due to the movement of sea ice that is frequently pushed onshore, scouring and scraping the coastline (Forbes et al. 2011). Coastal habitats of the Beaufort and Chukchi Seas, as described by the National Environmental Sensitivity Index (ESI) Shoreline data, are featured in **Figure 4.3.4-2**.

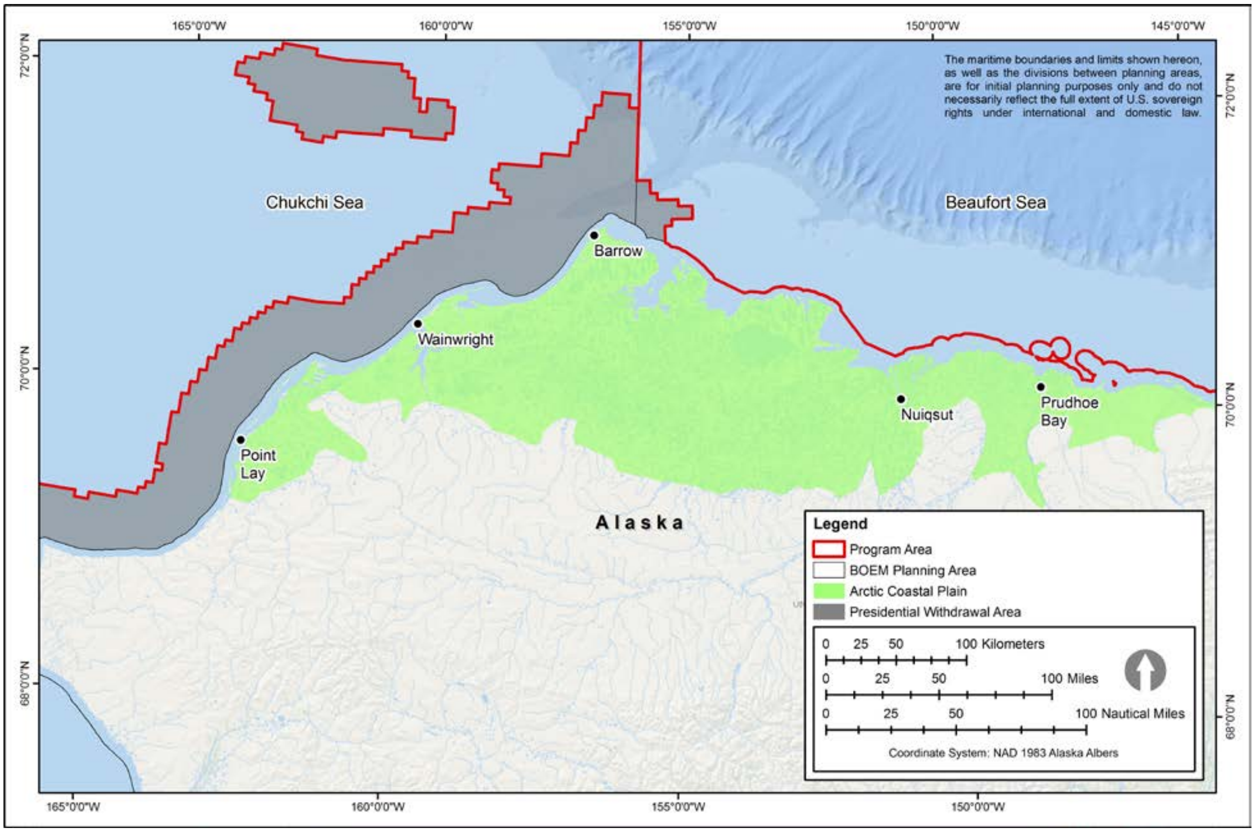


Figure 4.3.4-1. Arctic Coastal Plain

4.3.4.2 Cook Inlet Program Area

Physiography of this region includes rocky coastlines and numerous fjords, islands, and embayments (Wilkinson et al. 2009). Large salt marshes and mud flats are dominant coastal features along Cook Inlet, particularly along the western shore, although sand and gravel beaches and rocky shores are quite common at more exposed locations also (Lees and Driskell 2004). Coastal habitats of Cook Inlet, as described by the National ESI Shoreline data, are featured in **Figure 4.3.4-2**.

4.3.4.3 Gulf of Mexico Program Area

The GOM OCS has a highly developed oil and gas infrastructure that would likely continue for the foreseeable future. Coastal habitats are associated with a nearly continuous estuarine ecosystem that extends across the coast of the northern GOM. These habitats occur within shallow estuarine watersheds and offshore, to depths of up to 30 m (98 ft) (Fonseca et al. 2008). For the purposes of this analysis, 5.5 km (3 nautical miles [nmi]) offshore is considered the boundary between "coastal" and "offshore."

More than 60 percent of U.S. drainage flows into the GOM, including outlets from 33 major river systems and 207 estuaries (Morang et al. 2012). Three major estuarine and fluvial drainage areas (Texas, Mississippi River, and northeastern Gulf coast) have a large influence on coastal and estuarine habitats in the northern GOM (**Figure 4.3.2-1**). Coastal and estuarine habitats provide important nursery and adult habitat for numerous species of fish and invertebrates (**Appendix C**, Section 10.0), while seagrass habitats provide foraging habitat for sea turtles (**Appendix C**, Section 8.0), and marine mammals (manatees). Protection and conservation of numerous coastal and estuarine habitats are achieved through management and protected area designations.

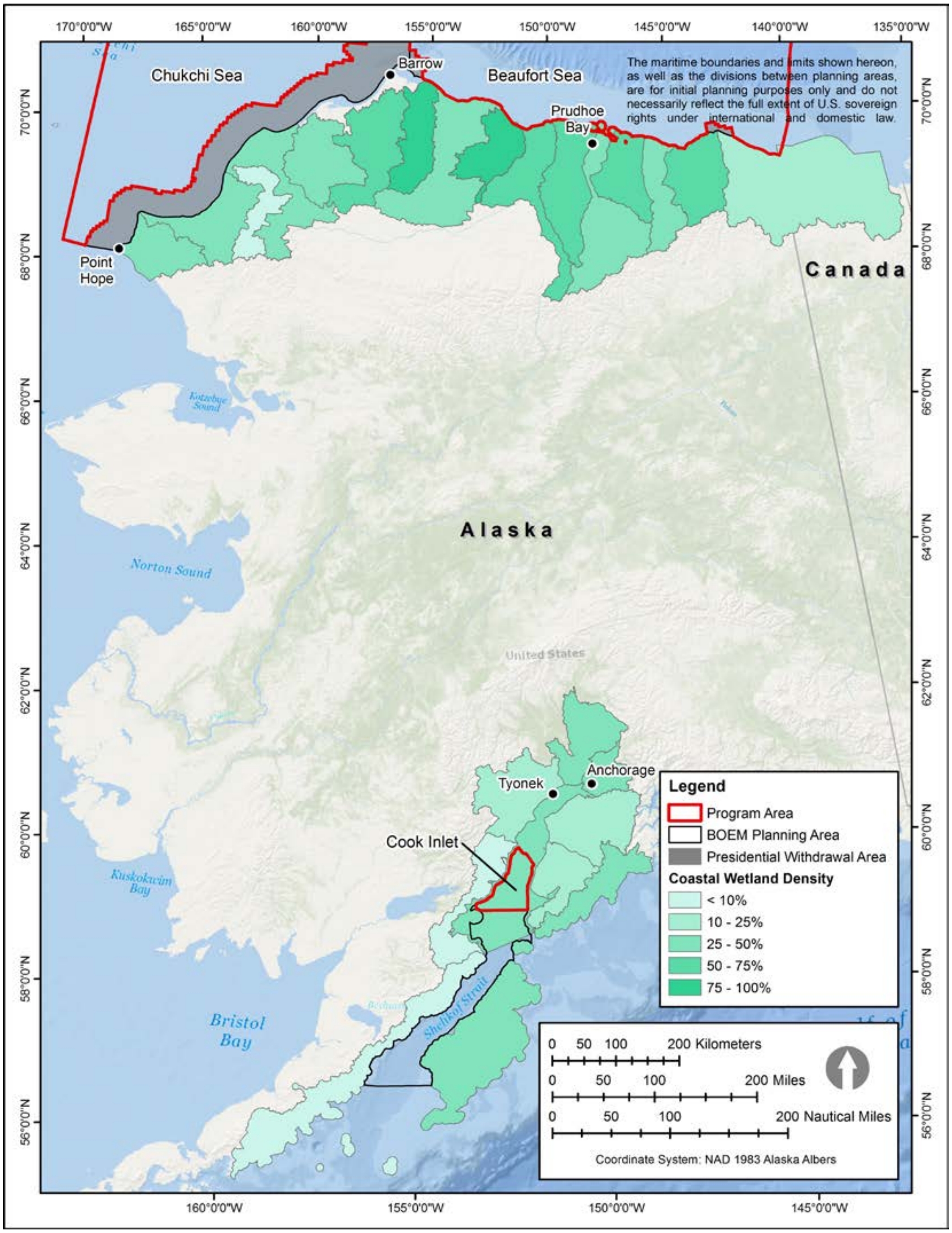


Figure 4.3.4-2. Coastal Wetland Density in the Alaska Program Areas

Seagrasses

Submerged aquatic vegetation (SAV) resources are a vital component of coastal aquatic ecosystems in the northern GOM, which has at least 26 species of SAV growing in fresh, brackish, and saline coastal environments (Cosentino-Manning et al. 2015). SAV that grows in saline environments is called seagrass. Seagrasses are a common and vital component of the GOM coastal ecology and economy (Carter et al. 2011, Yarbro and Carlson 2011) (**Appendix C**, Figure C-21). Seagrasses provide a variety of ecological services, including sustenance through food webs and habitat for marine life (fisheries in particular) as well as providing important nursery habitat for numerous commercially important fish and invertebrate species (**Appendix C**, Section 10.0). Seagrasses are also important economically (Bell 1993, Dawes et al. 2004).

SAV habitats were lost from oiling and from physical disturbance as part of response actions from the *Deepwater Horizon* spill. Chandeleur Islands seagrass, which is uniquely valuable in the region, was particularly affected, with more than 110 hectares (271 acres) of seagrass destroyed due to oiling. There were 876 m^2 (0.22 acres) of scars in Florida seagrass beds from 16 scars due to physical response activities (DWHNRT 2016).

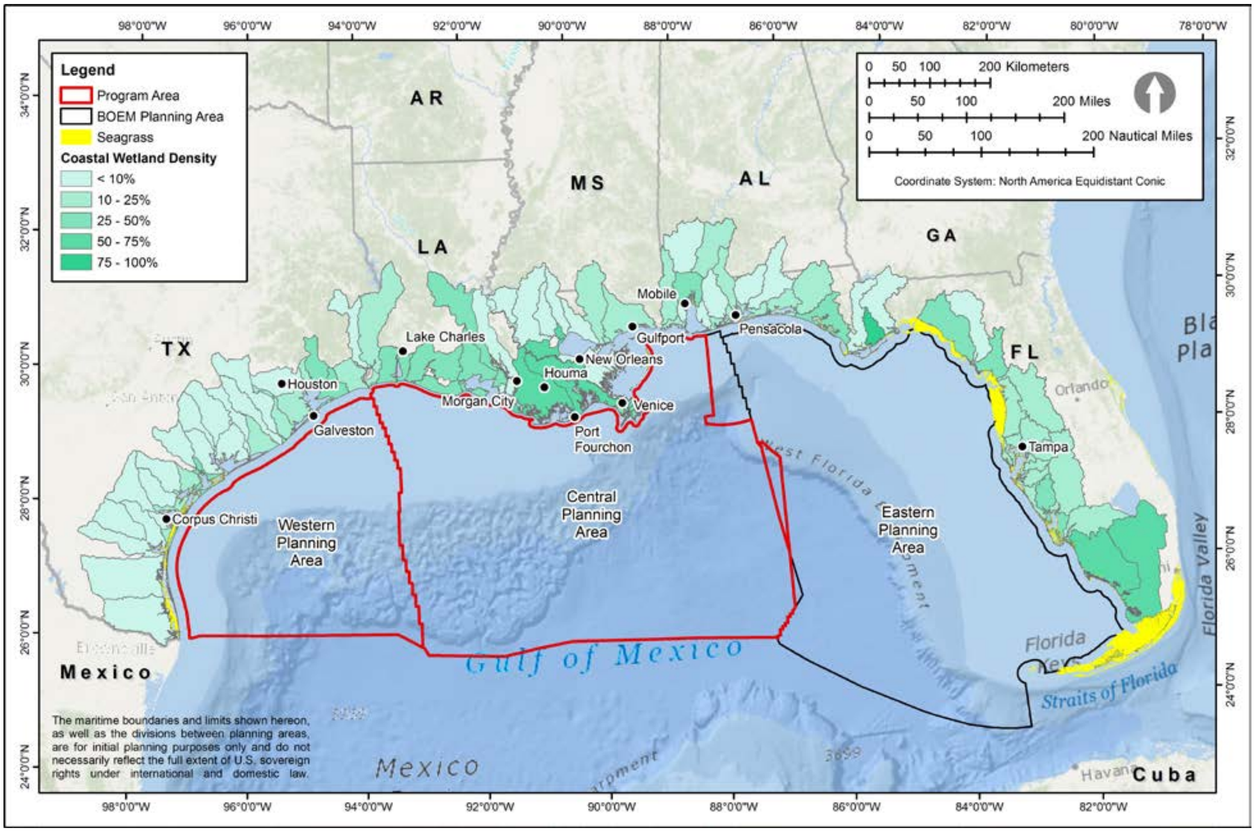
Wetlands

Wetlands are low-lying habitats where water accumulates long enough to affect the condition of the soil or substrate and promote the growth of wet-tolerant plants (LaSalle 1998). From a regulatory standpoint, a wetland is defined as "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (40 CFR 230.3, 33 CFR 328.3).

The most common coastal wetlands in the GOM include saltwater marshes, saltwater mangrove swamps, and non-vegetated areas such as sand bars, mud flats, and shoals (Gulf Restoration Network 2004, Dahl and Stedman 2013). Wetlands occur along all coastal areas of the GOM, with the highest density occurring in Louisiana in the Central Planning Area and in southern Florida in the Eastern Planning Area (**Figure 4.3.4-3**).

Coastal wetlands in the northern GOM are characterized by flat topography and are associated with several barrier islands, bays, peninsulas, lagoons, and estuaries (Handley et al. 2012). Brackish marshes dominate estuaries of the Central Planning Area and are the most extensive and productive in Louisiana. Louisiana has lost approximately 4,877 km^2 (1,883 mi^2) of land since the 1930s, with a current loss rate of 42.9 km^2/year (16.57 mi^2/year) (**Figure 4.4.4-1**; Couvillion et al. 2011), the causes of which are complex (Day et al. 2000). The most extensive coastal wetland areas in Mississippi are associated with the deltas of the Pearl River and Pascagoula River. In Alabama, most of the wetlands are in Mobile Bay and along the northern side of Mississippi Sound. Forested wetlands are the predominant wetland type along the coast of Alabama; large areas of estuarine marsh and smaller areas of freshwater marsh also occur (Wallace 1996). Along Florida's Gulf coast, coastal emergent wetlands make up a large component of the coastline and are most prevalent around the central panhandle, the Big Bend region, and southern Florida near Collier County and the Ten Thousand Island region (Stedman and Dahl 2008). The Big Bend region of Florida is dramatically different than the rest of Florida's sandy coasts, and is instead dominated by a marshland made up of black needle rush (*Juncus roemerianus*), with shell and sand beaches (FDEP 2010, BOEM 2013).

The *Deepwater Horizon* Natural Resource Damage Assessment (DWHNRT 2016) reported that the majority of oil from the *Deepwater Horizon* spill that made it to coastal wetlands collected within 50 meters (164 feet) of shore and that marsh edge habitat erosion doubled to 0.41 meters (1.35 feet) per year along at least 174 km (108 miles) of shoreline for at least 3 years (nearly 9 acres). Recovery time for coastal marshes ranges for 2 years for lighter oiled areas to 8 years for heavily oiled areas over about 1,160 km (721 miles) in Louisiana. Data show that heaviest oiling occurred in Louisiana in a 17.2 m (56.4-foot) width over 108 km (67 miles), giving some 185 hectares (458 acres) of coastal wetlands with heavy and probably persistent oil. Oiling could be detrimental to marsh vegetation by covering plants and soil surfaces, leading to stress and could penetrate to the roots. Oiling could lead to partial or complete plant death, but plants could also recover by regenerating new shoots (Pezeshki and Delaune 2015). NOAA also found that more than 800 km (497 miles) of boom was stranded in marshes, resulting in damage to a total of 21 hectares (52 acres), not including other damage caused by boom sweeping across marshes and efforts to remove the boom where vegetation was crushed by airboats, walking boards, foot traffic, and dragging the boom. While the total numbers of 210 hectares (519 acres) do not appear to be much compared to the large losses of coastal wetlands in Louisiana since the 1930s shown in **Figure 4.4.4-1**, every additional lost acre is now recognized as important. In addition, a total of 20 hectares (50 acres) of SAV was lost along the Lake Cataouatche shoreline in Jean Lafitte National Historical Park and Preserve due to summer river water releases as part of response actions.



Source: Seagrass data from NOAA 2015

Figure 4.3.4-3. Coastal Wetland Density in the Coastal Watersheds of the GOM Program Area

Coastal Barrier Islands and Beaches

Coastal barrier landforms consist of barrier islands, major bars, sand spits, and beaches that extend across the nearshore waters from the Texas-Mexico border to southern Florida, a distance of approximately 2,623 km (1,631 mi) (National Atlas 2013). Coastal barrier islands are important resources that protect the mainland by reducing wave action that can cause shoreline deterioration. Barrier islands are composed largely of sand or other unconsolidated soils and usually run parallel to shore (Zhang and Leatherman 2011). Barrier islands are present on more than half of the coastline that extends along the GOM, from the Mexican border to southern Florida (LaRoe 1976, BOEM 2015d). The importance of barrier islands and beaches is acknowledged by the designation of two national seashores (Padre Island in Texas, and Gulf Islands in Mississippi and Florida), and several National Wildlife Refuges (NWRs) along the coast of the northern GOM (e.g., Breton NWR in Louisiana) (see **Appendix C**, Section 5.2.3).

Barrier islands serve as critical stopover areas for numerous migrating birds (**Section 4.3.8**), especially along the northern GOM. Barrier islands also provide habitat for sand-dwelling crustaceans (e.g., mole crabs, ghost shrimp, clams) (Britton and Morton 1989) and burrowing small mammals (e.g., mice, rabbits). In addition, barrier island beaches provide important nesting habitat for sea turtles (**Section 4.3.7**).

Wave, wind, and tidal energy are environmental conditions that shape barrier islands, including their respective shorelines and sand dunes, to create a dynamic system (Zhang and Leatherman 2011). Most of the geographic changes experienced by barrier islands are due to storms, subsidence, deltaic influence, longshore drift, or anthropogenic stressors (BOEM 2012a). Most of the barrier islands in the GOM are migrating laterally and retreating landward to some extent (BOEM 2012a, Khalil et al. 2013), although some of the beaches on the western coast of Florida are stable or slowly accreting due to low wave energy and frequent renourishment projects (Morton et al. 2005).

Major barrier islands in the Western Planning Area generally are narrow, low-relief, and sediment starved (Paine et al. 2014). In far eastern Texas and western Louisiana, the coastline is dominated by expansive marshlands with inland lakes left by erosion during the last glaciations (BOEM 2012a). This stretch, east to Atchafalaya Bay, Louisiana, is primarily marshland with no barrier islands and beaches. In the Central Planning Area, barrier islands and beaches generally are eroding (McBride et al. 1992, Otvos and Carter 2008, Byrnes et al. 2013, Khalil et al. 2013). Barrier islands off the coast of Louisiana are highly influenced by the Mississippi River Delta (CPRA 2014). Major barrier islands of Mississippi and Alabama are eroding rapidly (Morton 2007). Florida's barrier island beaches are of low- to moderate energy, with low relief and small dunes composed mostly of quartz sand (Godfrey 1976). Most of the barrier island beaches in this region are wider and more stable than the eroding barrier islands of Mississippi, Alabama, and Texas (Hine et al. 2001, Otvos and Carter 2008).

Sand beaches and dunes also provide a physical buffer, protecting habitat and human communities from storms and hurricanes. NOAA found that the *Deepwater Horizon* spill oiled at least 965 km (600 mi) of sand beaches (barrier shoreline) and 701 km (436 mi) of beach habitat within the oiled area were injured by response activities with 45 million kg (100 million lbs) of oil waste materials removed (DWHNRT 2016).

4.3.5 Pelagic Communities

Pelagic communities are composed of phytoplankton, zooplankton, fish, birds, and marine mammals. These groups interact with one another and the physical environment to form larger scale pelagic ecosystems. Marine mammals, birds, and fishes are discussed in **Sections 4.3.6**, **4.3.8**, and **4.3.9**, respectively, and therefore this section will focus on phytoplankton and zooplankton (including larval fishes or ichthyoplankton). The Beaufort and Chukchi Seas are contiguous parts of the larger subarctic girdle (Wassmann 2015) but differ in fundamental environmental conditions so each program area is treated separately below.

4.3.5.1 Beaufort Sea and Chukchi Sea Program Areas

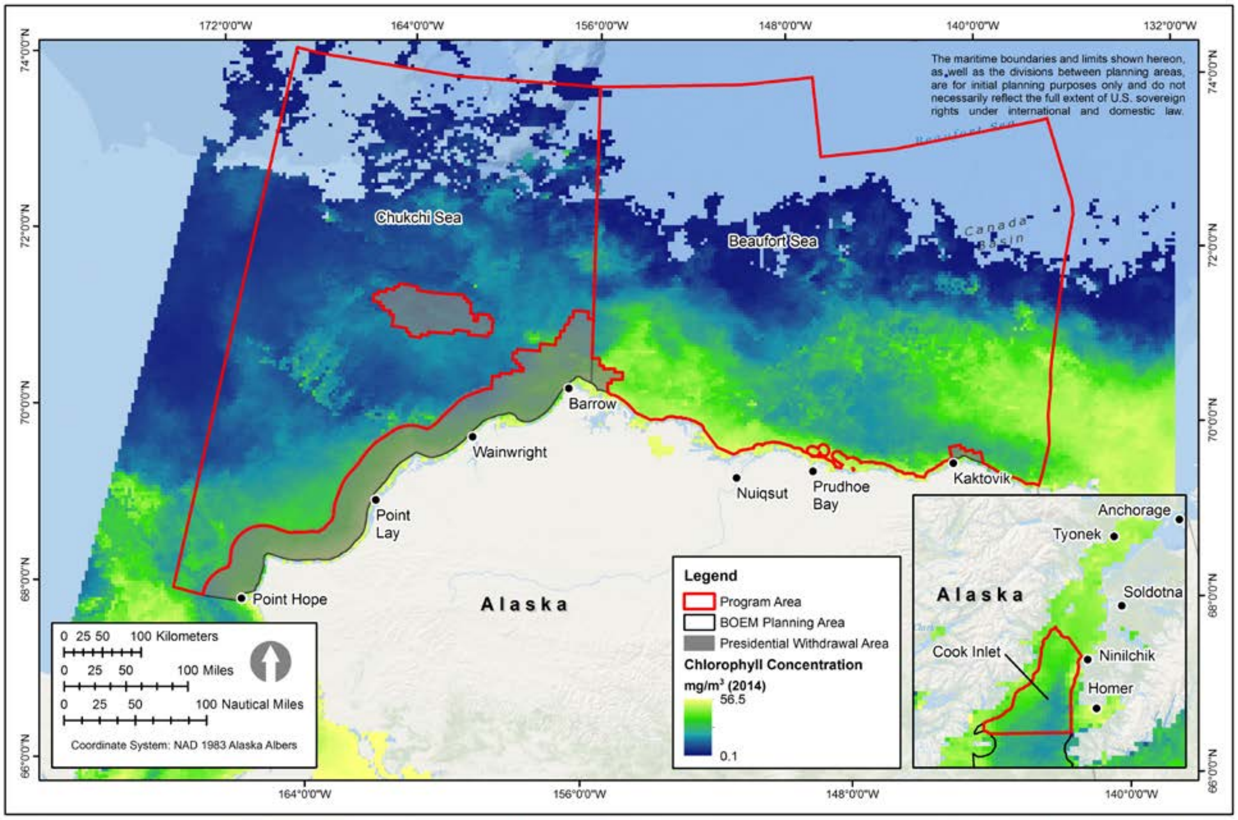
Pelagic communities in the Beaufort Sea follow a seasonal pattern of productivity that begins in spring when sea ice begins to retreat and nutrients from coastal rivers and deep waters reach the sunlight surface waters (Hopcroft et al. 2008). Sea ice is responsible for strong ice-edge phytoplankton blooms, which occur as melting sea ice releases organic matter and freshwater, creating a stratified upper water column with high nutrient concentrations (Hopcroft et al. 2008, Mundy et al. 2009). Phytoplankton communities are composed of cyanobacteria, diatoms, dinoflagellates, and include species such as *Micromonas* sp., *Chaetoceros* spp., Chrysophyceae, Pelagophyceae, and *Chrysochromulina* spp. (Lovejoy and Potvin 2011, Balzano et al. 2012). Phytoplankton distribution (chlorophyll-a) in the region is shown in Figure 4.3.5-1. Phytoplankton growing on the underside of sea ice can be a primary source of productivity in northern areas of the shelf that have permanent ice cover, and sea ice algal productivity and biomass can exceed that of the water column during the spring (Gradinger 2009). Diatoms are highly abundant in under-sea ice communities (Horner et al. 1992, Gradinger and Bluhm 2004, Poulin et al. 2011).

Phytoplankton are in turn fed upon by a variety of zooplankton. Many of the zooplankton taxa found in the Beaufort Sea originate from within the Arctic Ocean proper, but others are transported through the Chukchi Sea from the Bering Sea. Zooplankton in the Beaufort Sea is broadly grouped into shelf-coastal taxa, intermediate, and deep water taxa. Some zooplankton are advected into the Beaufort Sea from the adjacent Chukchi Sea. Krill (euphausids) for example, originating in deeper waters of the Bering Sea, are transported through the Chukchi Sea into the Beaufort Sea where they concentrate in particular areas along the edge (Berline et al. 2008). Ichthyoplankton communities in the Beaufort Sea are composed of arctic cod (*Boreogadus saida*), polar cod (*Arctogadus glacialis*), land lance (*Ammodytes hexapterus*), snailfishes (Liparidae), pricklebacks (Stichaeidae), and sculpins (Cottidae) (Suzuki et al. 2015). In the Arctic, zooplankton biomass and body size of some species has been increasing during recent years (Ershova et al. 2015).

Pelagic food webs in the Chukchi Sea depend on nutrients, phytoplankton, and zooplankton transported from the Pacific (Bering Sea) through the Bering Straits. The Chukchi Sea is a transition zone for pelagic communities between the Pacific Ocean (Bering Sea) and the Arctic Ocean. The influx of Pacific water is directly tied to seasonal retreats and advances of the sea ice. As water temperatures rise in late spring and early summer, at least five different water masses move through the Bering Strait into the Chukchi Sea (e.g., Andyra, Alaska Coastal Waters, Bering Sea). Phytoplankton components of these inputs consist of cyanobacteria, diatoms, dinoflagellates, and other photosynthetic microbes (Hill et al. 2005). About 30 percent of the cyanobacteria collected during a recent field study were represented members of the small-bodied genera *Prochlorococcus* sp. and *Synechococcus* sp., and the remaining 70 percent were a complex of non-cyanobacterical taxa (Lee et al. 2014). Phytoplankton abundance based on satellite interpretation of chlorophyll-*a* reflectance and expressed as milligrams per cubic meter (mg/m^3) during summer is shown in **Figure 4.3.5-1**. Under-ice phytoplankton blooms consisting of *Chaetoceros* spp., *Thalassiosira* spp., and *Fragilariopsis* spp. have been noted under Chukchi Sea ice (Arrigo et al. 2012). Chukchi Sea zooplankton communities are numerically dominated by crustaceans such as copepods, ostracods, cladocerans, decapods, amphipods, mysids, and euphausids (krill) (Ershova et al. 2015). Crustaceans, particularly larger copepods and krill, contribute significantly to the prey base for mammals, birds, and fishes. Other common zooplankton taxa include larvaceans, pteropods, and jellyfish. Zooplankton species composition varies among the incoming water masses. The zooplankton community composition in the Chukchi Sea varies over time and space. Generally, the communities were numerically dominated by copepods (*Pseudocalanus* spp., *Acartia* spp., *Calanus glacialis*, and *Oithona similis*); larvaceans (*Fritillaria borealis* and *Oikopleura vanhoeffeni*); and planktonic stages of bivalves, barnacles, and polychaetes (Questel et al. 2013). Biomass was dominated by *C. glacialis* and the chaetognath *Parasagitta elegans* (Questel et al. 2013). Two Arctic cephalopods are known to have circumpolar distributions: the pelagic squid *Gonatus fabriccii* and the octopus *Cirroteuthis muelleri* (Nesis 2001).

4.3.5.2 Cook Inlet Program Area

Cook Inlet pelagic waters are influenced by riverine and marine inputs, resulting in salinity gradients and horizontal mixing near the inlet. Cook Inlet's pelagic habitat is highly productive in the spring and summer as nutrient-laden riverine and marine waters flow into the area (Doroff and Holderied 2015). Phytoplankton blooms peak during spring and summer as the water column stratifies and sunlight levels increase (Doroff and Holderied 2015). Speckman et al. (2005) concluded that the abundance and distribution of chlorophyll and thus both zooplankton and forage fish in Cook Inlet were affected more by spatial variability in its physical oceanography than by inter-annual variability. Broad syntheses of the environmental data from the planning areas demonstrate that zooplankton abundances are variable from year to year with relatively stable long-term trends (Karnauskas et al. 2013, Zador et al. 2015). In the Gulf of Alaska, body sizes of numerically dominant zooplankters have decreased in recent years (Zador et al. 2015).



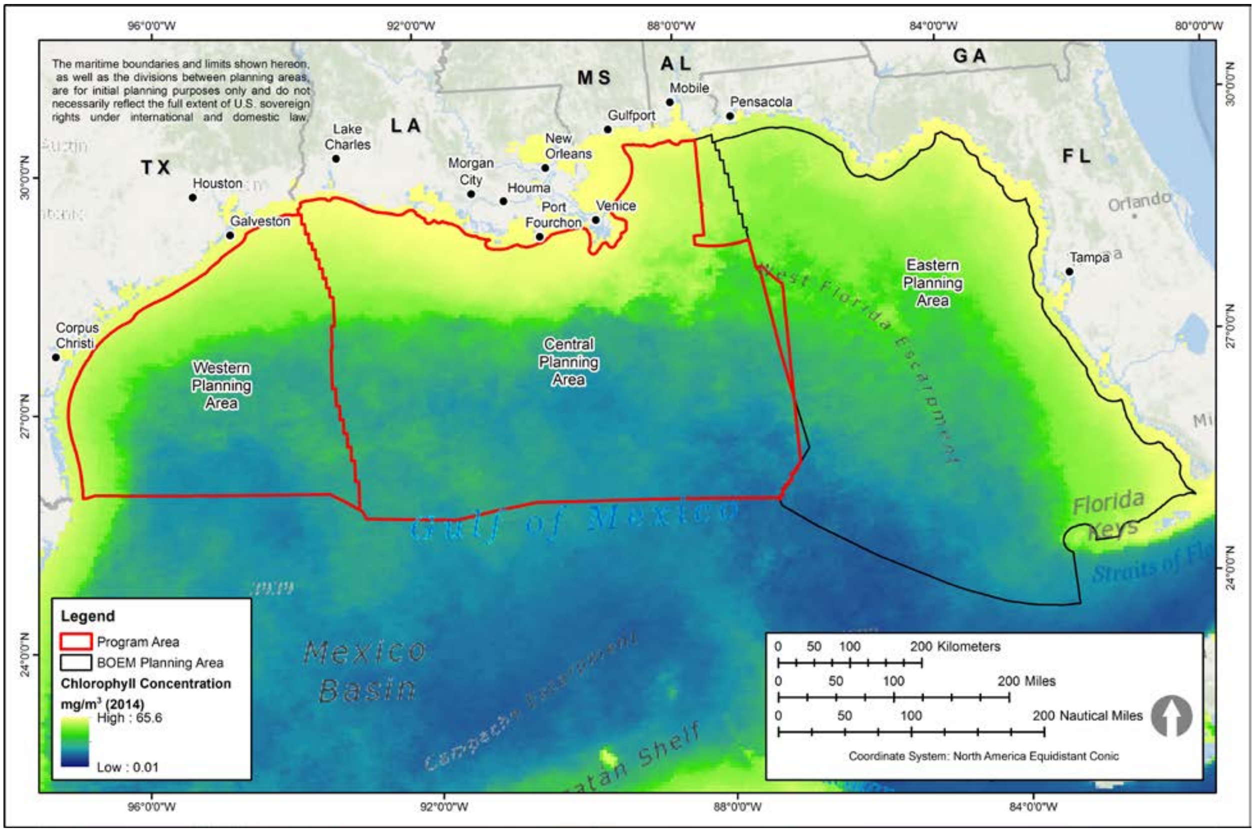
Source: Feldman and McClain 2015

Figure 4.3.5-1 Chlorophyll-*a* signature for the Chukchi and Beaufort Seas

4.3.5.3 Gulf of Mexico Program Area

Various plant and animal communities interact with the oceanographic environment to form pelagic ecosystems over shelf and oceanic waters in the GOM. These communities broadly include phytoplankton, zooplankton (including ichthyoplankton), *Sargassum*, fishes, sea turtles, birds, and mammals. This section discusses phytoplankton, zooplankton, and *Sargassum*.

In the GOM, zooplankton has varied over time, exhibiting both seasonal and inter-annual variation but also has a relatively stable long-term trend (Karnauskas et al. 2013). Ichtyoplankton trends have varied among taxa with patterns of increase, decrease, or no change evident for different taxa (Karnauskas et al. 2013). Phytoplankton including cyanobacteria, diatoms, dinoflagellates, and other photosynthetic microbes are the primary producers in GOM pelagic food webs (Biggs and Ressler 2001, Muller-Karger et al. 2015, Cardona et al. 2016). Phytoplankton growth and abundance is controlled by sunlight and nutrient availability. Nutrient inputs are highest in shelf waters where nutrient-laden freshwaters discharged by coastal rivers (particularly the Mississippi and Atchafalaya Rivers) enter the GOM (Cardona et al. 2016). Generally, light penetration is limited to the near-surface layers closer to shore and expand to greater depths in the clear oceanic waters. This produces a cross-shelf pattern in productivity: higher productivity nearshore that gradually declines with distance from shore. **Figure 4.3.5-2** illustrates the nature of this gradient using satellite imagery. At the offshore end of the gradient (> 200 m water depths) beyond the shelf edge, nutrient availability is much lower and phytoplankton productivity is low (Rooker et al. 2013). A notable exception to the cross-shelf gradient of decreasing productivity with distance from shore are when eddies spinning off the Loop Current trap fresher, cooler, nutrient-laden Mississippi River water and transport it from shallow to deep waters generally in an east-west direction. The movement of cold core eddies results in mobile productivity hotspots that affect zooplankton, ichthyoplankton, and other pelagic biota (Biggs and Ressler 2001, Muller-Karger et al. 2015).



Source: Feldman and McClain 2015

Figure 4.3.5-2 Chlorophyll-*a* signature from the Gulf of Mexico

Zooplankton and ichthyoplankton species composition also varies across the shelf from shallow to deep waters. For example larvae of coastal fish species such as menhaden, croakers, and seatrouts occur in inner shelf waters. Farther offshore, over the middle and outer shelf, larvae of flounders, sea robins, codlets, and snappers are prevalent; beyond the shelf break larvae of tunas, billfishes, lanternfishes, hatchet fishes, and bristlemouths numerically dominate (Ditty et al. 1988, Biggs and Ressler 2001, Muhling et al. 2012).

Most plankton generally reside in the upper layers (< 100 m) of the water column, but *Sargassum* exists entirely in the upper 5 m. *Sargassum* is a drifting plant (alga) that forms large, floating mats ranging in size from a few square centimeters (cm^2) to tens of m^2. The life history of *Sargassum* in the GOM is part of a larger cycle that includes the Mid-Atlantic Ocean and the Caribbean Sea (Frazier et al. 2015). This cycle begins in the Sargasso Sea (North Atlantic) where *Sargassum* remains year-round. However, winds and currents move some of this *Sargassum* south into the Caribbean Sea and eventually into the GOM via the Yucatán Channel. Once in the GOM, it moves into the western area where it uses nutrient inputs from coastal rivers, including the Mississippi River, for growth. As *Sargassum* abundance increases, plants continue to travel east during the summer months; however, a large quantity of plants travel to the nearshore where they are deposited on coastal beaches. *Sargassum* deposition on Gulf coast beaches is important because *Sargassum* facilitates dune stabilization and provides a pathway for nutrient and energy transfer from the marine environment to the terrestrial environment (Webster and Linton 2013). Eventually the plants moving eastward become incorporated into the Gulf Stream where they return to the Sargasso Sea. Throughout this cycle, plants continue to grow, die, and reproduce. When a plant dies, it can sink to the seafloor, transporting nutrients and resources with it (Parr 1939, Coston-Clements et al. 1991, Wei et al. 2012). Although the cycle continues year-round, the rapid growth of *Sargassum* populations in the western GOM typically occur during the spring/summer (Gower et al. 2006, Gower and King 2008, Gower and King 2011). Estimates suggest that between 0.6 and 6 million metric tons of *Sargassum* are present annually in the GOM, with an additional 100 million metric tons exported to the Atlantic basin (Gower and King 2008, Gower and King 2011, Gower et al. 2013). The spatial expanse of this life history facilitates the rapid recovery from episodic environmental perturbations because of the remote probability that any single event could impact the entire spatial distribution.

Sargassum mats provide shade and cover that attracts a diverse assemblage of invertebrates and fishes. *Sargassum* mats serve as habitat for an abundance of juvenile fishes including young jacks, filefishes, billfishes, tunas, tripletails, pipefishes, seahorses, sea chubs, and others. Because of the abundance of small fishes that typically assemble under *Sargassum* mats, larger predators such as dolphinfishes, sharks, tunas, wahoos, and billfishes routinely forage there (Dooley 1972, Casazza and Ross 2008). Critical habitat for *Sargassum* was designated for hatchling loggerhead turtles in July 2014 (79 *Federal Register* [FR] 39856), in the GOM OCS (**Section 4.3.7.3**, **Figure 4.3.7-1**).

4.3.6 Marine Mammals

The status, general ecology, general distribution, migratory movements, and abundance of marine mammals are discussed in greater detail in **Appendix C**, Section 7.0. Many marine mammal species are known to make wide-ranging movements and might not be present in a program area year-round; therefore, time periods of vulnerability to impacts from the activities associated with the Proposed Action could vary. For example, gray whales are present in the Arctic program areas during the summer but migrate south along the U.S. west coast to breeding grounds in Mexico. The majority of species in the GOM Program Area are considered distinct populations and do not undertake migrations.

4.3.6.1 Beaufort Sea and Chukchi Sea Program Areas

Fifteen species of marine mammals can occur within the Beaufort Sea and Chukchi Sea Program Areas. These include five species of baleen whale, four species of toothed whales and dolphins, five species of pinnipeds, and the polar bear (*Ursus maritimus*). The bowhead whale (*Balaena mysticetus*), fin whale (*Balaenoptera physalus*), and polar bear are federally listed as endangered or threatened species under the ESA. The USFWS has designated critical habitat for the polar bear that includes much of the Beaufort Sea and Chukchi Sea Program Areas (**Figure 4.3.6-1**). The Pacific walrus (*Odobenus rosmarus divergens*) is a candidate species for ESA listing.

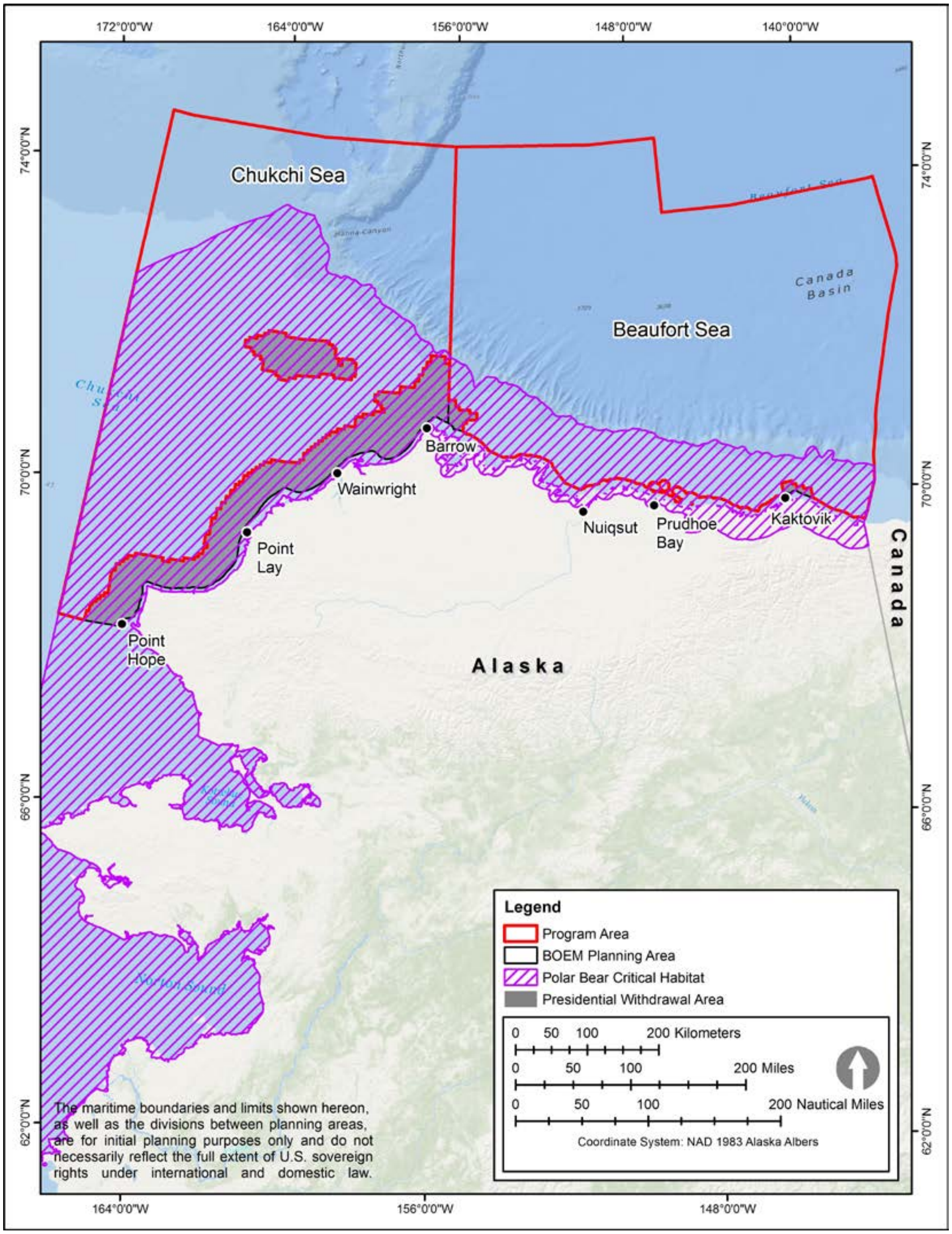


Figure 4.3.6-1. Polar Bear Critical Habitat in the Arctic

4.3.6.2 Cook Inlet Program Area

Ten species of marine mammals commonly occur within the Cook Inlet Program Area: three species of baleen whale, four species of toothed whales and dolphins, two species of pinnipeds, and the northern sea otter (*Enhydra lutris kenyoni*). The humpback whale, Cook Inlet DPS of beluga whale, Southwest Alaska DPS of northern sea otter, and the Western DPS of Steller sea lion (*Eumetopias jubatus*) are listed as threatened or endangered under the ESA. Critical habitat has been designated for the beluga whale, sea otter, and Steller sea lion. An additional eight species could be seen within the program area on rare occasions.

4.3.6.3 Gulf of Mexico Program Area

Twenty-two species of marine mammals regularly occur within the northern GOM: a baleen whale (the Bryde's whale [*Balaenoptera brydei*]), 20 species of toothed whales and dolphins, and the West Indian manatee (*Trichechus manatus*) (Jefferson et al. 2015, Waring et al. 2016). The sperm whale (*Physeter macrocephalus*) and manatee are listed as endangered under the ESA. There is designated critical habitat for the manatee in the GOM along the coast of Florida; it does not overlap with the GOM Program Area.

4.3.7 Sea Turtles

The status, general ecology, and general distribution of sea turtles are discussed in greater detail in **Appendix C**, Section 8.0.

4.3.7.1 Beaufort Sea and Chukchi Sea Program Areas

The Beaufort Sea and Chukchi Sea Program Areas are outside the distribution range for all sea turtle species and will not be discussed further in this section.

4.3.7.2 Cook Inlet Program Area

The Cook Inlet Program Area is generally outside the distribution range for all sea turtle species. However, sea turtles are occasional visitors to Alaska's gulf coast waters. Between 1960 and 2007, there were reports of 19 leatherback turtles (*Dermochelys coriacea*), 15 green turtles (*Chelonia mydas*) and 3 olive ridley turtles (*Lepidochelys olivacea*) (ADF&G 2008). BOEM does not consult with NMFS on sea turtles for activities in Alaska. Though rare sightings have been documented, these are considered extra-limital occurrences; thus, sea turtles within the Cook Inlet Program Area will not be discussed further in this section.

4.3.7.3 Gulf of Mexico Program Area

Five species of sea turtle occur within the northern GOM, including the GOM Program Area. These include representatives of two taxonomic families: Cheloniidae (loggerhead [*Caretta caretta*], green, hawksbill [*Eretmochelys imbricata*], and Kemp's ridley [*Lepidochelys kempii*]) and Dermochelyidae (leatherback) (NMFS 2015a). Olive ridley turtles do not occur in the GOM. **Table 4.3.7-1** provides a list of these species, along with their status, life stage, nesting locations, and ESA critical habitats within the GOM Program Area. Loggerhead critical habitat within and adjacent to the program area is shown in **Figure 4.3.7-1**.

The loggerhead turtle is the most common sea turtle species within the GOM Program Area. It is a circumglobal species that is found from tropical to temperate regions. In the GOM, loggerhead turtles nest primarily in southwestern Florida with minimal nesting outside of this area westward to Texas. There are designated critical habitats for the Northwest Atlantic Ocean DPS of loggerhead turtle (78 FR 18000), including nesting beaches, coastal areas, and OCS areas of the GOM. Located within or adjacent to the program area, these include designated critical habitat units for nesting, nearshore reproductive, breeding, migratory, and *Sargassum* (hatchling developmental) habitats (**Figure 4.3.7-1**).

Table 4.3.7-1. Sea Turtles Occurring in the GOM Program Area

Scientific Name	Common Name	Status1	Life Stage	States with Nesting Reported Adjacent to Program Area	ESA-Designated Critical Habitat within and/or Adjacent to Program Area
Caretta caretta	Loggerhead turtle	T[2]	All	TX, LA, MS, AL, FL	Nesting[5], *Sargassum*, Nearshore Reproductive Breeding, Migratory
Chelonia mydas	Green turtle	T[3]	All	--[4]	--
Eretmochelys imbricata	Hawksbill turtle	E	All	--[4]	--
Lepidochelys kempii	Kemp's ridley turtle	E	All	TX, MS, AL, FL	--
Dermochelys coriacea	Leatherback turtle	E	All	--[4]	--

Notes:
[1] ESA Status: E = endangered; T = threatened.
[2] The Northwest Atlantic Ocean DPS of the loggerhead turtle is classified as threatened (76 FR 58868).
[3] The North Atlantic DPS of the green sea turtle is classified as threatened (81 FR 20058).
[4] Though green, hawksbill, and leatherback turtles have been documented to nest on rare occasions on Gulf coast beaches, only loggerhead and Kemp's ridley turtles are considered routine nesters.
[5] Within the GOM, terrestrial critical habitat units have been designated for the Northern GOM, Dry Tortugas, and Peninsular Florida Recovery units of the Northwest Atlantic loggerhead turtle DPS along portions of the Mississippi, Alabama, and the west coast of Florida shorelines and the Dry Tortugas (**Figure 4.3.7-1**).

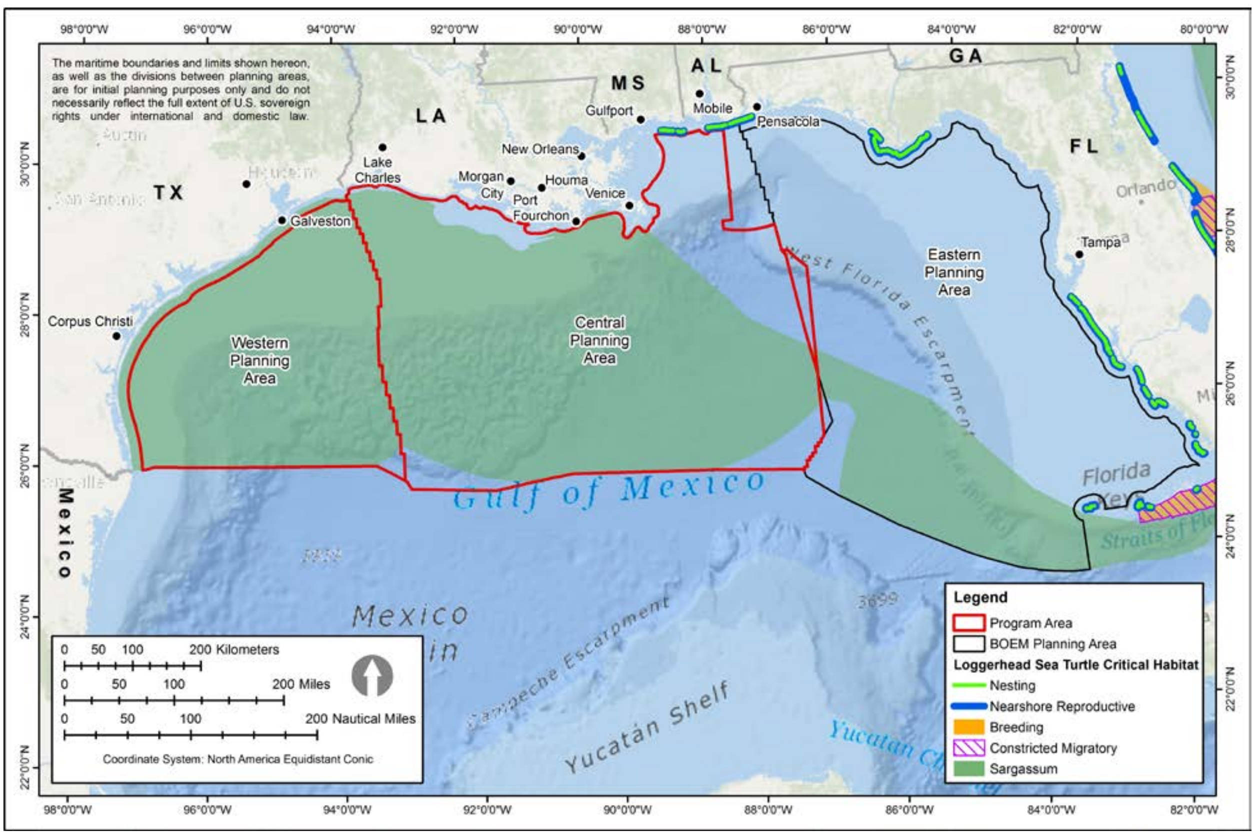


Figure 4.3.7-1. Designated Marine and Terrestrial Critical Habitat for Loggerhead Turtles in the GOM Program Area

Green turtles are found throughout the GOM but do not frequently nest on GOM beaches (NMFS and USFWS 2007a, NMFS and USFWS 2011). Satellite tagging data indicate that, similar to other sea turtles, green turtles display highly migratory behavior, making vast seasonal coastal and annual transoceanic migrations (Godley et al. 2003, Godley et al. 2008, Godley et al. 2010). Based on satellite tagging research by Hart and Fujisaki (2010), green turtles display daily and seasonal movement patterns associated with foraging strategies. Small juveniles often were found within regions of optimal foraging habitat (e.g., sources of marine algae) suggesting that juvenile green turtles could be found at higher abundance in various shallow-water inshore areas in the program area where macro-algae (seagrass) is reported.

The hawksbill turtle is a circumtropical species distributed mainly in waters between latitudes 30° north and 30° south. Though they regularly occur in the GOM, hawksbill turtles are not considered routine nesters on Gulf coast beaches due to the fact that nesting has only been documented on rare occasions (NMFS and USFWS 2007b, NMFS and USFWS 2013). Hawksbill turtles display highly migratory behavior; satellite-tagging data demonstrate short and long migrations from nesting to foraging grounds (NMFS and USFWS 2007b, Blumenthal et al. 2009).

The Kemp’s ridley turtle is found throughout the GOM (NMFS et al. 2011). Survey data from the GOM suggest that Kemp’s ridley turtles occur mainly in waters over the continental shelf. The primary habitat for adult Kemp’s ridley turtles is within nearshore waters < 37 m (121 ft.) deep; however, it is not uncommon for adults to swim farther from shore where waters are deeper (NMFS and USFWS 2015). Shallow coastal habitats serve as foraging grounds throughout the year, although there is evidence for seasonal offshore movements in response to low water temperatures in the winter (Bjorndal 1997). Key foraging areas within the program area include Sabine Pass, Texas; Caillou Bay and Calcasieu Pass, Louisiana; Big Gulley, Alabama; Cedar Keys, Florida; Ten Thousand Islands, Florida; and Ship Shoal, Louisiana (NMFS 2011, Hart et al. 2013, Hart et al. 2014). Similar to other sea turtles, Kemp’s ridley turtles display some seasonal and coastal migratory behavior; satellite-tagging data indicate that they transit between nearshore and OCS waters (within 80.5 km [50 mi] of the shore) from spring/summer to fall/winter, which coincides with seasonal water temperature changes (NMFS et al. 2010).

The leatherback turtle is found within the GOM and is the most abundant turtle in waters over the northern GOM continental slope (Mullin and Hoggard 2000), but nesting on GOM beaches is rare. Leatherback turtles appear to use continental shelf and slope waters in the GOM (Fritts et al. 1983a, Fritts et al. 1983b, Collard 1990, Davis and Fargion 1996). GulfCet I and II surveys suggest that the region from Mississippi Canyon to DeSoto Canyon, especially near the shelf edge, is an important habitat for leatherback turtles (Mullin and Hoggard 2000).

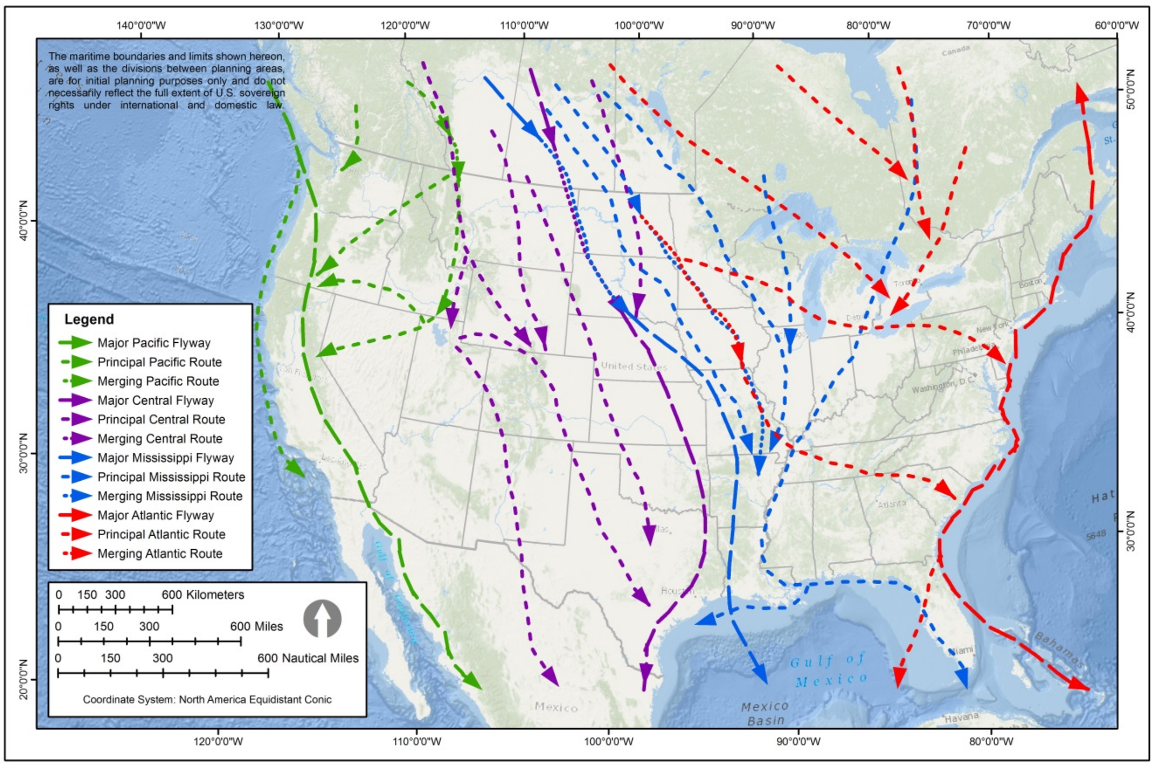
4.3.8 Birds

Status, general ecology, general distribution, migratory movements, and abundance of birds are discussed in greater detail in **Appendix C**, Section 9.0. Avian species within a family share common physical and behavioral characteristics. Because of these commonalities, birds are presented in this document in terms of ecological groups rather than individual species. Common behavioral characteristics within these ecological groups also result in similar potential impacts.

Time periods of vulnerability vary across species and families. Some species could be resident year-round within a single program area, such as the brown pelican (*Pelecanus occidentalis*) in the GOM. Other species migrate through one or more program areas over the course of the year, typically by following the Pacific Flyway from Alaska down the west coast or either the Mississippi or Central Flyway (**Figure 4.3.8-1**). Western sandpipers (*Calidris mauri*), semipalmated sandpipers (*Calidris pusilla*) and dunlin (*Calidris alpina*) are all examples of species that nest in Alaska (and other places) and migrate through or to the GOM in fall/winter. Some other species could be resident for only part of a year in only one of the program areas, such as the Arctic tern (*Sterna paradisaea*), which nests in Alaska in summer then migrates to the southern hemisphere for the rest of the year.

4.3.8.1 Beaufort Sea and Chukchi Sea Program Areas

Most birds occurring in the Beaufort and Chukchi Seas and their adjacent coastal habitats are migratory, being present for all or part of the period between May and early November. Few species are present in winter (i.e., snowy owls [*Bubo scandiacus*], ravens, ptarmigans), but multiple species arrive early in the spring, following ice leads that provide access to open water. Approximately 45 marine species, including waterfowl, seabirds, and shorebirds, breed in the Alaskan Arctic. Most nest in coastal tundra and near tundra ponds, although in some locations seabirds occur in large nesting colonies, notably at Cape Lisbourne in the Chukchi Sea and on barrier islands in the Beaufort Sea. A few species of passerines (i.e., buntings, longspurs, warblers, and wagtails) also regularly occur in coastal and OCS areas during migration and are common breeders along the ACP (**Figure 4.3.4-1**) (USFWS 2010). Several areas within the Beaufort and Chukchi Seas have been recognized as IBAs of global significance by the National Audubon Society, as described in **Table 4.3.8-1** and shown in **Figure 4.3.8-2**.



Source: USFWS 2015a

Figure 4.3.8-1. North American Flyways

Table 4.3.8-1. Important Bird Areas identified under the National Audubon Society IBA Program in or Adjacent to Beaufort Sea and Chukchi Sea Planning Areas

IBA	Borough	Status	Priority	Importance
Teshekpuk Lake-E. Dease Inlet	North Slope	Recognized	Global	Breeding area for federally listed Steller's eider and spectacled eider. Could support up to 30 percent of the Pacific Flyway brant population. Supports high densities of breeding shorebirds and waterfowl, as well as yellow-billed loon.
Ledyard Bay		Recognized	Global	Spring staging area and fall molting area for spectacled eider. Nearly all molting females pass through this area. Also important migratory staging area for other waterfowl such as king eider.
Kasegaluk Lagoon		Recognized	Global	Habitat for multiple shorebirds during the summer. Primary staging area for black brant, with up to 40,000 birds present in late summer. Hosts an Aleutian tern colony.
Beaufort Sea Nearshore		Identified	Global	Glaucous-winged gull and long-tailed duck breeding and foraging area
Northeast Arctic Coastal Plain		Recognized	Continental	Fall migration staging area for lesser snow goose, when more than 325,000 birds could be present.
Colville River Delta Marine		Identified	Global	Nesting habitat for breeding glaucous-winged gull
Beaufort Sea Shelf Edge 71° N, 152° W		Identified	Global	Foraging habitat for breeding glaucous-winged gull
Barrow Canyon and Smith Bay		Identified	Global	Habitat for thousands of breeding black-legged kittiwake, king eider, long-tailed duck, Sabine's gull, Arctic tern, and red phalarope
Chukchi Sea Nearshore		Identified	Global	Habitat for thousands of breeding Sabine's gull and glaucous-winged gull
Icy Cape Marine		Identified	Global	Habitat for thousands of breeding Pomarine jaeger and glaucous-winged gull
Point Lay Marine		Identified	Global	Habitat for thousands of breeding long-tailed duck
Lisburne Peninsula Marine		Identified	Global	Habitat for thousands of breeding black-legged kittiwake

Source: Audubon Alaska 2014

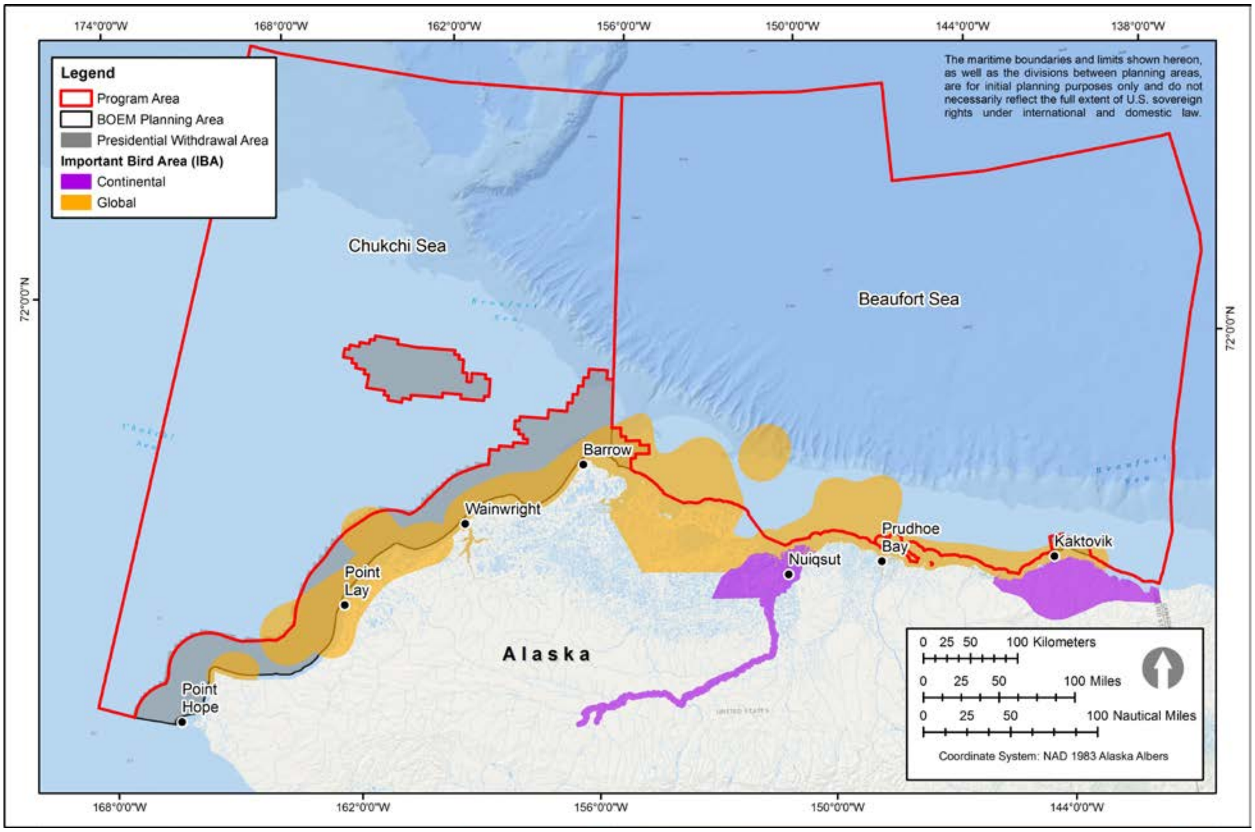


Figure 4.3.8-2. Important Bird Areas identified under the National Audubon Society IBA Program (2015) in or Adjacent to the Beaufort Sea and Chukchi Sea Planning Areas

Sigler et al. (2011) analyzed seabird distribution at sea and found that the north Bering Sea and Chukchi Sea birds form a distinctly separate group from the Beaufort Sea birds. The north Bering-Chukchi region was dominated by planktivorous birds (*Aethia* spp. auklets in the north Bering Sea and *Puffinus* spp. shearwaters in the Chukchi Sea), whereas the Beaufort Sea seabirds were primarily piscivorous, and circumpolar in distribution. Two ESA-listed species, spectacled eiders (*Somateria fischeri*) and Steller's eiders (*Polysticta stelleri*), breed in the Arctic. In 2001, the USFWS designated critical habitat considered to be essential for the conservation of spectacled eider (66 FR 9146). This habitat is in Ledyard Bay (**Figure 4.3.8-3**). There is no designated critical habitat for Steller's eiders in the Arctic.

4.3.8.2 Cook Inlet Program Area

Marine and coastal habitats of Cook Inlet host a large number of bird species. At least 237 avian species have been recorded in the Kodiak Island Archipelago on the eastern margin of Cook Inlet (MacIntosh 2009). Birds traveling to and from breeding areas in interior Alaska, the North Slope, and western coastal areas of Alaska use Cook Inlet during migration. Annual use patterns of Cook Inlet are characterized by the sudden and rapid arrival of very large numbers of birds in spring, typically in early May, followed by an abrupt departure in mid- to late May. As many as 175,000 shorebirds (primarily western sandpipers [*Calidris mauri*]) regularly occur in Cook Inlet during spring migration (Gill and Tibbitts 1999). Although fewer species and lower abundances of birds are present in the winter, habitats in Cook Inlet still support significant populations of overwintering birds, notably waterfowl, seabirds, and, most conspicuously, virtually the entire population of the nominate race of rock sandpiper, known as the Pribilof rock sandpiper (*Calidris ptilocnemis ptilocnemis*) (Agler et al. 1995, Larned and Zwiefelhofer 2001, Gill et al. 2002, ADNR 2009, Ruthrauff et al. 2012).

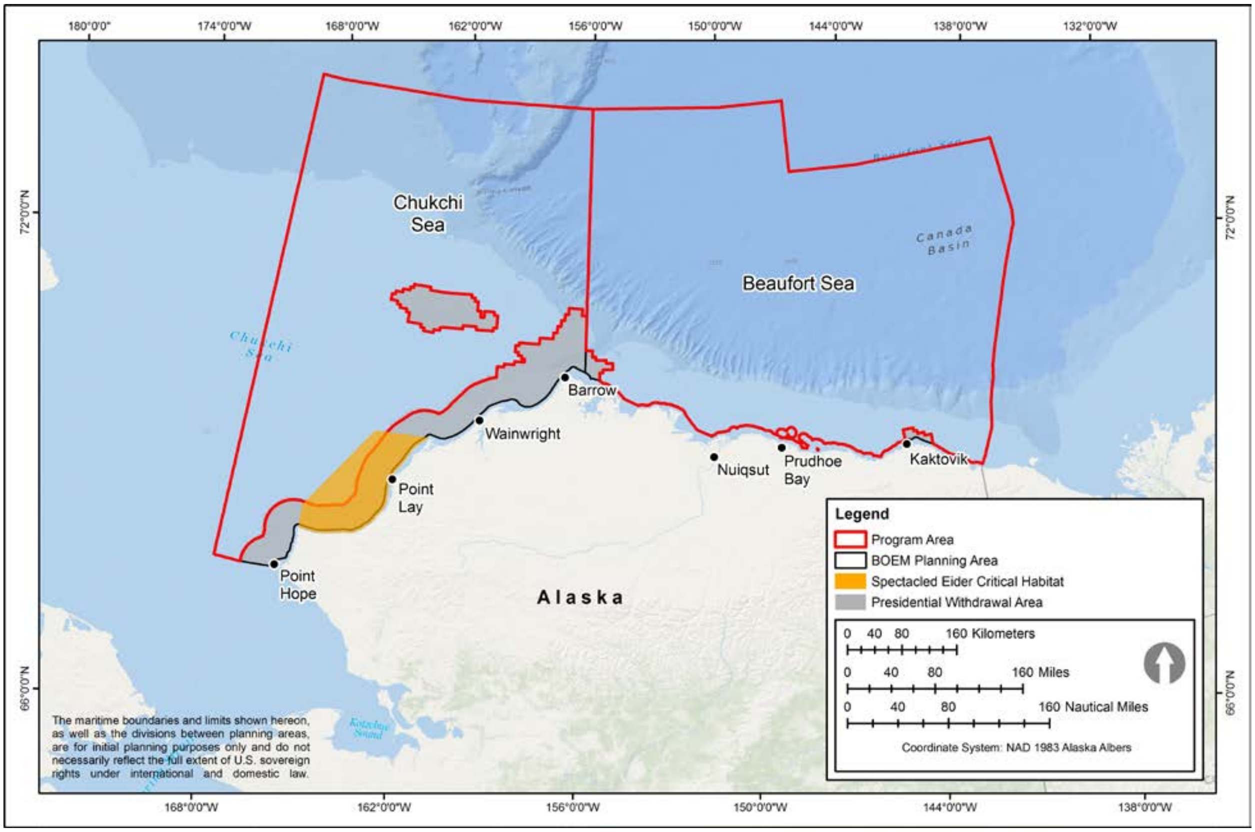


Figure 4.3.8-3. Designated Critical Habitat for the Spectacled Eider in the Chukchi Sea

Birds occurring within and adjacent to the Cook Inlet Planning Area encompass dozens of species that fall into at least 11 orders of seabirds, waterfowl, shorebirds, wading/marsh birds, and raptors. Coastal wetlands and bays along Cook Inlet provide important staging habitats for migratory birds, with large seasonal aggregations of waterfowl and shorebirds. Large numbers of seabirds and some waterfowl and shorebirds remain in Cook Inlet and its adjacent coastal areas to breed. Seabird nesting colonies are prominent on multiple small islands and on steep coastal slopes (NOAA 2002).

Numerous IBAs of global significance have been identified by the National Audubon Society within Cook Inlet, as shown in **Figure 4.3.8-4** and described below in **Table 4.3.8-2**. Of the sites identified or recognized as IBAs in the Cook Inlet area, Kachemak Bay also has received recognition as a Site of International Importance by the Western Hemisphere Shorebird Reserve Network because it hosts > 100,000 shorebirds on an annual basis (Matz 2014).

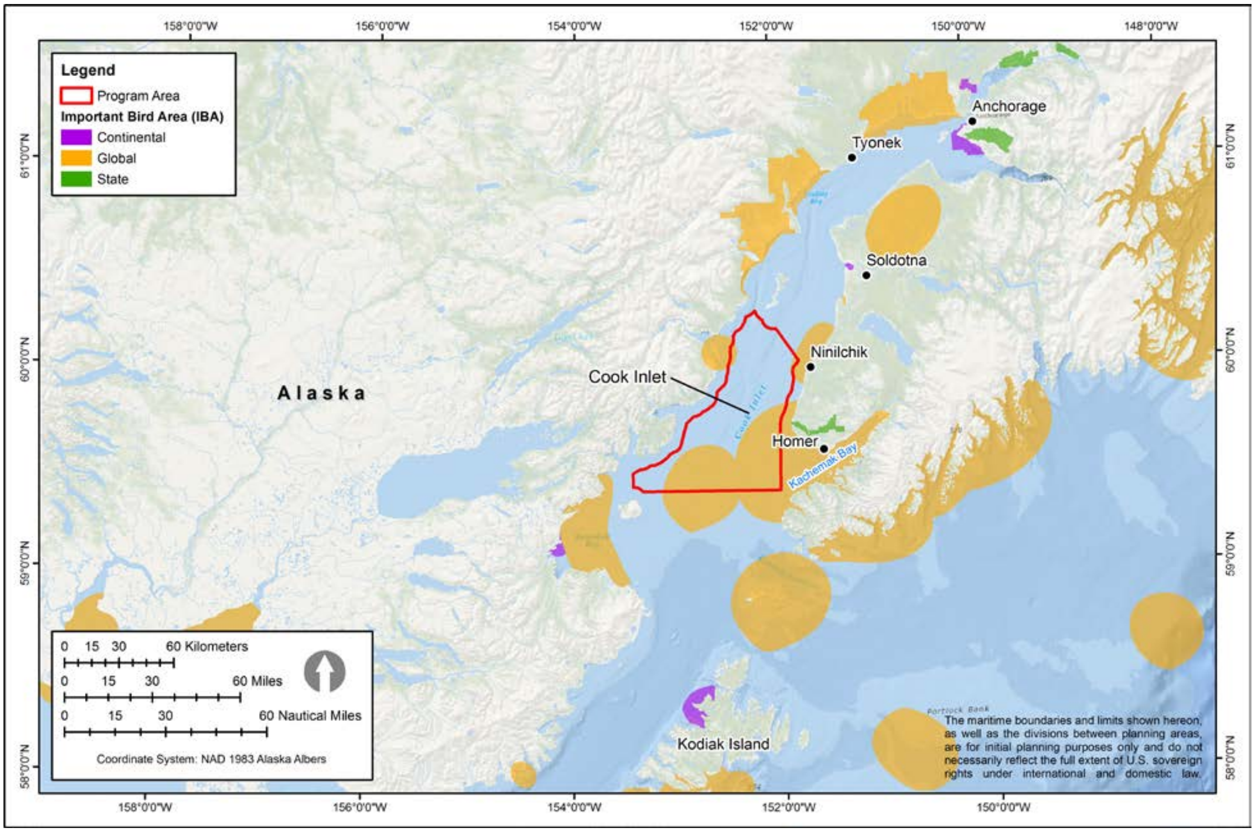


Figure 4.3.8-4. Important Bird Areas identified under the National Audubon Society IBA Program (2015) in the Cook Inlet Program Area

4.3.8.3 Gulf of Mexico Program Area

The northern GOM supports a diverse avifauna and includes a variety of coastal habitats that are important to the ecology of coastal and marine bird species. A broad range of habitats are used at different life and migratory stages. Open-water areas offshore are used for foraging and resting, while nesting occurs in estuarine and marsh habitats as well as beach and dune habitats. Some species (clapper rail [*Rallus crepitans*] and seaside sparrow [*Ammodramus maritimus*]) spend their lives in small areas in coastal marshes for all their life stages. The northern GOM is also home to many important bird colonies.

The northern GOM is a vitally important migration route and provides important wintering habitat for some bird species. Parts of the Central, Mississippi, and Atlantic Flyways (**Figure 4.3.8-1**) are used by hundreds of millions of migratory birds that converge on diverse coastal and terrestrial habitats along the northern Gulf coast, where some stay while others continue on to another migratory destinations (Russell 2005). Birds continue their migration along the northern Gulf coast, follow the Mexico-Texas coastline, or cross the GOM between Mexico's Yucatán Peninsula and the Texas coast. For many species such as the white pelican (*Pelecanus erythrorhynchos*), common loon (*Gavia immer*), and a variety of waterfowl and shorebirds, the coastal areas in the northern GOM provide important wintering habitat (Condrey et al. 1996). Portions of the shoreline in the northern GOM have been designated as critical habitat for wintering threatened and endangered piping plovers (*Charadrius melodus*) (66 FR 36038).

Table 4.3.8-2. Important Bird Areas identified under the National Audubon Society IBA Program in or Adjacent to the Cook Inlet Program Area

IBA	County	Status	Priority	Importance (Update)
Amakdedulia Cove	Kenai Peninsula	Recognized	Continental	Seabird nesting colony; summer waterfowl congregation area
Anchor River		Recognized	State	Migratory passerine concentration area
Barren Islands Colonies		Identified	Global	Contains 6 seabird nesting colonies, supporting 14 species and > 400,000 individuals; key species include pelagic cormorant, glaucous-winged gull, black-legged kittiwake, tufted puffin, and fork-tailed storm-petrel
Clam Gulch		Recognized	Global	Steller's eider wintering area; black scoter, long-tailed duck, and common eider present
Contact Point		Recognized	State	Seabird nesting colony for 6 species; spring waterfowl congregation area
Fox River Flats		Recognized	Global	Spring migration stopover area for 22 species; spring, fall, and winter waterfowl congregation area
Homer Spit	Kenai Peninsula	Recognized	Global	Steller's eider wintering area; rock sandpiper wintering area; spring migration stopover area for shorebirds, including western sandpiper and surfbird; whimbrel, wandering tattler, black oystercatcher, Pacific golden plover, bristle-thighed curlew, Hudsonian godwit, marbled godwit, bar-tailed godwit, black turnstone, and trumpeter swan present.
Kachemak Bay		Identified	Global	Kittlitz's murrelet, white-winged scoter, black scoter, pelagic cormorant, marbled murrelet
Kamishak Bay		Identified	Global	Non-breeding habitat for glaucous-winged gull
Kenai River Flats		Recognized	Continental	Spring staging area for Wrangell Island snow goose; seabird nesting colonies; migrant shorebirds, waterfowl and wading birds also use the area
Lower Cook Inlet 59° N, 153° W		Identified	Global	Non-breeding habitat for glaucous-winged gull
Redoubt Bay		Recognized	Global	Supports 70 percent of Cook Inlet spring migrant shorebirds; waterfowl, including multiple species of goose, swan and duck
Swanson Lakes		Recognized	Global	Trumpeter swan; red-throated loon; one of highest densities of common loon in North America
Trading Bay		Recognized	Global	Wrangell Island snow goose spring staging area; rock sandpiper nominate race wintering area; spring migrant stopover area for Hudsonian godwit, whimbrel, and American golden-plover; used by red-throated loon
Tuxedni Bay		Recognized	Global	Fall migration stopover for geese; summer and fall concentration area for scoters; spring migration stopover for long-tailed duck and Western sandpiper; black scoter, black oystercatcher, black turnstone, surfbird and whimbrel present
Tuxedni Island Colony		Identified	Global	Contains a seabird nesting colony hosting 3 species, including black-legged kittiwake

IBA	County	Status	Priority	Importance (Update)
Amalik Bay Colonies	Kodiak Island	Identified	Global	Contains 3 seabird nesting colonies, hosting 10 species, including red-faced cormorant
Northwest Afognak Island		Recognized	Continental	Breeding area for back oystercatcher; nesting and foraging habitat for other shorebirds and seabirds
Uganik Bay and Viekoda Bay		Recognized	Global	Contains 14 seabird nesting colonies; breeding area for black oystercatcher and other shorebirds; wintering area for multiple species of seabirds and waterfowl
Wide Bay		Recognized	Global	Contains a number of seabird nesting colonies; waterfowl, including emperor goose and Steller's eider routinely congregate in this area; bald eagle nesting sites present
Goose Bay	Matanuska-Susitna	Recognized	Continental	Spring and fall stopover for waterfowl
Palmer Hay Flats		Recognized	State	Spring and fall stopover area for waterfowl
Susitna Flats		Recognized	Global	Spring migration stopover area for waterfowl and shorebirds; rock sandpiper (nominate race) wintering area

Source: Audubon Alaska 2014

Six distinct taxonomic and ecological groups might be affected by OCS oil and gas activities: passerines, raptors, seabirds, waterfowl, shorebirds, and wading/marsh birds. Seabirds, waterfowl, shorebirds, and wading/marsh birds depend on marine and coastal habitats (such as beaches, mud flats, salt marshes, coastal wetlands, and embayments), and these birds have the greatest potential for being impacted by OCS-related oil and gas development activities.

Seven species of birds found within the northern GOM are listed under the ESA. Five are found in habitats within the Western and Central Planning Areas, where they might be affected by OCS oil and gas activities (Mississippi sandhill crane [*Grus canadensis pulla*], piping plover, red knot [*Calidris canutus*], whooping crane [*Grus americana*], and wood stork [*Mycteria americana*]). Two species are exclusive to Florida (Eastern Planning Area), in areas where they might be affected by a catastrophic oil spill but not by normal OCS oil and gas operations (Cape Sable seaside sparrow [*Ammodramus maritimus mirabilis*] and roseate tern [*Sterna dougallii*]).

4.3.9 Fish and Essential Fish Habitat

4.3.9.1 Managed Species and Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (FCMA) (16 U.S.C. § 1801-1882) established regional Fishery Management Councils (FMCs) and mandated that FMPs be developed to responsibly manage exploited fish and invertebrate species in U.S. waters. When Congress reauthorized the FCMA in 1996 as the Sustainable Fisheries Act, several reforms and changes were made. Among the changes, NMFS was required to designate and conserve EFH for species managed under existing FMPs. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (16 U.S.C. § 1801[10]). NMFS published the final rule implementing the EFH provisions of the Sustainable Fisheries Act (50 CFR part 600) on January 17, 2002. The rule included guidance to regional FMCs for identifying and defining EFH, clarified the intent of key terms, and required that Federal agencies consult with NMFS when planning or authorizing activities that could adversely affect EFH. BOEM consults with NMFS regarding such activities and implements measures to avoid, minimize, or mitigate impacts on EFH when appropriate.

The broad definition of EFH is useful for drawing management attention to the potential effects of human activities on coastal and marine environments. The additional designation of HAPC is used by

NMFS and the regional FMCs to increase focus on specific areas for purposes of research and conservation efforts, but does not confer specific protections or restrictions. HAPC designation and review processes vary by region, and discrete areas or habitat types could be selected for very different reasons. However, HAPCs also can serve as a mechanism for highlighting certain areas for greater scrutiny during the consultation process and for specific impact analyses. A complete description of the affected environment for fishes and EFH is provided in **Appendix C**, Section 10.0.

The following sections discuss federally managed species of fishes and invertebrates as designated in regional FMPs at a programmatic level. In all planning areas, general abundance trends of many managed species appear to be stable or increasing (Karnauskas et al. 2013, Zador 2015). The regional FMPs are summarized here to identify managed species and their EFH for the Arctic, Cook Inlet, and GOM. Only managed species are discussed here, which sometimes leaves out important fishery species that are not federally managed. Examples are Pacific halibut and Pacific herring in Cook Inlet and menhaden in the GOM. Also covered in this section are fishes listed as threatened or endangered under the ESA. Some EFH-designation species such as spiny lobster are outside of the program area boundaries but are retained because their habitat or life stages could be affected by a CDE. Additional details on listed species life histories and EFH designations by life stages are in **Appendix C**, Section 10.0.

4.3.9.2 Beaufort Sea and Chukchi Sea Program Areas

Fisheries resources in both the Beaufort Sea and Chukchi Sea Program Areas are managed under two FMPs: the Arctic Management Area (NPFMC 2009) and the Salmon Fisheries in the exclusive economic zone (EEZ) off Alaska (NPFMC 2009, NPFMC et al. 2012). The Arctic FMP encompasses all marine waters in the U.S. EEZ and all anadromous streams within the Chukchi and Beaufort Seas. The western boundary is demarcated by the 1990 U.S./Russia maritime boundary line, and the eastern limit is the U.S./Canada maritime boundary bisecting the Beaufort Sea (NPFMC 2009). The Arctic FMP governs commercial fishing for all stocks of finfish and shellfish in Federal waters except for Pacific salmon (*Oncorhynchus* spp.) and Pacific halibut (*Hippoglossus stenolepis*). These species are managed under the Salmon FMP (NPFMC et al. 2012) and the International Pacific Halibut Commission, respectively.

Commercial fishing is not permitted in Federal waters of the Beaufort and Chukchi Seas, but fishery species are present in these waters and EFH has been designated for several fishes and one species of crab (**Figure 4.3.9-1**) (NPFMC 2009). According to the Arctic FMC and NMFS, there has been no new information indicating that commercial fisheries could be supported in the Arctic Ocean and no reason to initiate a planning process for commercial fishery development (NPFMC 2009). EFH is described for Arctic cod (*Boreogadus saida*), saffron cod (*Eleginus gracilis*), and snow crab (*Chionoecetes opilio*) in the Arctic FMP (NPFMC 2009), and for chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), pink (*O. gorbuscha*), sockeye (*O. nerka*), and chum (*O. keta*) salmon in the Salmon Fisheries FMP (NPFMC et al. 2012). There are no ESA-listed fish or shellfish species in the Arctic program areas.

Based on the distribution of adult and juvenile saffron cod, EFH includes coastal waters and nearshore bays of the Chukchi Sea (NPFMC 2009). A small portion of saffron cod EFH overlaps with the Chukchi Sea Program Area in the southwest; the remaining saffron cod EFH in the Arctic falls within a Presidential Withdrawal area. Arctic cod EFH encompasses most pelagic and epipelagic waters in the Arctic planning areas (NPFMC 2009). The North Pacific FMC determined there was insufficient information to designate EFH for early life stages of these species (NPFMC 2009). Designated adult and juvenile snow crab EFH includes muddy bottom habitats of the inner and middle continental shelf (0 to 100 m [0 to 328 ft] depth) south of Cape Lisburne, Alaska. A very small area of snow crab EFH extends into the southwestern portion of the Chukchi Sea Program Area (NPFMC 2009). EFH for the five species of Pacific salmon in the Beaufort and Chukchi Sea Program Areas, as described in the Salmon FMP, includes all marine waters within the EEZ off the coast of Alaska (NPFMC et al. 2012).

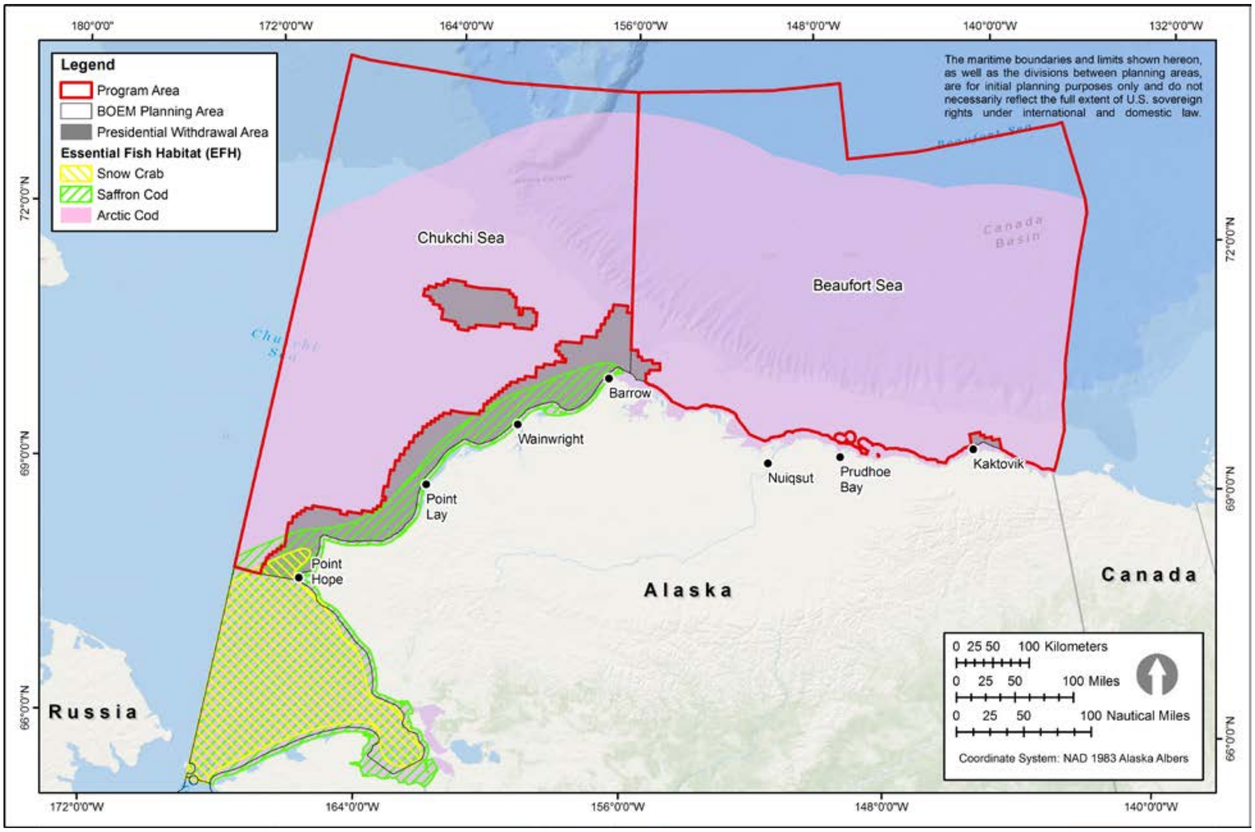


Figure 4.3.9-1. Distribution of EFH in and around the Arctic Program Areas

4.3.9.3 Cook Inlet Program Area

The program area (**Figure 4.3.9-2**) includes the upper boundaries of Cook Inlet, Alaska. FMPs applicable to Cook Inlet include the Gulf of Alaska (GOA) Groundfish FMP (NPFMC 2015), Scallop FMP (NPFMC 2014), and Salmon Fisheries FMP (NPFMC et al. 2012).

The GOA Groundfish FMP covers all commercial finfish except salmon (*Oncorhynchus* spp.), Pacific halibut, and Pacific herring (*Clupea pallasii*). All groundfish species from Gulf of Alaska (including Cook Inlet), except sablefish, have been above their sustainable abundance levels (Zador 2015). Species taken within the groundfish fishery are categorized as target species and ecosystem components by the NPFMC (2015). Target species are those that support single species or mixed species fisheries that are commercially important, and for which there is sufficient information available to manage each species based on its own biological merits. Ecosystem components include two elements: prohibited species and forage fishes. Prohibited species must be avoided by fishers targeting groundfish and, if caught, must immediately be released to minimize injury. Forage fishes are those species that are a critical food source for marine mammals, seabirds, and other fishes.

Species groups managed under the GOA Groundfish FMP are listed in **Appendix C**, Table C-20. Life stage-specific EFH has been designated for managed species whenever sufficient data were available; EFH was not designated for sharks, octopus, or forage fish due to insufficient information (NPFMC 2015). Descriptions of groundfish habitats are provided in the 2015 GOA Groundfish FMP. Most marine habitats within the Cook Inlet Program Area have been identified as EFH (**Figure 4.3.9-2**). Within Cook Inlet, non-pelagic trawling is prohibited to reduce crab bycatch and assist in the rebuilding of crab stocks (**Appendix C**, Figure C-50) (NPFMC 2015).

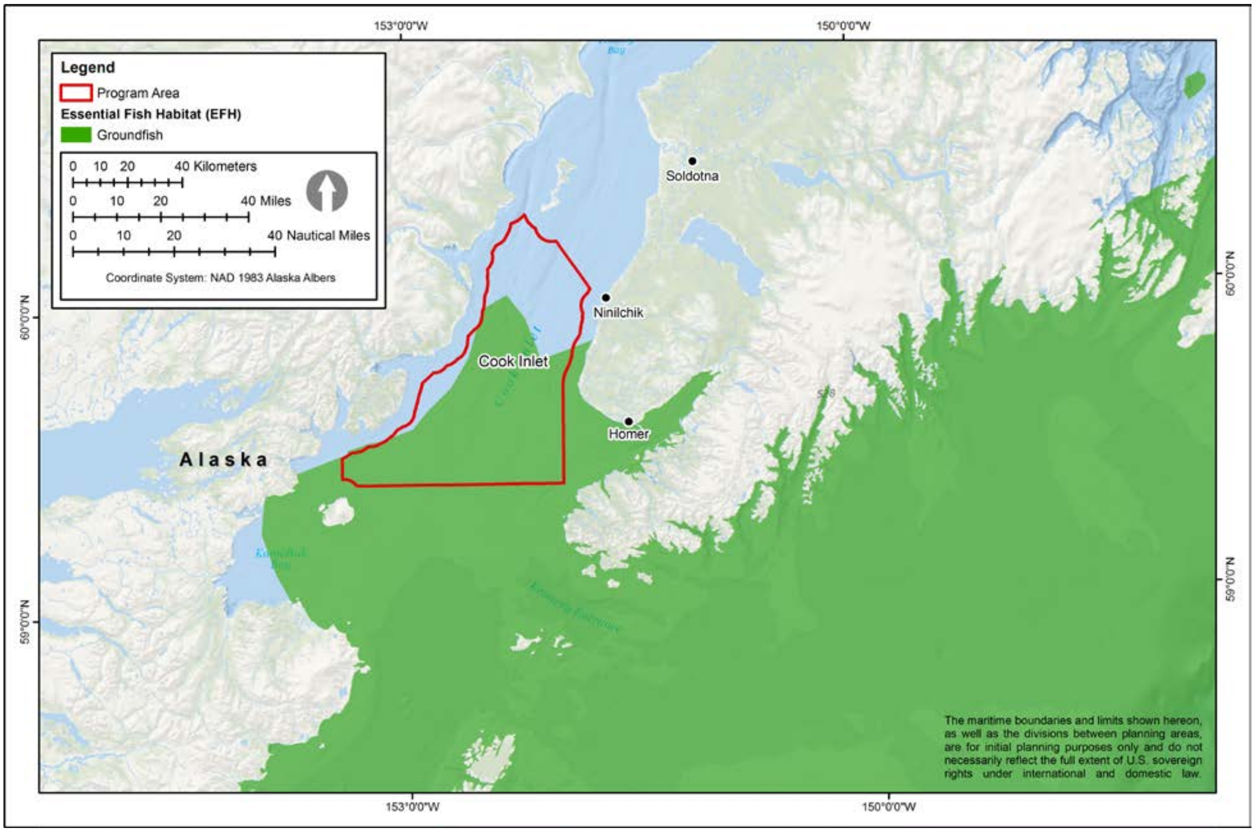


Figure 4.3.9-2. Distribution of Groundfish EFH in and around the Cook Inlet Program Area

Weathervane scallops (*Patinopecten caurinus*), the only commercially targeted scallop species in the Cook Inlet, are widely distributed from California to the Bering Sea, inhabiting waters ranging in depth from the intertidal to approximately 300 m (985 ft). EFH has been designated only for late juvenile and adult life stages, and includes clay, mud, sand, and gravel substrates to a depth of 200 m (656 ft) (NPFMC 2014). A small portion of the designated EFH lies within the Cook Inlet Program Area. Most, if not all, weathervane scallop EFH in the Cook Inlet Program Area and GOA coincides with areas also designated as groundfish EFH (**Appendix C**, Figure C-51). Pacific salmon EFH, as described in the Salmon FMP, includes all marine waters within the EEZ off the coast of Alaska and all anadromous streams (**Appendix C**, Figure C-52) (NPFMC 2012). Pacific salmon abundance has been fluctuating above historical averages (Zador 2015).

There are no HAPCs identified within Cook Inlet (NPFMC 2015). The Alaska Seamount Habitat Protection Areas and GOA Coral Protection Areas are the closest designated HAPCs within Alaskan EEZ, and are approximately 416 km (225 nmi) from the entrance of Cook Inlet.

4.3.9.4 Gulf of Mexico Program Area

The GOM has habitats ranging from coastal marshes to oceanic waters, supports a range of commercial and recreational fisheries. Commercial fisheries target shrimps, menhaden, red snapper, menhaden, swordfish, yellowfin tuna, and sharks (Karnauskas et al. 2015). The high productivity of continental shelf waters is heavily influenced by freshwater and sedimentary input from the Mississippi and Atchafalaya Rivers (Grimes 2001). The Loop Current and its associated eddies create a dynamic zone, with strong divergences and convergences that concentrate and transport plankton, including eggs and larvae of coastal and oceanic species (Biggs and Ressler 2001).

Fishery resources within the program area include 182 species managed under six FMPs. Species are grouped as follows: corals (142), reef fish (31), shrimp (4), coastal migratory pelagic fish (3), red drum (1), and spiny lobster (1). Coastal migratory pelagic fish species are jointly managed by the GOM Fishery Management Council (GMFMC) and the South Atlantic Fishery Management Council (SAFMC). In addition to these FMPs, 39 highly migratory species (HMS) (i.e., sharks, tunas, billfishes, and swordfish) occurring in the GOM are managed by the HMS Management Unit, Office of Sustainable Fisheries, NMFS. Brief programmatic-level descriptions of EFH are provided below with managed species or species groups organized under the broad headings hard-bottom species, soft-bottom species, and pelagic species.

A recent assessment of primary fishery species from the GOM indicate that abundance of red snappers, black groupers, gag groupers, king mackerels, and penaeid shrimps are increasing (Karnauskas et al. 2013, Hart and Nance 2012). On the other hand, abundance of secondary species such as tilefishes, some sharks, and yellowedge groupers have declined over the same period and abundance trends for other managed species are unknown. These differences can reflect the focus of management programs on the primary and not secondary species (Karnauskas et al. 2013).

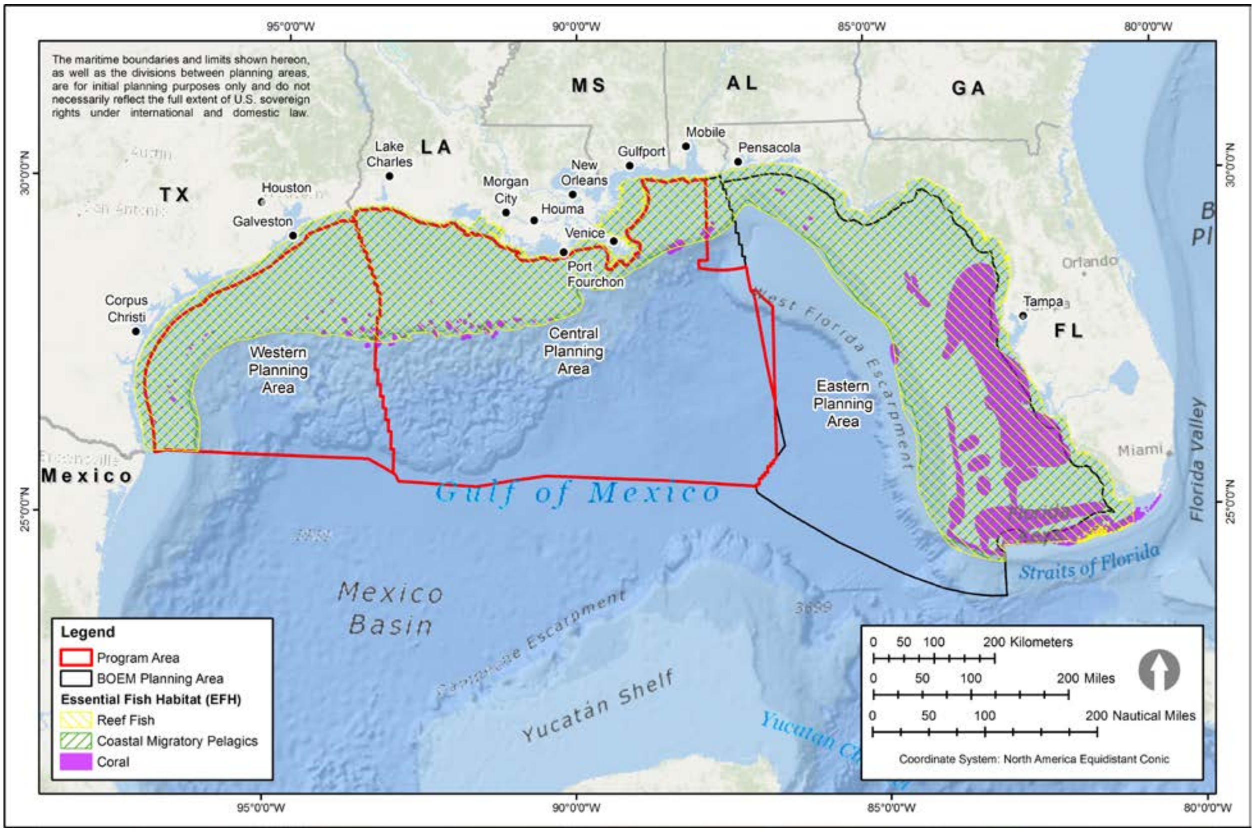
Hard-Bottom Species

Reef Fishes

The reef fish management unit consists of 31 species represented by six families, but is primarily composed of snappers (Lutjanidae) and groupers (Epinephelidae). The remaining families of tilefish (Malacanthidae), jacks (Carangidae), triggerfish (Balistidae), and wrasses (Labridae) contribute only nine species (**Appendix C**, Table C-22). EFH for the reef fish unit includes hard-bottom features found within the GOM including coral reefs, live hard-bottom, and rocky outcroppings. As defined within the FMP, EFH also includes all water from estuarine waters out to depths of 183 m (600 ft) managed by the GMFMC from the Texas-Mexico border east to the waters managed by the SAFMC (GMFMC 2005) (**Figure 4.3.9-3**). HAPCs found within the program area include the following:

- 29 Fathom Bank
- Alderice Bank
- Bouma Bank
- East and West Flower Garden Banks
- Florida Middle Grounds
- Geyer Bank
- Jakkula Bank
- MacNeil Bank
- Madison-Swanson Marine Reserve
- McGrail Bank, Pulley Ridge
- Rankin Bright Bank
- Rezak Sidner Bank
- Stetson Bank
- Sonnier Bank
- Tortugas North and South.

The HAPCs designated for these are based primarily on the presence of living coral reefs or hard bottom containing coral colonies. In addition to coral growth, the Madison-Swanson Marine Reserve, south of Panama City, Florida, is also a known spawning ground for gag grouper (*Mycteroperca microlepis*) and scamp grouper (*M. phenax*).

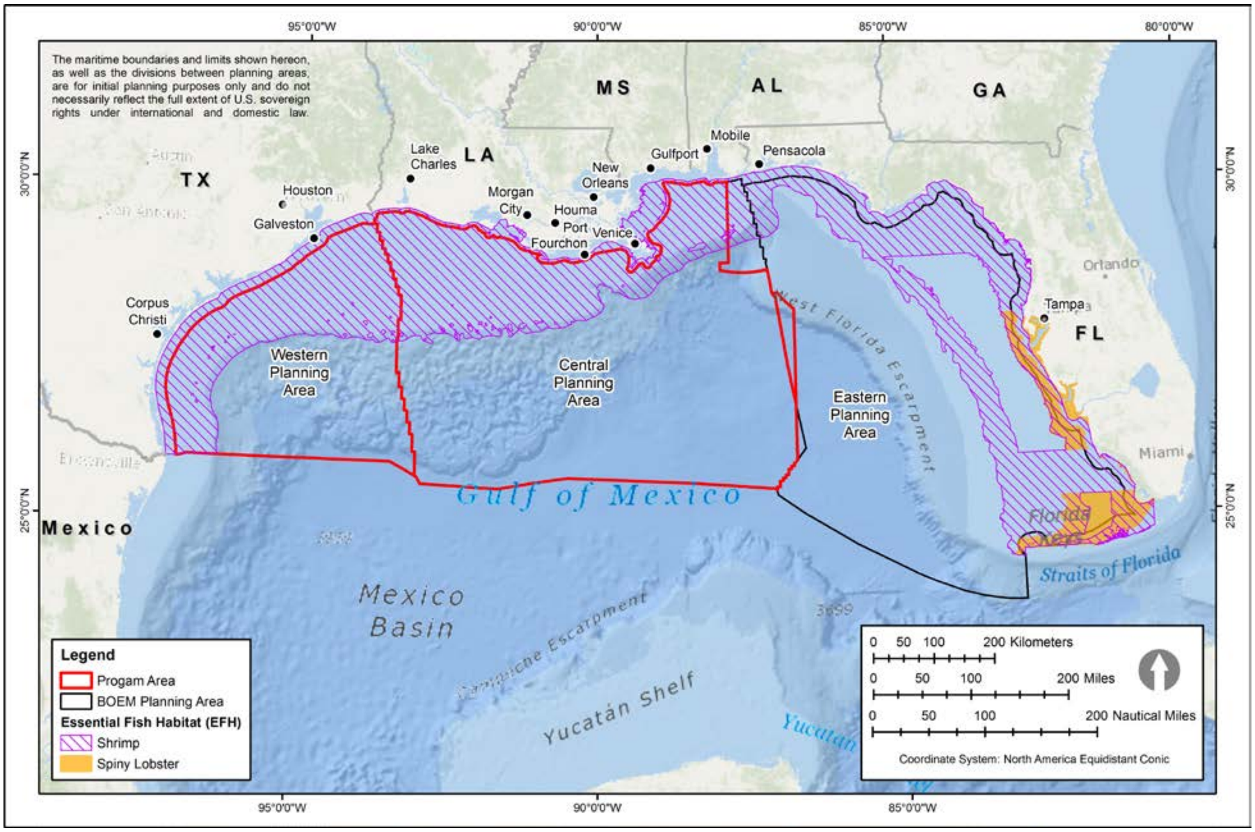


Source: GMFMC 2005

Figure 4.3.9-3. EFH for Coral, Reef Fish, and Coastal Migratory Pelagic Species within the Gulf of Mexico

Spiny Lobster

The spiny lobster management unit includes only one species of lobster. EFH for the spiny lobster extends from Tarpon Springs, Florida, to Naples, Florida, between water depths of 9 and 18 m (30 and 60 ft); and from Sanibel, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC out to water depths of 27 m (90 ft) (GMFMC 2005) (**Figure 4.3.9-4**). This EFH generally consists of coral reefs, areas of hard bottom, and rock outcroppings found over shelf waters along the western Florida coast and Florida Keys. This is EFH is outside of the Central and Western Planning Areas, but was included here because it could be affected by a CDE. No HAPC for spiny lobster has been established in the GOM Program Area.



Source: GMFMC 2005

Figure 4.3.9-4. EFH for Spiny Lobster and Shrimp within the Gulf of Mexico

Coral

The coral management unit encompasses 142 species of stony (Class Anthozoa) and soft coral (Class Hydrozoa). This includes fire or stinging corals (Order Milleporina), stony corals (Order Scleractinia), and black corals (Order Antipatharia). EFH for the coral management unit includes the total distribution of coral species and life stages throughout the GOM including: coral reefs in the North and South Tortugas Ecological Reserves, East and West Flower Garden Banks, McGrail Bank, and the southern portion of Pulley Ridge. Additionally, EFH includes hard bottom areas on the scattered pinnacles and banks from Texas to Mississippi, the shelf edge at the Florida Middle Grounds, the southwestern tip of the Florida Reef Tract, and hard bottom offshore of Florida from approximately Crystal River south to the Florida Keys (GMFMC 2005) (**Figure 4.3.9-5**).

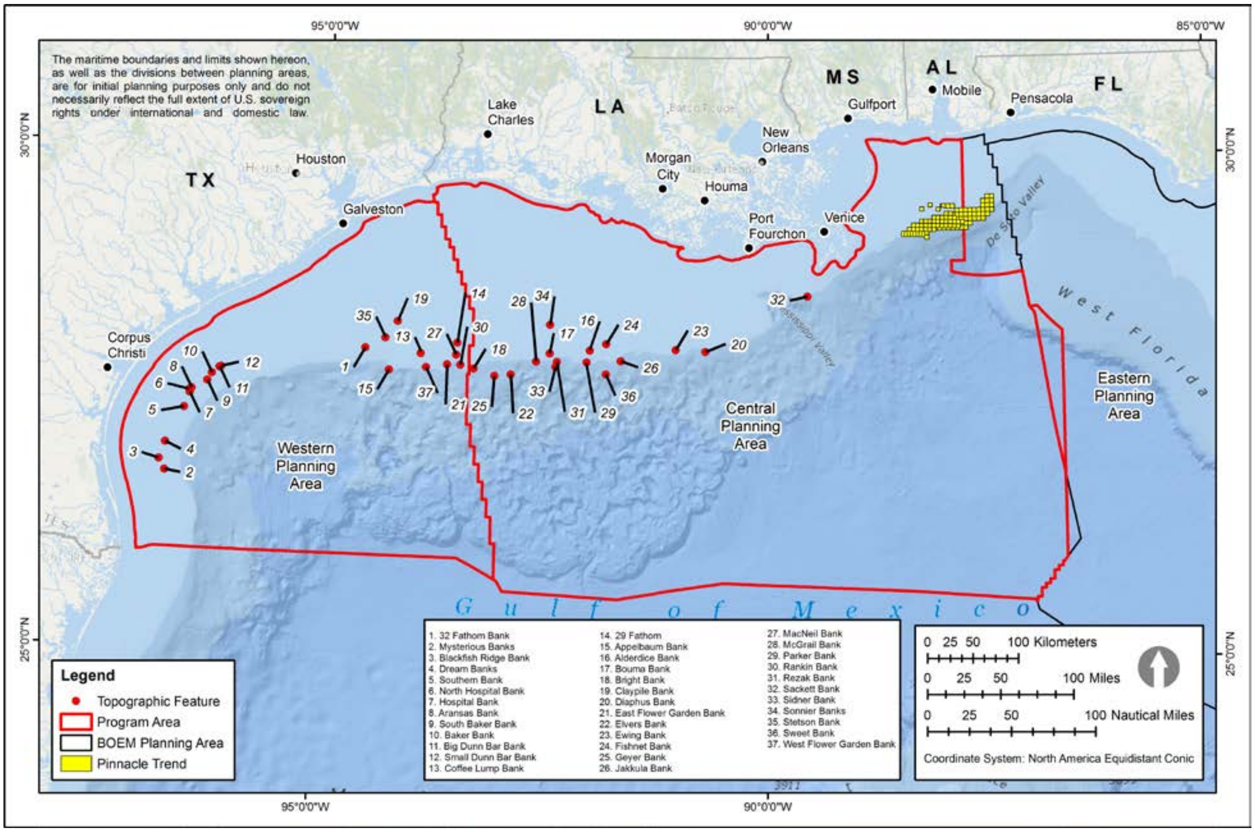


Figure 4.3.9-5. Topographic Features and Lease Blocks Subject to Pinnacle Trend Stipulations in the Gulf of Mexico Program Area

The original coral FMP (GMFMC 1982) established HAPCs such that the use of fishing gear deployed from vessels that would have contact with the seafloor was prohibited. These protections are unique relative to other HAPCs that do not prohibit bottom disturbance. The East and West Garden Flower Banks and Stetson Bank are identified by GMFMC as Coral HAPCs. McGrail Bank has also been identified as a unique coral system, granting it protections under the Coral HAPC definition (50 CFR 622.74).

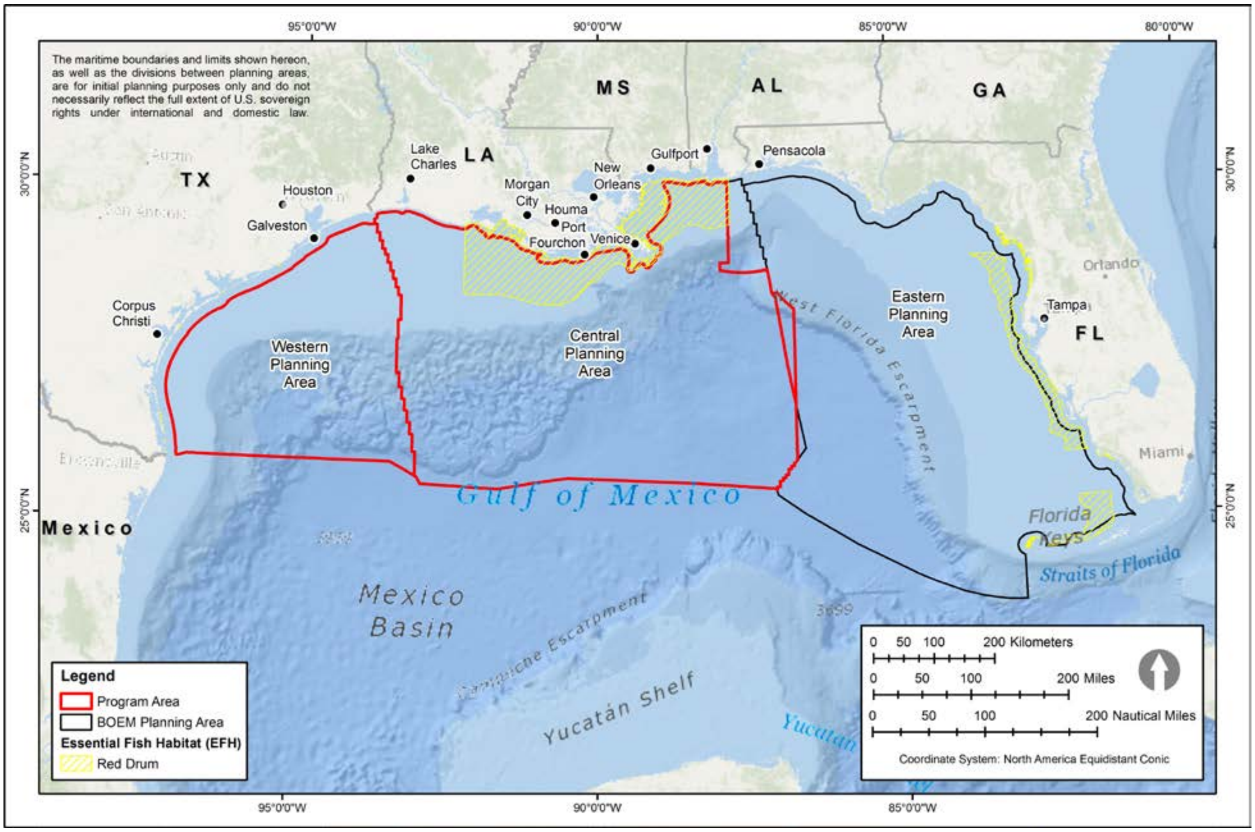
Soft-Bottom Species

Shrimp

The shrimp management unit consists of four species of shrimp including brown shrimp (*Farfantepenaeus aztecus*), white shrimp (*Litopenaeus setiferus*), pink shrimp (*F. duorarum*), and royal red shrimp (*Pleoticus robustus*). As described in the FMP, EFH for shrimp overlaps the GOM Program Area. It extends from the U.S.-Mexico border to Fort Walton Beach, Florida, from estuarine waters out to a water depth of 183 m (600 ft); from Grand Isle, Louisiana, to Pensacola Bay, Florida, from water depths of 182.8 and 594.4 m (600 – 1950 ft); from Pensacola Bay, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC to a water depth of 62 m (204 ft), with the exception of waters extending from Crystal River to Naples, Florida, between water depths of 18.2 and 45.7 m (60 and 150 ft); and in Florida Bay between water depths of 9.1 and 18.2 m (30 and 60 ft) (GMFMC 2005) (**Figure 4.3.9-4**). There are no HAPCs defined for shrimp species in the GOM Program Area.

Red Drum

The red drum management unit contains only one species. The red drum is a member of the drum and croaker family (Sciaenidae) that ranges from inshore, estuarine habitats to nearshore and OCS areas. EFH for red drum includes nearshore waters from Vermilion Bay, Louisiana, to the eastern edge of Mobile Bay, Alabama, out to 45.7 m (150 ft) water depth; Crystal River to Naples, Florida, between water depths of 5 and 10 fathoms; and Cape Sable, Florida, to the boundary managed by the SAFMC between water depths of 9.1 and 18.2 m (30 and 60 ft) (GMFMC 2005) (**Figure 4.3.9-6**). There is no HAPC defined for red drum in the GOM Program Area.



Source: GMFMC 2005

Figure 4.3.9-6. EFH for Red Drum within the Gulf of Mexico

Pelagic Species

Coastal Pelagic

The coastal migratory pelagic fish unit, as defined by the GMFMC and SAFMC (1983), includes three species representing two families: king mackerel (*Scomberomorus cavalla*) and Spanish mackerel (*S. maculatus*) in the Family Scombridae, and cobia (*Rachycentron canadum*) in the Family Rachycentridae (**Appendix C**, Table C-23). EFH for the coastal migratory pelagic fish is identical to that of the reef fish unit, encompassing all waters from the U.S.-Mexico border east to SAFMC managed waters, and from estuarine waters out to water depth of 183 m (600 ft) (GMFMC 2005). There are no HAPCs defined for any of the coastal migratory pelagic fish in the GOM Program Area.

Highly Migratory Species

There are 39 HMS currently managed in the GOM by the HMS Management Unit within the Office of Sustainable Fisheries under NMFS; all of these species spend all or a portion of their lifecycle within the GOM Program Area. All five species of billfish (Istiophoridae), blue marlin (*Makaira nigricans*), longbill spearfish (*Tetrapturus pfluegeri*), roundscale spearfish (*Tetrapturus georgii*), sailfish (*Istiophorus platypterus*), and white marlin (*Kajikia albida*) have designated EFHs within the GOM Program Area (**Appendix C**, Table C-24). While no EFH is designated for the spawning, egg, or larval life stage of these species, EFH is defined for juvenile and adult stages and is found throughout the central GOM from the U.S.-Mexico border to the Florida Keys. EFH for all life stages of swordfish (Xiphiidae) is throughout the program area from the 200-m (656 ft) depth contour to the EEZ boundary and associated with the Loop Current in the GOM. Five species of tuna (Scombridae), including skipjack tuna (*Katsuwonus pelamis*), blackfin tuna (*Thunnus atlanticus*), bluefin tuna (*T. thynnus*), yellowfin tuna (*T. albacores*), and bigeye tuna (*T. obesus*), spend all or some of their lifecycle in the GOM with three species (skipjack, Bluefin, and yellowfin) known to spawn within the program area. These tuna species inhabit oceanic waters with EFH for all life stages generally limited to the northern and central GOM, offshore of the continental shelf break. In 2009, NMFS established a HAPC for bluefin tuna in the GOM (NMFS 2009). The bluefin tuna HAPC is west of 86° west and seaward of the 100-m depth contour, extending to the boundary of the U.S. EEZ. This HAPC includes most of the areas where larval collections have been documented and overlaps with juvenile and adult bluefin tuna EFH (Atlantic Bluefin Tuna Status Review Team 2011).

Although not directly managed by the GMFMC, dolphinfish (*Coryphaena hippurus*) and wahoo (*Acanthocybium solandri*) are also considered highly migratory pelagic fishes and are found throughout the program area. Twenty-eight shark species are included within the highly migratory species management unit (**Appendix C**, Table C-25). Shark species are divided into three categories based on their distribution and life history: small coastal sharks (5 species), pelagic sharks (7 species), and large coastal sharks (16 species). Small and large coastal shark species commonly occur over continental shelf waters while pelagic sharks spend a greater portion of their life cycle within deep, oceanic waters. All federally managed shark species have EFH within the program area ranging from all coastal GOM waters to select offshore areas where the species are thought to regularly feed, congregate, or reproduce.

4.3.9.5 Listed Fishes

There are no ESA-listed species in the Arctic or Cook Inlet Program Area. Two fish species within the GOM Program Area have been listed under the ESA. Smalltooth sawfish (*Pristis pectinata*) of the Family Pristidae is a member of the cartilaginous class of fishes (Chondrichthyes) and is listed as endangered. Critical habitat has been described for smalltooth sawfish, but it is outside of the Central and Western Planning Area. Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is a member of Family Acipenseridae of the ray-finned fishes (Class Actinopterygii). This species, listed as threatened, has critical habitat designated in the GOM including the project area (**Figure 4.3.9-7**). Supporting information on the life history of these species is in **Appendix C**, Section 10.0.

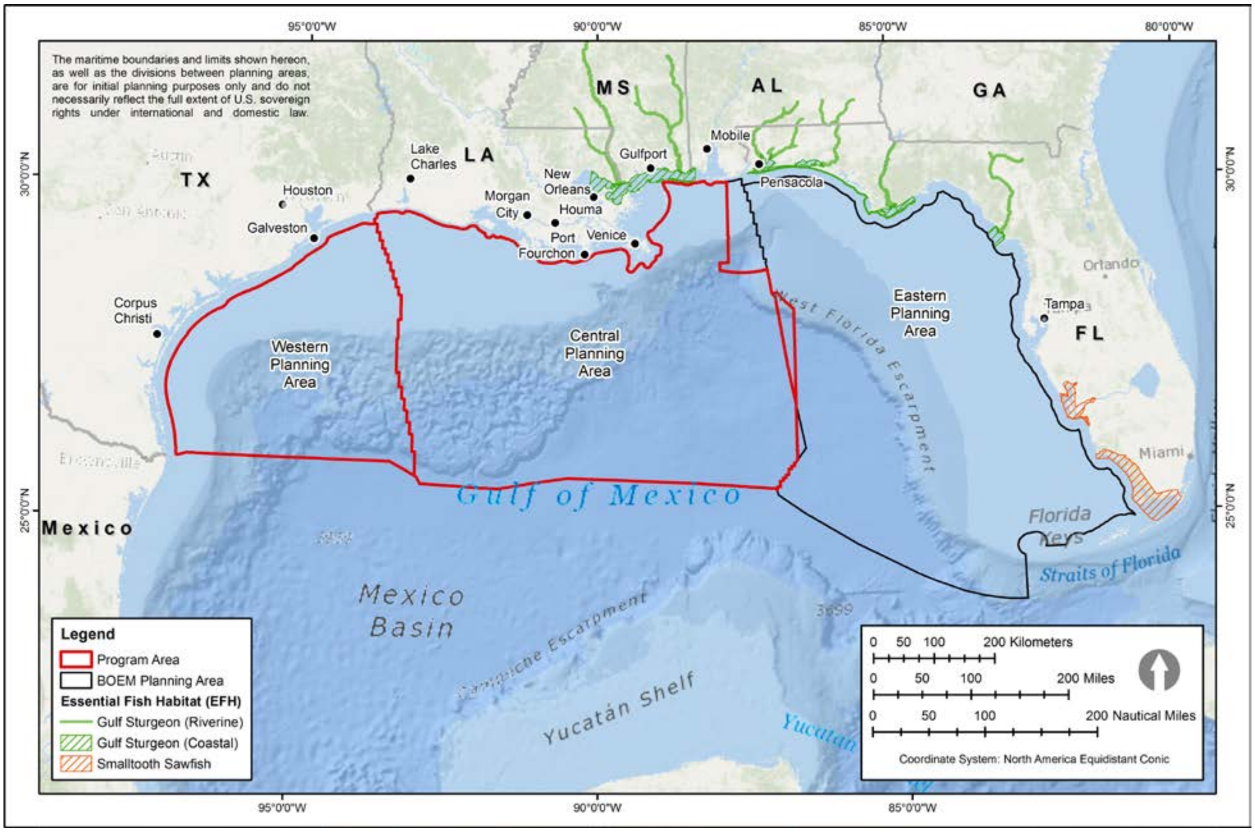


Figure 4.3.9-7. Critical Habitat for Gulf Sturgeon and Smalltooth Sawfish in the Gulf of Mexico

4.3.10 Arctic Terrestrial Wildlife and Habitat

This section describes terrestrial mammals that use the ACP (see **Figure 4.3.4-1**) and Arctic foothill habitats during breeding, feeding, and wintering that could be affected by OCS activity in the Beaufort Sea and Chukchi Sea Program Areas. Among the terrestrial mammals that occur in the Arctic, caribou, arctic fox, muskox, and grizzly bear are the species most likely to be affected by development. Other species, such as moose, are too sparse in the ACP to be appreciably affected by development. The ecoregions referenced in this section were developed by the Commission for Environmental Cooperation for North America (Wilkinson et al. 2009).

4.3.10.1 Arctic Coastal Plain

The ACP is relatively flat and borders the Beaufort Sea and the eastern portion of the Chukchi Sea, encompassing most of the Beaufortian ecoregion. The ACP includes a complex mosaic of vegetation types, the distribution and extent of which are strongly influenced by local soil characteristics, elevation, temperature, and moisture (BLM 2012). Freshwater wetlands, including a wide variety of vegetation types, cover nearly all of the coastal plain and foothills (ADNR 2008, BLM 2002, BLM and MMS 2003, BLM 2012).

On the ACP, the presence of thick, continuous permafrost that is generally near the soil surface restricts soil drainage and results in saturated soils over most of the area (BLM 2002, BLM and MMS 2003). Wetland plant communities, characterized by sedges, grasses, dwarf shrubs, and mosses, are the predominant vegetation types of the ACP (BLM 2002, MMS 2007, USACE 2012). Numerous small lakes and ponds are scattered across the landscape. Even small-scale variations in the land surface elevation alter patterns of species occurrence and influence the distribution of plant communities. These variations determine the occurrence of wet, moist, and dry tundra (BLM and MMS 2003, USACE 2012). Flooded tundra and aquatic vegetation cover types also occur. Coastal plain soils generally consist of an organic mat over fine-textured mineral soil. Over much of the near coastal area inland from Point Barrow, along the Beaufort Sea to the Canning River, wet graminoid moss communities, with moist communities on higher microsites, are the predominant plant communities (Raynolds et al. 2006). Wet sedge moss communities, with moist communities such as tussock-sedge and dwarf-shrub communities on higher microsites, extend over much of the ACP from near Point Lay on the Chukchi Sea coast to the border of Canada. Non-tussock sedge, dwarf-shrub, forb, and moss tundra communities, both on mesic soils, occur at the margin of the ACP near the Arctic Foothills. Tussock-sedge, dwarf-shrub, and moss tundra communities occurring on sandy soils in complex with lakes and wet tundra are the predominant community type over a large area south of Teshekpuk Lake, in the central portion of the ACP.

Ground patterns form polygons in much of the east-central portion of the ACP. Low polygons, enclosed by rims, are common and support wet sedge/moist sedge tundra in basins and dwarf shrub tundra on rims, with troughs between polygons (Bliss 1999). Near the coastline, high-centered polygons bordered by deep troughs support moist sedge and dwarf shrub tundra. Over much of the ACP, thaw lakes (typically 1–7 m [3–23 ft] in depth) shaped and oriented by wind direction cover 20-50 percent of the surface area (Gallant et al. 1995). Lake margins and smaller ponds frequently support the fresh grass marsh vegetation type, generally in surface water depths of 0.2–2 m (0.7–7 ft) (Viereck et al. 1992).

Thaw lakes generally follow a cyclical pattern of draining and reforming (Koch 2016). Wet tundra communities, later becoming wet sedge meadow communities, commonly become established in drained basins (BLM 2002). Surface water in these areas can be present much of the growing season and be up to 15 cm (0.5 ft) deep (Viereck et al. 1992).

Barren areas along major streams are composed of 60 percent barren peat, mineral soil, or gravel. These areas can have patches with sparse cover of forbs and dwarf shrubs. The margins of ACP rivers typically include gravel bars, sandbars, and sand dunes (BLM 2002). Active sand dunes support dunegrass communities, while floodplains support low willow shrub and seral herb communities. Large, braided rivers on the ACP, such as the Sagavanirktok River, include extensive areas that are predominantly unvegetated or sparsely vegetated. Some plant communities near the Sagavanirktok and Kadleroshilik Rivers are maintained in early and mid-successional stages by the deposition of windblown silt from the river channel (MMS 2002, BLM 2002).

4.3.10.2 Arctic Foothills

Inland from the Chukchian ecoregion and southwestern Beaufortian ecoregion coast, the Arctic Foothills extend across northern Alaska between the ACP and the Brooks Range, reaching to the Beaufort Sea near the border of Canada. Thick permafrost extends over the hills and plateaus of the Arctic Foothills, and most soils are poorly drained with thick organic layers (BLM 2002). Although the foothills have more distinct drainage patterns and fewer lakes than the ACP, much of the landscape in the foothills consists of wetlands.

A wide variety of plant community types occurs on the foothills (Raynolds et al. 2006). Near the Chukchian ecoregion coast, the wet sedge moss communities (with moist communities on higher microsites), non-tussock sedge, dwarf-shrub, forb, moss communities (mesic soils), prostrate dwarf-shrub, forb, and lichen (dry limestone slopes) are the predominant community types. Farther inland, and extending along much of the southwestern Beaufortian ecoregion, the tussock-sedge, dwarf-shrub, moss community type, on mesic soils, is a predominant community type of the Arctic Foothills. Also occurring near the coast are erect dwarf-shrub, lichen communities on mesic sites, prostrate dwarf-shrub, and lichen communities on dry granitic slopes. The foothills approach the Beaufort Sea along the northeastern coast of Alaska. Here, tussock-sedge, dwarf-shrub, moss (mesic soils), erect dwarf-shrub (mesic soils), and prostrate dwarf-shrub, sedge community types (dry limestone slopes) occur at or near the coast.

4.3.10.3 Terrestrial Mammals Occurring in the Arctic Coastal Plain and Foothills

Approximately 30 terrestrial mammal species occur in the Arctic region of Alaska (BOEM 2012b). The species of primary concern in this assessment include caribou (*Rangifer tarandus*), Arctic fox (*Alopex lagopus*), muskox (*Ovibos moschatus*), and grizzly bear (*Ursus arctos*; this species is also known as the brown bear in some portions of Alaska). The other species not discussed in this assessment are either very rare, such as wolverine (*Gulo gulo*), or are typically located in or closer to the mountains, and thus not abundant in the impact area such as Dall sheep (*Ovis dalli*), wolf (*Canis lupus*). Moose (*Alces alces*) have experienced a population decline of about 75 percent across most of the North Slope since 2008 (Harper and McCarthy 2014). Due to their low abundance and limited distribution in the Arctic program areas, moose are not considered further in this assessment. Hares, lemmings, voles, and ermines are also present but their numbers and distribution are not well documented in the scientific literature. It is possible that OCS oil and gas development could have a negligible to moderate impact on them because of where they appear to be found and that further analyses would be needed at the lease sale stage for more certainty.

Caribou

Among the terrestrial mammals that occur along the coast of the program area, barren-ground caribou is the species that could be affected most by proposed OCS oil and gas activities. Two large and two smaller caribou herds use habitats of the ACP in the program area: the Western Arctic Herd (WAH) and Porcupine Caribou Herd (PCH) are the larger herds, and the Central Arctic Herd (CAH) and Teshekpuk Lake Caribou Herd (TCH) are the smaller ones. **Figure 4.3.10-1** is provided to show the general range of the four herds. Caribou herd ranges overlap and their habitat use varies greatly within these ranges depending on the season. A thorough analysis of caribou habitat use and potential impacts would be undertaken if a lease sale EIS were warranted in the future since detailed alternatives would exist and could be evaluated at that point. Migration patterns, calving grounds, insect relief areas, and winter range and distribution of caribou are discussed in greater detail in **Appendix C**, Section 11.0.

The WAH ranges over approximately 157,000 mi^2 in northwestern Alaska from the Chukchi Sea coast east to the Colville River, and from the Beaufort Sea coast south to the Kobuk River (Harper and McCarthy 2015). In winter, the range extends south as far as the Seward Peninsula and Nulato Hills, and east as far as the Sagavanirktok River north of the Brooks Range and the Koyukuk River south of the Brooks Range. Since 1996, much of the WAH has shifted its winter range from the Nulato Hills to the eastern half of the Seward Peninsula, and has generally been more dispersed than prior to that time (Dau 2005). In 1970, the WAH numbered approximately 242,000 caribou and by 1976, had declined to about 75,000 animals. From 1976–1990, the WAH grew by 13 percent annually, and from 1990–2003, growth had declined to 1–3 percent annually (Dau 2005). In 2003, the WAH was estimated at > 490,000 animals (Dau 2005). Sutherland (2005) estimated that local residents harvest approximately 14,700 WAH caribou annually. In 2013, the WAH was estimated at 234,000 animals, which is a decrease of approximately 15 percent per year between 2011 (about 325,000 caribou) and 2013 (Harper and McCarthy 2015).

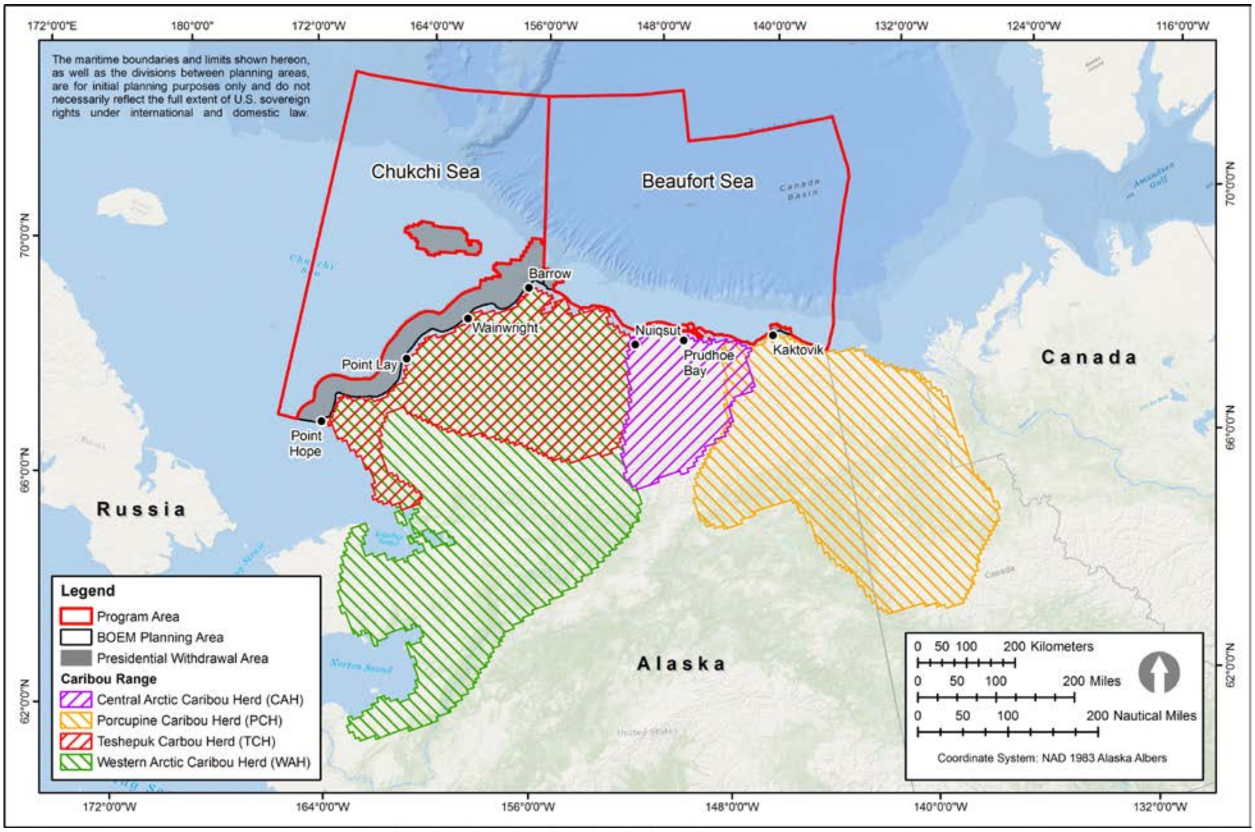


Figure 4.3.10-1. Caribou Herds in the Alaskan Arctic and Coastal Communities

The PCH migrates between Alaska and the Yukon and Northwest Territories in Canada. Most of the herd's 130,000 mi^2 range is remote, roadless wilderness (Harper and McCarthy 2015). The PCH is an important subsistence resource for Native people of Alaska and Canada and provides valued hunting and wildlife viewing opportunities for nonlocal Alaska residents and nonresidents. The PCH remained more stable than other Alaska herds during the 1960s and 1970s at about 100,000 caribou. In 1979, the population began a steady increase and reached 178,000 caribou by 1989. Annual rates of growth averaged about 5 percent from 1979 to 1989 where the population then decreased to 160,000 caribou in 1992, probably in response to lower yearling recruitment after harsh winters (Arthur et al. 2003). The herd continued to decline to an estimated 129,000 animals in 1998 and 123,000 in 2001, likely due to increased adult mortality due to density dependent nutritional effects, disease, and losses to predation and human harvest (Arthur et al. 2003). Estimates of population size could not be obtained during 2002-2009 due to inadequate survey conditions, but in 2010, a successful photocensus survey was conducted, resulting in a population estimate of 169,000 caribou (Harper and McCarthy 2015). In 2013, a photocensus survey resulted in a population estimate of 197,000 caribou representing an average annual growth rate of 5 percent from 2010 through 2013 (Harper and McCarthy 2015).

The CAH grew from an estimated 5,000 animals in 1975 (Cameron and Whitten 1979) to about 31,857 animals in 2002 (Lenart 2005a). In 2013, the estimated population size was 50,753 caribou (Harper and McCarthy 2015). Although the CAH traditionally calved between the Colville and Kuparuk rivers and between the Sagavanirktok and the Canning rivers on the eastern side, the greatest concentration of caribou calving has shifted southwest as oil field development expanded in those areas (Lawhead and Johnson 2000, Lenart 2005a). The CAH's range extends from the Itkillik River east to the Canning River, and from the Beaufort coast south into the Brooks Range. Its summer range extends from Fish Creek, just west of the Colville River, eastward along the coast (and inland approximately 30 mi) to the Katakturuk River. The CAH winters in the foothills and mountains of the Brooks Range. It often overlaps with the PCH on summer and winter range to the east and with the WAH and TCH herds on summer and winter range to the west (Lenart 2005a).

The TCH is found primarily within the NPR-A, with its summer range extending between Barrow and the Colville River. In some years, most of the TCH remains in the Teshekpuk Lake area all winter. In other years, some or all of the herd winters in the Brooks Range or within the range of the WAH. The TCH was estimated to number more than 28,000 animals in 1999 (Bente 2000). The TCH increased at a rate of 14 percent per year between 1989 and 1993 and since then has stabilized or increased slightly (Bente 2000). In 2002, the TCH was estimated at approximately 45,166 caribou (Carroll 2005) while in 2011, was estimated at approximately 55,704 caribou (Harper 2013).

Arctic Fox

Between 1929 and 1967, the arctic fox population on the North Slope increased as the values and harvest rates of white fox pelts declined (Chesemore 1967). Fox populations peak whenever lemmings (their main prey) are abundant. Other food sources include ringed seal pups and the carcasses of other marine mammals and caribou, which are important throughout the year (Chesemore 1967, Hammill and Smith 1991). Tundra nesting birds also are a large part of their diet during the summer (Chesemore 1967, Fay and Follmann 1982, Quinlan and Lehnhausen 1982, Raveling 1989). Based on a controlled experiment where food such as moose and reindeer carcasses were placed outside of some arctic fox dens, Angerbjorn et al. (1991) determined that the availability of winter food sources directly affects the foxes' abundance and productivity. Arctic foxes on the Prudhoe Bay oil field readily use development sites for feeding, resting, and denning; their densities are greater in the oil fields than in surrounding undeveloped areas, though it is likely that differences in accessibility between developed and undeveloped portions of the study area could have affected density estimates (Eberhardt et al. 1982, Burgess et al. 1993). Development on the Prudhoe Bay oil fields has likely led to increases in fox abundance and productivity, due to the availability of garbage as a food source (Burgess 2000). However, arctic foxes are particularly subject to outbreaks of rabies, and their populations tend to fluctuate with the occurrence of the disease and with changes in the availability of food. Marine mammals are an important part of the diet of arctic foxes that occur along the coast of western Alaska (Anthony et al. 2000).

Muskoxen

Indigenous populations of muskoxen were extirpated in the 1800s in northern Alaska (Smith 1989). Muskoxen were reintroduced on the Arctic NWR in 1969 in the Kavik River area (between Prudhoe Bay and the Refuge) in 1970, and west of the NPR-A near Cape Thompson in 1970 and 1977 (Smith 1989). The reintroductions to the east established the Arctic NWR population, which grew rapidly and expanded both east and west of the NWR (Garner and Reynolds 1986). North Slope muskoxen are found as far east as the Babbage River in northwestern Canada and as far west as the Kogru River. Common drainages where muskoxen have been observed include the Colville, Itkillik, Kuparuk, Sagavanirktok, Canning, Sadlerochit, Hulahula, Okpilik, Jago, and Aichilik Rivers (Lenart 2005b). There are muskoxen west of Prudhoe Bay as far as Fish Creek in northern NPR-A and quite a few in the Itkillik Hills south of Kuparuk all the way to the Colville River. There also was a major release at Cape Thompson on the Chukchi Sea coast that resulted in muskoxen expanding northward into the western Brooks Range, and that herd appears to be doing well (Shideler 2006a, pers. commun.). In 1998, a total of about 800 muskoxen were observed within a roughly 500-km diameter area between the Itkillik River west of Prudhoe Bay and the Babbage River in northwestern Canada (Reynolds 1998). By 2005, the Alaska Department of Fish and Game (ADF&G) estimated that there were 450–550 muskoxen in eastern Alaska and northwestern Canada, and that it is probable that the trend will continue downward (Lenart 2005b). While the exact number of muskoxen that occur inland of the Beaufort Sea and Chukchi Sea Program Areas has not been determined, it is likely that a transitory number of lone bulls frequent the area coming from populations that breed east of the Colville River. The most important habitats for muskoxen appear to be riparian, upland shrub and moist sedge-shrub meadows (Johnson et al. 1996).

Muskoxen generally do not migrate but move in response to seasonal changes in snow cover and vegetation. Calving takes place from about April to early June (Garner and Reynolds 1986) and the distribution of muskoxen during the calving season, summer, and winter is similar (Reynolds 1992).

Grizzly Bear

The grizzly bear population on the western North Slope was considered stable or slowly increasing in 1991. Densities were highest in the foothills of the Brooks Range and lowest on the Arctic North Slope (Carroll 1991). On the North Slope, grizzly bear densities vary from about 0.3–5.9 bears per 100 mi^2, with a mean density of 1 bear per 100 mi^2. The number of grizzly bears between the Colville and Canning Rivers adjacent to the central Beaufort Sea area increased in the 1990s due to the presence of anthropogenic food sources associated with oil development. The increase in numbers during the 1990s was countered by mortality from removal of problem bears and from hunting along the Dalton Highway and rural communities that has reduced bear numbers, resulting in a local population that is stable or slightly declining (Shideler 2006b, pers. commun.). An estimated 60–70 bears, or approximately 4 per 1,000 km^2, currently inhabit the central North Slope Coastal Plain (Shideler and Hechtel 2000). Since 1990, the ADF&G has captured and marked 121 bears between Teshekpuk Lake and the Canning River while studying the bears' use of the oil fields (Shideler 2006b, pers. commun.).

These bears have very large home ranges (201–13,880 km^2) (Shideler 2006b, pers. commun.) and travel up to 50 km a day (Shideler and Hechtel 2000). On the North Slope, grizzly dens occur in pingos, banks of rivers and lakes, sand dunes, and steep gullies in uplands (Harding 1976, Shideler and Hechtel 2000). Bears on the North Slope enter dens primarily in the last 2 weeks of September through early November and emerge in mid-April to early June, with adult males entering dens the latest and emerging the earliest (McLoughlin et al. 2002, Shideler and Hechtel 2000). In 1992, the estimated population for Game Management Unit 26A, the area west of the Itkillik River including all of NPR-A, was 900–1,120 bears (Carroll 2005). A 3-year bear survey flown in 2000, 2001, and 2003 in a 20,000 km^2 area in Unit 26B and eastern Unit 26A resulted in a density estimate of 18.3 bears/1000 km^2, indicating a healthy and stable population (ADF&G 2014). Grizzly bears in the western Brooks Range use a variety of food sources including the seasonally available caribou, beach-cast marine mammal carcasses, and, to some degree, seasonal salmon and char runs that occur in major Chukchi Sea coast drainages. Grizzly bears also eat Arctic ground squirrels as well as berries, sedges and a variety of herbaceous plants.

4.3.10.4 Listed Species

There are no state- or federally listed endangered or threatened terrestrial mammal species known to occur in the terrestrial habitats of the ACP or the Arctic Foothills (ADF&G 2015, USFWS 2015b). Arctic hares are rare on the North Slope. The Bureau of Land Management (BLM) treats them as a Special Status Species and they are provided with special protection in the permitting process. Their numbers are a point of concern even though they are not listed under the ESA.

4.3.11 Archaeological and Historical Resources

Cultural resources can be defined as the "broad array of stories, knowledge, people, places, structures, and objects, together with their associated environment, that contribute to the maintenance of cultural identity and/or reveal the historic and contemporary human interactions with an ecosystem" (Ball et al. 2015). This includes tangible heritage (e.g., historic structures, monuments, archaeological sites, artifacts) and intangible heritage (e.g., cultural and spiritual environment, community expressions, practices, and values, cultural items) (Ball et al. 2015, King 2000). Information on cultural practices (e.g., the cultural significance of subsistence activities) can be found in **Section 4.3.16**. For the following discussion, archaeological resources are defined as any material remains of human life or activities that are at least 50 years of age and are of archaeological interest (30 CFR 550.105). By the careful scientific study of archaeological sites, features, and artifacts, archaeologists are able to extract information such as past human behavior, cultural adaptation, and related topics. Significant archaeological resources are those that meet the criteria of significance and integrity for eligibility on the National Register of Historic Places (*National Register*), as defined in 36 CFR 60.4. Historical resources are a broader category that include archaeological resources (if they pertain to the post-contact period), but for this analysis, are generally considered built structures or landscapes that meet the requirements of significance and integrity for eligibility on the *National Register*. Detailed information for archaeological and historic resources is provided in **Appendix C**, Section 10.

BOEM has funded multiple studies in the Arctic, Cook Inlet, and GOM planning areas to assess the potential location and significance for cultural resources based on archaeological, geological, and historical research. BOEM maintains regional databases of reported shipwreck losses, as well as those resources found through industry- and BOEM-funded surveys. The majority of OCS archaeological resources within the planning areas are shipwrecks; onshore archaeological resources include pre- and post-contact sites (pre- and post-contact sites for this discussion refer to periods before or after nonindigenous contact was first made with the peoples inhabiting the North American continent).

Onshore archaeological and historic resources occur adjacent to all of the program areas. These resources are under the jurisdiction of state or Federal land management agencies and include pre- and post-contact archaeological sites as well as historical built structures, and districts that are eligible for listing on the *National Register*. Some examples of these types of resources are lighthouses, coastal fortifications, stone formations, fish weirs, houses, and other built structures that have viewsheds or other associations with the sea.

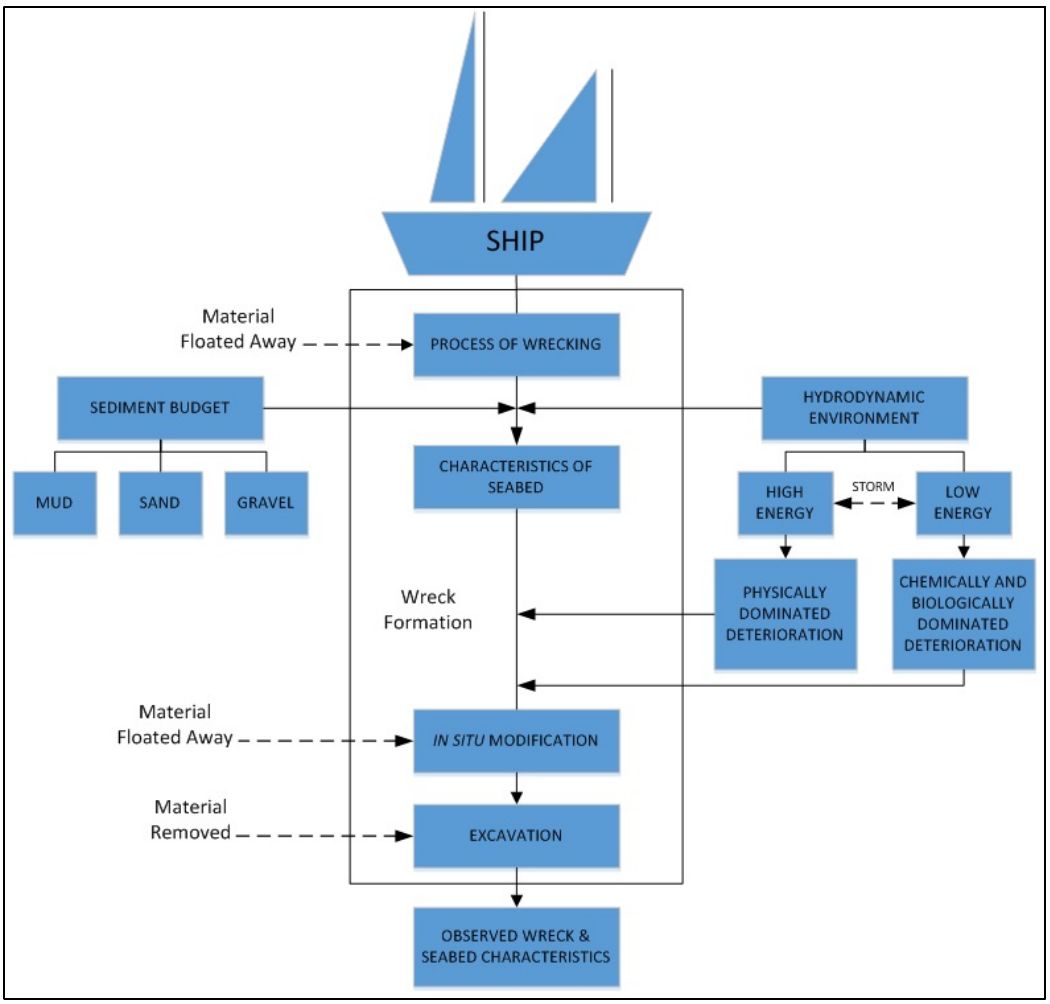
Based on BOEM's analysis and more than 30 years of experience managing impacts on archaeological resources on the OCS, it is estimated that there are thousands of shipwrecks on or under the seafloor of the OCS. Because of the mobility of watercraft, combined with the unknown nature of how most were lost (e.g., fire, storm, war), it is impossible to reliably predict where a shipwreck might be located on the OCS.

This section describes, in a general manner, the nature of expected archaeological and historical resources on the OCS, without distinction for program area or regional differences. Information regarding the historic resources associated within each program area can be found in **Appendix C**, Section 12.0. Archaeological resources on the OCS mostly compose post-contact shipwrecks. For example, in the last 7 years, oil and gas surveys in the GOM, covering 737 whole or partial lease blocks, have located more than 2,500 magnetic or acoustic signatures within survey data that are indicative of shipwreck sites; 68 have been confirmed. Proper study and analysis of shipwreck sites on the OCS can provide unique insights into local, regional, national, and global cultural patterns, in addition to enhancing understanding of our shared past, that could not have survived in written or oral tradition. Several significant shipwreck sites located in recent years include casualties from the U-boat campaign during World War II (both German and Allied vessels), and early 19th century armed sailing vessels that carried a mixed cargo of weapons and wares from the Yucatán Peninsula.

There is also the potential in certain OCS areas for the preservation of pre-contact archaeological sites; such sites would have been in terrestrial areas exposed during the last ice age or glacial maximum, when sea level was as much as 120 m (394 ft) lower than today and were subsequently submerged during sea level rise as the glaciers melted and retreated. Fishers have periodically found pieces of extinct North American megafauna and stone tools entangled in their nets and other gear, but associated archaeological sites are extremely difficult to find, even using current state-of-the-art survey technologies. BOEM is funding several studies to advance the scientific methods needed to locate submerged and buried pre-contact archaeological sites. BOEM's survey guidelines continue to be informed by current scientific standards, that, when used appropriately, can be used to locate certain relict landforms that might have survived sea level rise over the past 19,000 years and were formerly suitable for human habitation.

An important point of consideration when discussing archaeological resources, especially those in a submerged and underwater marine environment, is that these resources are remnants or vestiges of past cultural activity. All archaeological sites go through taphonomic (site formation) processes, where each site is impacted by anthropogenic and/or natural forces until it comes into an equilibrium with its environment (**Figure 4.3.11-1**). Once equilibrium is reached, deterioration slows and sites can be preserved for hundreds, and, in rare cases, thousands, of years.

Significance of these resources is directly related to the cultural data that can be extracted through the use of archaeological methods and analyses. Any disturbance of these sites can result in the irretrievable loss of data, and changes to the equilibrium of a site could result in long-term changes to the site's integrity and preservation.



Source: Modified from Ward et al. 1999

Figure 4.3.11-1. Site Formation Processes for a Shipwreck

4.3.12 Population, Employment, and Income

The total projected population, employment, and associated labor income in 2015 for the states that would be most impacted by OCS oil and gas activities are presented in **Table 4.3.12-1**. In the GOM, Texas and Florida have the largest overall economies, followed by Louisiana, Alabama, and Mississippi. Alaska is more sparsely populated and supports lower overall employment and labor income than states in other regions.

Table 4.3.12-1. Projected 2015 Population, Employment, and Income

State	Population	Employment	Labor Income ($ thousands)
Alaska	751,202	476,579	29,233,310
Gulf of Mexico			
Texas	27,248,258	16,155,163	876,375,805
Florida	20,061,019	10,962,178	480,580,846
Alabama	4,891,849	2,617,784	115,565,858
Louisiana	4,684,193	2,711,651	130,849,456
Mississippi	3,027,545	1,580,515	64,070,075

Source: Woods and Poole Economics, Inc. 2015

4.3.12.1 Beaufort Sea and Chukchi Sea Program Areas

The NSB is adjacent to the Beaufort Sea and Chukchi Sea Program Areas. It had an estimated 9,703 residents,[2] representing < 1 percent of Alaska's total population in 2014. The majority of its residents are Alaska Natives, mostly Iñupiat. The NSB population grew at an average annual rate of approximately 0.7 percent from 2010 to 2014, similar to the state's growth rate of 0.9 percent (USCB 2015). As of 2010, approximately 75 percent of employed residents worked for the NSB and other government entities, native corporations, and similar organizations. A large percentage of the labor force is unemployed, under-employed, or "discouraged," and not actively seeking employment (NSB 2011a). North Slope oil field workers usually are scheduled for 2-week on, 2-week off or similar duty rotations. The vast majority of these workers commute from outside the area, and are housed in enclaves onshore, on drill ships, or on OCS production facilities while on duty. A large proportion of these workers live in south-central Alaska in the Kenai Peninsula Borough (KPB), the Municipality of Anchorage (MoA), or the Matanuska-Susitna (Mat-Su) Borough. Most of the others commute from out of the state.

4.3.12.2 Cook Inlet Program Area

Cook Inlet is adjacent to or near south-central Alaska, which contains the most heavily populated communities in the state and historically has supplied workers for oil and gas activities in Cook Inlet state waters. South-central Alaska grew at an average annual rate of 1.5 percent between 2000 and 2009 with an estimated annual rate of growth slightly > 1.1 percent between 2010 and 2014, to an estimated 456,369 individuals, or approximately 60 percent of Alaska's total population. Within the region, recent annual population growth has been higher in the Mat-Su Borough north of the Cook Inlet Program Area, with annual growth of 2.4 percent (10 percent total) between 2010 and 2014, although growth has slowed from > 4 percent per year over the previous two decades (USCB 2015).

[2] For consistency, the description of the affected environment for Alaska uses USCB population statistics. The NSB's *Economic Profile and Census Report* (2011a) shows a total borough population of 7,998.

4.3.12.3 Gulf of Mexico Program Area

Table 4.3.12-2 presents data from Woods and Poole Economics, Inc. (2015), regarding the total projected population, employment, and associated labor income in 2015 for the Gulf coastal regions of each state; these Gulf coastal regions correspond to the 133 near-coastal counties and parishes in the BOEM-defined GOM Economic Impact Areas. The Gulf coastal zone supports high levels of population, employment, and labor income in many areas, such as near Houston, Texas; New Orleans, Louisiana; and Tampa, Florida.

Table 4.3.12-2. Projected 2015 Population, Employment, and Labor Income in Gulf Coastal States

Area	Population	Employment	Labor Income ($ thousands)
Coastal Texas	9,399,497	5,378,314	328,994,955
Coastal Florida	8,748,653	4,448,697	187,122,278
Coastal Louisiana	3,466,529	2,069,738	103,307,467
Coastal Alabama	736,626	389,937	15,735,439
Coastal Mississippi	511,176	252,391	10,818,240

Source: Woods and Poole Economics, Inc. 2015

The GOM has an extensive existing OCS oil and gas industry. While this industry provides economic contributions to many areas, the largest concentrations of OCS oil and gas companies and supporting activities are near Houston, Texas, and in coastal Louisiana. Quest Offshore Resources, Inc. (2011) provides more information regarding the GOM OCS oil and gas industry. For example, this report estimates that the GOM OCS oil and gas industry supported 215,400 jobs and yielded $21.8 billion in GDP in the five Gulf states in 2009. The GOM also supports large tourism, fishing, and marine transportation industries.

4.3.13 Land Use and Infrastructure

4.3.13.1 Beaufort Sea and Chukchi Sea Program Areas

The Beaufort Sea and Chukchi Sea Program Areas are in the U.S. Arctic OCS region off Alaska's North Slope. The North Slope is characterized by extreme remoteness, long winters, and low population densities. While oil and gas development in the area dates back to the 1970s, most activity has been relegated to the central Arctic on state lands and adjacent waters of the Beaufort Sea. As such, only the Beaufort Sea Program Area has a well-developed network of oil and gas infrastructure.

Land uses surrounding the Beaufort Sea and Chukchi Sea Program Areas consist primarily of subsistence use and oil and gas activities around Prudhoe Bay. Various Federal and state agencies oversee large amounts of land in the Arctic, including the Arctic NWR, Gates of the Arctic National Park (NP), and the NPR-A. Additionally, it is estimated that less than one percent of charted, navigationally significant Arctic waters have been surveyed with modern technology to determine depth and hazards to navigation.

Oil and gas infrastructure occurs intermittently along the Arctic coast from the northeastern corner of the NPR-A to the Canning River. The core of production activity occurs in an area between the Kuparuk Field and the Sagavanirktok River. As shown in **Figure 4.3.13-1**, a majority of oil and gas supporting infrastructure is concentrated around the Prudhoe Bay and Kuparuk Field, which is served by nearly 483 km (300 mi) of interconnected gravel roads and more than 644 km (400 mi) of pipeline routes. Total oil and gas supporting infrastructure in the North Slope covers approximately 7,429 hectares and is mainly comprised of gravel pads, roads and causeways, airstrips, and exploration sites (Raynolds et al. 2014).

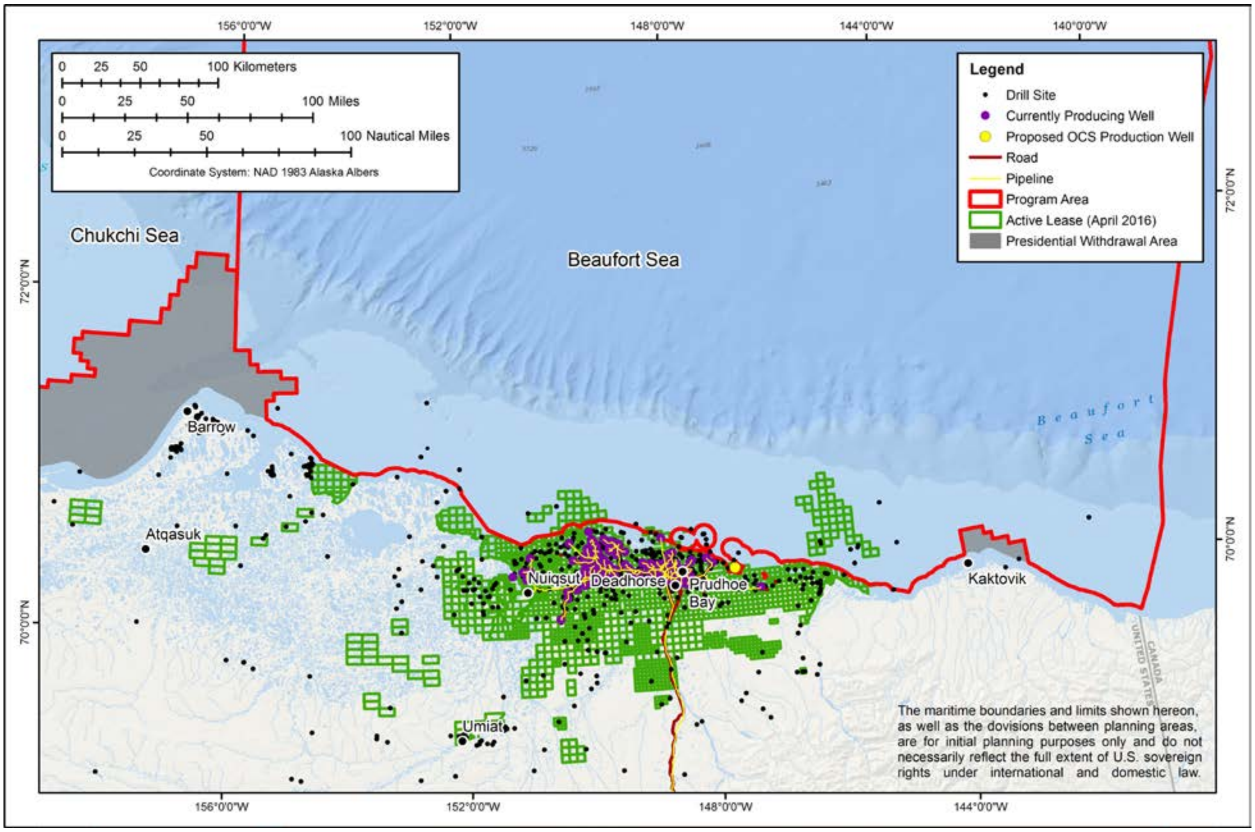


Figure 4.3.13-1. North Slope Oil and Gas Industry Supporting Infrastructure

Given current oil and gas activities occurring within Prudhoe Bay, it is likely that all planned and future development would use the existing network of onshore oil and gas infrastructure, and the transportation system for oil based out of Prudhoe Bay. This network reaches almost as far east as the Arctic NWR western border and almost as far west as the eastern border of the NPR-A. Oil and gas infrastructure is discussed further in **Appendix C**, Section 14.0.

4.3.13.2 Cook Inlet Program Area

The Cook Inlet Program Area is in south-central Alaska and covers approximately 1.08 million acres of seafloor, stretching roughly from Kalgin Island in the north to Augustine Island in the south. At its northernmost point, the inlet narrows and splits into two bodies of water, the Turnagain and Knik Arms. The city of Anchorage is the cultural and business hub of Alaska and is between these two arms of Cook Inlet. Land use in the Cook Inlet Program Area is diverse and includes a wide range of business and support services for a variety of industries, including the well-developed oil and gas industry associated with state leasing. The Cook Inlet region also provides established hubs for air, rail, road, and marine transport throughout the state. Lands in the vicinity of the Cook Inlet region feature large NPs, NWRs, and a National Forest, notably including the Lake Clark National Park and Preserve (NPP), the Katmai NPP, the Kenai Fjords NP, the Kenai NWR, the Kodiak NWR, and the Chugach National Forest.

The Cook Inlet Program Area and surrounding lands have multiple important port facilities to support oil and gas activities, including Anchorage, Nikiski, and Homer. The Port of Anchorage receives goods that support 75 percent of the population and all five of the state's military bases. The port also supports the staging and fabrication of modules used in the North Slope oil and gas industry, and has a cargo facility that is served by a railroad connecting it to Alaska's interior and the port at Seward. The Cook Inlet and Kenai Peninsula area have an extensive road network to support oil and gas activities and are served by the Ted Stevens Anchorage International Airport in Anchorage as well as numerous smaller airfields and facilities. The more remote western side of Cook Inlet is not connected to the road system and is home to the village of Tyonek, several commercial set-net fish sites, and several oil camps.

Oil and gas resources are produced onshore and offshore on state lands in the region, but there are no active Federal leases in the Cook Inlet Program Area. On state lands north of the Cook Inlet Program Area, there are approximately 17 offshore platforms in the northern portion of the inlet, hundreds of miles of subsea pipelines, and onshore processing and support facilities. Crude oil production is handled through the Trading Bay Production Facility with nearly all of the oil going to Tesoro's Refinery in Kenai, and natural gas is processed through several plants in Nikiski and transported via pipeline for domestic consumption or processed at the Kenai LNG plant and exported to Asia (ADNR 2015b, AOGA 2015). Further discussion of oil and gas infrastructure in the Cook Inlet region can be found in **Chapter 3** and **Appendix C**, Section 14.0.

4.3.13.3 Gulf of Mexico Program Area

The GOM region adjoins five coastal states (Texas, Louisiana, Mississippi, Alabama, and Florida), and spans approximately 2,623 km (1,630 mi) of coastline. Land uses within the states are a heterogeneous mix of urban areas, manufacturing, shipping, agricultural, oil and gas activities, and recreation. Due to the abundance of urban areas, high population densities around the coasts, and wide variety of land uses, the GOM is one of the most mature yet complex areas for oil and gas development.

The GOM Program Area is composed of the Western, Central, and a portion of the Eastern Planning Area not subject to Congressional Moratorium. This area contains a mix of bays, estuaries, wetlands, barrier islands, and beaches. As described in **Sections 4.3.4**, **4.3.14**, and **4.3.15**, the GOM coast provides significant environmental and economic value to the region, supporting fishing, shrimping, and other recreational and tourism activities. Along the GOM coast are numerous state parks and beaches as well as units of the NPS and USFWS. Notable features in the area include Padre Island National Seashore, the Atchafalaya Basin, the Mississippi River Delta, Gulf Islands National Seashore, Mobile Bay, and Everglades NP.

All states in the GOM Program Area participate in the CZM Program and have taken various approaches to managing their coastal lands. The CZM Program is a voluntary partnership between the Federal Government and the U.S. coastal and Great Lakes states and territories authorized by the CZMA to address national coastal issues. Key elements of the national CZM Program include the following:

- Protecting natural resources
- Managing development in high-hazard areas
- Giving development priority to coastal-dependent uses
- Providing public access for recreation
- Coordinating state and Federal actions.

Oil and gas development and production play an important role in determining land uses in many communities surrounding the GOM. The use of oil and gas infrastructure and trends in new facility development closely follow the level of activity in offshore drilling, with increased deepwater drilling having provided an important stimulus for increased facility use and development in recent decades. Because of the large size of the structures involved, construction and servicing of remote deepwater facilities require deeper ports than needed for nearshore operations. There are several ports with deepwater access along the GOM coast that provide substantial logistical support to the oil and gas industry, including Port Fourchon, the Port of Morgan City, and the Port of Iberia, all in Louisiana, and the Port of Galveston in Texas.

Other existing OCS-related infrastructure in the region are shown on **Figures 4.3.13-2** and **4.3.13-3**. More information on infrastructure supporting offshore oil and gas activities can be found in **Chapter 3** and **Appendix C**, Section 14.0.

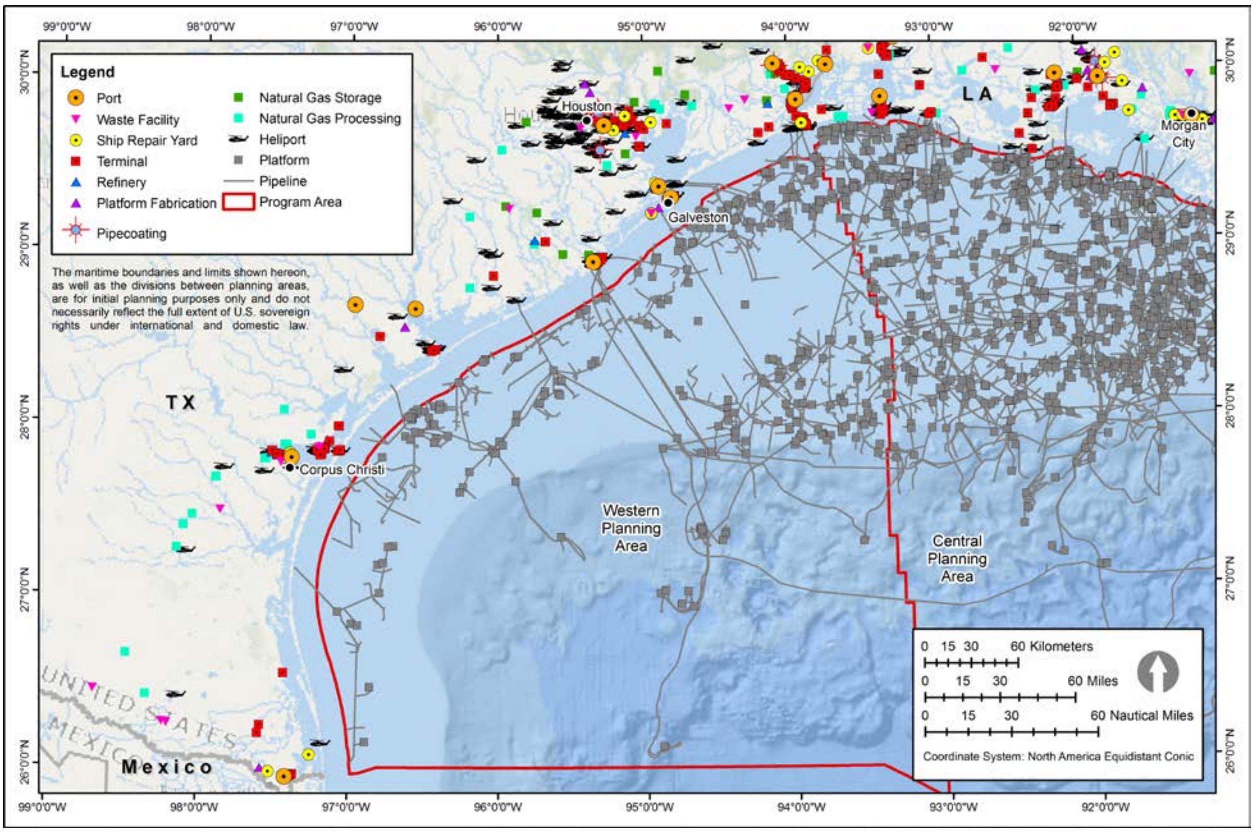


Figure 4.3.13-2. Western GOM Oil and Gas Infrastructure

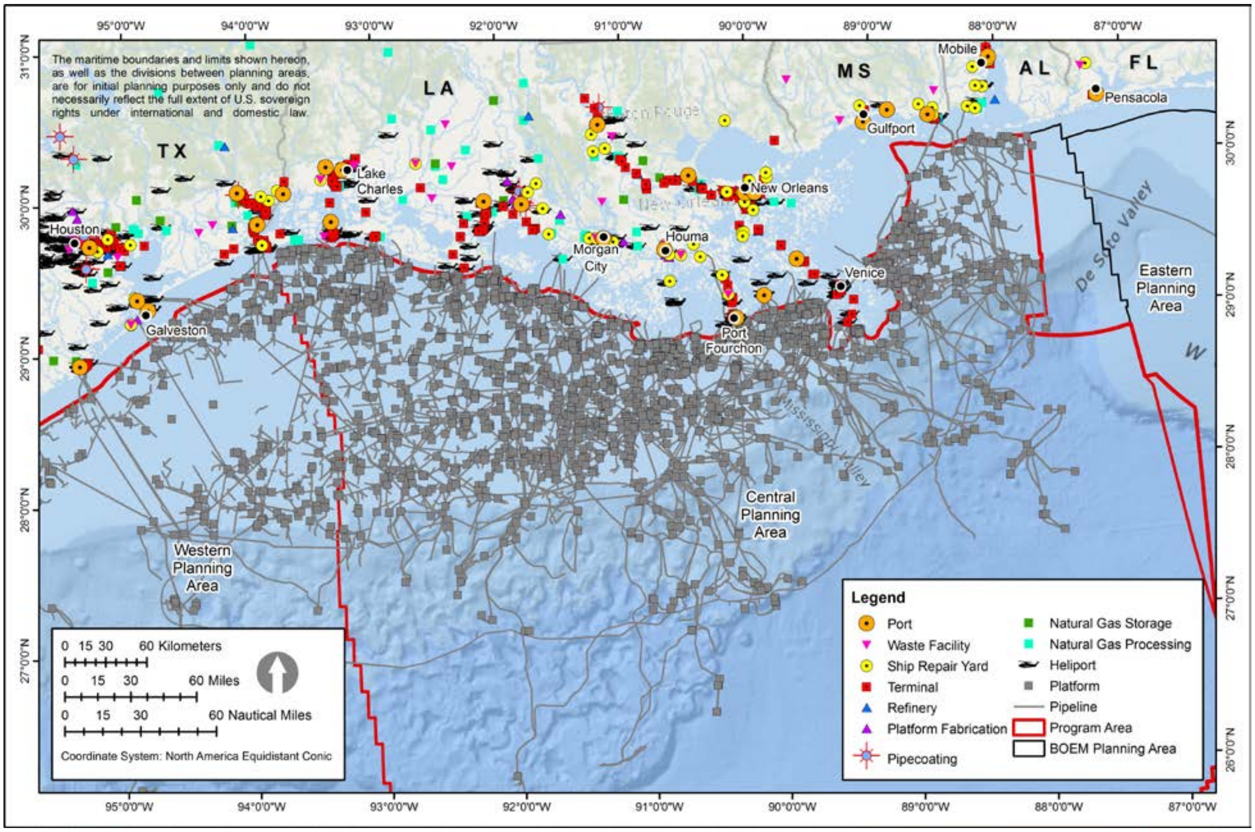


Figure 4.3.13-3. Central GOM Oil and Gas Infrastructure

4.3.14 Commercial and Recreational Fisheries

Commercial and recreational fishing is discussed in detail in **Appendix C**, Section 15.0. Subsistence fishing, which is believed to occur primarily in state waters, is more important to the cultural value of communities bordering the program area rather than the biological or economical aspects, and is therefore considered a sociocultural resource (**Section 4.3.16**). While fisheries and fish have strong linkages, fisheries are unique because it is a regulated industry of targeting, catching, and landing managed fish and bycatch, generally driven by the economics or enjoyment of fishing. Therefore, fish/EFH and fisheries could both be impacted by an IPF, but that is not always the case, and the level of impact could differ, and even be opposite. For example, closing a fishing area could benefit a fish population but be detrimental to the fisheries industry. Fisheries, then, are explored in this section, separately from fish and EFH.

On a national scale, commercial fisheries in 2014 generated approximately $5.5 billion in revenue and supported 1.4 million jobs nationally each year, while recreational fishing generated more than $60 billion and supported 439,000 jobs (NOAA 2016b). Ex-value price is a term used to describe the economic value of commercial fishery landings, and ex-vessel price is the post-season adjusted price per pound for the first purchase of commercial harvest. The ex-vessel value is usually established by determining the average price for an individual species, harvested by a specific gear, in a specific area. Most often, the value of fisheries is reported as ex-vessel, which is used in this section.

4.3.14.1 Beaufort Sea and Chukchi Sea Program Areas

Although some commercially valuable species' ranges extend into the Beaufort and Chukchi Seas, no commercial fishing is currently permitted within these program areas. Recreational fishing occasionally occurs in Federal waters of the Beaufort Sea and Chukchi Sea Program Areas (NPFMC 2009); however, no landings data are currently available.

4.3.14.2 Cook Inlet Program Area

Some commercial fishing occurs within the Cook Inlet Program Area, while sport fishing is limited to surrounding state waters. The Cook Inlet Program Area is within Lower Cook Inlet (LCI) and supports appreciable commercial and recreational fisheries. Fisheries in the Cook Inlet area are managed by the ADF&G (in state waters, 4.8 km [3 mi] from shore), or by the NPFMC (in Federal waters, > 4.8 km [3 mi] from shore). LCI fisheries target the five Pacific salmon (pink [*Oncorhynchus gorbuscha*], sockeye [*O. nerka*], chum [*O. keta*], coho [*O. kisutch*], and chinook [*O. tshawytscha*]); walleye (or Alaska) pollock (*Gadus chalcogrammus*); other groundfishes, including Pacific cod (*Gadus microcephalus*), sablefish (*Anoplopoma fimbria*), flatfish, and rockfish (*Sebastes* spp.); and Pacific halibut (*Hippoglossus stenolepis*). Mollusk and shellfish species commercially harvested in the LCI area are octopus, which could be retained as bycatch to other directed fisheries, weathervane scallop, and razor clams. Salmon are harvested commercially with active purse seines and passive gillnets; groundfish are caught with hooks and lines, jigs, and pots; and sablefish and some Pacific cod are caught with longlines. In the most recent evaluation by NMFS (2016), only the blue king crab stock from the Pribilof Islands was overfished (i.e., below the population size that would maximize fishery yields). None of the Alaska fish stocks were deemed subject to overfishing (i.e., a harvest rate higher than the rate that would produce maximum fishery yields).

In the larger North Pacific region, commercial fishing landed 5.7 billion pounds of finfish and shellfish, which generated more than $1.7 billion in 2014, a revenue decrease of 11 percent from 2013, but still more than any other state in the U.S. Dominating the landings revenue were salmon ($546 million), walleye pollock ($400 million), and crab ($238 million). Based on biomass, however, walleye pollock contributed the most weight (3.1 billion pounds, or 55 percent) (NOAA 2016b). Per pound, Pacific halibut were the most valuable ($3.58), while walleye pollock the least ($0.14) (NOAA 2016b). While these data provide insight into regional trends, it is also useful to look at trends in the Cook Inlet Program Area.

Federal fisheries are divided by statistical areas, which attribute landings to a geographic area. Quantity and value of commercial catch for Cook Inlet from statistical areas used to manage fisheries were extracted from the NOAA Fisheries Catch Accounting System database, via the Alaska Fisheries Information Network (AKFIN). Data are available from 2003–2014. Substantially more fishing activity and value occurred in the program area in 2013 and 2014 than previous years. The ex-vessel, or landing, value for all LCI commercial fisheries in 2013 was $661,452, and for 2014 it was $484,839. The vast majority of commercial fishing activity that occurs in the program area occurs in statistical area 525931. Statistical areas in Alaska are 1 degree longitude by 1/2 degree latitude boundaries. The landward boundary of 525931 is the 3 nmi line that separates Federal and state waters. Within both 2003–2014 and the more active range of 2010–2014, 95 percent of the ex-vessel revenue (96 percent of catch) from fish caught in the program area came from statistical area 525931. Confidentiality restrictions prevent showing the values in other areas for all years. Although detailed catch amounts and economic values for area 525931 cannot be disclosed, there are a number of vessels that are active in the area. In the Cook Inlet Program Area from 2003–2014, the number of vessels per year ranged from 4 to 17, with a total of 46 unique vessels actively fishing.

In the most recent 2014 data summarized by NOAA (2016b), more than 287,000 recreational fishermen (59 percent of which are from out of state), spent about 960,000 days fishing in Alaska (NOAA 2016b). Recreational fishing in the Cook Inlet Program Area consists predominantly of hook and line fishing for halibut and the five salmon species; at the state level, halibut was caught the most (659,000 harvested or released), followed by rockfish and coho salmon (483,000 and

450,000, respectively). Economically, recreational fishing contributed $589 million in sales, $240 million in income, and $357 million in value-added impacts. A total of 5,167 full- or part-time jobs were also generated due to recreational fishing.

Cook Inlet commercial and recreational fisheries are being impacted by climate change through warming salmon streams (Kyle and Brabets 2001), which can impact migration, spawning, and recruitment. While other factors, such as sea level, salinity, and water temperature, could have already been affected by climate change, continued research is needed to identify the implications to the current environment.

4.3.14.3 Gulf of Mexico Program Area

Commercial fishing in the GOM Program Area supports some of the most productive and valuable fisheries in the U.S., and is described in detail in **Appendix C**, Section 15.0. Key fisheries target shrimp (Superfamily Penaeoidea), eastern oysters (*Crassostrea virginica*), blue crab (*Callinectes sapidus*), menhaden (*Brevoortia* spp.), snappers (Lutjanidae), groupers (Epinephelidae), tunas (*Thunnus* spp. and *Katsuwonus pelamis*), mackerels (*Scomberomorus* spp.), and swordfish (*Xiphias gladius*). Shrimps are primarily harvested by bottom trawl; menhaden by purse seine; red snapper (*Lutjanus campechanus*), mackerels, tunas, and cobia (*Rachycentron canadum*) by hook and line; and tilefishes (Malacanthidae) by hook and line or bottom longline; and swordfish and various shark species by pelagic longline. Several species occurring in Federal waters (i.e., shrimps, snappers, groupers, mackerels) are managed by the GMFMC, while the HMS Division of the Office of Sustainable Fisheries manages pelagic species (i.e., tunas, swordfish, sharks); and the Gulf States Marine Fisheries Commission manages menhaden (NMFS 2015b). Based on a 2015 analysis of fish stocks in the Gulf, gray triggerfish (*Balistes capriscus*), greater amberjack (*Seriola dumerili*), and red snapper were overfished, but no stocks were subject to overfishing (NMFS 2016).

Historically, pounds landed peaked in the mid-1980s. Finfish landings, targeted by both commercial and recreational fishermen (excluding menhaden), peaked in the mid-1970s and has experienced a steady decline in the decades following. The seafood industry in the Gulf generated, on average between 2006 and 2009, about $4 billion in annual sales impacts and $1.65 billion in income impacts; this includes wages, salaries, benefits, and proprietary income generated from the industry. Also within this period, the seafood sector generated about 82,600 full- and part-time jobs. In a more recent economic analysis of fisheries in the GOM by NOAA (2016b), 2014 commercial landings totaled 1.1 billion pounds of finfish and shellfish, worth $1 billion. Fisheries that brought in the highest revenue were shrimp ($588 million), oysters ($87 million), blue crab ($73 million), and menhaden ($71 million). Louisiana topped the region in both revenue and pounds landed. Menhaden contributed the most volume to landings (67 percent), but had the lowest ex-vessel price per pound ($0.07). The highest value fishery was stone crab ($5.51 per pound).

Recreational fishing extends from the shoreline to blue offshore waters beyond the shelf break, encompassing both state and Federal waters; however, most recreational fishing practiced by privately owned or charter/party/rental boats (generally ≤ 20 m [66 ft] long) is concentrated nearshore in state waters (< 4.8 km [3 mi] from shore). Recreational anglers primarily use hook and line to seek red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), Atlantic croaker (*Micropoginias undulatus*), spotted seatrout (*Cynoscion nebulosus*), scombrids such as mackerels and tunas, snappers, sheepshead (*Archosargus probatocephalus*), and jacks (Carangidae). Spotted seatrout were the most commonly targeted (14 million fish harvested or released), followed by red drum (5.3 million fish) and Atlantic croaker (4.8 million fish) (NOAA 2016b). Additional details regarding recreational fisheries are discussed in **Appendix C**, Section 15.0.

From 1981 to 2010, the recreational sector was responsible for roughly 25 percent of all finfish catches from the Gulf. Data from 2014 indicate 2.9 million recreational fishermen, 91 percent of which were local residents, took 21 million fishing trips in the Gulf (NOAA 2016b). From 2006 to 2009, the recreational sector generated, on average, $13 billion in sales impacts and $8 billion in value added impacts, which represent the contribution of recreational fishing to the GDP. The recreational sector supported about 189,200 full- and part-time jobs (Karnauskas et al. 2013); highest employment impacts were identified for western Florida, followed by Texas and Louisiana (NOAA 2016b). While the GOM region accounts for about 50 percent of all of the marine recreational harvest in the United States, the historical trend is for recreational fishing remains stable at present levels (Karnauskas et al. 2013).

An emerging trend in the GOM region is increasing interest in leveraging existing infrastructure for increasing OCS aquaculture to enhance economic capacity in the region. Aquaculture is of interest in the GOM due to the area's broad continental shelf, many developed ports, and existing infrastructure of oil and gas platforms. Development and effective management of OCS aquaculture in the GOM requires balancing the benefits of aquaculture such as economic development, expanded protein supplies, and decreased fishing pressure on wild stocks with environmental and social concerns (DeVoe and Hodges 2002). Spatial conflicts could exist with the oil and gas industry; however, NOAA's aquaculture management plan requires baseline environmental surveys to be completed for potential aquaculture operations, which would include addressing potential siting conflicts (NOAA 2016c).

4.3.15 Tourism and Recreation

4.3.15.1 Beaufort Sea and Chukchi Program Areas

Tourism and recreational activities on the North Slope of Alaska include hunting, hiking, kayaking, and rafting in the numerous parks, preserves, and refuges adjacent to the Beaufort Sea and Chukchi Sea Program Areas, such as Gates of the Arctic NPP, Arctic NWR, and Kobuk Valley NP. Gates of the Arctic NPP and the Arctic NWR are accessible to communities within the NSB and the Northwest Arctic Borough (NWAB). With sea ice extent retreating, cruise ships are venturing farther north, and tourism opportunities are increasing. Cruise ships occasionally are witnessed by coastal communities as they transit through the Beaufort and Chukchi Seas during open water season, and more cruise liners are scheduling trans-Arctic expeditions in waters off the coast of Alaska. The Port of Anchorage is expected to begin expansion construction in 2017 to accommodate additional marine and traffic, including cruise ships (Port of Anchorage 2015). A study commissioned by the U.S. Committee on the Marine Transportation System (ICCT 2015) predicts that by 2025, the number of vessels operating on the North Slope will increase by 165–340 percent over current levels, assuming no further oil and gas development. Further opening of the Northwest Passage in Canada is facilitating increased cruise interests. The approximate route of the first cruise ship to traverse the Arctic through the Chukchi Sea and Beaufort Sea Program Areas and Canada's Northwest Passage to New York City, New York, during summer 2016 is shown in **Figure 4.3.15-1**.

Tourism opportunities in the NSB usually operate out of Barrow or Deadhorse. Travel to these areas is primarily by air, although personal vehicles and occasional bus tours arrive in Deadhorse via the Dalton Highway that runs between Deadhorse and Fairbanks. Barrow offers cultural and educational opportunities at the Iñupiat Heritage Center, which houses native artifacts and promotes local arts and crafts. Larger communities and centers such as Barrow and Deadhorse (as well as Kotzebue in the NWAB) have increased temporary lodging options through hotels and bed & breakfasts, which facilitate tourism opportunities. Many communities more in the interior of the NSB do not have large-scale or commercial lodging options that would facilitate growth of a tourism industry.

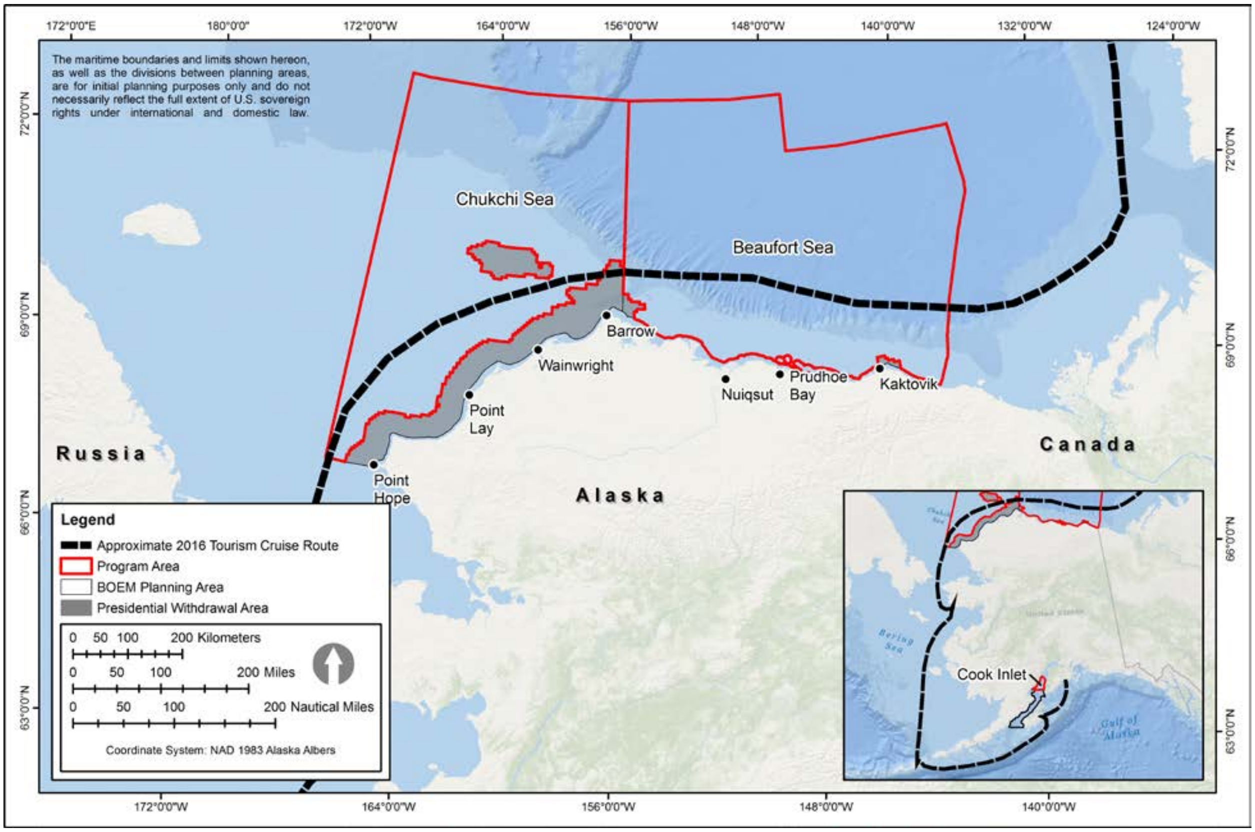


Figure 4.3.15-1. Approximate Route of Cruise Ship Crystal Serenity, Summer 2016

Kotzebue is the second largest community north of the Arctic Circle. Half of the land in the NWAB is federally owned and protected, which is a draw for tourism. Most visitors typically access this area via air travel as there are no highways or roads connecting Kotzebue to the remainder of Alaska. This makes Kotzebue a main airport transportation hub for travel to and within the NWAB. The Bering Land Bridge National Preserve is in Shishmaref, just southeast across Kotzebue Sound, and is well known for its archaeological sites and geological features (Nuttall 2012). Area hot springs are also becoming a popular destination for tourists.

Tourism and recreational opportunities within the U.S. Arctic are limited by physical access. Employment opportunities provided an estimated 300 jobs during 2014–2015. During this time, the tourism industry within the Arctic regions accounted for $31 million of GDP (ADCCED 2015).

While access to the Arctic and growing public interest in the Arctic environment has the potential to expand tourism and recreational-based opportunities within the NSB and NWAB, the remoteness, lack of automobile access and lodging, relatively short open-water season (approximately 4 months, though weather dependent), and extreme weather all present challenges to growth of a tourism industry within Alaska. See **Appendix C**, Section 16.0 for more discussion on the affected environment.

4.3.15.2 Cook Inlet

In and around the Cook Inlet Program Area, there are abundant recreational opportunities, including hunting, fishing, hiking, cruising, boating, wildlife viewing, and sightseeing. Tour ships based out of the contiguous U.S. and Canada regularly traverse southeastern Alaska as well as transit within Cook Inlet. The Alaska Marine Highway Ferry System is used by numerous independent travelers to access the region. Marine vessels used for tourism include cruise ships, ferries, and tour boats. Cook Inlet has less cruise ship activity than southeastern Alaska and Prince William Sound; however, cruise ships dock at the Port of Anchorage weekly during the tourist season, which generally runs from May through September. Anchorage and the Port of Anchorage are to the north and outside of the Cook Inlet Program Area. However, vessel traffic with an Anchorage or Port of Anchorage destination must transit through the program area (**Figure 4.3.15-2**). As of 2015, the Port of Anchorage was expanding, in part to accommodate increased cruise ship interest. Over the next 10 years, the Port projects between 6 and 18 cruises annually (Port of Anchorage 2015).

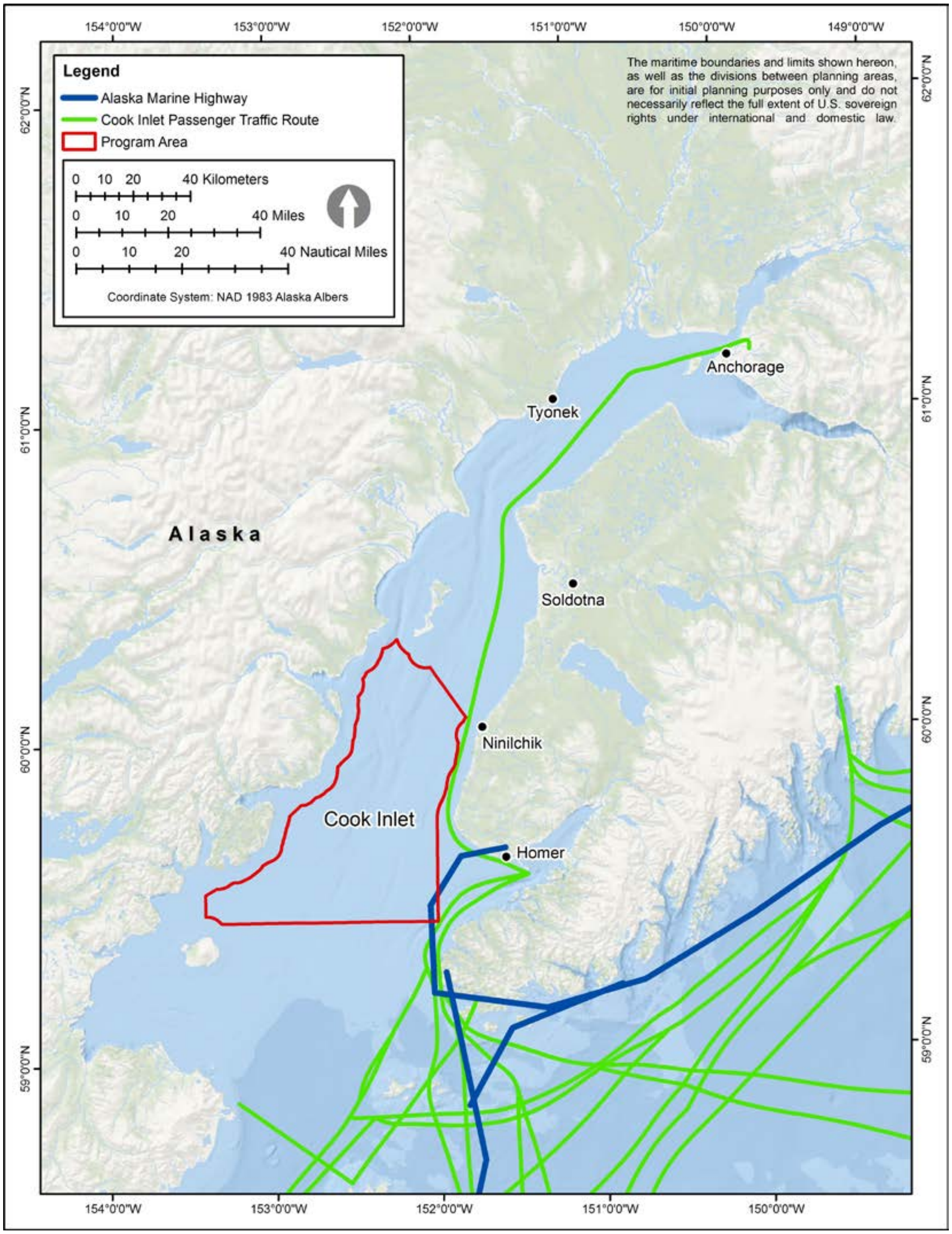


Figure 4.3.15-2. Cook Inlet Passenger Traffic

The Cook Inlet Planning Area is home to several NPPs, including Kenai Fjords NP, Lake Clark NPP, Katmai NPP, and Aniakchak National Monument and Preserve.

Most of south-central Alaska's recreational fishing activity is based in the Cook Inlet area. Popular recreational and subsistence fishing locations include the Kenai, Kasilof, Ninilchik, and Susitna Rivers. Little Suisitna River and Deep Creek are also popular with recreational fishers, and these areas contribute greatly to the local economy. Cook Inlet is home to all five Pacific salmon species, and the open fishing season generally runs from May through September, depending on species and regulation. Cook Inlet also is the site of recreational fishing seasons for different groundfish and shellfish. Recreational fishing is discussed in **Section 4.3.14**.

The abundant presence of wildlife has prompted development of many recreational viewing activities, especially for bears on the western side of Cook Inlet and in the Cook Inlet Program Area; in addition to an active hunting industry. In 2015, fish and game licenses contributed $30.6 million in gross revenue in Alaska (ADF&G 2016).

Sea kayaking, charter boats, hiking, and bus tours are popular summer tourist activities for scenic and wildlife (e.g., beluga whale) tours. Winter recreational activities include snow machining (also known as snowmobiling), skiing, and ice fishing.

Seasonal fluctuations occur within the recreation and tourism employment sectors, but the summer months from May to September are peak tourism season. Cruise ship travel in Alaska generally begins in May and runs through the middle of September, directly and indirectly impacting regional employment in the tourism sector.

Recreation and tourism are major sources of employment in the Cook Inlet region. In 2013, the recreational and tourism industry employed an estimated 21,300 people. The MoA accounts for 78.4 percent of tourism-related employment in the Cook Inlet region.

South-central Alaska is a popular destination for visitors and residents of Alaska, especially for recreational fishing. According to a 2015 report completed by the McDowell Group for the Alaska Department of Commerce, an estimated 44 percent ($798 million) of the visitor spending within the State of Alaska (2013 to 2014) is focused within south-central Alaska (inclusive of the MoA, the Mat-Su Borough, and the KPB). During the same time, approximately 19,200 people in south-central Alaska were employed in the tourism and recreational industries in seasonal or long-term positions, accounting for a labor income of $604 million (ACCED 2015). Within south-central Alaska, the visitor industry contributed $2.06 billion to the local economy, resulting in a labor impact of $604 million (ADCCED 2015).

The Cook Inlet area is also known for its dynamic bathymetry, which has formed a coarse basin environment over time from glacial activity. The Inlet starts forming ice in October and melts by spring. This area is also known for flooding, coastal erosion, active faults, earthquakes, volcanoes, and tsunamis (ADNR 2009).

4.3.15.3 Gulf of Mexico Program Area

The GOM is a popular destination for tourists worldwide. The warm coastal waters provide numerous recreational and tourism opportunities. Beach visitation, recreational fishing, boating and diving, nature watching, and other water-based activities are primary activities among visitors. In addition to beaches, visitors have access to several national, state, and local parks and wildlife refuges as well as public and private boat docks and marinas, boat launches, and equipment rental and tour boat companies.

Tourism is critical to the regional economies of the GOM. In 2009, more than 455,000 workers were employed in the travel and tourism industry in the coastal counties adjacent to the program area (BLS 2010). The *Deepwater Horizon* explosion, oil spill, and response that began on April 20, 2010, impacted the tourism industry in the GOM. Real and perceived impacts of the *Deepwater Horizon* explosion, oil spill, and response on recreational resources curtailed tourism spending immediately after the incident. Tourists' concerns that the *Deepwater Horizon* explosion, oil spill, and response had impacted water quality, the shoreline, and seafood quality led to a high rate of leisure trip cancellations between April and December 2010 (Oxford Economics 2010). The influx of media, relief workers, and Government officials to the region during response and cleanup phase helped offset some, but not all, of the economic activity lost through the reduction in leisure travel (Oxford Economics 2010). Charter boat operations, restaurants, and attractions were especially affected, while casinos were minimally impacted (Eastern Research Group, Inc. 2014).

Because most economic data are released after a time lag, and given restrictions placed on disclosure of data specific to *Deepwater Horizon* from litigation, limited information is available to estimate long-term impacts of the accident to the tourism industry. Additionally, the *Deepwater Horizon* explosion, oil spill, response, and the national economic recession made analysis of economic impacts of the oil spill to specific industries such as tourism more complex. BOEM has several completed and ongoing studies designed to estimate the long-term impacts of the *Deepwater Horizon* explosion, oil spill, and response on tourism in the GOM.

Recovery and restoration efforts resulting from *Deepwater Horizon* include beach restoration, restoring damaged habitats, and projects to improve water quality. These projects are ongoing, and data from the long-term impacts are incomplete, as discussed in **Section 1.4.6**.

4.3.16 Sociocultural Systems

4.3.16.1 Beaufort Sea and Chukchi Sea Program Areas

Residents of the communities bordering the Arctic program areas are primarily Iñupiat, and they live in a mixed subsistence-cash economy. They view subsistence foods and activities as essential for both their physical health and spiritual well-being. The protection of these subsistence resources is central to food security due to the high cost of commercial food supplies in remote communities throughout the North Slope. Subsistence hunting for and consumption of marine mammals, particularly bowhead and beluga whale, walrus, and seals, are central to their culture (BOEM 2015b, NSB 2011b). Whaling crews and other subsistence users are based in the communities of Kaktovik, Nuiqsut, Atqasuk, Barrow, Point Lay, Wainwright, Point Hope, Kotzebue, Kivalina, Wales, Little Diomede, Gamble, and Savoonga (AEWC 2016, University of Arkansas 2016). Seal, seal oil, and fish are also important parts of the diet, providing a significant source of calories. Natives of these communities also rely on caribou for nourishment, except for Little Diomede, Savoonga, and Gamble. Anaktuvuk Pass Natives rely on caribou for subsistence but do not hunt marine mammals (NSB 2011b). Subsistence activities include gathering eggs from nesting birds, gathering plants and berries, caribou hunting, and fishing in the summer; river fishing, whaling, and caribou hunting in the fall; fox trapping, fishing, crabbing, and hunting seals, polar bears, and caribou in winter; and whaling and seal hunting in the spring.

Whaling is a very strenuous and dangerous activity. Subsistence hunting for marine mammals varies according to the village, but tends to focus in areas within 40 km (25 mi) offshore. Village whaling occurs in the spring and fall, based on ice and weather conditions and variations in whale migration patterns. **Figure 4.3.16-1** shows bowhead whale migration and the location of whaling communities (Galginaitis 2009, Huntington and Quakenbush 2009, Quakenbush and Huntington 2010, Huntington 2013). The whalers from the respective communities hunt in the following seasons:

Gambell, Wainwright, Point Lay, Point Hope, Kivalina, Wales, and Little Diomede (spring); Kotzebue (spring, for beluga whales); Barrow (spring and fall), Nuiqsut and Kaktovik (fall) (AEWC 2016).

Whaling is typically accomplished by crews of 10 to 15 whalers (Galginaitis 2009) in the spring hunt, but as few as two in the fall hunt (BOEM 2016f). In the spring, whales migrate through leads in the ice and whalers prefer to use traditional walrus or bearded seal skin boats (or umiaq) so they can move quietly through the ice leads, avoiding unnecessary noise. The umiaqs are powered by the crew members paddling through the water and traversing over ice; no outboard motors are used on umiaqs. In the fall, when open water prevails, whaling crews use more durable wood, aluminum, or fiberglass boats. The harsher fall weather conditions and rougher seas with floating ice demand a sturdier vessel capable of greater speed to find and pursue whales in the open water. Confronting potentially extreme weather and rough seas in a small vessel is physically demanding; going offshore as far as 22 miles from Point Lay and 40 miles from Wainwright (Stephen R. Braund and Associates 2013), and 80 km (50 mi) from Cross Island (Galginaitis 2009) demonstrates the capability of the whaling crews. Harvested bowhead whales range in size from 9 to 15 m (30 to 50 ft) long, and weigh between 30 and 50 tons. Once the whale is captured, the crews must tow it over the ice (during spring) or through the water (in the fall) back to their community. It can take up to 10 hours to tow a 35–50 feet long whale 25 miles. The whale meat can start to spoil anywhere between 12–24 hours after the whale is caught (depending on the size), thus further limiting the distance whalers travel in search of the whale (Galginaitis 2009, BOEM 2016f).

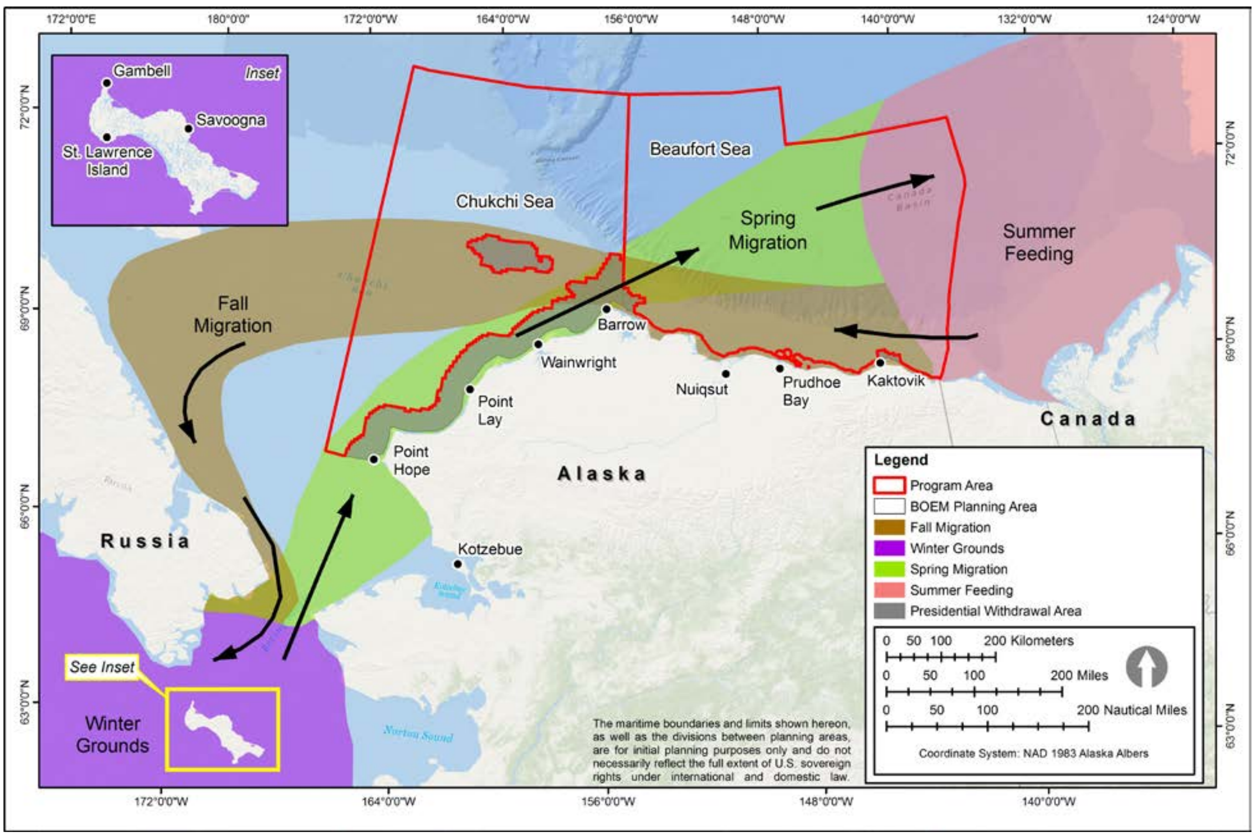


Figure 4.3.16-1. Bowhead Whale Migration and North Slope Communities

Males make up nearly all of the whaling crews. In recent years, women have begun to participate in whaling crews. However, traditionally, the role of women has been to prepare walrus and seal hides for skin boats as well as anoraks, make caribou skin pants, and other articles of clothing for the whaling crews. Women, particularly the wives of whaling captains, are responsible for ensuring the whaling crew and community are fed when the whale is brought back to the community. Children start to learn the roles of their parent near the age of 14 or younger.

Villages share extensively with other communities. Cultural values reflect the Iñupiat traditional emphasis on maintaining a close relationship with natural resources and other members of their communities, with particular focus on kinship, maintenance of the community, cooperation, and sharing. Subsistence is a central activity that embodies these values, with bowhead whale hunting the paramount subsistence activity (Brower and Taqulik 1998, BOEM 2015c).

Climate change in recent decades has affected Arctic ice conditions and diminished the polar ice cap, allowing bowhead whale to migrate north earlier and farther offshore, which can make subsistence hunting more difficult and dangerous. This change in migration patterns could diminish harvesting or make it more difficult or impossible at times. See **Section 4.2.1** for a further discussion on climate change.

Approximate populations of the North Slope communities are as follows: Barrow (4,970); Atqasuk (250); Anaktuvuk Pass (390); Kaktovik (310); Nuiqsut (420); Point Hope (710); Point Lay (260); and Wainwright (550) (NSB 2005a, NSB 2005b, NSB 2014d, NSB 2015b, NSB 2015c, NSB 2015d, NSB 2016a, NSB 2016b). These small and remote communities are within the NSB, which encompasses more than 94,000 square miles, and consequently the NSB has a low population density (NSB 2016c). This is true for the other areas around Kotzebue and Kivalina, and to a certain extent for Wales, Gambell, and Savoonga. It would take only a relatively small amount of oil and gas activity and infrastructure to outsize these small communities. In the adjacent Chukchi and Beaufort Seas, there is no visible offshore oil and gas infrastructure; therefore, the community residents are accustomed to unobstructed views of these seas. In general, onshore oil and gas infrastructure is minimal with little industrial development; there is one major exception: Prudhoe Bay and surrounding fields. A connected field is in Alpine near Nuiqsut, and there are legacy wells in and around Barrow and in NPR-A (BLM 2013).

The communities of the North Slope are not connected to the more extensive road system in Alaska, except Nuiqsut, which can be accessed to the road system for 4 months out of the year through the nearby Alpine petroleum field via ice roads. Travelers must fly to the communities of the North Slope from nearby communities or from the larger cities such as Fairbanks or Anchorage. Also, subsistence hunters traverse as far as 80 km (50 mi) offshore (Galginaitis 2009) and where no OCS infrastructure can currently be seen.

4.3.16.2 Cook Inlet Program Area

The area directly west of the Cook Inlet Program Area has a sparse population base generally devoid of towns, villages, or residential congregations, but does have snow-capped mountains and the rugged country of the Lake Clark NPP. The communities of Nondalton and Port Alsworth are on the western edge of the Lake Clark NPP on Lake Clark, approximately 70 miles from the Cook Inlet western shores. These communities are not connected to the larger road system in Alaska; transportation to and from these communities is by airplane.

Directly east of the program area are the coastal communities of Kasilof, Clam Gulch, Ninilchik, Anchor Point and Homer, Alaska. The eastern side of the inlet has a road extending from Kenai (a coastal community north of the program area) to Homer. That road leads north to Anchorage and the rest of the state’s road system (KPB 2015). The 2010 populations of the communities on the road system on the eastern side of Cook Inlet are as follows: Kenai (7,100), Kasilof (549), Clam Gulch (176), Ninilchik (883), Anchor Point (1,930) Homer (5,003) (USCB 2010). These communities have more than 95 percent of the population from Kenai to Homer. In 2010, the population of Anchorage was 293,000 (USCB 2010). The population of these communities could have a significant increase if the natural gas terminal and associated facilities at Nikiski are built. The landscape and basic road system are not likely to change in the future. People living in or touring on the eastern side of Cook Inlet have views of snow-capped mountains to the west (KPB 2015). These attract tourists from around the U.S. and the world. People in these communities also can see oil and gas platforms on the western side of the inlet in state waters (Talberth and Branosky 2013).

Subsistence activities in the Cook Inlet region include fishing for salmon, trout, halibut, and shrimp. Common marine subsistence sources include the Steller sea lion, northern sea otter, harbor seal, and all five species of salmon, along with a variety of other non-salmonid fish (MMS 2003). Data from the State of Alaska and the Federal fisheries shows that slightly less than 3.6 million sockeye salmon were harvested in the Cook Inlet area, with subsistence fishers taking just 1,515 individuals, or 0.04 percent. The same data show that subsistence fishers took zero of the more than 20,000 chinook salmon harvested by sport, commercial, personal, and educational user groups (Ninilchik Traditional Council 2013). The number of harvested salmon has fluctuated in recent times and is likely to do in the future. Anchorage residents harvested more than 360,000 pounds of the five types of salmon in 2012 (Fall et al. 2014). Subsistence activities are likely to continue into the foreseeable future. Under state laws, all Alaskan residents can engage in subsistence activities; however, only Alaska Natives are allowed to take marine mammals for subsistence use under Federal law.

The KPB along the southeastern coast of Cook Inlet has direct access to the Cook Inlet Program Area, and many communities are active commercial and recreational fishers and constitute a community focused on fishing. That is, these communities are fishing-dependent and engaged in the harvesting and processing of fishery resources to meet social and economic needs, and include fishing vessel owners, operators, and crew. In addition, the National Standard Guidelines define a fishing-dependent community as a social or economic group whose members reside in a specific location and share a common dependency on commercial or recreational fishing, or on directly related fisheries-dependent service and industries (for example, boatyards, ice suppliers, tackle shops) (50 CFR §600.345(b)(3)). Commercial and recreational fishing is likely to continue into the foreseeable future. The five species of salmon and halibut are the most sought after of all recreational species. The Cook Inlet beluga whale was listed as endangered in 2006, and subsistence hunters have voluntarily stopped hunting them until the population increases.

4.3.16.3 Gulf of Mexico Program Area

The Western Planning Area is home to the Texas Coastal Bend (i.e., coastal counties of the GOM in Texas) and has a total population of 7.18 million. Houston has the highest concentration of this population, with approximately 2.1 million residents (Wilson and Fischetti 2010); in contrast, there are stretches of the coast with very sparse population. The Texas Coastal Bend encompasses several bays. The culture of the population is rural, urban, and suburban, with a mix of mainly Hispanic and Anglo traditions. However, African Americans and Asian/Pacific Islanders live in this area and have their own cultural traditions as well. The population in rural and suburban areas of the Texas Coastal Bend is predominantly white. All of these groups have access to and enjoy recreational fishing in coastal waters, and beach recreation, especially on barrier islands.

The Louisiana, Mississippi, and Alabama Gulf coastal areas adjacent to the Central and Eastern Planning Areas are known for their recreational fishing. Tourists enjoy beach activities and recreational fishing on the Alabama coast, staying in the many high-rise condos to the east of Mobile Bay. Tourism and recreation are a major industrial sector, contributing to the local economy in dollars spent for hotels, restaurants, and beach- and fishing-oriented retail products. Commercial and recreational fishing are also an important component of local communities and culture. The following ports are proximate to the program area and are major activity centers for charter boats in the GOM: South Padre Island, Port Aransas, and Galveston-Freeport in Texas; Grand Isle-Empire-Venice in Louisiana; Gulfport-Biloxi in

Mississippi; and Orange Beach-Gulf Shores in Alabama. Additionally, the following areas are major activity centers for headboats in the rest of the Gulf: South Padre Island, Port Aransas, and Galveston-Freeport in Texas and Orange Beach-Gulf Shores in Alabama.

Several groups living along the Louisiana coast are central to the culture of the region and rely on fisheries and related marine resources. Cajuns recreationally harvest fish and shellfish from the bayous (Henry and Bankston 2002); they also fish as part of their subsistence. The United Houma Nation and the Chitimacha Tribe in southeastern Louisiana depend on subsistence diets, recovering foods from coastal areas. Vietnamese fishers, who fish in the near offshore, retain up to 25 percent of their catch for family and barter use (Alexander-Bloch 2010).

The oil and gas industry is also a mainstay of the culture of the GOM, particularly in southern Louisiana and parts of Texas. For example, Port Fourchon has historically been a land base for OCS oil support services as well as a land base for the Louisiana Offshore Oil Port (LOOP). The overwhelming majority (> 95 percent) of tonnage handled at the LOOP is oil- and gas-related (Greater Lafourche Port Commission 2016). These aspects of the sociocultural environment are well established and are not likely to change in the foreseeable future. These are the most important sociocultural aspects of Gulf states needed for analysis of potential impacts of OCS activities.

4.3.17 Environmental Justice

The fundamental tenet of environmental justice is fair treatment and meaningful involvement of all people in the environmental decisionmaking process, particularly people of color and low-income populations. Environmental justice requires the same degree of environmental quality and protection from health hazards and equal access to the decisionmaking process in all communities.

E.O. 12898 (59 FR 7629; February 11, 1994) establishes Federal agency responsibilities for environmental justice:

> To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands (Section 1-101).

In 1997, the CEQ (1997b) issued *Environmental Justice: Guidance under the National Environmental Policy Act* for implementing E.O. 12898 under NEPA (Guidance). The Guidance provides the following definitions for two key terms used in the E.O.:

> **Low-income population**: Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies would consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.

> **Minority**: Individual(s) who are members of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

For purposes of this analysis, BOEM prefers to use the term *people of color/communities of color*, because a numerical term of value for individuals would not be appropriate. While zoning laws are designed to protect public health, the effects of historical practices to exclude low-income communities and communities of color still can be observed, often in close proximity to industrial zones (Maantay 2002).

This Programmatic EIS has a three-part analytical methodology for the assessment of environmental justice impacts: (1) describe the geographic distribution of people of color and low-income populations in each program area; (2) assess whether oil and gas activities at any stage of development would produce reasonably foreseeable impacts that are high and adverse in those areas; and (3) if impacts are moderate to major, determine whether the impacts would disproportionately affect people of color and low-income populations. The geographic distribution of these vulnerable communities is based on demographic data from the 2014 American Community Survey (ACS) conducted by the U.S. Census Bureau (USCB). Data were collected at the "shoreline" county level for all coastal shoreline counties. Tables C-63 through C-66 in **Appendix C**, Section 18.0, list the percentage of people living below the poverty level by state and county adjacent to the program areas. Note that the poverty thresholds take into account family size and age of individuals in the family. For example, in 2014 the poverty line for a family of five with three children below the age of 18 was $28,252; whereas the threshold was $12,071 for a single adult (DeNavas-Walt and Proctor 2015).

4.3.17.1 Beaufort Sea and Chukchi Sea Program Areas

The Beaufort Sea Program Area is seaward of the Iñupiat communities of Kaktovik and Nuiqsut, and reaches just east of the community of Barrow. Subsistence hunters rely on caribou herds as a source of protein to supplement other harvests (e.g., whaling and fishing) to feed their communities. For a detailed reference to the sociocultural environment (most notably subsistence harvest activities) of this area, see **Section 4.3.16**.

Factors that can affect these communities are their vulnerability to storms and storm surge, shoreline change (erosion and accretion), cost of living, and distant proximity to hospitals, grocery stores, and modern conveniences. Because these villages are so remote, the cost of living and scarcity of food sources are high. Healthcare, treatment, and emergency care requires plane travel to metropolitan areas.

Social vulnerabilities can make it more difficult for communities to recover after a disaster: "…evidence indicates that the poor are more vulnerable at all stages—before, during, and after—of a catastrophic event. The findings are similar for racial and ethnic minorities; children, elders, or disabled people…" (Flanagan et al. 2011).

The USCB estimated that in the previous 12 months in the City of Kaktovik, 14.8 percent of the population lived below the poverty level. This is 4.6 percent higher than the average for the NSB of 10.2 percent, and 1.2 percent higher than the national average of 15.6 percent. In the City of Nuiqsut, 3.0 percent of the population lived below the poverty level. This is 6.5 percent lower than the average for the NSB and 12.6 percent lower than the national average (USCB 2014a, USCB 2014b). In the cities of Kaktovik and Nuiqsut, 94.9 percent and 93.8 percent of the population identifies as American Indian/Alaska Native, respectively (USCB 2014b, USCB 2014c).

The Chukchi Sea Planning Area is seaward of the Iñupiat communities of Barrow, Wainwright, Point Lay, and Point Hope. For a detailed reference to the sociocultural environment (most notably subsistence harvest activities) of this area, see **Section 4.3.16**.

Figure 4.3.17-1 shows the percent below the poverty level for coastal states adjacent to the program areas (USCB 2014d, USCB 2014e, USCB 2014f, USCB 2014g) estimated that in Barrow, 12.3 percent of the population lives below the poverty level. This is 2.1 percent higher than the average for the NSB and 3.3 percent lower than the national average. In the city of Wainwright, 19.3 percent of the population lives below the poverty level. This is 9.1 percent higher than the average for the NSB and 3.7 percent higher than the national average. In the village of Point Lay, 16.7 percent of the population lives below the poverty level. This is 2.9 percent higher than the average for the NSB and 2.2 percent lower than the national average. In the city of Point Hope, 11.9 percent of the population lives below the poverty level. This is 1.7 percent higher than the average for the NSB and 3.7 percent lower than the national average. **Table 4.3.17-1** shows the percentage and of the population by gender that is below the poverty level (USCB 2014d, USCB 2014e, USCB 2014f, USCB 2014g).

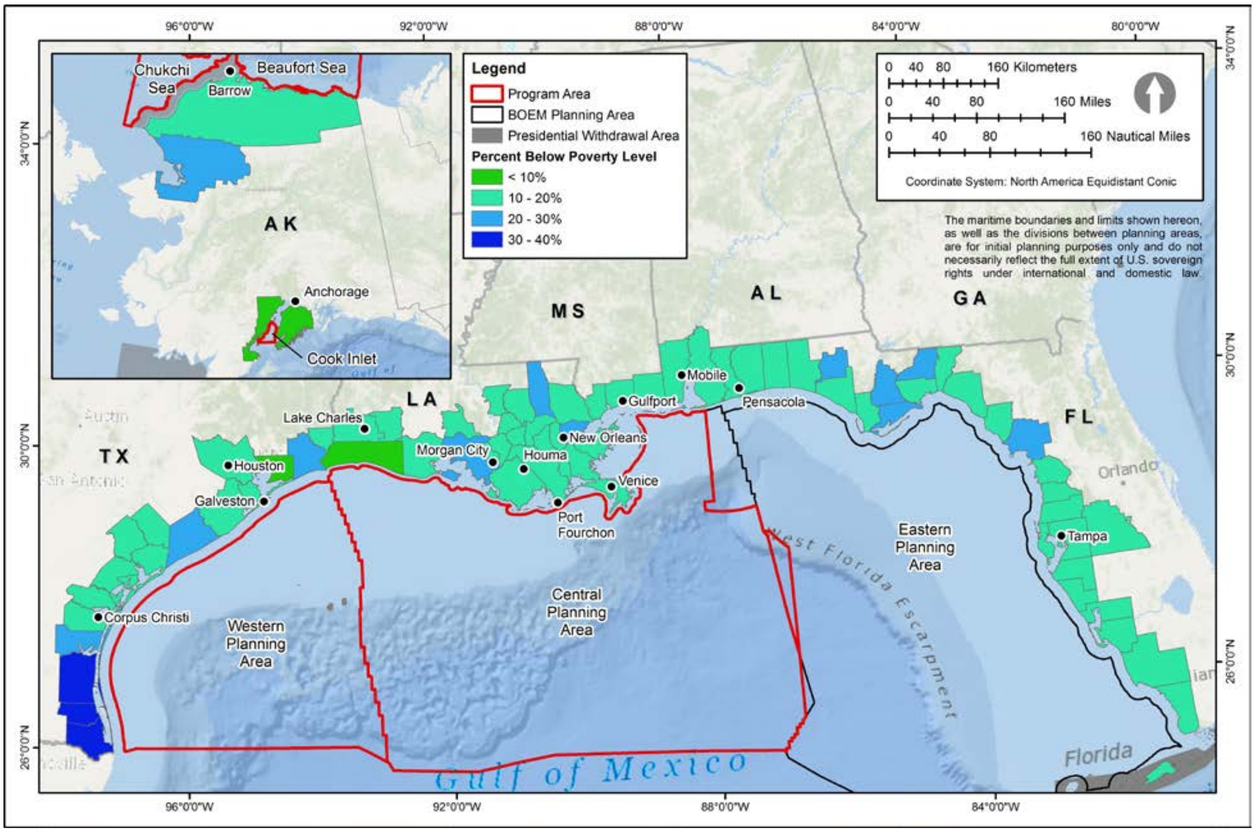


Figure 4.3.17-1. Percent of the Population below the Poverty Level for Coastal States adjacent to the Program Areas

Table 4.3.17-1. Percentage of Females and Males below the Poverty Level per Jurisdiction

Jurisdiction	Percentage of Population–Alaska Native	
	% Below Poverty, Female	% Below Poverty, Male
Kaktovik	14.9	14.7
Barrow	12.3	12.4
Wainwright	19.5	19.1
Point Lay	28.2	8.5
Point Hope	15.0	9.1

Sources: USCB 2014d, USCB 2014e, USCB 2014f, USCB 2014g

Evidence of climate change is occurring more rapidly in the Arctic than in other parts of the world. The annual temperatures in Alaska have increased by 3.6°F, and winter temperatures have increased by 5°F since the 1950s (NSB 2014b). Evidence of climate change can be observed in and around Kaktovik, where there are failed ice cellars, shallower lakes, and areas where the ground has collapsed. These conditions have been attributed to thawing permafrost from higher temperatures. Failure of ice cellars from rising temperatures and increased flooding is resulting in a decrease in places for safe handling and storing of subsistence harvests. In addition, climate change has other impacts that would affect Kaktovik: a later freeze up has been associated with increased erosion from coastal storms; ocean acidification is occurring faster in Arctic waters than in other areas; reduced sea ice cover is affecting ice-dependent species such as ice seals and polar bears; thawing permafrost releases methane gas, which plays a role in climate change; general drying trends could lead to more tundra wildfires; vegetation composition is changing with more brush cover than in the past; changing climate impacts the distribution and numbers of fish and wildlife which in turn impacts subsistence hunting, fishing and gathering (NSB 2014b).

> "…participation in traditional subsistence activities is a vital part of maintaining cultural integrity on the North Slope. The community of Barrow and the NSB both organize subsistence classes and community events such as traditional whaling feasts that celebrate subsistence as a source of cultural pride." (NSB 2012).

Barrow is unique amongst the NSB communities in that it is more culturally and ethnically diverse, but also is considered the transportation hub and seat of the local governments.

> "…Barrow is truly unlike other communities. Its remote location makes access and transportation logistically difficult and expensive. It is considered to be one of the coldest and driest places in the United States, with an annual average temperature of about 12 degrees Fahrenheit (°F) and less than five inches of annual precipitation. Barrow is also the borough seat of government where diverse issues converge, among them Native Iñupiat subsistence rights, oil and gas development activity and study of climate change in the Arctic" (NSB 2014c).

One factor that makes these coastal communities even more vulnerable to the elements is shoreline change, which has been cause for certain communities to abandon previous settlements and move their villages more inland.

> "Erosion of the shoreline of the Chukchi Sea has been taking place in Wainwright for over four decades. Public testimony in Wainwright indicated that some houses in the community have been moved as many as three times since 1965 to avoid Chukchi Sea erosion of the coastal bluffs. Some from Wainwright said that they believe coastal erosion accelerated when the beach in front of Wainwright was mined for gravel in 1967. The disappearance of ice cellars next to the coast as well as the loss of high coast bluffs were also reported by residents" (NSB 2014d).

4.3.17.2 Cook Inlet Program Area

Cook Inlet is home to the majority of Alaska's population and intersects the KPB. Onshore of the Cook Inlet Planning Area is the Native Village of Nanwalek, the Native Village of Port Graham, the Kenaitze Indian Tribe, the Ninilchik Village Tribe, the Eklutna Native Village, the Village of Salamatoff, the Seldovia Village, and the Native Village of Tyonek, which are all distinct, tribal communities.

Subsistence fishing is a cultural tradition that provides a means of nutritional sustenance in the Cook Inlet, and is open to all residents of the state. Subsistence is "an activity performed in support of the basic beliefs and nutritional need of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities" (Fall et al. 2004). Subsistence fishing is for direct personal or family consumption. Many Alaskans participate in subsistence fishing and processing, and it is an important element of Alaska's social and cultural heritage. For a more complete discussion of subsistence and its cultural and nutritional importance, see **Section 4.3.16.**

Subsistence fishing and hunting are important parts of the economies of rural Alaskan communities, providing food, clothing, and employment. Subsistence food sources contribute approximately 39 percent of the caloric requirements of the rural population. Approximately 2.5 percent of daily caloric requirements of urban populations are met through subsistence activities (Fall 2014).

Although it is difficult to establish the economic importance of subsistence harvests because the consumption and exchange of subsistence products typically do not occur in the marketplace, estimates of their importance have been made based on the dollar value of replacing such products in the commercial market. Using a replacement value of $4 per pound, the replacement value of subsistence harvests in rural Arctic Alaska is estimated to be $44 million annually; at $8 per pound, the replacement value is estimated at $88 million. In Alaska as a whole, the replacement value of subsistence products is estimated to be $201 million annually (Fall 2014).

Figure 4.3.17-1 shows the income characterization of the area via percent of the population below the poverty level for coastal states adjacent to the program areas. In the KPB, 8.6 percent of the population lives below the poverty level. This is 1.3 percent lower than the average for the State of Alaska and 5.5 percent lower than the national average of 15.4 percent. Approximately 11 percent of all residents of the KPB identify as a person of color.

Estimates in the KPB show that 10.1 percent of the population that lives below the poverty level is female, and 8.5 percent is male. **Table 4.3.17-2** shows the percentage of the population by gender living below the poverty level (USCB 2014h).

Table 4.3.17-2. Percentage of Females and Males living below the Poverty Level per Jurisdiction

Jurisdiction	% Total Population Below Poverty	% Total Population: Females Below Poverty	% Total Population: Males Below Poverty
Kenai Peninsula Borough	9.3	10.1	8.5
Cohoe	16.1	15.8	16.4
Ninilchik	16.9	18.0	15.9
Tyonek	21.7	23.3	20.0
Beluga	40.0	0.0	66.7

Source: USCB 2014h

The Cook Inlet area is also known for its dynamic bathymetry, which has formed a coarse basin environment over time from glacial activity. The inlet starts forming ice in October and melts by spring. This area is also known for flooding, coastal erosion, active faults, earthquakes, volcanoes, and tsunamis (ADNR 2009).

4.3.17.3 Gulf of Mexico Program Area

The GOM region is still recovering from the adverse effects of several hurricanes over the past 15 years as well as the effects of the 2010 *Deepwater Horizon* oil spill. These events have had disproportionate effects on communities of color and low-income populations, especially in terms of property damage and loss of income. This makes these groups more vulnerable to any new hazard or natural disaster (Osofsky et al. 2011)

The Western Planning Area is seaward of coastal counties off Texas. For a detailed reference to the sociocultural environment of this area, see **Section 4.3.16**. Demographic data were analyzed using the USEPA mapping application EJSCREEN, which uses 2010 census data to display communities that could be more vulnerable than others to disasters or negative impacts. Nueces County, home to Corpus Christi, is in the 79th percentile in the nation for communities of color. This county is also home to a distinct community, a state-recognized tribe, the Lipan Apache Tribe. In the top percentiles in the state for communities of color are Kleberg, Kenedy, Willacy, and Cameron Counties.

Figure 4.3.17-1 shows the percent of the population below the poverty level for coastal states adjacent to the program areas. In Cameron and Kenedy Counties, the percentage of the population living below the poverty level is 34.8 percent and 26.1 percent, respectively. In Willacy County, 40 percent of the population lives below the poverty level. This is 22.4 percent higher than the average for the State of Texas and 24.6 percent higher than the national average of 15.4 percent. **Table 4.3.17-3** shows the percentage of the total population, and of females and males living below the poverty level within the highlighted counties (USCB 2014i, USCB 2014j, USCB 2014k). For additional data, see **Appendix C**, Section 18.0.

Table 4.3.17-3. Percentage of Females and Males below Poverty Level within Highlighted Counties

Jurisdiction	% Total Population Below Poverty	% Total Population: Females Below Poverty	% Total Population: Males Below Poverty
Cameron County, Texas	34.8	36.6	33.0
Kenedy County, Texas	32.8	30.1	22.3
Willacy County, Texas	38.0	40.9	35.0

Sources: USCB 2014i, USCB 2014 j, USCB 2014k

The Central Planning Area is seaward of coastal counties off Louisiana, Mississippi, Alabama, and a small portion of Florida, see **Section 4.3.16**. On the coast of Louisiana, there is one federally recognized tribe, the Chitimacha Tribe of Louisiana, and three state-recognized tribes, the Biloxi-Chitimacha Confederation of Muskogee, the Pointe Au Chien Indian Tribe, and the United Houma Nation, all residing in Lafourche, Terrebonne, and Jefferson Parishes. These tribes are especially vulnerable to impacts from increasing shoreline erosion and saltwater intrusion due to their location on the coast. Additional geographic vulnerabilities for this area are increasing frequency of storms and storm surge as well as shoreline erosion and accretion. Many of these geographic vulnerabilities have been linked to a change in climate.

Table 4.3.17-4 shows the percentage of the total population, and of females and males living below the poverty level, within the highlighted jurisdictions. Orleans Parish has a poverty rate that is 8.1 percent higher than the average for the State of Louisiana, and 12.1 percent higher than the nation average (USCB 2014l). In Harrison County, Mississippi, the poverty rate is 2.6 percent lower than the average for the State of Mississippi and 4.4 percent higher than the national average (USCB 2014m). In Mobile County, Alabama, the poverty rate is 1.0 percent higher than the average for the State of Alabama and 4.3 percent higher than the national average (USCB 2014n). Plaquemines Parish, the parish that reaches farthest into the GOM, is in the 94th percentile in the nation for a low-income community and in the 85th percentile as a community of color (USEPA 2016c). For further county comparisons, see **Appendix C**.

Table 4.3.17-4. Percentage of Females and Males below Poverty Level, per Highlighted Jurisdiction

Highlighted Jurisdictions	% Total Population Below Poverty	% Total Population: Females Below Poverty	% Total Population: Males Below Poverty
Orleans Parish, Louisiana	27.3	29.5	25.0
Harrison County, Mississippi	19.9	21.6	18.2
Mobile County, Alabama	19.8	21.8	17.6

Sources: USCB 2014l, USCB 2014m, USCB 2014n

4.4 IMPACT ASSESSMENT

Impact levels are defined in **Section 4.1.2**; analyses in the following sections rely on these definitions such that the basis for an impact finding is directly applicable to how that impact level is defined. Fully predicting the degree of effect specific to the activities that would occur if leases are issued is impossible at the programmatic scale being considered here. It is, therefore, imperative that any subsequent regional or site-specific analyses consider the most recent science available at the time of the decision. Impacts from routine operations could affect species listed under the ESA more seriously than species that are not listed. As described in **Section 4.1**, this is considered in the impact level definitions. In addition, impacts on ESA species will be analyzed in greater detail at the individual lease sale level.

4.4.1 Alternative A – The Proposed Action

This section discusses **moderate** to **major** impacts that would result in program areas from routine operations under Alternative A, the Proposed Action, or any slight timing-related options described in **Section 2.4**. Negligible to minor impacts are disclosed and provided for all resource areas in **Appendix E**. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**. A description of the IPFs associated with the Proposed Action is provided in **Section 3.6**.

Some impacts involve features specific to particular program areas, and these are identified as warranted. However, most conclusions on impacts from the Proposed Action involve considerations that are common to all program areas, particularly at the programmatic scale being considered here. For this reason, the discussion of impacts for Alternative A in this section is not structured by program area for most resources. Impacts or discussions relevant to a specific program area is provided if needed. The impact discussion does not specifically refer to each OCS planning area evaluated in this Programmatic EIS. This is because either (1) the program area and the planning area are essentially the same, as in Alaska; or (2) the planning areas are adjacent areas such as in the GOM Program Area (Western and Central/Eastern Planning Areas) whose separate consideration would not lead to different impacts conclusions.

4.4.1.1 Air Quality

Potential impacts on air quality associated with the Proposed Action include routine operations from emissions from vessels, helicopters, stationary engines such as generators, and equipment leaks, commonly known as fugitive emissions. In addition, icebreakers (ships used to provide access and protect OCS facilities from ice) are expected to be used in the Beaufort and Chukchi Seas and Cook Inlet.

While there could be some expansion or modification to existing port facilities, it is unlikely these construction activities would contribute much criteria or precursor pollutants to the ambient air. In the Artic, onshore worker enclaves would contribute some criteria and precursor emissions to the ambient air. In addition, accidental events would result in emissions from the spill, or from *in situ* burning and vessels used for cleanup. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**. An overview of the potential impacts associated with the activities associated with the Proposed Action is presented in **Figure 4.4.1-1**.

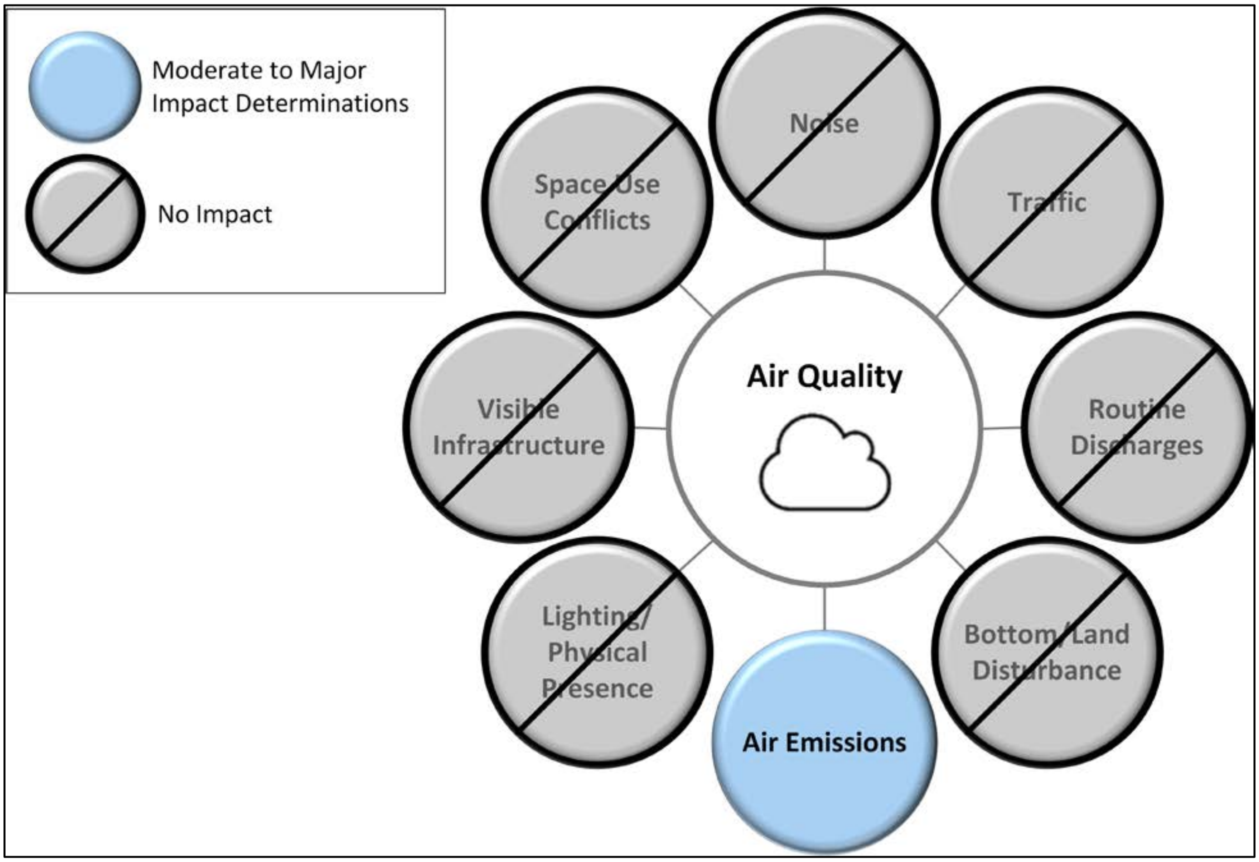


Figure 4.4.1-1. Impact-Producing Factors and Impact Determinations for Air Quality associated with Routine Activities

The criteria pollutants released by OCS sources include CO, NO_2, PM, and SO_2. NO_x .and VOCs released by OCS sources are precursor pollutants for O_3, which is formed through photochemical reactions in the atmosphere. When examining the NAAQS Secondary Standards, the USEPA examines NO_x, which includes NO and NO_2, and also SO_x, and includes many sulfur oxide varieties (USEPA 2015d). For consistency, BOEM does the same in this analysis since this could only overestimate the amount of NAAQS emitted by the Proposed Action.

Table 4.4.1-1 provides the estimated high-price scenario air emissions from OCS activities by planning area for the Proposed Action. The table also annualizes the numbers to make it clear emissions would not be released all at once. These emissions were estimated using emissions factors from BOEM's 2012 Revised OECM and represent a high-price scenario. This includes emissions increases from diesel and gasoline engines used to power vehicles, aircraft, and vessels used to transport equipment, personnel, and oil products along with all OCS operations, such as drilling equipment and generators.

Table 4.4.1-1. Estimated Air Emissions from the Proposed Action's OCS Activities in Thousands of Short Tons per Year, High-Price Scenario

Pollutant	Planning Area				
	Western	Central and Eastern	Beaufort Sea	Chukchi Sea	Cook Inlet
NOx	222.23	1,271.65	2,656.44	943.90	46.83
SOx	4.78	31.44	34.32	22.97	2.19
PM10	7.33	40.35	131.07	43.20	1.19
PM2.5	7.12	39.17	117.58	38.92	1.15
CO	60.81	319.15	1,068.87	348.02	13.00
VOC	11.31	63.29	320.29	210.02	15.34

Source: Industrial Economics, Inc. and SC&A, Inc 2015
Note: The high-price scenario would likely result in the highest level of emissions for the Proposed Action.
Key: CO = carbon monoxide; NO_x = nitrogen oxides; $PM_{2.5}$= particulate matter with a diameter equal to or less than 2.5 microns; PM_{10}= particulate matter with a diameter equal to or less than 10 microns; SO_x = sulfur oxides; VOC = volatile organic compound

Due to USEPA regulations restricting air emissions, routine oil and gas operations are required to limit NO_x, SO_x, PM_{10}, and $PM_{2.5}$ emissions. Impacts in nonattainment areas are expected to be relatively small due to regulatory requirements from BOEM's plan approvals process and the USEPA's permitting process. Both evaluations require operators to mitigate impacts if operations affect any nonattainment areas. For operations with the potential to impact attainment areas, incremental concentrations of NO_x, SO_x, and PM are required to be within the maximum allowable PSD increments, and no significant impacts from CO are expected. This would be demonstrated through the USEPA's PSD permit process or BOEM's plan approval process, depending on agency jurisdiction.

There could be some visibility impacts due to nitrate formation from NO_x, PM_{10}, and $PM_{2.5}$ emissions; however, these are expected to be minor. Visibility impacts are evaluated, as needed, by the USFWS. For plans emitting more than 250 short tons per year of NO_x, SO_x, or PM within 100 km of a Class I Area, the plan is sent to USFWS for review. Plans within 100–200 km of Class I Areas are sent to USFWS if they meet a certain distance-to-emissions ratio established by USFWS. This ratio is the same as is used by the Federal Land Managers Air Quality Related Values Work Group to demonstrate compliance (NPS 2010). Breton NWR is the only Class I Area within 200 km of the Proposed Action where BOEM has air quality jurisdiction in the nearby OCS.

Recently, BOEM funded a modeling study (BOEM 2016g, BOEM 2016h, BOEM 2016i) evaluating the contribution, if any, to the degradation of ambient air quality from OCS sources in the GOM. The ongoing study is evaluating current OCS activity and the Proposed Action's contribution as part of a larger re-evaluation of BOEM's air quality regulations. A draft interim deliverable suggests OCS sources are contributing to ambient criteria pollutants, visibility reduction, and acid deposition in the GOM region. The modeling suggests impacts are largely over the OCS, but are also seen over state submerged lands, onshore and in nearby Class I and Sensitive Class II Areas. This includes contributing minor amounts of emissions to the O_3 nonattainment areas in the Houston, Texas and New Orleans, Louisiana metropolitan areas. These results are still preliminary, but suggest wider impacts than had previously been observed. Once the results are finalized, they will be fully discussed and addressed in future leasing documents. This study is expected to close in 2017.

The Proposed Action's overall impact on air quality over the OCS and adjacent onshore areas is **moderate** in the GOM, and **minor** near the Artic OCS and Cook Inlet. Emissions of airborne pollutants during oil and gas activities on the OCS would increase criteria pollutant concentrations over adjacent onshore areas. However, due to the dispersion and mixing of pollutants in the atmosphere and regulations requiring the use of emissions control technology or equipment to meet air emissions standards, measurable impacts at the nearest air quality monitoring stations would be **minor** to **moderate**. BOEM and USEPA regulations require mitigation measures to prevent or reduce impacts in areas defined as nonattainment by USEPA. For operations demonstrating the potential to impact attainment status, existing methods of regulating pollutants by the USEPA and BOEM are expected to maintain attainment statuses.

4.4.1.2 Water Quality

IPFs for water quality that could result in moderate impacts are routine discharges including (1) sanitary wastes, gray water, cooling water, and other miscellaneous discharges and (2) drilling mud/cuttings/debris/produced water. Non-routine events could also result in moderate or major impacts. An overview of the potential impacts associated with the activities associated with the Proposed Action is presented in **Figure 4.4.1-2**. Discussion of impacts from accidental events and CDEs is provided in **Section 4.4.5**.

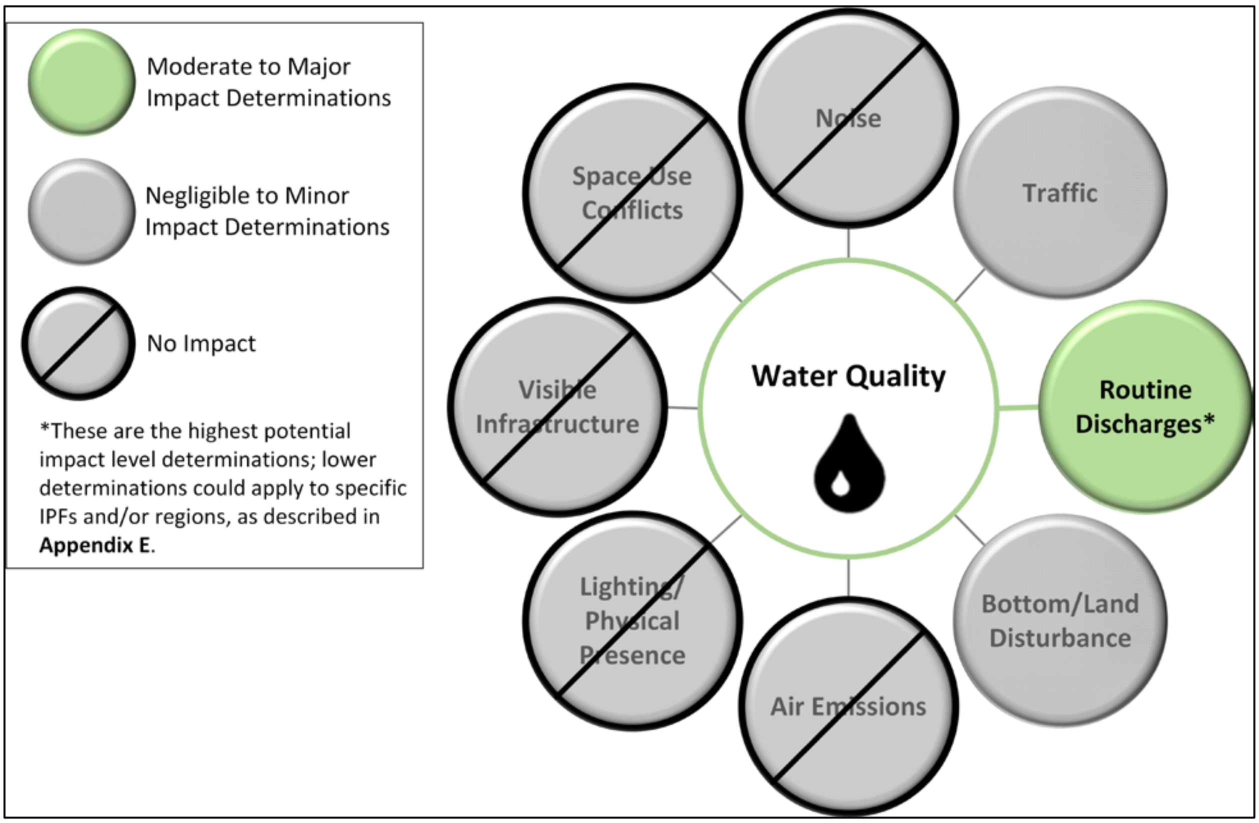


Figure 4.4.1-2. Impact-Producing Factors and Impact Determinations for Water Quality associated with Routine Activities

Sanitary Wastes, Gray Water, Cooling Water, and Other Miscellaneous Discharges

Routine operations lead to discharges including sanitary wastes, gray water, cooling water, and other miscellaneous discharges (e.g., bilge, ballast, and fire water; deck drainage). Sources of these discharges are vessels (support, service/construction, seismic, and drilling) and platforms. The types of discharges are discussed in **Section 3.6**.

Discharges would occur during normal operations, in small volumes, and would produce local and temporary effects on water quality. Discharges are expected to be diluted and dispersed rapidly through mixing by currents. Compliance with applicable state-issued or NPDES permits and USCG regulations would prevent or minimize most impacts on receiving waters. In the Chukchi Sea coastal waters, routine discharge sources would primarily be from vessels traveling to and from ports. This is due to the existing 40.2-km (25-mi) Presidential Withdrawal in the Chukchi Sea Program Area.

The activities associated with the Proposed Action would contribute to the use of new and existing onshore facilities throughout the program areas. These onshore support facilities would discharge into local wastewater treatment plants and waterways during routine operations and could impact coastal water quality; the types of onshore facilities are discussed in **Section 3.1**. Indirect impacts could occur from nonpoint-source runoff such as rainfall that has drained from infrastructure (e.g., a public road or parking lot) and could contribute hydrocarbons, trace-metal pollutants, and suspended sediments. These indirect impacts would be minimal due to existing regulations. All discharges are regulated by the state, the USEPA and NPDES permitting, or the USCG (**Table 4.4.1-2**) (**Appendix C**, Section 3.0). Within marine waters, routine discharges would occur from platforms, drilling vessels, and supply and service/construction vessels as part of normal operations and could contribute to degradation of water quality but within acceptable parameters.

Drilling Mud/Cuttings/Debris/Produced Water

Additional operations potentially affecting coastal and marine water quality include operational discharges from exploration, development, production wells, and from production structures (i.e., platforms [including gravel islands] and FPSOs). These operational discharges include drilling muds, cuttings, and produced water. Drilling muds, cuttings, and produced water are described in **Section 3.6**.

The volume of the water-based drilling fluids and cuttings at each wellsite varies depending on the well characteristics (diameter and depth). Environmental effects of discharged muds and cuttings are localized because of settling, mixing, and dilution (Neff 2005). While the total volumes of drilling muds and cuttings discharged to the ocean during drilling operations are large, impacts on water quality are minimal (NRC 1983, Neff 2005). Discharges of small amounts of materials are intermittent and take place only during drilling operations, spaced over a few to several months. As such, discharged drilling mud does not increase to high concentrations in the water column and affects only a small parcel of water (Neff 2005). According to the NRC (1983) and Neff (2005), periodic minor increases in turbidity reflecting suspended particulate material concentrations in the upper water column during mud and cuttings discharges are unlikely to have an environmentally significant effect on water quality. Once discharged, the larger particles of cuttings, representing approximately 90 percent of the mass of the mud solids, form a plume that settles quickly to the bottom within 100 m (328 ft) of the discharge point (Neff et al. 2000). The remaining mass forms another plume in the upper water column that drifts with prevailing currents away from the platform and is rapidly diluted in the receiving waters within approximately 1 to 2 km (3,281 to 6,562 ft) downcurrent from the discharge point (NRC 1983, Neff et al. 2000, Neff 2005). Within the Chukchi Sea, impacts on the coastal environment would be further mitigated by the 40.2-km (25-mi) coastline buffer under the Proposed Action.

Generally, produced water is the largest individual discharge produced by normal operations (Veil et al. 2005) associated with oil and gas production. Commonly, the amount of produced water is low when production begins but increases over time near the end of the field life (NRC 2003a). In a nearly depleted field, production could be as high as 95 percent water and 5 percent fossil fuels (Rabalais et al. 1991). The composition of produced water depends on whether crude oil or natural gas is being produced and generally includes a mixture of liquid or gaseous hydrocarbons, dissolved or suspended solids, produced solids such as sand or silt, and injected fluids and additives that could have been placed in the formation (e.g., biocides, corrosion inhibitors, water clarifiers) as a result of exploration and production activities (Veil et al. 2005).

Table 4.4.1-2. Discharges and Disposal Regulations

Type	Occurrence		Disposal		Regulations
	Coastal	Marine	Coastal	Marine	
Sanitary Waste	N/A	Yes	N/A	Routinely processed through onsite USCG-approved marine sanitation devices before ocean discharge[1]	Sections 402 and 403 of the CWA: NPDES permits
Gray water	N/A	Yes	N/A	Screened to remove solids, then discharged[1]	N/A
Miscellaneous water (bilge, ballast, and fire water and deck drainage) including those from service vessels	Yes	Yes	Open ocean discharge	Open ocean discharge	Point-source discharges: USEPA and NPDES storm-water effluent limitation guidelines USCG bilge and ballast water regulations based on the MARPOL Annex I, Regulations for the Prevention of Pollution by Oil
Point and nonpoint source discharges from onshore facilities	Yes	N/A	Discharge into local wastewater treatment plants and waterways during routine operations	N/A	Point-source discharges are regulated by USEPA and NPDES stormwater effluent limitation guidelines control stormwater discharges
Cooling water	N/A	Yes	N/A	Open ocean discharge	NPDES permits as established by Section 316(b) of the CWA
Drilling muds/cuttings: SBM and WBM	N/A	Yes	N/A	SBM is prohibited under the CWA. SBM-wetted cuttings, WBM, and WBM cuttings are permitted for ocean discharge as long as they meet local regulatory requirements. Spent SBM fluid must be transported to shore for reuse or disposal.	Within marine waters, must comply with an existing NPDES permit
Produced water	N/A	Yes	N/A	Produced water must be treated, then discharged to the ocean	Within marine waters, must comply with an existing NPDES permit
Debris	Yes	Yes	Discharge or disposal of solid debris from OCS structures and vessels is prohibited	Discharge or disposal of solid debris from OCS structures and vessels is prohibited	N/A

Key: CWA = Clean Water Act; MARPOL = marine pollution N/A = not applicable; NPDES = National Pollutant Discharge Elimination System; SBM = synthetic-based mud; USEPA = U.S. Environmental Protection Agency; USCG = U.S. Coast Guard; WBM = water-based mud

Produced water could degrade water and sediment quality in the immediate vicinity of the discharge as it can contain elevated concentrations of salts, petroleum hydrocarbons, metals, and naturally occurring radioactive material, some of which are toxic and persist in the marine environment. Studies in coastal waters have shown contaminated sediments exist in areas up to 1,000 m (3,280 ft) from a produced water discharge point, indicating water quality in that zone has been affected by produced water discharges (Rabalais et al. 1991). In shallow shelf waters, hydrocarbons from produced water have been shown to accumulate in bottom sediments up to 300 m (984 ft) from an outfall (Rabalais et al. 1991). In OCS waters, contaminated sediments are localized around offshore platforms (NRC 2003a).

Bierman et al. (2007) conducted a modeling study to assess the incremental impacts of produced water discharges on dissolved oxygen in the northern GOM, to determine the contribution to the hypoxic zone. The predicted incremental impacts of produced water on dissolved oxygen conditions from the model were small and had little impact on the hypoxic zone. Overall, impacts on water quality are expected from the discharge of produced water, but these impacts are anticipated to be localized, and background concentrations are expected to exist away from the immediate discharge location. **Figure 4.4.1-3** shows the environmental processes acting on produced water and drilling waste in the marine environment.

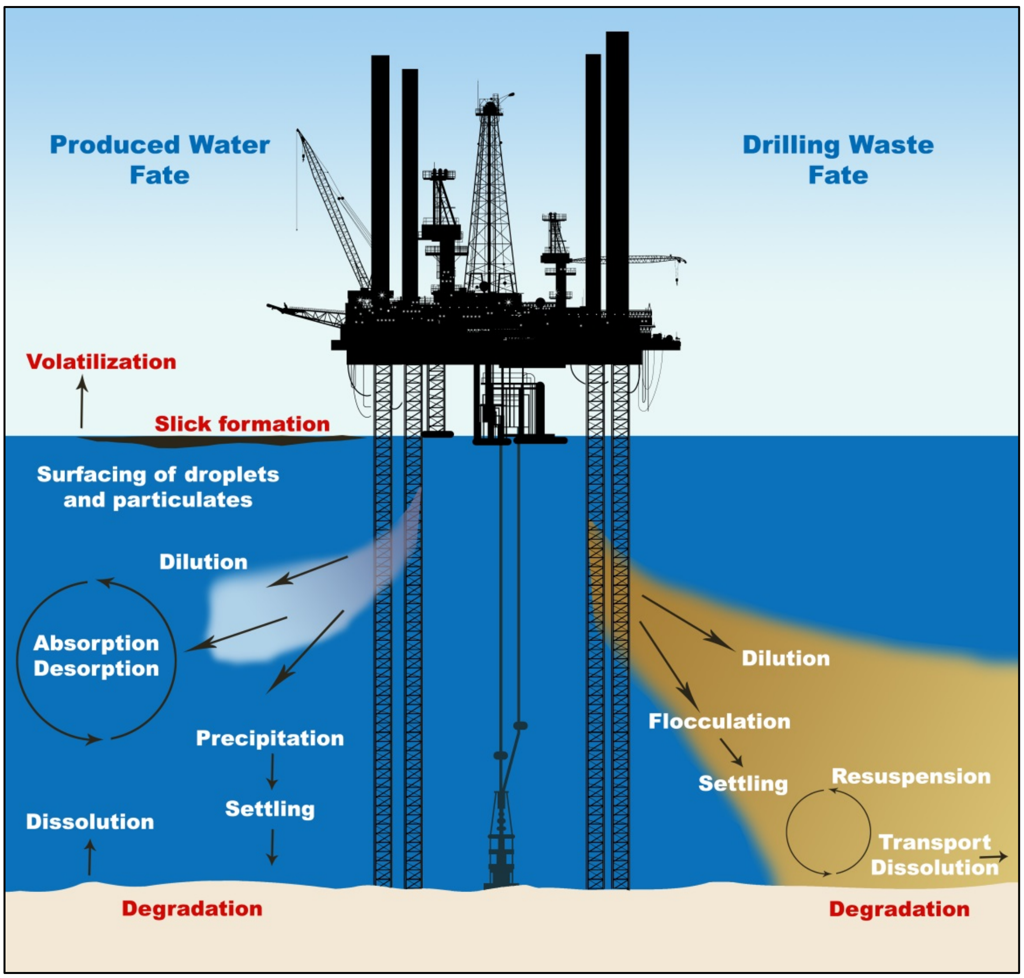


Figure 4.4.1-3. Environmental Fate of Wastes from OCS Oil and Gas Drilling and Production Activities

Impacts on coastal and marine water quality due to routine operations and operational discharges under the Proposed Action would be unavoidable. Compliance with NPDES permit requirements and USCG regulations would reduce or minimize impacts on receiving waters caused by discharges from normal operations. Impacts on water quality from routine and operational discharges associated with the Proposed Action are expected to range from **negligible** to **moderate** because some discharges are considered avoidable with proper measures and other discharges would be unavoidable. These discharges do not threaten the viability or integrity of water quality and the impacts are typically short-term. Fully predicting the degree of effect from the activities associated with the Proposed Action is impossible at the programmatic scale considered here. It is, therefore, imperative that any subsequent regional or site-specific analyses consider the most recent science available at the time of the decision as well as additional mitigation measures to limit the potential for impacts on water quality.

4.4.1.3 Marine Benthic Communities

Based on impact screening of the activities and affected resources, the only IPFs for marine benthic communities with impact determinations greater than minor are localized impacts from muds and cuttings discharges and accidental spills and CDEs. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-4**. Drilling muds and cuttings discharges could have **moderate** impacts on localized areas near discharge locations because of the potential for accumulation and burial described below. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**. Impacts that are expected to be negligible to minor are identified and summarized in **Appendix E**.

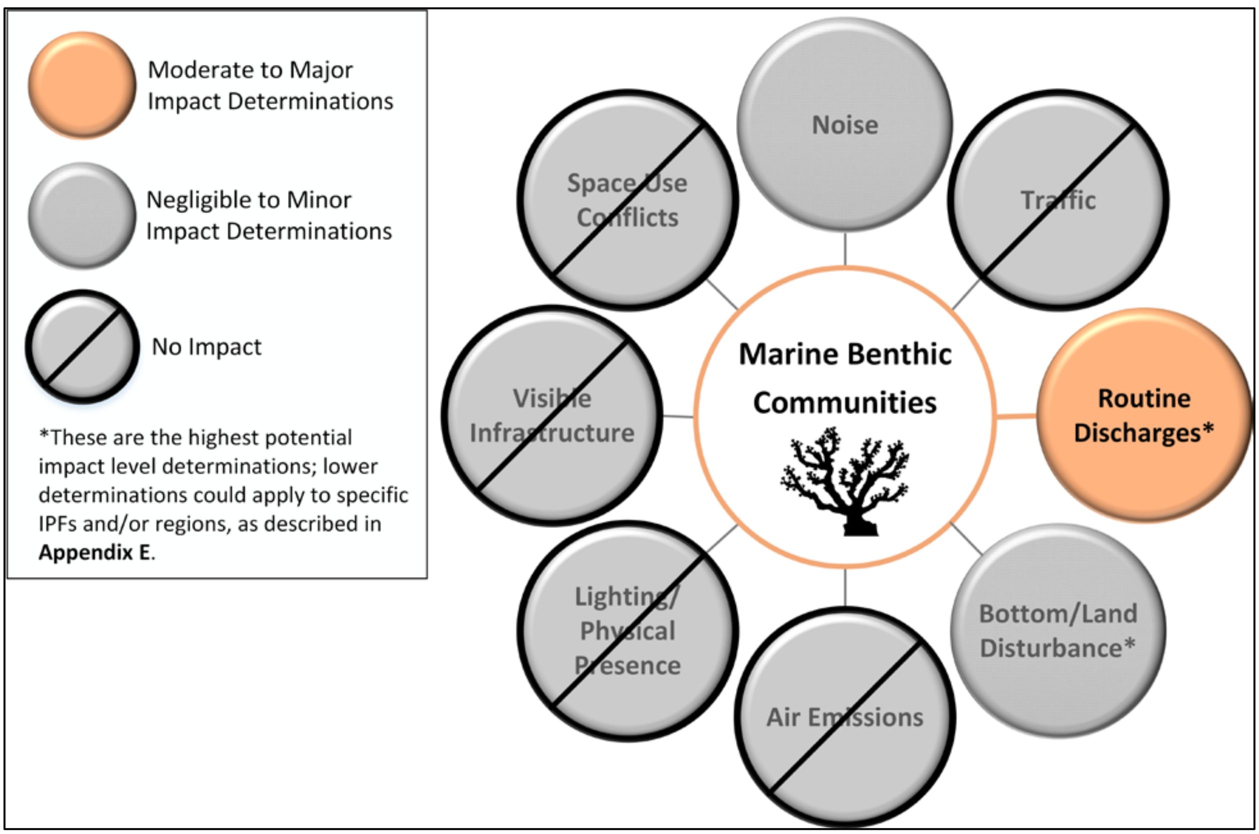


Figure 4.4.1-4. Impact-Producing Factors and Impact Determinations for Marine Benthic Communities associated with Routine Activities

Studies have found drill cuttings can be detectable up to 1 km (0.6 mi) from the wellsite, depending on whether cuttings were discharged near the water surface or near the seafloor (CSA 2004, CSA 2006). Concentrations of barium, heavy metals, hydrocarbons, and synthetic drilling fluids could be elevated around drill sites (CSA 2004, CSA 2006). Mud and cuttings discharged close to the seafloor settle relatively quickly and deposit in thick, concentrated layers (Neff 2005). Settled muds could smother organisms, change sediment characteristics and biogeochemical functions, and promote loss of food resources in the immediate area of the discharge. The biodegradable synthetic drilling fluids attached to the drilling waste could deplete oxygen (Trannum et al. 2010), and therefore could create local sediment anoxia. These impacts would be especially severe for immobile/sessile organisms that cannot avoid the impacted area (e.g., various invertebrates, algae, some fish). In the case of discharges released near the water surface in deep water, drilling muds and cuttings would spread out in a thin veneer over a wide area (CSA 2004). Cuttings likely would be deposited within 250 m (820 ft) of the well (CSA 2006). Their impacts would be less intense than discharges released closer to the seafloor. Cuttings shunted to the seafloor (required in the vicinity of topographic features in the GOM) form piles concentrated within a smaller area than do sediments discharged at the sea surface (Neff 2005). Although studies have not reported impacts on chemosynthetic organisms or corals resulting from exposure to contaminants in muds or cuttings, infauna have shown effects at distances < 100 m (330 ft) from the discharge. These include reduced reproductive fitness, altered populations, and acute toxicity (Chapman et al. 1991, Carr et al. 1996, Kennicutt et al. 1996, Montagna and Harper 1996, CSA 2004). Because of BOEM's distancing requirements for drilling wells, contact of coral or chemosynthetic communities with concentrated and potentially harmful levels of any such toxin is not expected.

Evidence for biological (sediment community), physical, and chemical recovery was detected 1 year after discharge, so full recovery could occur over several years as sediment contaminants biodegrade and are buried by natural deposition and bioturbation (CSA 2004, CSA 2006). Thus, depending on the extent of impact and recovery time, impacts from drilling mud and cuttings discharges could range from **negligible** to **moderate** in the immediate vicinity of the impact in all program areas. Application of BOEM distancing requirements has effectively protected both chemosynthetic and deep coral communities in the GOM from routine discharges to date. In the GOM, NTL 2009-G40 "Deepwater Benthic Communities" increased (effectively doubled from the prior NTL) the distance of avoidance from sensitive deepwater biological communities, including both chemosynthetic communities and deep coral habitats, for drilling discharges (610 m) and anchoring (152 m). Only soft-bottom communities would be anticipated in close proximity to drilling areas of the Beaufort Sea, Chukchi Sea, and Cook Inlet. In the case of the planned Liberty Development in the Beaufort Sea, which is very close to the Bolder Patch hard-bottom community, disposal of drilling waste by injection in an on-site waste disposal well is anticipated. If this plan was not followed, **moderate** impacts on soft-bottom benthic communities as well as the boulder-related hard-bottom communities could occur.

In summation, marine benthic community impacts from drilling mud and cuttings discharges could be **moderate** in the immediate vicinity of the wells, but **negligible** to **minor** overall with sensitive habitats being protected through distancing requirements.

4.4.1.4 Coastal and Estuarine Habitats

OCS activities that could impact coastal and estuarine habitats include vessel activity such as tanker and barge transport, survey vessel trips and support vessels, roads, and onshore support bases and pipelines to shore and distribution points. Through preliminary screening of the activities and affected resources, IPFs for coastal and estuarine habitats are (1) vessel and vehicle traffic, (2) bottom/land disturbance, and (3) routine and non-routine discharge events (**Table 3.6-3**). An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-5**. Impact levels would not rise above **minor** for vessel and vehicle traffic (**Appendix E**) except for in the GOM, where erosion could be

moderate. The same would be the case for land disturbance except for in the Chukchi Sea Program Area, where impacts could be **moderate** (see paragraph below). Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**. There are no IPFs associated with routine operations that would result in moderate or major impacts on coastal and estuarine habitats in the Beaufort Sea or Cook Inlet Program Areas because there would be little need for new or expanded onshore facilities (see **Appendix E**).

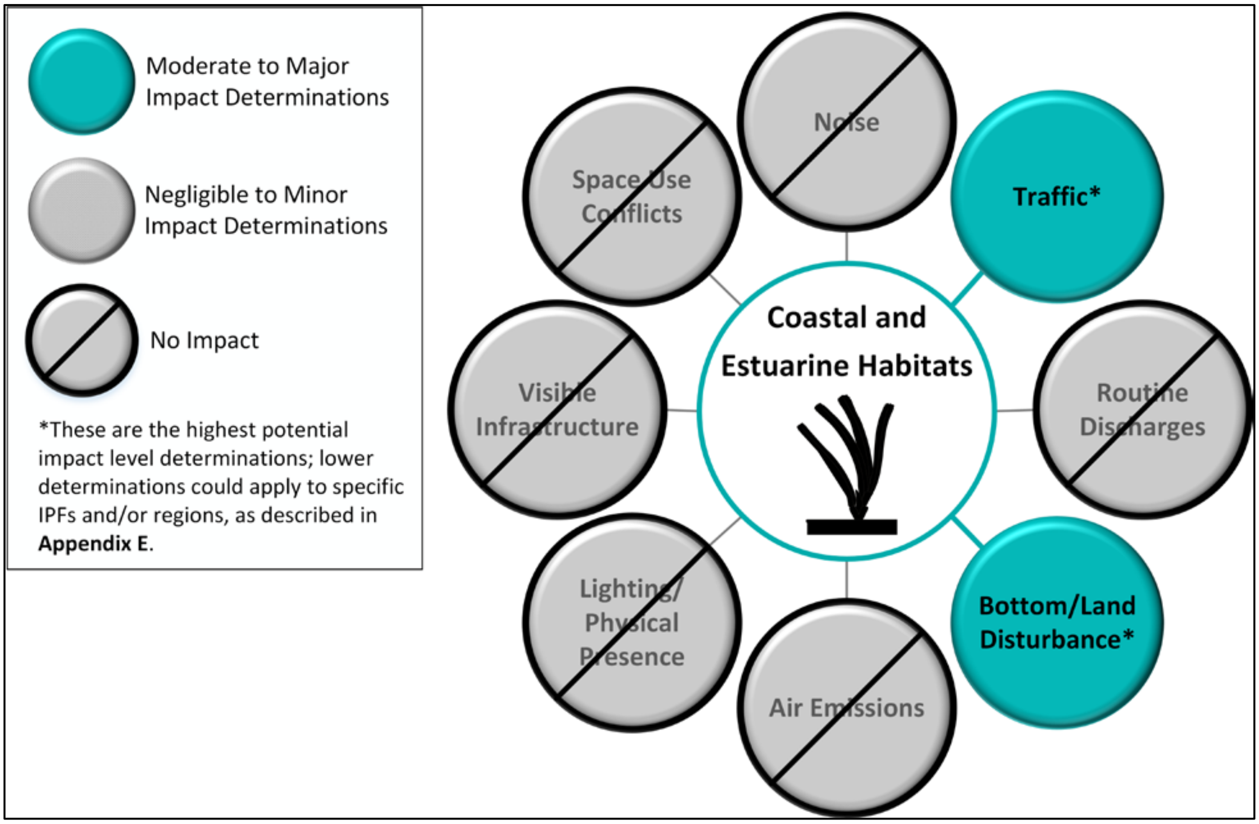


Figure 4.4.1-5. Impact-Producing Factors and Impact Determinations for Coastal and Estuarine Habitat associated with Routine Activities

Construction of onshore facilities in the Chukchi Sea Program Area for shore bases, temporary and permanent roads, pipelines, and expansion of existing and development of new fill material sources could result in **moderate**, direct impacts, mostly in wetland areas because of the extensive nature of wetlands in the ACP. Up to several hundred acres of wetland habitat could be impacted by shore bases and roads, while up to several thousand acres of wetland habitat could be impacted by pipeline construction. Most of these impacts could be long-term. Indirect impacts could occur from dust, oil spills, and fire. Indirect dust impacts could be long-term where roads are not paved while recovery from winter construction compaction, oil spills, and fire would be variable depending on size and intensity and on vegetation type. For example, vascular vegetation was impacted for 5–6 years and lichens were impacted for several decades from fire (Jandt et al. 2008). Whereas onshore oil spills can be contained and cleaned up more easily than OCS spills because of visual identification and access, impacts could still last several years (McKendrick and Mitchell 1978). Construction in nearshore and onshore water bodies and wetlands are likely subject to jurisdiction of the U. S. Army Corps of Engineers under authority of Section 10 of the Rivers and Harbors Act and/or Section 404 of the Clean Water Act. Pipelines in the NPR-A would also be subject to the authority of the BLM. These agencies would be expected to require mitigation that would reduce impacts and require compensatory mitigation in some cases.

4.4.1.5 Pelagic Communities

There are no IPFs associated with routine operations that would result in moderate or major impacts on pelagic communities. Discussion of negligible to minor impacts is provided in **Appendix E**. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-6**. Oil spills are considered non-routine, accidental occurrences, and could have **minor** to **major** impacts on pelagic communities. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**.

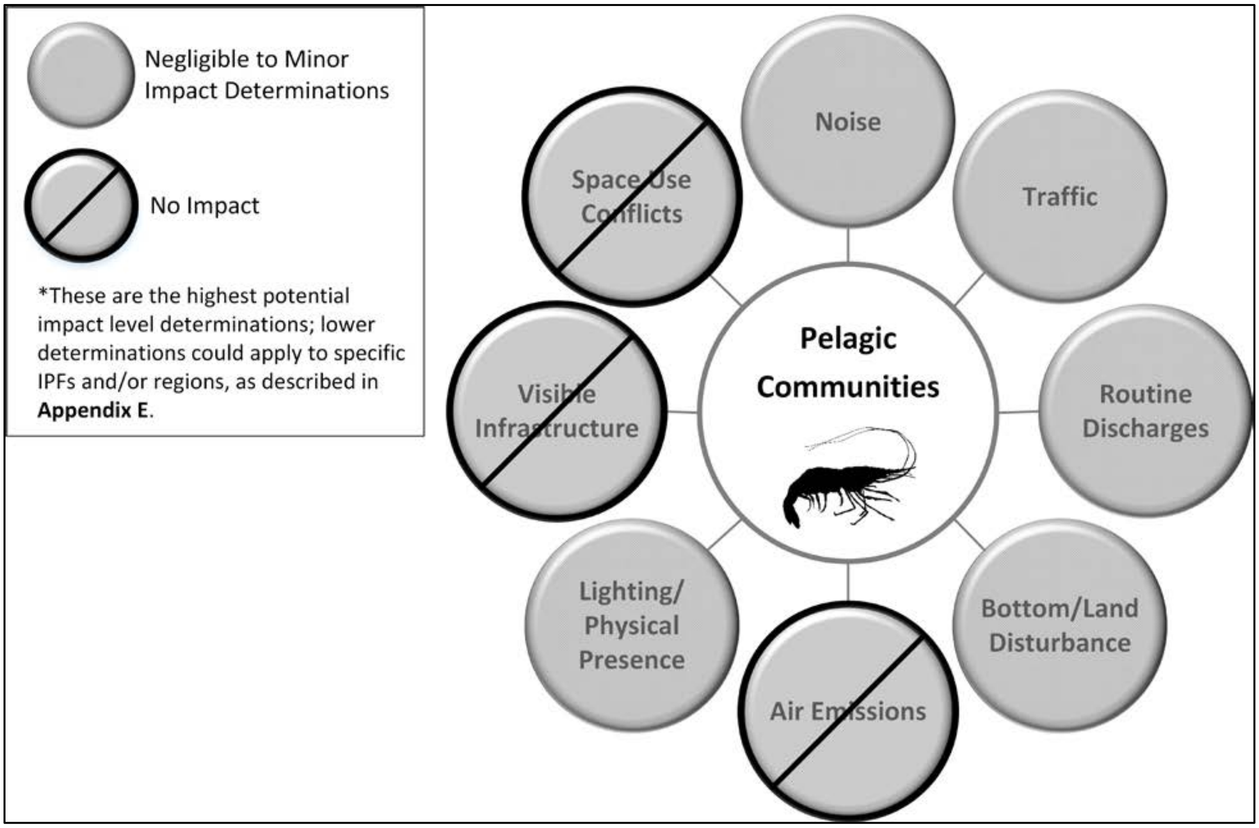


Figure 4.4.1-6. Impact-Producing Factors and Impact Determinations for Pelagic Communities associated with Routine Activities

4.4.1.6 Marine Mammals

IPFs associated with routine operations that would result in **negligible** to **moderate** impacts on marine mammals include seismic noise and vessel, aircraft, or vehicle traffic. For certain marine mammals in Alaska (e.g., walrus, seals, polar bear), aircraft traffic and onshore infrastructure development also would result in **negligible** to **moderate** impacts. For benthic feeders in the Chukchi Sea (e.g., walrus), drilling muds/cuttings/debris would result in **negligible** to **moderate** impacts. Impacts associated with exploration, development, and production will be evaluated in greater depth and with more specificity to the geographic area at the lease sale EIS stage, should a lease sale move forward. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-7**. Oil spills are considered non-routine, accidental occurrences. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**.

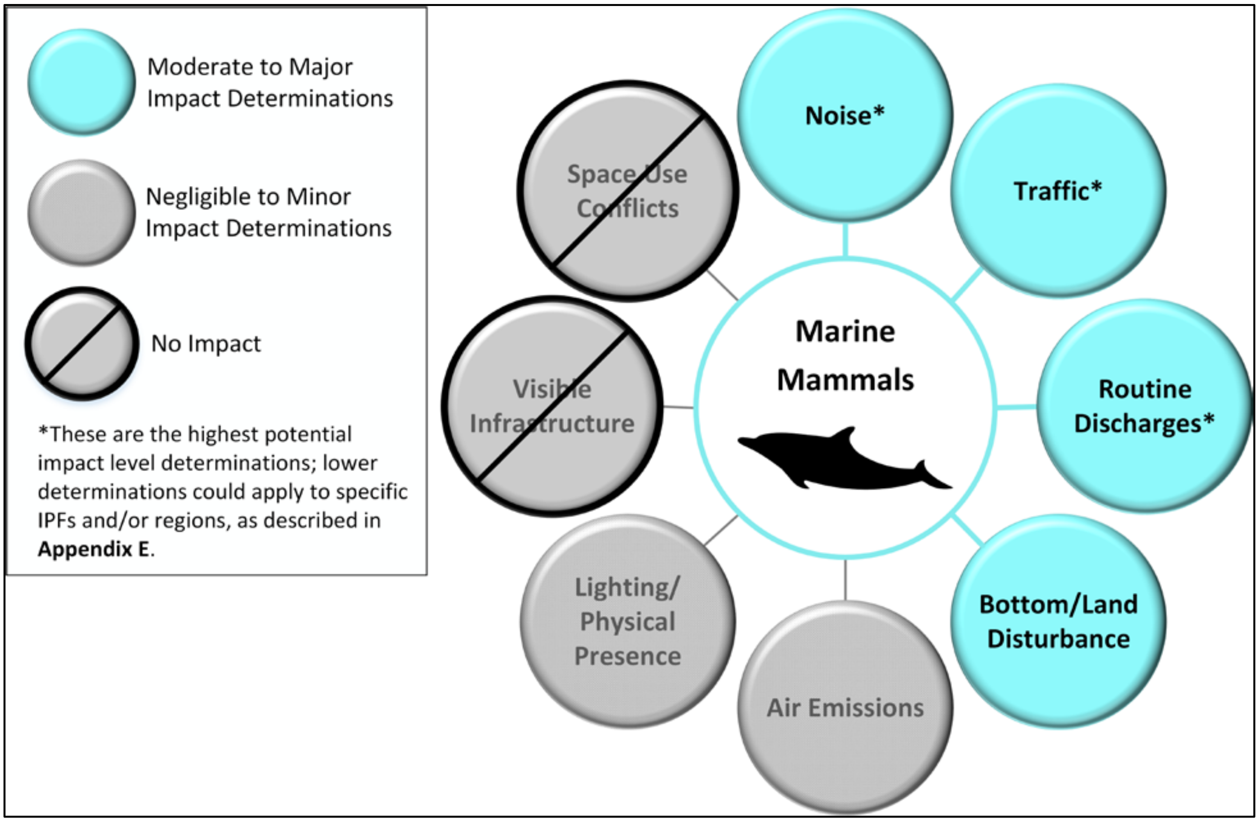


Figure 4.4.1-7. Impact-Producing Factors and Impact Determinations for Marine Mammals associated with Routine Activities

Noise

Overall, there is the potential for impacts on marine mammals from noise associated with activities under the Proposed Action. The potential for mortality or hearing loss is unlikely when the mitigation described in **Appendix I** is applied. There is greater potential for impacts such as masking and behavioral disruption given the lower noise intensity needed to cause these effects, the greater spatial scale at which these noise levels occur (compared to those that would result in hearing loss), and the decreased effectiveness of mitigation measures at these greater distances (**Appendix I**). In addition, it is largely unknown whether masking and behavioral disruption can, and at what levels, result in population-level effects. Research is underway by BOEM and others to study this aspect of the issue more closely.

As stated in **Section 1.4**, in conducting this analysis, the Programmatic EIS examines existing scientific evidence relevant to evaluating the reasonably foreseeable significant adverse impacts of oil and gas E&D activities on the human environment. BOEM has identified impacts from sound (including impacts from particle motion) as an area of incomplete or unavailable information. The subject matter experts that prepared the Programmatic EIS diligently searched for pertinent information, and BOEM's evaluation of such impacts is based on research methods and theory generally accepted in the scientific community. BOEM's subject matter experts acquired and used previously developed and newly available scientifically credible information, and, where gaps remained, exercised their best professional judgment to extrapolate baseline conditions and impact analyses using accepted methodologies based on credible information. At the programmatic stage, incomplete and unavailable information does not affect the ability of the decisionmaker to make an informed choice. Subsequent site- or project-specific analyses will allow for the incorporation of new research and additional evaluation of unavailable or incomplete information. For purposes of this Programmatic EIS, all impacts reasonably foreseeable at later stages of the oil and gas development process have been considered, and the characterization of impact magnitude and duration is supported by scientific evidence. Routine operations resulting in noise that could impact marine mammals include G&G surveys (including seismic surveys), icebreaking, platform construction, pile driving, anchoring, and platform removal. A more complete description of acoustics in general and seismic survey impacts can be found in **Appendix D**. Marine mammals that co-occur with heavy sea ice and ice-breaking activity could be impacted by noise, or their prey species could be disturbed. Some marine mammals would avoid ice-breakers while others could be drawn to take advantage of the temporary leads that are created.

Based on available information about potential effects from these sound sources, it is assumed that impacts on marine mammals from noise associated with routine operations would be **negligible** to **moderate** based on the source of noise (IPF), the location of the sound source, and the implementation and effectiveness of impact mitigation measures (**Appendix I**). Subsequent regional or site-specific analyses will consider the most recent science available at the time of the decision as well as additional mitigations to limit the potential for masking or behavioral disruption if needed (e.g., time-area closures, limiting activities in space and time).

Under the Proposed Action, as many as 950 platforms would be removed with explosive severance from the GOM Program Area, the vast majority of these (up to 850) from the Central Planning Area. Most of these removals would be limited to the continental shelf. Physical removal of structural components would generate noise that could disturb and displace marine mammals in proximity of the removal (MMS 2005). In 2006, NMFS issued a Biological Opinion to BOEM that included several conservation recommendations to minimize adverse effects on marine mammals from explosive removals of OCS structures, including limits on the type and size of explosives that can be used; the times when detonations can occur; requirements for the placement of explosives at a minimum depth of 15 m (49 ft) below the surface of the seafloor; and requirements for a monitoring plan that uses qualified observers to monitor the detonation area for protected species, including sea turtles and marine mammals, prior to and after each detonation. The monitoring plan also would specify that any detection of a protected species within the planned blast zone would, without exception, delay detonation of the explosive charges until the individual animals are cleared from the blast area. Implementation of these guidelines by BSEE for all explosive platform removals conducted under the Proposed Action would minimize the potential for physical injuries to marine mammals in the program area. Though monitoring for and clearing the blast area of marine mammals is an effective mitigation to reduce risk of injury, it is possible that marine mammals could still go undetected within the blast area and could still experience non-injurious or injurious disturbances from the detonations. Potential impacts on marine mammals under the Proposed Action are expected to be **negligible** to **moderate** because individuals who are not detected by observers could be exposed to noise over the established regulatory thresholds to prevent injury such as temporary or permanent threshold shifts. Although extremely unlikely, mortality could occur if an individual is too close to the explosive removal operations. Mortality of one or few individuals would be irreversible, but would only rise to a **moderate** impact because population-level impacts are not expected.

Traffic

Vessel traffic could disturb marine mammals, and collisions between moving vessels and marine mammals would result in injury or death of individuals. Impacts on marine mammals from aircraft traffic are largely limited to behavioral disturbances. Most reports of vessel collisions with marine mammals involve large whales, but collisions with smaller species also occur (van Waerebeek et al. 2007). Most severe and lethal whale injuries involved large ships at higher speeds (> 80 m [262 ft]). Vessel speed was found to be a significant factor for severe or lethal injuries, with 89 percent of the records involving vessels moving as speeds > 14 knots (kn) (16 mph). Seismic operations generally are conducted at speeds of 4 to 6 kn (4.6 to 7 mph), with a maximum speed < 8 kn (9 mph). Marine mammal species of concern for possible ship strikes include slow-moving cetacean species (e.g., North Pacific right whales) and deep-diving species resting on the surface (e.g., sperm whales, pygmy/dwarf sperm whales, beaked whales). The North Pacific right whale population is very small, making the loss of any individuals a major impact. However, this species is not likely to occur within the Alaska program areas. Under the Proposed Action, all authorizations for shipboard surveys would include guidance for vessel strike avoidance and use of PSOs for certain operations. In the unlikely event that a collision occurs, its impact would depend on the number of individuals and the population status of the species affected. Vessel strikes would result in **negligible** to **moderate** impacts on marine mammals. Although very unlikely, mortality of one or few individuals could occur and would be irreversible. This would only rise to a **moderate** impact because impacts on North Pacific right whales are not expected and for all other species, population-level impacts are not expected.

In the Alaska program areas, aircraft traffic is an important IPF for certain marine mammals. Aircraft could be used for crew transfers, ice surveys, supply transportation, or other purposes. Many flights could occur at low altitudes due to low cloud ceilings (for safety). Low-altitude flights could disturb pinnipeds, polar bears, or sea otters resting on ice, on barrier islands, or at coastal haul outs. In addition to energetic costs, pinnipeds such as walrus, which haul out in dense groups, risk being injured by trampling when large groups are disturbed and flee into the water. Calves are at higher risk, but juveniles and adults also could be injured or killed during disturbance events. The FAA requests that aircraft avoid walrus haul outs by prescribed distances. Aircraft associated with oil and gas operations are also required to avoid walrus haul outs by prescribed distances through MMPA authorizations, which minimizes the risk of these events. Onshore traffic associated with OCS infrastructure or the building of onshore infrastructure has the potential to disturb polar bears, seals, or walrus. Aircraft traffic would result in **negligible** to **moderate** impacts on pinnipeds, polar bears, and sea otters.

Bottom/Land Disturbance and Routine Discharges

Drilling debris, made up of cuttings and drilling muds, released during exploration drilling operations could cover benthic habitat, making it unavailable for some period of time. The depth of the well and the amount of area covered by cuttings would determine the length of time that it would take the habitat to be re-colonized. Benthic-feeding marine mammals (e.g., walrus, gray whales, bearded seals) could be displaced from foraging areas temporarily. Water quality and visibility could also be temporarily impacted, which could affect the ability of seals or some whale species to locate prey (primarily fish or invertebrates).

Without appropriate mitigation, some habitat loss, alteration, or restriction of access to a preferred habitat could occur in the Arctic or Cook Inlet. MMPA authorizations and ESA consultations are designed to eliminate or minimize the potential for these impacts. Careful timing of activities and siting of onshore and OCS infrastructure, particularly with regard to ESA-listed species, also decrease the likelihood or severity of potential impacts. Adverse modification of critical habitat could not legally be authorized under the ESA. The impact on marine mammals in most cases would be **negligible** to **moderate** because, although the area available for foraging is very large in comparison to the amount of habitat lost temporarily, if important foraging or resting areas were disturbed, the impact would be more severe (e.g., moderate).

4.4.1.7 Sea Turtles

IPFs associated with routine operations that could result in **negligible** to **moderate** impacts for sea turtles include noise and vessel traffic. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-8**. Impacts associated with noise and vessel traffic are discussed below. Impacts that are expected to be negligible to minor are identified and summarized in **Appendix E**. Oil spills are considered non-routine, accidental occurrences. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**.

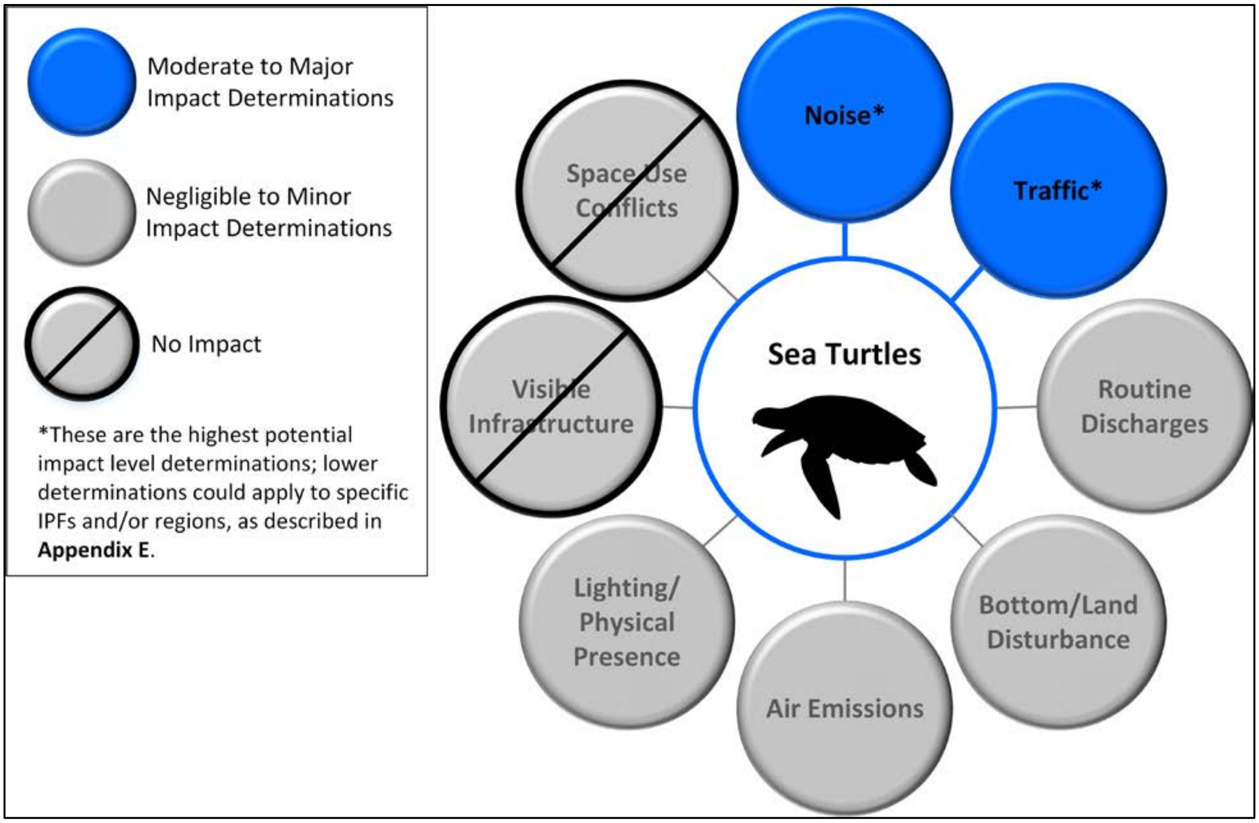


Figure 4.4.1-8. Impact-Producing Factors and Impact Determinations for Sea Turtles associated with Routine Activities

Noise

Sources of noise that are associated with routine operations within the GOM Program Area that could affect sea turtles include seismic surveys, vessels, aircraft, drilling, pipeline trenching, production activities, OCS construction, and decommissioning (explosive platform removal) of OCS structures. **Appendix D** provides a comprehensive discussion of sound in the marine environment. All of these sources are expected to have **negligible** to **minor** impacts (**Appendix E**) with the exception of seismic surveys and decommissioning activities, which are expected to have **negligible** to **moderate** noise-related impacts. Sea turtles are low-frequency specialists and the potential for noise impacts from these sound sources, as described in the ensuing text, is highly variable and depends on the specific circumstances.

Seismic Surveys

Seismic surveys would occur in open ocean areas where highly motile adult and subadult sea turtles move freely to avoid the relatively slow-moving sound sources and exposure to injurious sound levels, including levels that would affect behavior beyond aversion. Furthermore, the projected OCS surveys would be performed in a systematic fashion along pre-plotted transects, so it is presumed that exposure to elevated sound would be somewhat localized and short-term in duration, or regional in scale with lengthy periods of time between passages of the source vessel(s) on parallel transects near any given area. Consequently, it is reasonable to assume that adult and subadult sea turtles could and likely would avoid approaching seismic sound sources where received sound levels would possibly induce auditory injury (permanent threshold shift [PTS] injuries). Post-hatchling sea turtles generally reside at or near the sea surface and would be less likely to be injured by the sound field produced by an airgun array during a survey, due to the location of the airgun approximately 10 m (33 ft) below the surface, the downward focus of the seismic signal, and the rapid decay of waterborne seismic signals at the sea surface due to the "Lloyd mirror" effect (Urick 1983).

The range of potential effects on sea turtles from noise, in order of decreasing severity and modified slightly from the four zones initially outlined by Richardson et al. (1995), includes death; non-auditory physiological effects; auditory injury-hearing threshold shift; auditory masking; and stress and disturbance, including behavioral response. Given the predominant low-frequency sound sources, limited sound pressure levels (SPL) and durations, and directionality of higher-frequency sound sources associated with seismic activities, it is not likely that routine operations would generate sounds loud enough to cause direct mortality to sea turtles. Unlike marine mammals, criteria for the onset of auditory impairment have not been developed for sea turtles, mainly because of the few data that exist on sea turtle hearing. The current NMFS criterion for Level A harassment of cetaceans is a received SPL of 180 dB re 1 µPa (micropascals); although not explicitly referring to temporary thresholds shifts (TTS), this criterion is based on the potential for "overt behavioral, physiological, and hearing effects on marine mammals in general" (CSLC and MMS 1999, Popper et al. 2014).

TTS, by definition, is temporary and recoverable damage to hearing structures (sensory hair cells) that can vary in intensity and duration. In contrast, PTS results in the permanent though variable loss of hearing through the loss of sensory hair cells (Clark 1991). Auditory masking is defined as the obscuring of sounds of interest by other, stronger sounds, often at similar frequencies. Spectral, temporal, and spatial overlap between the masking noise and the sender/receiver determines the extent of interference; the greater the spectral and temporal overlap, the greater the potential for masking. Masking sounds can interfere with the acquisition of prey or mates, the avoidance of predators and, in the case of sea turtles, the identification of an appropriate nesting site (Nunny et al. 2008). Because sea turtles appear to be low-frequency specialists, the potential masking noises would fall mainly within the range of 50 to 1,000 Hz (e.g., airgun surveys). Disturbance can induce a variety of effects, including subtle changes in behavior, more conspicuous dramatic changes in activities, and displacement. Limited data exist on noise levels that induce behavioral changes in sea turtles (Moein et al. 1995, McCauley et al. 2000).

Overall, there is the potential for impacts on sea turtles from noise associated with activities under the Proposed Action. Existing mitigation protocols for airgun surveys (including ramp-up of airgun arrays, visual monitoring of an acoustic exclusion zone by PSOs, and start-up and shutdown requirements) would be implemented to reduce residual risk further (**Appendix I**). Although these measures are not assumed to be 100 percent effective, they are expected to substantially reduce the risk of impacts on sea turtles. Limitations to the effectiveness of mitigation measures are due to a variety of factors, including the physical conditions, the presence of animals at the surface, and difficulty in detecting individuals when they are on the surface (particularly subadults and juveniles – hatchlings are likely to be missed entirely).

There is greater potential for impacts to cause masking and behavioral disruption given the lower noise intensity needed for these effects to occur, the greater spatial scale at which these noise levels occur (as compared to those that would result in hearing loss), and the decreased effectiveness of mitigation measures (**Appendix I**) at greater distances. Furthermore, it is largely unknown whether masking and behavioral disruption can, and at what levels, result in population-level effects. Research is underway by BOEM and others to study this aspect of the issue more closely.

Based on available information about potential effects from these seismic sources and consideration of mitigation measures being applied, it is assumed that effects on sea turtles would be **negligible** to **moderate** because of the limitations to the effectiveness of existing mitigation measures, the risk of auditory masking and behavioral disruption, and all species of sea turtles impacted are currently listed under the ESA. Fully predicting the degree of effect is impossible at the programmatic scale considered here. It is therefore imperative that any subsequent regional or site-specific analyses consider the most recent science available at the time of the decision as well as additional mitigation measures to limit the potential for masking or behavioral disruption (e.g., time-area closures, limiting activities in space and time).

Decommissioning (Platform Removal, including Explosive Use)

Under the Proposed Action, platforms could be removed with explosives from the GOM Program Area, thus increasing the risk to sea turtles in the GOM. Most of the removals are limited to the continental shelf. Potential impacts on sea turtles from explosive removals of OCS structures include physical injury from detonations, including auditory PTS and other physical injuries, temporary auditory impairment (i.e., TTS), and physical disturbance. Physical removal of structure components would generate noise that could disturb and displace sea turtles in proximity of the removal (MMS 2005). In 2006, NMFS issued a Biological Opinion to BOEM that included several conservation recommendations to minimize adverse effects on sea turtles from explosive removals of OCS structures, including limits on the type and size of explosives that can be used; the times when detonations can occur; requirements for the placement of explosives at a minimum depth of 15 m (49 ft) below the surface of the seafloor; and requirements for a monitoring plan that uses qualified observers to monitor the detonation area for protected species, including sea turtles and marine mammals, prior to and after each detonation. The monitoring plan also would specify that any detection of a protected species within the planned blast zone would, without exception, delay detonation of the explosive charges until the individual animals are cleared from the blast area. The implementation of these guidelines by BSEE for all explosive platform removals conducted under the Proposed Action would minimize the potential for physical injuries to sea turtles in the program area. Though monitoring for and clearing the blast area of sea turtles is an effective mitigation to reduce risk of injury, it is possible that sea turtles could still go undetected within the blast area and would still experience non-injurious or injurious disturbances from the detonations. Potential impacts on sea turtles under the Proposed Action are expected to be **negligible** to **moderate** because of the possibility for undetected animals to be within the blast area at the time of detonation and all species of sea turtles impacted are currently listed under the ESA.

Vessel Traffic

Vessel traffic is anticipated in association with exploration, drilling, production, construction activities, and platform removal (decommissioning) and would occur primarily in waters of the continental shelf. Sea turtles spend at least 20 to 30 percent of their time at the surface for respiration, basking, feeding, orientation, and mating (Lutcavage et al. 1997), and they are vulnerable to collisions (ship strike) with moving vessels during this time. Any project-related vessel strike with a sea turtle is expected to result in the death of the sea turtle.

Survey vessels conducting exploration surveys are large in size, relatively slow moving, and would account for most of the proposed survey miles traveled; these surveys could occur throughout the GOM Program Area. Most exploration survey vessels remain in OCS waters during survey projects and receive supplies and fuel by supply vessels and helicopters. Survey areas could be extensive or localized. Though survey vessels generally work at slow speeds (4.5 kn), relatively smaller supply vessels move between shore bases and the survey vessels at higher speeds and could present a greater risk of striking surface-oriented sea turtles. However, no specific incidences of vessel collisions have been documented. Vessels supporting drilling and production as well as OCS construction operations are expected to operate at specific sites and move slowly when working at these sites; however, their transits to and from designated shore bases would be conducted at higher speeds.

Operators in the GOM are required to comply with Joint BOEM-BSEE NTL 2012-G01, which provides guidance for avoiding protected species and reporting any injured/dead protected species in the GOM region (**Appendix I**). Considering the relatively slow operational speeds of survey vessels, combined with the implementation of vessel strike avoidance measures during all operations and the required PSOs during the exploration survey, strikes from vessels are expected to be avoided during daylight hours. However, transiting vessels (e.g., to and from shore bases) are expected to travel at higher speeds and collisions could occur, especially at night and during periods of poor visibility and poor weather conditions. Though vessel strikes are expected to be a rare occurrence, potential impacts on sea turtles under the Proposed Action are expected to be **negligible** to **moderate** because sea turtles are still at risk of vessel collisions while implementing existing mitigations, any collisions are expected to result in injury or mortality, and all sea turtle species impacted are currently listed under the ESA.

4.4.1.8 Birds

As discussed in **Section 3.6**, through preliminary screening of the activities and affected resources, IPFs for birds are (1) noise; (2) traffic; (3) routine discharges including drilling mud/cuttings/debris; (4) bottom/land disturbance; (5) air emissions; (6) lighting/physical presence; and (7) non-routine events (**Table 3.6-3**). Based on impact screening of the activities and affected resources, the only IPFs for birds found to have impact determinations greater than minor are accidental spills and CDEs. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-9**. The impact discussions provided in **Appendix E** include federally listed threatened or endangered bird species because the routine operations potentially impacting these species are similar to that of non-listed species. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**. Impacts that are expected to be negligible to minor are identified and summarized in **Appendix E**.

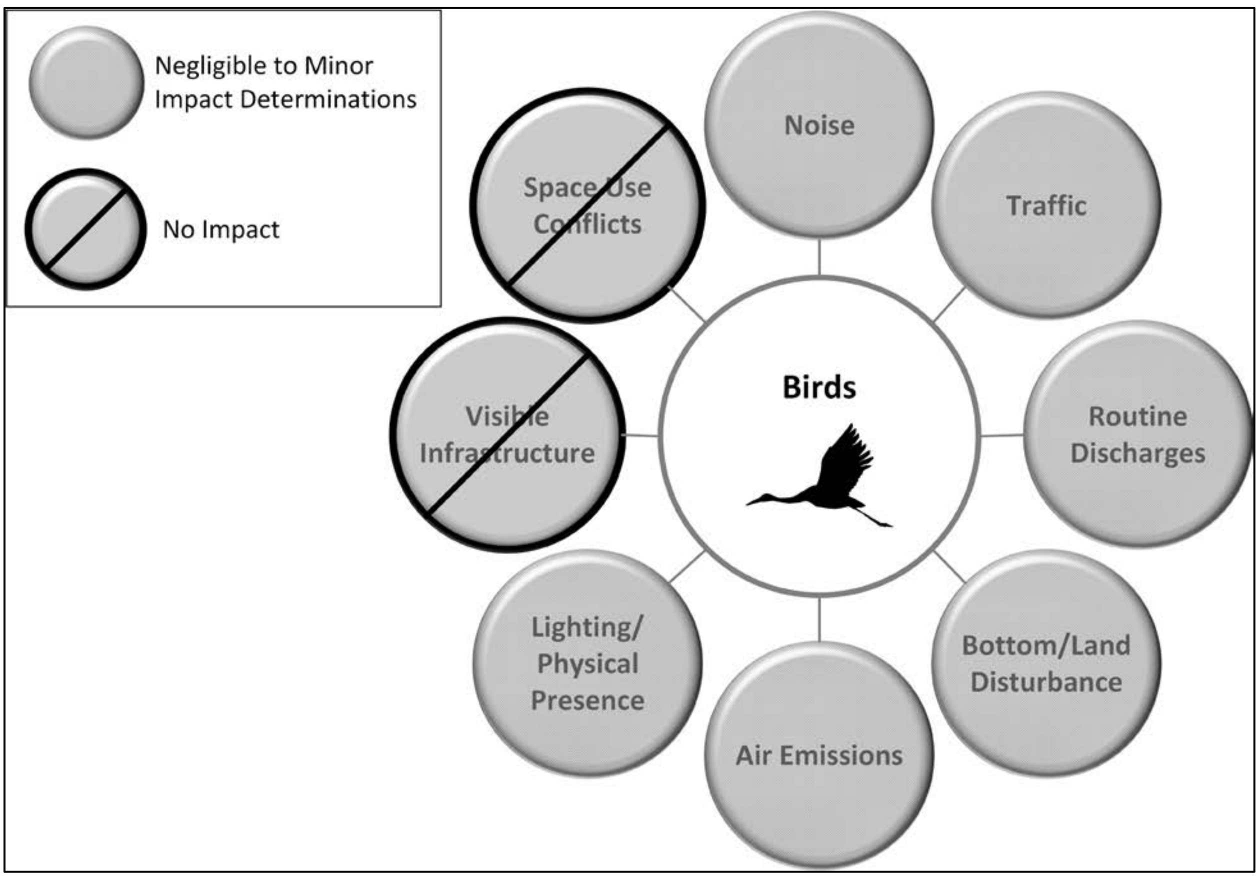


Figure 4.4.1-9. Impact-Producing Factors and Impact Determinations for Birds associated with Routine Activities

4.4.1.9 Fish and Essential Fish Habitat

The only IPF with the potential for **moderate** to **major** impacts on managed/listed species and EFH are oil spills, since they have the potential to impact a range of species and habitats. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-10**. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**. The other relevant IPFs considered (i.e., noise, routine discharges, bottom/land disturbance, and lighting/physical presence) are expected to cause negligible to minor impacts primarily due to the small number of fish impacted, which would not be expected to have noticeable population-level effects. Rationale for minor and negligible impacts is provided in **Appendix E**.

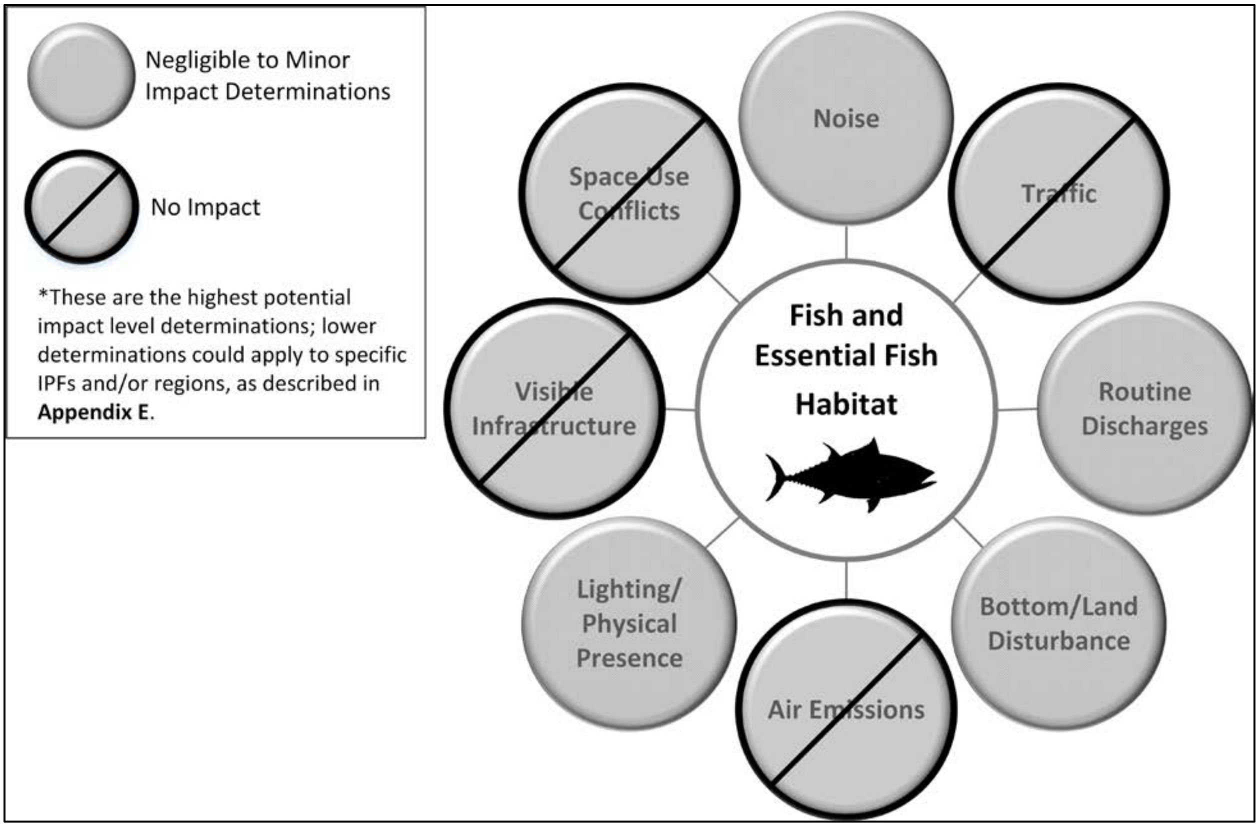


Figure 4.4.1-10. Impact-Producing Factors and Impact Determinations for Fish and Essential Fish Habitat associated with Routine Activities

4.4.1.10 Arctic Terrestrial Wildlife and Habitat

Through preliminary screening of the activities and affected resources, IPFs affecting terrestrial habitat and wildlife are (1) noise; (2) traffic; (3) bottom/land disturbance; (4) lighting/physical presence; (5) air emissions; and (6) accidental spills (**Table 3.6-1**). Based on impact screening of the activities and affected resources, the only IPFs for arctic terrestrial habitat and wildlife with impact determinations greater than minor are traffic, bottom/land disturbance, lighting/physical presence, and accidental spills and CDEs. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-11**. Oil spills are considered non-routine, accidental occurrences and could have minor to major impacts on terrestrial habitats and wildlife. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**. Impacts that are expected to be negligible to minor are identified and summarized in **Appendix E**.

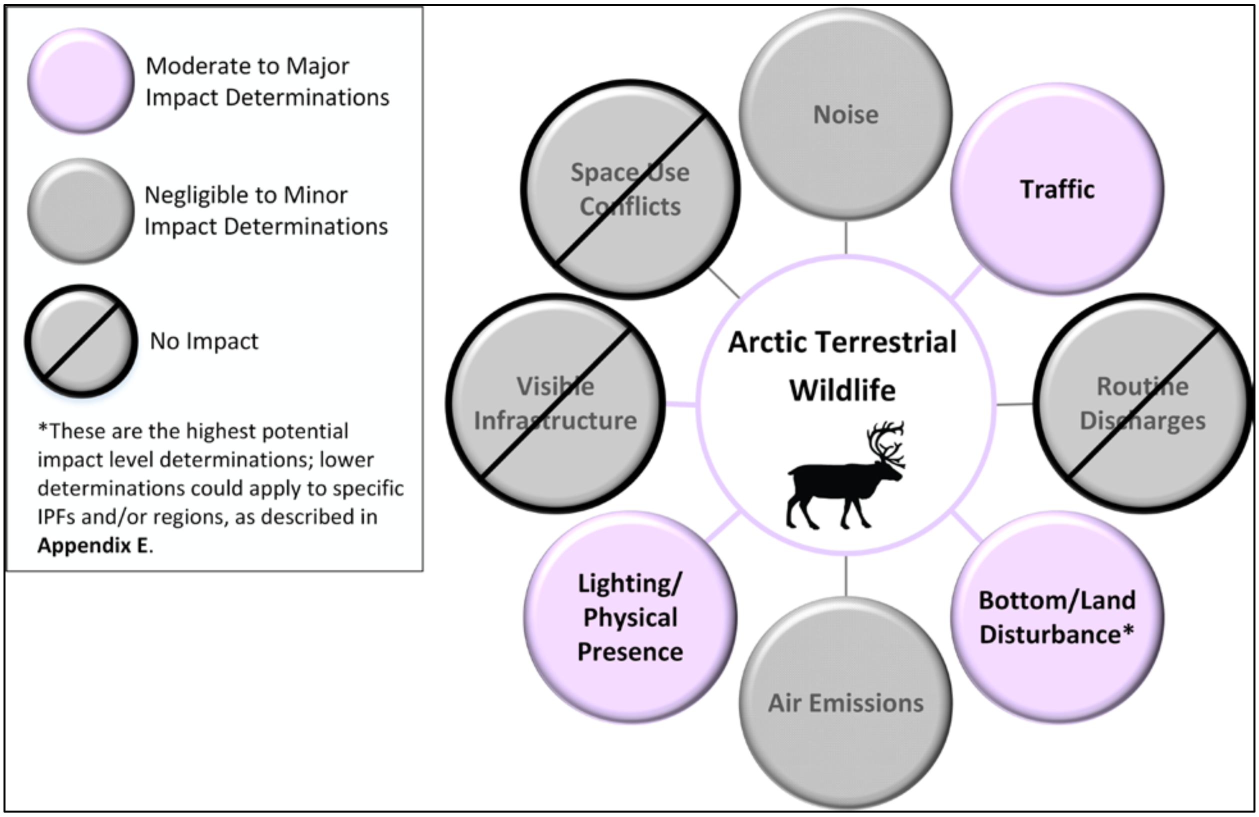


Figure 4.4.1-11. Impact-Producing Factors and Impact Determinations for Arctic Terrestrial Wildlife and Habitat associated with Routine Activities

Traffic

Caribou have been shown to exhibit panic or violent flight reactions to aircraft flying at elevations of 60 m (162 ft) or less and exhibit strong escape responses (animals trotting or running from aircraft) to aircraft flying at 150–300 m (500–1,000 ft) (Calef et al. 1976). These documented reactions of caribou were from aircraft that circled and repeatedly flew over caribou groups. Some of the aircraft traffic is likely to pass overhead of caribou intermittently, and the disturbance reactions of caribou with this sort of limited and periodic exposure are expected to have no effect on caribou herd distribution and abundance. The majority of flight paths would have aircraft flying from coastal communities to OCS operations using helicopters, with the potential for some marine mammal monitoring and marine mammal surveys using fixed-wing aircraft. Based on previous experience, there would be a limited number of flight routes over onshore coastal areas with rotary or fixed-wing aircraft that could affect terrestrial mammals. The ensuing effect of low-altitude flights on caribou in coastal areas would likely be **minor** (most common effect) to **moderate** (extreme incidents of disturbance) depending on the number of caribou affected and their reaction to aircraft operations. Effects on bull caribou in the program area could include escape reactions. Beyond the energetic losses individual animals would incur, greater effects would be unlikely for adult male caribou. If female caribou with calves or parturient caribou cows are disturbed, female caribou could become separated from the calves, or caribou fetuses could abort as a byproduct of in vitro stresses. Such death among caribou calves supports the analytical assumption of moderate effects. However, tolerance to aircraft, ground-vehicle traffic, and other human activities have been reported in studies of ungulate populations in North America (Brown et al. 2012).

Muskoxen cows and calves appear to be more sensitive (responsive) to helicopter traffic than males and groups without calves, and muskoxen in general are more sensitive to overflights by helicopter than by fixed-wing aircraft (Miller and Gunn 1979). A cow disturbed during the calving season could abandon her calf, if the calf is a day or two old (Lent 1970). However, muskoxen appear to habituate to helicopter flights above 500 ft (180 m), at least for a time (Miller and Gunn 1980). Groups of muskoxen responded less to fixed-wing flying over them during the summer, rutting season, and fall than during winter and calving periods (Miller and Gunn 1980).

Most onshore construction activities such as gravel mining, ice-road construction, and ice-road traffic are assumed to occur during the winter months when grizzly bears are denning. Grizzly bear use of earthen dens along riverbanks during winter months where gravel extraction occurs for the construction of gravel pads supporting OCS development could occur. This activity could displace a few bears from den sites. A study on the impact of vehicle traffic in northwestern Montana indicated that grizzly bears avoided habitat within 500 meters of the highway and made most their crossings at specific locations at night when vehicle traffic volume was low. Grizzly bears preferred to cross in locations that were relatively flat and closer to cover (Waller and Servheen 2005). Conversely, studies have suggested that oil development could have stabilized Arctic fox populations in developed areas due to increased food availability (BOEM 2011a, Stickney et al. 2014).

Vehicle collisions can occur throughout the year for caribou, muskoxen, and bears as well as other less common or smaller species. Because of vehicle collisions in the past and the likelihood that they would continue in the future, especially with an expanded road network into previously road-less areas, the overall effect on wildlife is **moderate**.

Bottom/Land Disturbance and Lighting/Physical Presence

Routine operations that would result in land disturbance and potentially affect terrestrial habitat and wildlife include onshore construction of roads, pipelines, ports construction facilities, processing facilities, airfields, and shorebases, which could result in the loss, alteration, and fragmentation of preferred habitat for terrestrial habitat and wildlife.

A recent study found that as the amount of infrastructure increased, high density calving of caribou shifted from the developed areas of Kuparak to inland areas with lower forage biomass (Cameron et al. 2005). Caribou were relatively unsuccessful at crossing roads in July and early August, especially when in large herds, when harassed by insects. Further, abundance and movements of female caribou were lower in developed areas near Prudhoe Bay. Abundant oil development infrastructure could have also caused female caribou to consume less forage during the calving period and experience a lower energy balance during the insect season compared to female caribou in disturbance-free conditions. This likely leads to poorer body condition and lower parturition rates for female caribou in developed areas compared to undeveloped areas (Cameron et al. 2005). Wolfe et al. (2000) summarized that caribou moved away from point sources of disturbance, increased activity and energy near disturbance, delayed or failed to cross linear structures, shift away from extensive and intensive development, and were killed by collisions with vehicles and by hunting along roads, and that cows and calves were the most easily disturbed.

Smith and Cameron (1985) documented caribou responses to pipelines and found that the numbers varied greatly between two study years. Caribou adopted a variety of strategies for crossing the pipeline. Some eventually crossed beneath elevated sections of the pipeline, some crossed buried sections of the pipeline, some paralleled the pipeline and did not cross, and some left the main group and could not be accounted for. Although most crossings occurred where roads and pipelines intersected with lakes, the highest crossing success was at a section of buried pipeline isolated from road traffic.

Construction of onshore facilities in the Chukchi Sea Program Area for shorebases, temporary and permanent roads, pipelines, and expansion of existing and development of new fill material sources could result in **moderate**, direct impacts from bottom/land disturbance and physical presence of infrastructure, mostly in wetland areas because of the extensive nature of wetlands in the ACP, even far inland towards the foothills. Up to several hundred acres of wetland habitat could be impacted by shorebases and roads, while up to several thousand acres of wetland habitat could be impacted by pipeline construction. The resultant loss and fragmentation of terrestrial habitats could be permanent.

Indirect impacts could occur from dust, oil spills, and fire. Onshore oil spills can be contained and cleaned up easier than offshore spills because of visual identification and access. While indirect dust impacts could be ongoing where roads are not paved, recovery from winter construction compaction, oil spills, and fire would be variable. For example, vascular vegetation would be impacted for 5-6 years and lichens could be impacted for several decades from fire (Jandt et al. 2008). The physical presence of onshore infrastructure could cause animals to expend additional energy by altering movement patterns and altering foraging for caribou in a large area that has no oil and gas infrastructure (Fancy 1983). The degree to which these impacts would occur depends largely on the location of infrastructure and pipelines, which are currently unknown. It is likely that a more northern pipeline route would reduce impacts on the WAH compared to a route originating from the southern end of the Chukchi Sea Program Area since it would cross a much smaller area to connect to TAPS, but the effects would not be enough to reduce the impact determination level from moderate.

4.4.1.11 Archaeological and Historical Resources

An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-12**. At the programmatic level, the only IPFs with the potential for **moderate** or **major** impacts on archaeological and historical resources are bottom/land disturbance and non-routine events. A discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**. Impacts that are expected to be negligible or minor are identified and summarized in **Appendix E**.

The nature of direct and indirect effects is shown in **Figure 4.4.1-13**. Direct impacts on archaeological sites generally occur when there is an activity that affects the seafloor in which a site is embedded. Direct impacts from oil and gas activities can include anchoring impacts, associated anchoring line (cables and chains) and tackle, bore holes, nodal emplacement, oiling from accidental spills, visual impacts, pipeline construction, and the construction of artificial islands (Arctic, Beaufort Sea). Indirect impacts can include scour related to a structure or pipeline installation, anchoring and site access activities related to oil spill cleanup, and looting from the release of site location data gathered during oil and gas exploration.

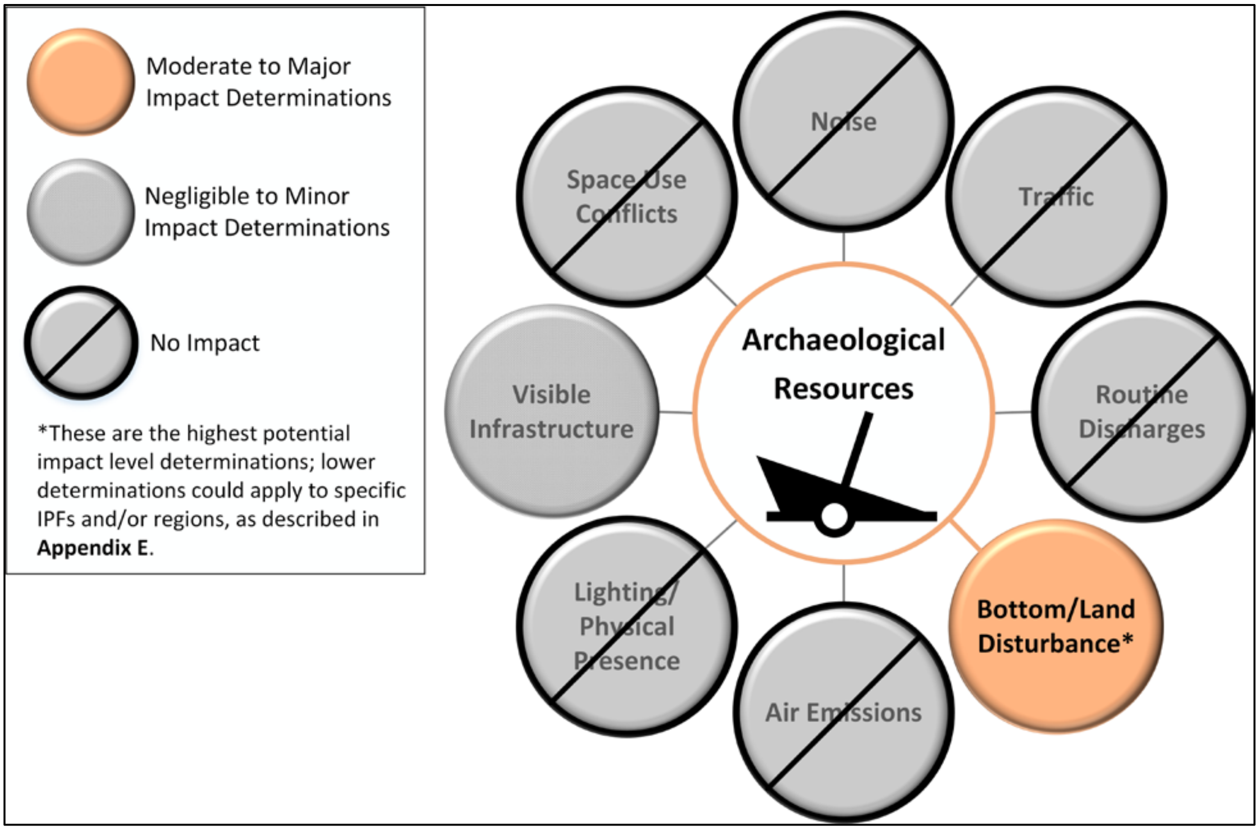


Figure 4.4.1-12. Impact-Producing Factors and Impact Determinations for Archaeological and Historical Resources associated with Routine Activities

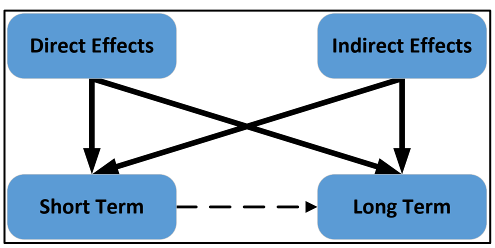


Figure 4.3.1-13. Relationship between Direct and Indirect Effects

Direct and indirect effects can be short- or long-term in nature. With archaeological sites, there is a complex relationship between short-term, direct impacts and the resultant long-term effects. For example, if an anchor cable cuts through a shipwreck, there is a direct impact on the site resulting in the loss of cultural information. If the site is not properly stabilized, its disturbance can open new areas of a site that had previously reached an equilibrium with the environment, which then results in rapid change to that part of the site and additional loss of cultural information over the long-term until the site reaches a new state of equilibrium (**Figure 4.3.11-1**). Additional damage can occur from storm events acting on the exposed sections of a site, which might have been structurally weakened from the anchoring impact.

Another example relates to the accidental oiling of a shipwreck site. Most shipwrecks serve as habitats and are quickly colonized by a range of marine organisms. As part of the site-formation process, an equilibrium is reached with the environment, which includes marine growth that could provide some protection for the wreck from natural processes (**Figure 4.3.11-1**). If an accidental oil spill impacts a site, some of the marine organisms that have colonized the surface of the wreck would be killed, thereby changing the environmental conditions and associated biological activity at the site due to the addition of hydrocarbon-rich oil. This could accelerate microbial activity on the site of wooden shipwrecks, accelerating deterioration of any remaining wooden structure. These processes are not well understood, and BOEM is undertaking a study to understand the impacts on wooden and metal shipwrecks from oil spills in the GOM (MBAC 2015).

BOEM's current regulations give discretion to the Regional Director as to whether an archaeological survey will be required for a specific lease block. Where archaeological surveys are required and are conducted in compliance with BOEM survey standards prior to oil and gas activities on the OCS, the majority of potential archaeological sites can be located and mitigation strategies developed to avoid any adverse impacts. The nature of OCS oil and gas E&D activities makes it relatively easy to avoid potential archaeological resources on the OCS identified as a result of archaeological surveys; however, without the data obtained through archaeological surveys, BOEM cannot determine whether a resource is present within a lease and whether it might be impacted through development. The magnitude of potential anchoring, drilling, and decommissioning impacts would be considered **moderate** to **major** if they were to occur on an archaeological site; in some cases, the impacts would not even be realized without a post-activity seafloor survey. If an archaeological survey is done to BOEM standards prior to the approval of any bottom/land disturbance, avoidance mitigation would be put in place for any potential archaeological or historical resource discovered during the survey and impacts would be **negligible** to **minor**.

4.4.1.12 Population, Employment, and Income

Impacts on population, employment, and income are not the result of single IPFs related to routine operations, but rather are the result of the full range of direct and indirect industry activities that are expected to take place as a result of the Proposed Action. These include all activities associated with the full lifecycle of OCS development projects (i.e., exploration through decommissioning) as projected in BOEM's E&D scenarios. The low- and high-price scenarios described in **Section 3.2** are direct inputs to BOEM's regional economic impact models, collectively for different regions referred to as MAG-PLAN.[3] BOEM uses regional MAG-PLAN models to estimate the levels of economic activities needed to support OCS oil and gas exploration, development, and production. Because of the wide range of projected activities in BOEM's low- and high-price scenarios, regional MAG-PLAN models also forecast a wide range of potential economic impacts.

The increases in employment and income anticipated to result from the activities associated with the Proposed Action are likely to be viewed favorably by most affected communities. Increases in population can have both positive and negative impacts. If local employment and associated population rise substantially over a sustained period, there is the potential for strains on public infrastructure and services. However, the nature of oil and gas employment are such that the MAG-PLAN employment estimates do not always translate directly to the number of new workers needed in local communities (i.e., some represent the continuation of existing jobs as previous projects are completed and are in effect not "new," some would be "new" but filled by long-distance commuters,[4] and some would represent "new" part-time jobs but in effect result in more work hours for already employed workers). These characteristics of

[3] There are different regional versions of the model, including MAG-PLAN Alaska (BOEM 2011b) and MAG-PLAN GOM (BOEM 2012c, BOEM 2016k), which were used to support the Final Programmatic EIS analyses. They share a consistent approach but are tailored to the characteristics of each region, including operating climate and conditions, extent of OCS oil and gas development and supporting infrastructure, onshore demographics, etc.
[4] Those jobs most closely associated with exploration, development, and production typically require 12-hour shifts for a week or more at a time, followed by a similar period off-duty, so many workers and their families do not need to move near the location to which they report for duty.

industry employment weaken the traditional positive relationship between employment growth and local population growth.

Overall socioeconomic impacts depend on future activity levels. If oil and gas development activity levels are consistently very high, employment and labor income impacts would likely be toward the high end of the range. The greater the employment increases, the more likely that population would increase as well. Possible adverse implications from rapid population increases, particularly in remote areas, can include strains on public infrastructure such as local housing, roads, schools, emergency response facilities, and utilities. The next section presents information regarding the regional economic impacts of these routine OCS oil and gas activities. For more information on national costs and benefits, as well as on fiscal and other impacts, see the Net Benefits Analysis in Chapter 5 and Equitable Sharing Considerations in Chapter 8 of the *2017-2022 Outer Continental Shelf Oil and Gas Leasing Proposed Final Program*, published concurrently with this Programmatic EIS.

Oil spills are considered non-routine, accidental occurrences and could have negative impacts on local and state population, employment, and labor income. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**.

Arctic OCS: Introduction

Most jobs resulting from the activities associated with the Proposed Action for the Arctic OCS would likely be filled by people living outside the NSB, which is the local jurisdiction adjacent to both the Beaufort and Chukchi Seas. Nonresidents accounted for 35 percent of those working in Alaska's oil and gas industry in 2014 (ADLWD 2016),[5] and this figure does not include the high proportion of residents commuting long distances from other parts of the state. For Arctic OCS operations, most exploration, development, and production workers would fly in, stay in enclaves[6] for their 2-week rotations, and then fly back home when their rotations were finished. Employment of NSB residents is likely to be almost exclusively of two kinds: working for firms that provide industry support services (e.g., construction, professional and technical services, transportation, retail/wholesale, and utilities) and working in government, which is the primary employer in the NSB. Local government's status as a major local employer is solely due to the revenues it receives from the oil and gas industry. As discussed above, the nature of OCS oil- and gas-related employment is such that a very high percentage of "new" employment would likely be filled by non-resident commuters or increased hours for local residents rather than by new residents moving into the NSB for work. Therefore, while local employment and income impacts would occur in the NSB and would be important to residents, most impacts on population, employment, and income would occur in south-central Alaska or out of the state.

Oil production and overall industry spending would provide important benefits for the NSB and the State of Alaska. Revenues from taxes on onshore support infrastructure, Federal 8(g) revenue sharing (from leases within 4.8 km [3 mi] of state waters), [7] and dividends from investments in petroleum service companies are important to the state and local governments, native corporations, and individual citizens. For example, oil and gas revenues represent approximately 90 percent of Alaska's general fund unrestricted revenues (ADLWD 2016), and oil and gas property taxes provide more than 95 percent of property tax revenues—about $35,000 per capita—for the North Slope Borough (ADCCED 2016a). Depending on timing, oil prices, and other factors, new OCS production to partially offset continued

[5] This includes only workers reported under the oil and gas industry, and is indicative of employment for work on North Slope projects, which provide most of the state's oil and gas production activity.
[6] Oil and gas companies operating on the North Slope negotiate with local communities to use enclave development and other measures to reduce local impacts. Future OCS activities are highly likely to involve similar discussions in the planning process.
[7] Given the distance of the program area from shore, 8(g) revenue sharing—listed as a source of revenue accompanying Beaufort Sea leasing—would not apply to Chukchi Sea acreage.

decline in Prudhoe Bay and other North Slope production areas could help extend the viability of TAPS at some point in the future, which would allow jurisdictions adjacent to the Arctic subregion to retain vital revenue sources from onshore facilities associated with continued OCS and onshore production.

Beaufort Sea Program Area

The activities associated with the Proposed Action are expected to increase employment and labor income in Alaska. For the Beaufort Sea Program Area low-price scenario, there are exploration activities but no commercial discoveries or production. Under BOEM's low-price scenario, employment projections only include those jobs that could result from exploration activities. Therefore, the range of employment and income that might result from the activities associated with the Proposed Action is wide. MAG-PLAN Alaska estimates that the Proposed Action is likely to generate an annual average of approximately 520 jobs over a period of about 15 years under the low-price, exploration-only scenario and up to 23,000 total jobs in Alaska over several decades under the high-price, high-development scenario.[8] The associated annual labor income would average between $10 million and $1.3 billion.

The population impacts from routine activities are expected to be **negligible** under the low-price scenario to possibly **moderate** under a high sustained activity scenario due to the nature of OCS oil and gas related employment. Impacts on income and associated government revenues for the NSB and the state as a whole could range from **negligible** in the low-price scenario to **moderate** in the case of a sustained level of high OCS development similar to that in the high-price scenario.

Chukchi Sea Program Area

The activities associated with the Proposed Action are expected to increase employment and labor income in Alaska. One exception would be during an early infrastructure construction phase resulting from commercial discoveries.[9] This phase could require construction of temporary or permanent worker enclaves and related infrastructure and might result in disruptions in nearby communities, such as strains on public services and infrastructure, occurring along with the positive impacts of both employment opportunities and new sources of tax revenues (see above). There would be important employment and income benefits for NSB residents (and possibly for residents of the nearby NWAB), but most impacts on population, employment, and income would occur in south-central Alaska or out of the state.

As for the Beaufort Sea, commercial discoveries and production from the Chukchi Sea are unlikely in the low-price scenario, but BOEM has analyzed impacts that could result from exploration-only activities in its low-price scenario. The range of employment and income that might result from the activities associated with the Proposed Action therefore is wide. This is consistent with the uncertainty for areas like the Arctic program areas.

MAG-PLAN Alaska estimates that the activities associated with the Proposed Action are anticipated to generate an annual average of approximately 200 jobs over several years under the low-price, exploration-only and up to 9,300 jobs in Alaska over several decades under the high-price scenario.[10] The associated labor income would range between $3 and $535 million per year.

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[8] These include additional direct, indirect, and induced jobs—those created by lessees, contractors, support industries, and worker households. A large proportion of the employment and income impacts would occur in a variety of support industries; therefore, MAG-PLAN does not confine its estimates solely to results that would be reported under the oil and gas sector in standard employment statistics.

[9] There is already existing infrastructure to support production onshore and in state waters adjacent to the Beaufort Sea and Cook Inlet Program Areas. Additional infrastructure requirements to support production in the Chukchi Sea are described in **Section 4.3.13.1**.

[10] These include additional direct, indirect, and induced jobs—those created by lessees, contractors, support industries, and worker households. A large proportion of the employment and income impacts would occur in a

The population impacts from routine activities are expected to be **negligible** under the low-price scenario to possibly **moderate** under a high, sustained activity scenario due to the nature of OCS oil and gas related employment.

Impacts on income and associated government revenues for the NSB and the state as a whole could range from **negligible** in the low-price scenario to **moderate** in the case of a sustained level of high OCS development similar to that in the high-price scenario.

Cook Inlet Program Area

The activities associated with the Proposed Action are expected to increase employment and labor income in Alaska. MAG-PLAN Alaska estimates that the activities associated with the Proposed Action are likely to generate an annual average of 1,200 to 4,580 new jobs with an associated labor income of $65 to $265 million annually over a few decades.

There is a large existing oil and gas workforce living in the KPB, so it is likely that many workers would commute to work sites from nearby communities and that many others would commute from Alaska's larger population centers or from outside the state. Therefore, the population impacts on the KPB from routine activities are expected to be minor in the low-price scenario to moderate in the case of a sustained level of high OCS development similar to that in the high-price scenario. For the state as a whole, the impacts are expected to be **negligible to minor**.

Oil production and overall industry spending would provide important benefits for the KPB in the form of tax revenues to the state, Federal 8(g) revenue sharing (from leases within 4.8 km [3 mi] of state waters), and other factors. Impacts on income and associated Government revenues for the KPB could range from minor in the low-price scenario to moderate in the case of a sustained level of very strong OCS development similar to the high-price scenario. For the state as a whole, the impacts are likely to be **negligible** to **minor**.

Gulf of Mexico Program Area

Because of the historically well-developed support industries for oil and gas activities along and near the Gulf coast, the employment and labor income generated by the activities associated with the Proposed Action would primarily sustain activity levels rather than create a new influx of workers and income. However, high levels of OCS oil and gas development would cause more new job creation. BOEM uses the MAG-PLAN GOM model to estimate levels of economic activities likely to result from OCS oil and gas exploration, development, and production. Because of the wide range of projected activities in BOEM's low- and high-price scenarios, MAG-PLAN GOM also forecasts a wide range of potential economic impacts. BOEM estimates that the activities associated with the Proposed Action in the GOM would create or save an average of approximately 8,600 to 48,000 jobs annually, with an associated labor income of $520 million to $2.9 billion. The economic impacts would peak 10 to 20 years into the program at levels of 36,000 to 139,000 jobs and $2.2 to $8.4 billion in labor income. The impacts on population would be approximately proportional to the impacts from new employment. These population impacts would be **negligible** to **minor** because the Proposed Action largely would maintain the status quo in terms of jobs and revenue, although there could be some strains on public services and infrastructure. MAG-PLAN GOM estimates that 30 to 40 percent of the impacts on population, employment, and labor income would occur in Texas; 20 to 30 percent would occur in Louisiana; 5 to 10 percent would occur in Mississippi and Alabama each; up to 5 percent would occur in Florida; and 15 to 25 percent would occur in the rest of the U.S. The exact percentages would depend on the types and locations of OCS activities that would arise.

variety of support industries; therefore, MAG-PLAN does not confine its estimates solely to results that would be reported under the oil and gas sector in standard employment statistics.

The activities associated with the Proposed Action would generate Government revenues through bonus bids, rental payments, and royalty payments. The activities associated with the Proposed Action in the GOM are expected to generate average annual Federal revenues of approximately $400 million in a very low-price environment to as much as $4 billion per year in a very high-price environment. If it is assumed that OCS revenues would be spent in approximately the same proportions as overall Federal spending, the revenue impacts of OCS activities would not be overly concentrated along the Gulf coast. In addition, modest additional portions of OCS revenues have been allocated to Gulf states, including 8(g) revenues (from leases within 4.8 km [3 mi] of state waters) and revenue sharing arising from the Gulf of Mexico Energy Security Act (GOMESA) of 2006. The latter will increase for Gulf states other than Florida in 2017. Increased Government revenues would have positive impacts on population, employment, and income due to direct Government employment or through the spending of these revenues on goods and services. The activities associated with the Proposed Action also would support local tax bases, corporate profits, and the functioning of energy markets, which would positively impact population, employment, and income.

4.4.1.13 Land Use and Infrastructure

The development of oil and gas facilities within the Arctic, Cook Inlet, and the GOM would have direct and indirect impacts on existing land use, future development patterns, and infrastructure. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-14**. Potential impacts of routine activities from implementing the Proposed Action are analyzed by IPF in each program area where the impacts are expected to be moderate; impacts from the Proposed Action that would be negligible or minor are discussed in **Appendix E**. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**. In general, the nature and magnitude of impacts on land use and infrastructure would depend on the level and location of new construction, the degree to which the area is already developed, and, in the case of accidental spills or a CDE, the size and location of the spill. Minor to moderate impacts imply that that the existing land use and infrastructure would likely be able to accommodate new leases. Land use changes would be potentially needed only in frontier areas where new oil and gas facilities would be constructed, and in areas possibly requiring new transportation networks.

Beaufort Sea and Chukchi Sea Program Areas

Proposed oil and gas production within the Arctic has the potential to impact land uses within and around the Chukchi Sea and Beaufort Sea Program Areas. As described in **Appendix C**, Section 14.0, a majority of the oil and gas supporting infrastructure is closer to the Beaufort Sea Program Area than the Chukchi Sea Program Area due to operations around Prudhoe Bay and Deadhorse. It is anticipated that any new OCS oil and gas leasing in the Arctic would rely heavily on the existing oil transportation system and network of oil and gas infrastructure adjacent to the Beaufort Sea Program Area, but new infrastructure would still be required to bring oil to market as described in the E&D scenarios for both program areas.

The E&D scenario for the Beaufort Sea Program Area (**Table 3.2-2**) anticipates oil production to range from 0 to 3.7 Bbbl and 0 to 6.4 trillion cubic feet (tcf) for gas. It is anticipated that the area could have activities supporting 25 to 90 exploration and delineation wells, 0 to 1,840 development and production wells, 0 to 25 platforms/structures, 0 to 660 km [0 to 410 mi] of offshore pipeline for oil, 0 to 660 km [0 to 410 mi] of offshore pipeline for gas, 0 to 16 km [0 to 10 mi] of onshore pipeline, and 0 to 10 new pipeline landfalls.

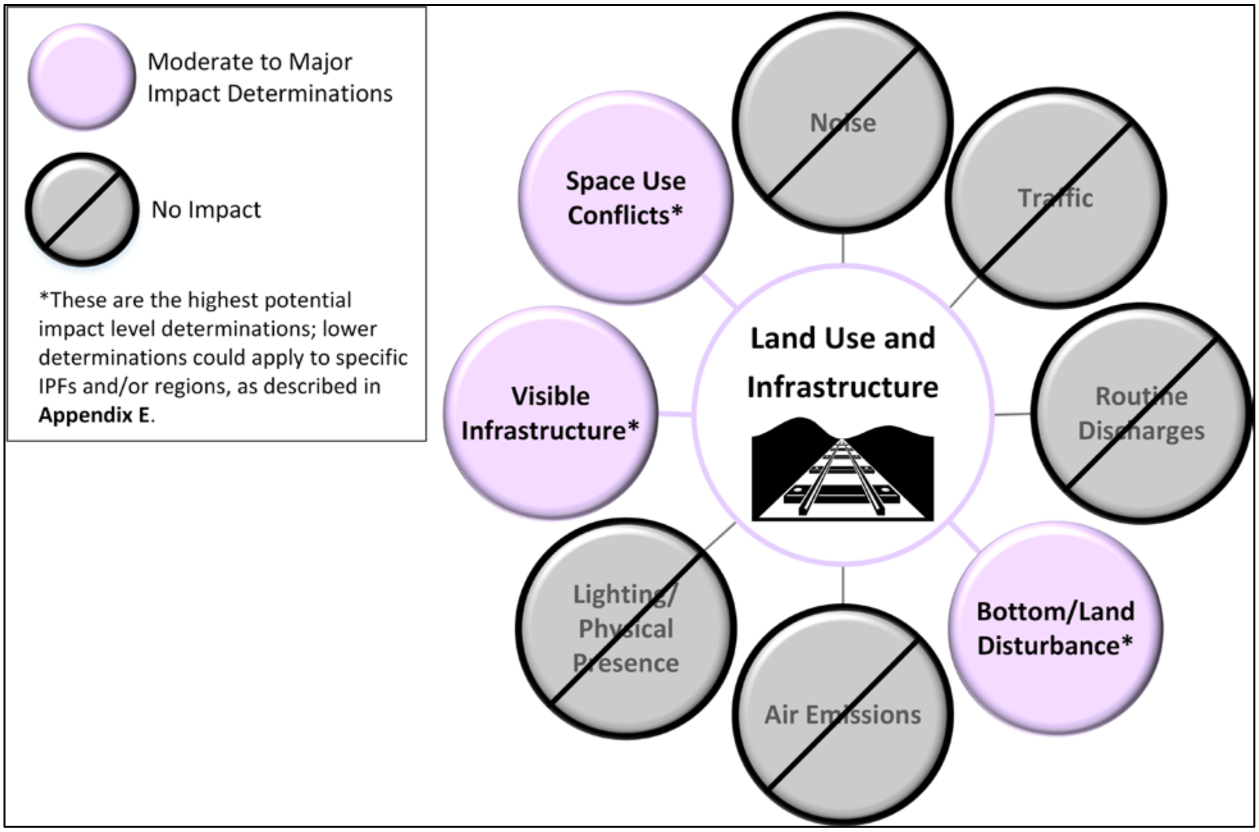


Figure 4.4.1-14. Impact-Producing Factors and Impact Determinations for Land Use and Infrastructure associated with Routine Activities

The E&D scenario for the Chukchi Sea Program Area (**Table 3.2-3**) anticipates oil production to range from 0 to 4.2 Bbbl and 0 to 1.8 tcf for gas. It is anticipated that the area could have activities supporting 4 to 30 exploration and delineation wells, 0 to 565 development and production wells, 0 to 7 platforms/structures, 0 to 306 km[0 to 190 mi] of offshore pipeline, 0 to 483 km[0 to 300 mi] of onshore pipeline for oil, 0 to 483 km [0 to 300 mi] of onshore pipeline for gas, and 0 to 2 new pipeline landfalls. These infrastructure needs would likely impact future land use, development patterns, and infrastructure.

Bottom/Land Disturbance

The physical presence of onshore oil and gas support facilities and a pipeline infrastructure within portions of the Arctic region would represent an initial industrialization in certain areas. In many cases, this change in land use and specific zoning requirements would result in the modification of an often pristine environment to one that supports oil and gas infrastructure. While the development of new technologies and practices tend to be less damaging to the environment than those associated with past activities, the addition of these facilities have the potential to permanently alter land uses within the region. As described in **Section 4.3.16**, villages and other North Slope communities rely on subsistence resources for their traditional way of life. As such, modification of land uses within areas not already used for oil and gas activities could impact these subsistence communities and the ecosystems on which these communities depend. For example, ancillary exploration, production, and development activities have the potential to result in increased levels of trash or marine debris, all of which would be deleterious to local wildlife or inhibit the intended use of a property from land users. Impacts on wildlife from ancillary activities are further discussed in **Section 4.4.1.10**.

At the same time, there are some benefits that could be realized from new construction, including increased access to temporary and permanent roads that would aid in connecting North Slope communities. This would allow greater access to healthcare services, community centers, and commercial and residential development. Impacts regarding subsistence activities and Tribal communities are further discussed in **Sections 4.4.1.16**. The activities associated with the Proposed Action would require significant investment within and adjacent to the Beaufort Sea and Chukchi Sea Program Areas to construct OCS platforms, wells, pipelines, and other onshore support facilities. Compared to the Chukchi Sea Program Area, the Beaufort Sea Program Area has an existing network of onshore oil and gas infrastructure and a transportation system for oil. As such, it is anticipated that impacts on nearby land uses would be decreased, but any new development in the Arctic will be evaluated at a project-specific level and subject to all applicable local, state, and Federal regulations.

Under the Proposed Action, it is anticipated that any exploration, development, production, and decommissioning activities in the Beaufort Sea Program Area would use the relatively well-developed oil and gas infrastructure in Prudhoe Bay. It is anticipated that oil produced from leases issued in the Beaufort Sea Program Area would tie into the TAPS and be brought to market. Additional construction of new oil and gas infrastructure in the immediate area would likely represent a continuation of industrial and commercial activity. Unlike the Beaufort Sea, the Chukchi Sea does not have an existing transportation system for oil. Because there is currently no development or production in the Chukchi Sea Program Area, construction of a transportation system and the associated supporting nearshore infrastructure would constitute new development and a subsequent change in land use. Since the TAPS is approximately 483 km (300 mi) east of a potential Chukchi Sea landfall, bringing to market produced oil from the Chukchi Sea Program Area would require construction of an overland pipeline that would traverse the NPR-A to Prudhoe Bay. This could represent a considerable change in land use because only a small portion of the NPR-A currently supports oil production. Additionally, a pipeline does not exist to transport gas produced from the Chukchi Sea or Beaufort Sea Program Areas. It is expected that gas produced from these areas would be reinjected and used for enhanced oil recovery until a gas transportation system becomes available. If a gas transportation network is constructed in the future, it would likely consist of an overland pipeline connecting the Chukchi Sea Program Area to Prudhoe Bay, and another gas transportation system extending from Prudhoe Bay to southern Alaska.

Due to the remote and pristine landscapes associated with the Arctic, construction of oil and gas support facilities could result in considerable impacts on local land uses. These activities would be subject to local, state, and/or other Federal permitting and regulations, including provisions for the siting of facilities. Specific timelines and requirements would vary by location, because BOEM is typically not the permitting or regulatory agency for development activities that occur onshore. However, the extent of the impacts associated with these activities could be considered **moderate** and would depend on the specific location within the Arctic and the particular community in which the facilities would be placed.

Visible Infrastructure

In the Arctic, the addition oil and gas infrastructure would contribute to the development of an industrial landscape in certain parts of the North Slope. While some of these areas currently support exploration, development, and production activities, a majority of the Arctic maintains its original landscape, which is characterized by rolling hills and tundra. **Table 3.2-2** summarizes the E&D scenario for the Beaufort Sea Program Area, recognizing that existing infrastructure, including airfields, docks, and storage and processing facilities, would decrease the need for new development. However, visible infrastructure such as new platforms, artificial gravel islands, offshore pipelines, and short onshore tie-ins are expected to be necessary for hydrocarbon development. Similarly, the E&D scenario for the Chukchi Sea Program Area (**Table 3.2-3**) would require the development of new infrastructure because the nearby area has not been designated or developed for oil and gas activity. For both the Beaufort Sea and Chukchi Sea Program Areas, impacts from OCS visible infrastructure would consist of potential flaring on platforms and special-use lighting associated with increased vessel traffic and for navigation. Because drilling and shipping typically take place 24-hours per day, light pollution from these and other ancillary activities during hours of peak darkness could impact viewsheds. It is anticipated that some of these impacts from visible infrastructure would be reduced in areas like the Chukchi Sea Program Area, given the 25-mile Presidential Withdrawal from leasing, but a majority of the region is not accustomed to oil and gas activity. Since impacts would be more drastic in undeveloped areas, the introduction of new oil and gas infrastructure could permanently alter viewsheds. As such, visual impacts on land use are expected to be **minor** to **moderate**, depending on the duration and area in which these activities are expected to occur.

Space-Use Conflicts

The Beaufort Sea and Chukchi Sea Program Areas are fully within the Arctic boundary as defined by the U.S. Arctic Research and Policy Act, a boundary recognized by the USDOD. Conflicts between oil and gas activities and scheduled military operations onshore and offshore can be largely avoided through close coordination with the USDOD and lease sale-specific terms and conditions. Although OCS oil and gas activities associated with Arctic E&D scenario could affect military activities, the USDOD and USDOI have cooperated on oil and gas leasing issues for many years in the GOM and have developed mitigation measures that minimize the potential for conflicts. The same mitigation measures and level of cooperation would likely be applied in the Arctic, which would minimize potential space-use conflicts.

As referenced above in land disturbance impacts on wildlife and subsistence communities, it is likely that space-use conflicts would arise when areas typically reserved for subsistence uses are converted to support oil and gas activities. Though these impacts are further described in **Sections 4.4.1.16** and **4.4.1.17**, it is anticipated that all new construction would be developed in accordance with local land use policies. The *North Slope Borough Area Wide Comprehensive Plan* is periodically updated to guide land uses within the borough, and it is expected that all new development would be consistent with the goals and policies laid out by the community to protect the land and cultural resources of the NSB (NSB 2016c). As such, it is anticipated that space-use conflicts would result in **minor** to **moderate** impacts on land use and infrastructure.

Cook Inlet Program Area

Bottom/Land Disturbance

As indicated in **Table 3.2-4**, production within the Cook Inlet Program Area under the Proposed Action is anticipated to range from 0.08 to 0.34 Bbbl of oil and 0.04 to 0.15 tcf of gas. The E&D scenario for the Proposed Action estimates the development of 5 to 15 exploration wells, 30 to 100 production wells, 2 to 5 new platforms, 145 to 306 km (90 to 190 mi) of new offshore pipeline, and 1 waste handling facility. All of this development would be considered new in the Cook Inlet region and would be expected to impact future land use, development patterns, and current infrastructure. While there currently are no active Federal leases within the inlet, offshore producing platforms are currently operating on state submerged lands of the Cook Inlet. These platforms are served by more than 322 km (200 mi) of subsea oil and gas pipelines and other onshore facilities that would likely be used for exploration, development, and production activities from leases issued as part of the Proposed Action. These facilities are further discussed in **Appendix C**, Section 14.0.

Due to a long history of oil and gas development, it is anticipated that existing land use categorizations within the Cook Inlet region would be able to accommodate the influx of new oil and gas infrastructure as a result of potential leases issued under the Proposed Action. Many of the basic onshore support and processing infrastructure necessary to support the anticipated levels of activity are already in place within Cook Inlet, but these transport, loading, and storage capabilities would require expansion or retrofitting to handle an increased volume of produced oil and gas.

Since the area currently supports state leases, new infrastructure would likely be built as infill within an existing industrial or port area, or within an area designated for this type of development. A greater impact on the existing physical landscape would be experienced in those areas not already used for facilities that support oil and gas production. For example, the construction of a pipeline landfall in an area not zoned for industrial activity could involve modifications to land use plans, clearing land, preparing a right-of-way, and digging and backfilling trenches. These types of activities or similar ones could alter the physical composition of the landscape, thus potentially limiting the intended, actual, or future use of an area by local users and wildlife. This type of construction could also have considerable impacts in and around lands used for subsistence activities, which are analyzed in **Section 4.4.1.16**. As such, the extent of the impacts associated with oil and gas activities would depend on their specific locations within the Cook Inlet. However, impacts on land use and infrastructure are expected to be **minor** to **moderate** and limited in extent due to the presence of existing onshore support infrastructure for oil and gas.

Gulf of Mexico Program Area

Bottom/Land Disturbance

As indicated in **Table 3.2-5**, anticipated production of oil in the GOM includes a range of 2.1 to 5.6 Bbbl of oil and 5.5 to 22 tcf of natural gas. The E&D scenario for the Proposed Action anticipates the development of up to 3 gas processing plants and up to 10 pipeline landfalls. Under the 10-sale case as part of the Proposed Action, a majority of increased demand would be met by equipment upgrades or expansions at existing facilities. This is partly due to the well-developed web of infrastructure already in place in the GOM and, as a result, would not require extensive development of new facilities to serve new activity. However, these activities still have the potential to impact existing and future land use, development patterns, and infrastructure. BOEM continuously collects new data and monitors changes in infrastructure demands to support scenario projections that reflect current and future industry conditions.

Under the Proposed Action, the E&D scenario projects the development of up to three new gas processing plants. While natural gas production on the OCS shelf (shallow water) has been declining, deepwater gas production has been increasing, though not at the same pace. Overall, the combined trends of increasing onshore shale gas development, decreasing OCS gas production, and increasing efficiency and capacity of existing gas-processing facilities have lowered demands for new gas-processing facilities in the GOM region. Spare capacity at existing facilities should be sufficient to satisfy new gas production for many years, although there remains a chance that new gas processing facilities could be needed given the 10 lease sales proposed as part of the Proposed Action. Furthermore, BOEM projects the potential construction of one new pipeline landfall to connect new operations to the existing OCS pipeline infrastructure.

Bottom/land disturbing activities associated with potential development of new gas processing plants and a pipeline landfall include activities such as grading and clearing land, excavation, foundation building, and backfilling trenches. If proposed in areas not currently zoned to support this type of development, oil and gas infrastructure development could potentially limit the intended, actual, or future use of an area by local users and wildlife. Given the presence of existing oil and gas infrastructure in the GOM, it is not anticipated that new construction would result in an extensive change to existing development patterns.

During decommissioning, potential changes to the physical and infrastructural makeup of the GOM coast could occur. The decommissioning of rigs and defunct equipment would use onshore facilities, but are not expected to cause substantial changes to land use, development patterns, and infrastructure. These alterations likely would be site-specific and their extent would depend on the existing composition of land use and infrastructure in that area.

Dismukes (2010) maintains that existing solid waste disposal infrastructure is adequate to support existing and projected OCS oil and gas drilling and production needs in the GOM. Existing onshore facilities would continue to be used to dispose of wastes generated offshore. However, no new disposal facilities are expected to be licensed as a direct result of a Proposed Action. There is no current expectation for new onshore waste disposal facilities to be authorized and constructed during the 2017-2022 period as a direct result of the activities associated with the Proposed Action.

If new infrastructure is needed onshore, development of certain facilities would be subject to local, state, or other Federal permitting and regulations. While BOEM anticipates that most development would likely occur in areas already established for oil and gas development, specific timelines and requirements would vary by location. Furthermore, BOEM is not the permitting or regulating agency for development activities that occur onshore. As such, bottom/land disturbance activities in the GOM are expected to be **minor** to **moderate,** and future development will be evaluated at a project-specific level and subject to all applicable local, state, and Federal regulations.

4.4.1.14 Commercial and Recreational Fisheries

Through preliminary screening of the activities and affected resources, IPFs for commercial and recreational fishing are (1) noise; (2) routine discharges; (3) bottom/land disturbance; (4) lighting/physical presence; (5) space-use conflicts; and (6) non-routine events (**Table 3.6-3**). An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-15**.

There are no IPFs associated with routine operations that would result in moderate or major impacts on commercial and recreational fisheries. Impacts that are expected to be negligible to minor are identified and summarized in **Appendix E**. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**.

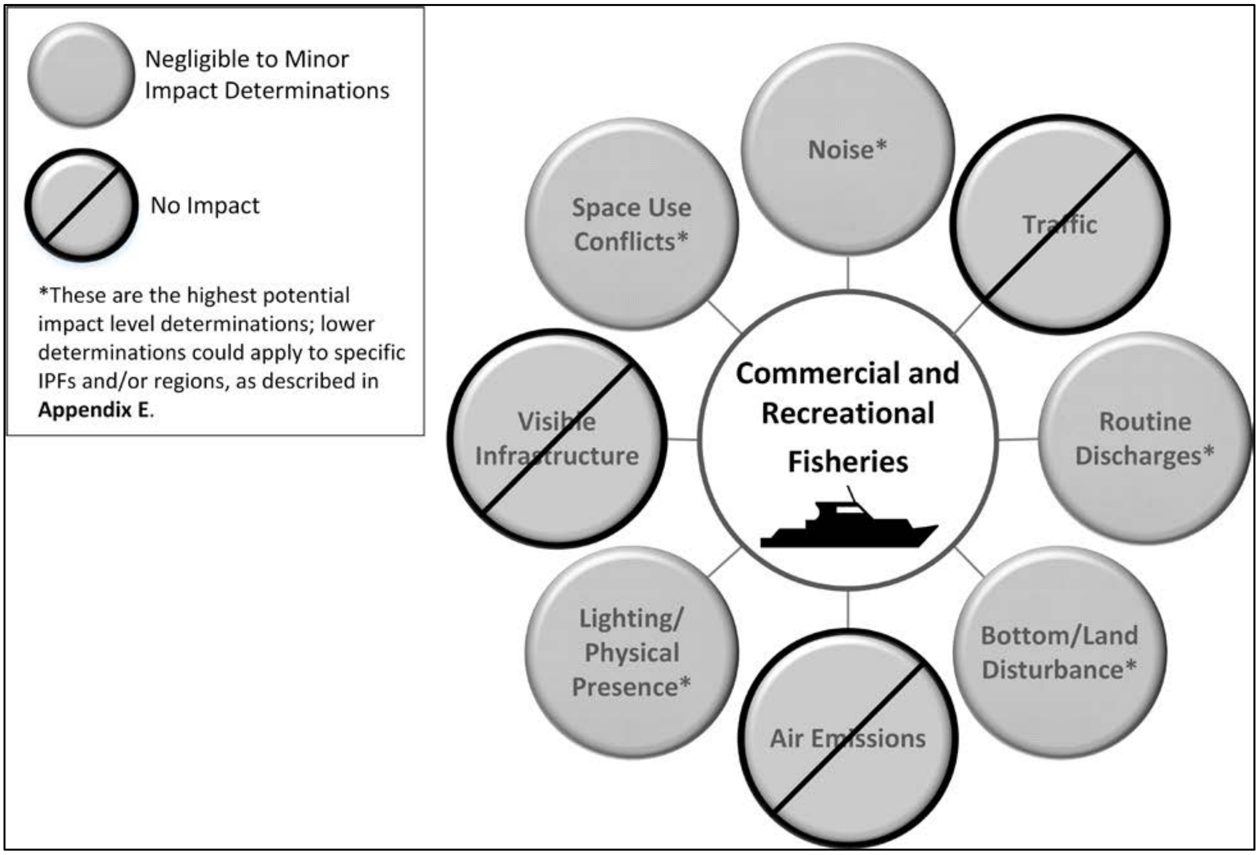


Figure 4.4.1-15. Impact-Producing Factors and Impact Determinations for Commercial and Recreational Fisheries associated with Routine Activities

4.4.1.15 Tourism and Recreation

The Proposed Action and associated ancillary activities could impact the scenic quality of coastal areas through IPFs of lighting, visible infrastructure, noise, and traffic. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-16**. These impacts would be more substantial in areas where there is little industrial activity such as on the North Slope of Alaska, and relatively minor in previously developed areas such as the GOM (**Appendix E**).

Adverse effects from non-routine (not permitted) actions such as a CDE could affect tourism and recreation areas. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**.

Noise

Noise associated with OCS and onshore construction would impact tourism and recreational uses of coastal resources. Any noise impacts on tourism would be temporary in nature; construction normally lasts for a period of months. Effects from noise would be expected to immediately cease once the construction phase is complete. The magnitude of the noise impact would decrease as development occurs farther from the coast and popular recreational areas, but would be greater in areas with low preexisting development and noise levels.

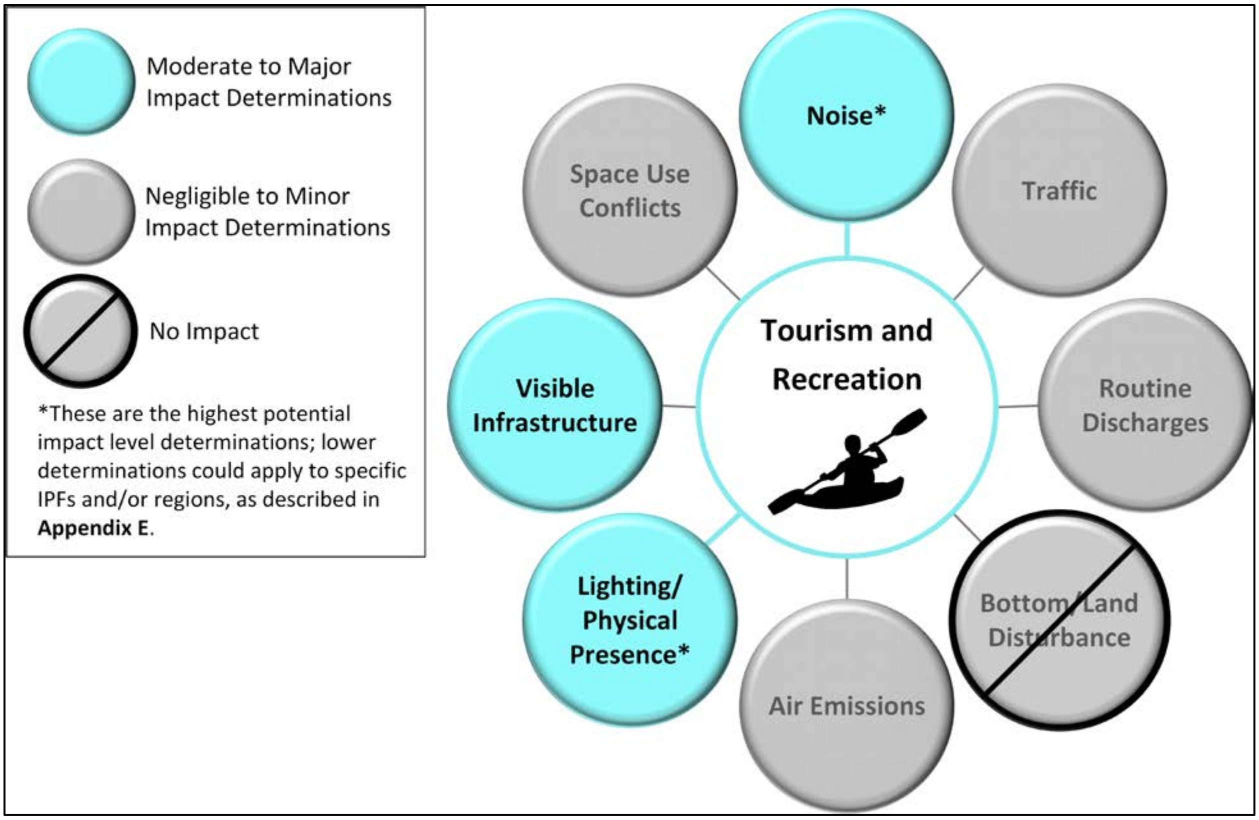


Figure 4.4.1-16. Impact-Producing Factors and Impact Determinations for Tourism and Recreation associated with Routine Activities

For example, the Arctic NWR is 4.8 km (3 mi) south and onshore of the Beaufort Sea Program Area. Visitors in the northern end of the Arctic NWR, adjacent to the shore, could be affected by noise sources associated with OCS and onshore construction. This could have a **minor** to **moderate** impact on recreation because of the natural and remote experiences visitors to the NWR typically seek.

In the Chukchi Sea, noise associated with OCS construction and drilling operations would be intermittent, and any impacts on tourism temporary in nature. Mitigation measures could assist in further limiting impacts on OCS wildlife tourism opportunities. Noise sources associated with drilling operations and platform operations would have a **minor** to **moderate** impact on the recreation experience in the area. While the proposed development would occur farther from shore than the Beaufort Sea Program Area, the coast adjacent to the Beaufort Sea and Chukchi Sea Program Areas has little ambient noise from development, because it is remote compared to the GOM Program Area. The impact of noise in the more developed Cook Inlet and GOM Program Areas would be **negligible** to **moderate**, depending on the location and timing of construction, because of the existing and robust activity already occurring in these areas.

Lighting and Visible Infrastructure

The impact of lighting and visible infrastructure on recreation and tourism would vary by region and program area. In the Beaufort Sea and Chukchi Sea Program Areas, there is little industrial infrastructure and activity (**Section 4.4.1.13**). The remote wilderness onshore and nearshore of these areas plays a key role in attracting visitors for recreation. Onshore construction, lighting, and visible infrastructure could impact coastal tourism industries in these areas, depending on their proximity to recreational activities. Onshore construction and visible infrastructure adjacent to the Beaufort Sea and Chukchi Sea Program

Areas would have an impact on the natural landscape and views of the area. Lighting from the proposed activities would have a more noticeable impact in the winter months, due to shortened hours of daylight. However, in the summer months, there would be a greatly minimized impact due to long hours of daylight in the Arctic. **Minor** to **moderate** effects on tourism and recreation are expected in the Beaufort Sea and Chukchi Sea Program Areas because there is little development in these remote areas and some small impacts would be more noticeable in such remote locations. These impacts would usually last for months (exploration) to decades (production), with full recovery expected with decommissioning and removal of facilities.

In the Cook Inlet Program Area, there is a baseline of previous development in state waters. Activities associated with the Proposed Action are likely to have a **negligible** to **moderate** impact on tourism and recreation, depending on the phase of the action. Construction operations would have a greater impact because they are mobilized from shore, but are temporary in nature. Exploration and development activities would be less noticeable than construction activities to tourists on account of the distance to shore, which would be farther from existing oil and gas activity in state waters.

In the GOM, there is a baseline condition for lighting, visible infrastructure, and noise from existing activity, and the contribution of the activities associated with the Proposed Action in the GOM is likely **negligible** to **moderate**, depending on the location of development, proximity to recreational resources, and phase of development.

4.4.1.16 Sociocultural Systems

Communities of the North Slope have strong ties to subsistence activities, which is broader than harvesting food and food security. Cultural dimensions include the tradition of sharing and kinship. These cultural traditions play a critical role in the wellness of the population, and with mental health in particular (Stephen R. Braund and Associates 2009). Abrupt changes to these practices by industrial development could have an impact on the well-being and mental health of indigenous people (NSB 2014a). An overview of IPFs and the potential impacts on sociocultural systems from activities associated with the Proposed Action is presented in **Figure 4.4.1-17**. The following analysis is for IPFs that directly or indirectly affect sociocultural systems and result in potential effects ranging from moderate to major. IPFs resulting in negligible to minor effects are discussed in **Appendix E**. Potential impacts on other resources can also have cascading effects and implicate sociocultural systems; those impacts are discussed broadly following specific consideration of direct and indirect effects of IPFs. The following analysis focuses on the Beaufort Sea and Chukchi Seas Program Areas, since Cook Inlet and the GOM Program Areas would have only **negligible** to **minor** effects. Analysis of potential impacts from accidental spills and CDEs on sociocultural systems is provided in **Section 4.4.5**.

The exploration and development scenarios for the Alaska program areas represent a wide range, from a more probable exploration-only scenario in the Arctic to a more optimistic but less probable sustained high-price, high-development scenario. The full range is considered in the Programmatic EIS so as not to understate potential environmental impacts (**Section 3.2.1**).

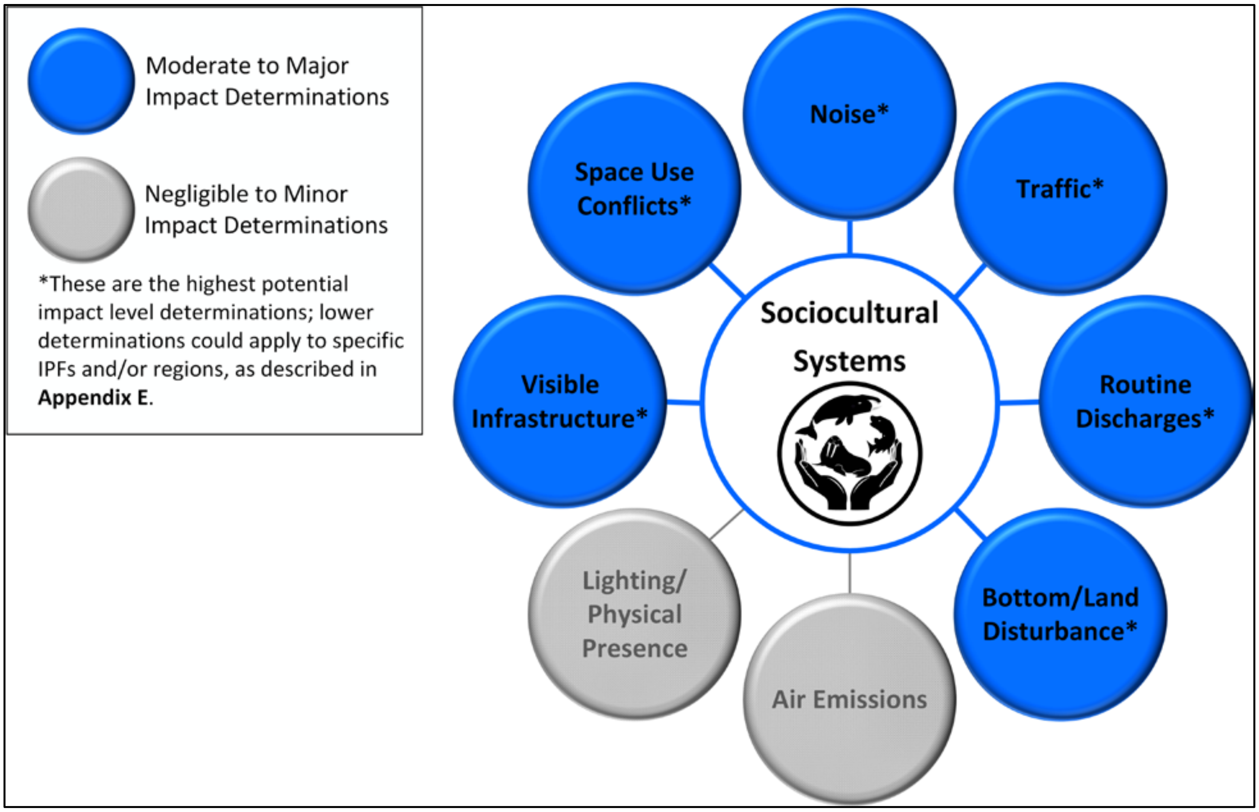


Figure 4.4.1-17. Impact-Producing Factors and Impact Determinations for Sociocultural Systems associated with Routine Activities

The high-price scenario for the Beaufort Sea and Chukchi Sea Program Areas is expected to increase labor income mostly in the State of Alaska as most jobs resulting from the activities associated with the Proposed Action are likely to be filled by people living outside of the NSB. Oil and gas property taxes make up about 95 percent of property tax revenue for the NSB (**Section 4.4.1.12**), and industry would add taxable infrastructure in the process of project development. An increase in tax revenue means an increase in opportunity for improved public infrastructure (e.g., road, sewer and water, community buildings) and services (e.g., healthcare, education, fire and rescue) for areas within the NSB (NEI 2006). In addition to tax revenue, oil and gas workers bring additional revenue to these communities from lodging, for which there are no substitutes in the area. Significant increases in individual and community income and improved community services would result in improved standard of living, sense of well-being, and lifestyle amenities at the individual, family, and community levels. However, significant increases in community income are unlikely.

Noise

There are five components of noise (seismic activities, vessel and helicopter traffic, well drilling, support infrastructure construction, and platform removal) that could have a **moderate** to **major** impact on marine subsistence because bowhead whales could change their normal migration paths and make subsistence hunting more difficult, dangerous, or impossible (**Figure 4.3.16-1**; BOEM 2015b, Richardson et al. 1990, Stephen R. Braund and Associates 2009, Huntington and Quakenbush 2009, Quakenbush and Huntington 2010, Huntington 2013). Bowhead whales migrate in the spring and fall and this timing is important relative to OCS activities (**Figure 4.3.16-1**; BOEM 2015b). Bowhead and beluga whales are the marine mammals most sensitive to noise associated with industry activities and therefore the most likely to change their migration paths. These species reduce communication calls when anthropogenic noise sources are nearby, and could move away from the source of that anthropogenic noise (BOEM 2015b, Richardson et al. 1990) (see **Section 4.2.2.11**).

Noise signatures resulting from the various components could further cause **moderate** to **major** impacts on local and regional cultural identities because subsistence hunting of marine mammals is central to the culture of the Iñupiat and a cornerstone of food security (Stephen R. Braund and Associates 2009, BOEM 2015b, NSB 2011b). A decreased availability of subsistence food sources such as the bowhead whale could have cultural and nutritional impacts.

Noise could displace caribou, resulting in hunters having to traverse longer distances and at greater expense and risk, which contributes to decreased availability of an important subsistence food source. Of particular concern is noise from helicopters and small aircraft (Stephen R. Braund and Associates 2009, Ahtuangaruak 2015). Onshore infrastructure construction noise could have a **moderate** effect because it could disrupt the small remote communities that have very little industrial development. Increased noise could ultimately lead to changes in subsistence-harvest patterns and hunting success; in turn, these changes could implicate food security, sense of well-being, and cultural identity of Alaska Natives.

Vessel Traffic

Subsistence hunting of marine mammals in the Beaufort Sea, Chukchi Sea, and northern Bering Sea regions is central to the culture of the Alaska Natives and important for food security (BOEM 2015b, NSB 2011b, Stephen R. Braund and Associates 2009). Increased vessel traffic could cause a **moderate** to **major** effect because of potential interruptions or disturbance of subsistence activities if not avoided or mitigated. Moreover, such disturbances cause hardship because of increased time spent hunting, as well as increased cost to travel farther from traditional hunting areas. Increased vessel traffic could also cause bowhead whales, beluga whales, bearded seals, or walrus to change their normal migration patterns or behaviors and make hunting for them more difficult if not impossible (BOEM 2015b, Richardson et al. 1990, Stephen R. Braund and Associates 2009, Huntington 2013). Vessel traffic could result in changes to subsistence-harvest patterns and hunting success; in turn, these changes could implicate food security, sense of well-being, and cultural identity of Alaska Natives.

Bottom/Land Disturbance

Under the Proposed Action, new pipelines would run from the subsea environment to shore. Subsistence resources like clams and caribou could be affected because of seafloor or coastal habitat disturbance. For example, heavy road traffic can deflect caribou from their normal migration routes when elevated less than seven feet, and especially when snow builds up, leading to diminished subsistence resources (Stephen R. Braund and Associates 2009). The NSB and local agencies require permits for such facilities and activities that could mitigate effects. Impacts from drilling muds, cuttings, and debris could have up to a moderate impact on marine mammals (**Section 4.4.16**), depending on timing and location of activity near a foraging area. An impact on whales could affect whale behavior during the whaling season, causing up to a **moderate** impact on communities that harvest whales. Depending on the nature of the changes in habitat and displacement of marine or terrestrial animals, changes in seafloor and land disturbance could have a **moderate** impact on subsistence-harvest patterns and the availability of subsistence resources. These changes could implicate food security, sense of well-being, and cultural identity of Alaska Natives.

Routine Discharges

Impacts from drilling muds, cuttings, and debris and other routine discharges could have up to a **moderate** impact on marine mammals (**Section 4.4.16**), depending on timing and location of activity near a foraging area. The USEPA has determined that any discharges authorized by NPDES permits, with the effluent limits, restrictions, and requirements imposed by the permits, would not result in contamination of food resources, although there is a perception among subsistence hunters that discharges could affect marine mammal behavior and the availability of subsistence resources. If whales avoid areas where discharges occur, especially during the whaling season and if traditional subsistence-harvest patterns and hunting success are affected, there is the potential for a **moderate** impact. These changes could implicate food security, sense of well-being, and cultural identity of Alaska Natives.

Space-Use Conflicts

Regarding OCS space-use conflicts, the presence of OCS infrastructure could have a **moderate** to **major** impact on subsistence activities if hunt routing, success, or quality of experience is affected, or alternatively, facilities and oil and gas operations cause bowhead whales to change their normal migration paths, thus making subsistence hunting more difficult (BOEM 2015b, Richardson et al. 1990). An increase in the presence of field crews and oil workers conducting related land-based operations also has the potential to effect birds and terrestrial mammals, like caribou. This potential impact is very important because subsistence hunting of marine and terrestrial mammals is central to the culture of the Iñupiat and important for food security (BOEM 2015b, NSB 2011b).

Visible Infrastructure

A majority of the oil and gas supporting infrastructure in the Arctic is closer to the Beaufort Sea Program Area than the Chukchi Sea Program Area due to operations around Prudhoe Bay and Deadhorse. It is anticipated that any new OCS oil and gas leasing in the Arctic would rely on the existing oil transportation system and network of oil and gas infrastructure adjacent to the Beaufort Sea Program Area to the extent possible; however, new infrastructure would still be required to bring oil and natural gas to market as described in the E&D scenarios for both program areas. New OCS infrastructure would be needed, except for gravel islands in state waters in the Beaufort Sea. The presence of new infrastructure could affect the experience of the seascape, even during subsistence activities. Subsistence hunters can traverse as far as 80 km (50 mi) offshore in search of their harvest where they do not currently see such development (Galginaitis 2009).

Additionally, because drilling and shipping typically take place 24-hours per day, light pollution from these and other ancillary activities during hours of peak darkness could impact viewsheds. It is anticipated that some of these impacts from visible infrastructure would be reduced in areas like the Chukchi Sea Program Area, given the 25-mile Presidential Withdrawal from leasing, but a majority of the region is not accustomed to oil and gas activity. Since impacts would be more drastic in undeveloped areas, the introduction of new oil and gas infrastructure could permanently alter viewsheds.

New onshore infrastructure related to OCS development could also cause **moderate** to **major** effects if there is oil and gas industrial development in areas previously undeveloped, or large expansion in the vicinity of small communities. Any changes in onshore facilities and infrastructure associated with OCS development could block or interfere with views of the natural landscape.

Other Factors affecting Sociocultural Systems

In addition to direct and indirect effects on subsistence hunting and fishing, there are several other aspects of sociocultural systems that could be affected. Potential changes in population, employment, and income; changes in tourism and recreation; environmental justice; and impacts on archaeological and historical cultural resources can also affect socioeconomic or cultural aspects of the Iñupiat way of life. The potential for these changes are described in other resource sections, whereas the implications for sociocultural systems are highlighted here.

Changes in population, employment, and income (discussed in **Section 4.4.1.12**) spurred by oil production and overall industry spending would provide important economic benefits to individuals, the

NSB, Native corporations, and the State of Alaska from tax revenues, Federal revenue sharing, and dividends from investments. Oil production could also extend the viability of TAPS at some point in time and other onshore oil and gas infrastructure, which could continue tax revenues going to the NSB budget. Oil and gas property taxes make up about 95 percent of property tax revenue for the NSB (**Section 4.4.1.12**), and industry would add taxable infrastructure in the process of project development. This means that NSB residents would continue to have access to key public services and infrastructure paid for by these taxes. Any increased tax revenue to the NSB could also translate into improved public infrastructure (e.g., road, sewer and water, community buildings) and community services (e.g., healthcare, education, fire and rescue) for areas within the NSB (NEI 2006). In addition to tax revenue, oil and gas workers bring additional revenue to these communities from lodging, for which there are no substitutes in the area. Increases in individual and community income and improved community services could result in improved standard of living, sense of well-being, and lifestyle amenities at the individual, family, and community levels. The greater the economic benefits that are directed to the NSB from sources discussed above, the less local residents need to pay for public goods and services; this could allow for greater discretionary income for families and individuals to invest in the subsistence-cash economy.

Increased infrastructure and services would not only serve NSB residents, but also tourists who visit the region for outdoor recreation and other opportunities. Tourists visit the North Slope to appreciate Alaska Native culture. One of the most important tourist attractions is the Iñupiat Heritage Center, which is supported by the NSB in large part with tax revenues on oil and gas infrastructure. The Iñupiat Heritage Center houses Native artifacts, has a library focusing on Native culture, and provides tourists the opportunity to observe Alaska Natives carve ivory and make other crafts. Increased number of tourists could come by plane and cruise ships, take bus tours and other guided tours, use taxi services, stay at hotels and lodges, and eat at local restaurants. The spending by tourists in the NSB could supplement the income of the NSB residents and communities. Infrastructure improvements discussed above could in turn encourage greater tourism. Influx of tourism might not only affect Alaska Native well-being, but has the potential to influence culture and way of life.

Impacts on sociocultural systems are also related to environmental justice concerns. **Section 4.3.17** indicates that 8 to 28 percent of Alaska Natives in NSB communities are living below the poverty level, a substantial portion of the population. The Proposed Action could disproportionately affect such individuals who rely on subsistence, both as a food source and essential experience of the Iñupiat culture. The construction and presence of new oil and gas infrastructure could diminish the quality of life for residents who value more remoteness and lack of disturbance.

Another important aspect of the Alaska Native culture is the stewardship of archaeological and historic resources, which can include individual residences (such as indigenous sites that could be composed of housepits, cache pits, ice cellars, and related features), churches, inns, trading posts, lighthouses, fishing and mining camps, and piers and docks. In the Arctic, onshore coastal pre-contact sites are often found in association with certain geologic features. The Iñupiat value these resources because they represent the connection to ancient culture that is millennia old. Any adverse impact on these resources could have a major sociocultural effect given the value Alaska Natives place on tradition and heritage.

4.4.1.17 Environmental Justice

In the analysis of direct and indirect effects on environmental justice, BOEM determined whether the potential impacts of the Proposed Action would be negligible, minor, moderate, or major. Moderate to major effects are discussed in detail in **Chapter 4** of the Programmatic EIS. Impacts that are expected to be negligible to minor are identified and summarized in **Appendix E**. IPFs associated with routine operations that could result in **moderate** to **major** impacts for vulnerable communities include noise, discharges, bottom/land disturbances, air emissions, lighting/physical presence, visible infrastructure, space-use conflicts, and non-routine events. Moderate or major impacts are only expected for the Alaska program areas. An overview of the potential impacts associated with the Proposed Action is presented in **Figure 4.4.1-18**. It is important to note that where these impacts affect culture due to economic development, they have not been given a value of positive or negative. The moderate to major impacts in this section could affect these communities, but whether those impacts are interpreted as good or bad is at the determination of the reader. Discussion of impacts from accidental spills and CDEs is provided in **Section 4.4.5**.

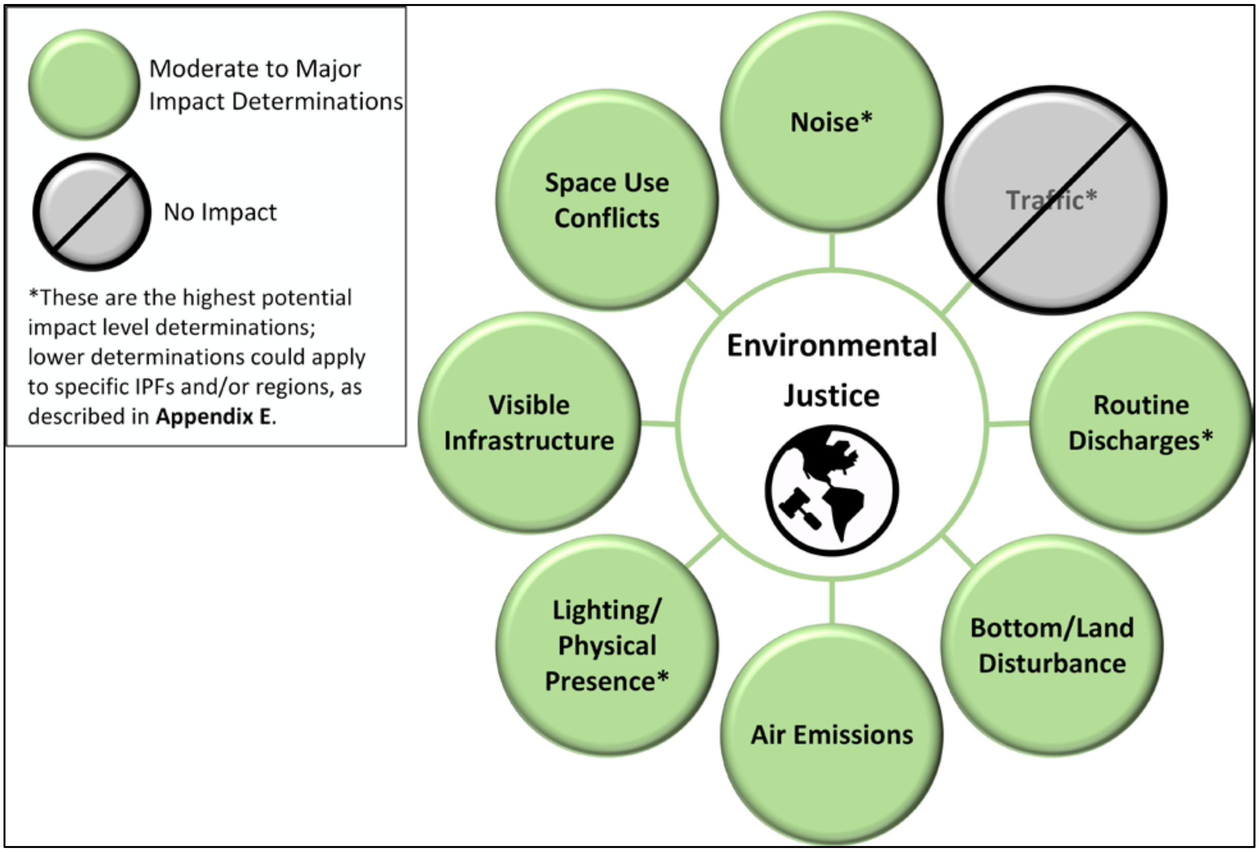


Figure 4.4.1-18. Impact-Producing Factors and Impact Determinations for Environmental Justice associated with Routine Activities

Onshore activity is not under the jurisdiction of BOEM. Therefore, subsequent regional or site specific analyses will consider the most recent zoning and population data available at the time of the decision as well as additional mitigation measures designed in concert with affected communities. Mitigation measures and government-to-government and government-to-ANCSA corporations consultations with federally recognized Tribes and ANCSA corporations are designed to limit effects from routine events.

The E&D scenarios for the Alaska program areas represent a wide range, from a more probable, exploration-only scenario in the Arctic to a more optimistic but less probable sustained high-price, high-development scenario. The full range is considered in the Programmatic EIS so as not to understate potential environmental impacts (**Section 3.2.1**).

The high-price scenario for the Beaufort Sea and Chukchi Sea Program Areas is expected to increase labor income primarily in the State of Alaska as most jobs resulting from the activities associated with the

Proposed Action are likely to be filled by people living outside of the NSB. Oil and gas property taxes make up about 95 percent of property tax revenue for the NSB (**Section 4.4.1.12**), and industry would add taxable infrastructure in the process of project development. An increase in tax revenue means an increase in opportunity for improved public infrastructure (e.g., road, sewer and water, community buildings) and services (e.g., healthcare, education, fire and rescue) for areas within the NSB (NEI 2006). In addition to tax revenue, oil and gas workers bring additional revenue to these communities from lodging, for which there are no substitutes in the area. Significant increases in individual and community income and improved community services would result in improved standard of living, sense of well-being, and lifestyle amenities at the individual, family, and community levels. However, significant increases in community income are unlikely.

Noise

There is the potential for impacts on marine mammals taken for subsistence from noise associated with activities under the Proposed Action in the Beaufort Sea and Chukchi Sea Program Areas. Subsea noise is unlikely to directly impact vulnerable communities onshore, but could impact their subsistence harvests (e.g., migration behavior) nearshore and on the OCS. Animals used for subsistence harvest, particularly the bowhead whale, are central to the Iñupiat culture (**Section 4.3.1.16**). These animals would be impacted by noise generated from routine activities (**Sections 4.4.1.6**).

Based on available information about potential effects on marine mammals (**Section 4.4.1.6**), any construction, vessel traffic, or air traffic noise impacts on marine or terrestrial animals impacting subsistence harvest activities could have a **moderate** to **major** impact on these communities, because there is little nutritional substitute for these foods, and noise can cause animals to deflect from usual course. Therefore, any subsequent regional or site-specific analyses will consider the most recent science available at the time of the decision as well as additional mitigations to limit the potential for masking or behavioral disruption (e.g., time-area closures, limiting activities in space and time).

Construction, vessel traffic, and aircraft traffic noise could have a **moderate**, direct impact on people in vulnerable coastal communities adjacent to the Beaufort Sea and Chukchi Sea Program Areas who are not accustomed to ambient noise that comes with living in populated areas. This is an added complexity of development in such a remote area.

Routine Discharges

There is the potential for impacts on marine mammals with regard to subsistence from routine discharges associated with activities under the Proposed Action in the Beaufort Sea and Chukchi Sea Program Areas. Routine (permitted) discharges are unlikely to directly impact vulnerable communities onshore, but could impact their subsistence harvests nearshore and on the OCS. Animals used for subsistence harvest are central to the Iñupiat culture (**Section 4.3.16**). Some of these animals, such as the walrus and bearded seal, could be impacted by routine discharges generated from routine activities (**Sections 4.4.1.6**).

Based on available information about potential effects on marine mammals with regard to subsistence (**Section 4.4.1.6**), impacts on marine mammals from routine discharges could have a **negligible** to **moderate** impact on communities because there is little nutritional substitute for these foods, and real or perceived contamination can be a psychological cause of distress to people relying on these foods as a main staple. Therefore, any subsequent regional or site-specific analyses will consider the most recent science available at the time of the decision.

Bottom/Land Disturbance

Similar to routine discharges, bottom/land disturbance on the OCS as the result of activities such as drilling or construction could affect marine mammals important for subsistence use. This includes disturbance of or displacement from important foraging habitat, a concern mainly for species such as walrus and bearded seal who feed on the seafloor. Based on available information about potential effects on marine mammals (**Section 4.4.1.6**), impacts on marine mammals that are important for subsistence from bottom/land disturbance could have a **negligible** to **moderate** impact on communities because there is little nutritional substitute for these foods and real or perceived contamination can be a psychological cause of distress to people relying on these foods as a main staple. Therefore, any subsequent regional or site-specific analyses will consider the most recent science available at the time of the decision.

Onshore Construction

In the Arctic program areas, there is little industrial infrastructure and activity (**Section 4.3.13**). Onshore construction could impact vulnerable communities in these areas, depending on its proximity to those communities, particularly those near industrial areas.

Much of the Alaska Native population resides in the coastal areas of Alaska. Any new onshore and OCS infrastructure occurring between 2017 and 2022 could be near these populations or near areas where subsistence hunting and fishing occur. Any adverse environmental impacts on fish and mammal subsistence resources from installation of infrastructure and facilities could have disproportionately higher health or environmental impacts on Alaska Native populations.

While the data are inconclusive on why development affects only some caribou (particularly gravid females) migrating between ranges, recent studies have shown that some caribou travel away from their ranges to avoid intersecting roads, like the road that leads to the Red Dog Mine in northwestern Alaska (Wilson et. al 2016). Highly adaptable and migratory, the caribou of the Arctic travel between ranges and subsist on meager Arctic vegetation (Klein 1999, Cronin et al. 2000).

Onshore construction in the coastal areas onshore of the Beaufort Sea and Chukchi Sea Program Areas would be particularly unique in that these communities are geographically isolated. Impacts from these activities would be experienced solely by communities of color, given the cultural identity of the population of the North Slope. Activities associated with onshore construction adjacent to the Beaufort Sea and Chukchi Sea Program Areas could have a **moderate** to **major** impact on vulnerable communities, depending on the mitigation being applied, because of the disturbance in baseline of cultural norms from lighting, visible infrastructure, and noise.

While zoning laws are designed to protect public health, the effects of historical practices to exclude low-income communities and communities of color still can be observed, often in close proximity to industrial zones (Maantay 2002).

Air Emissions

In the Arctic program areas, there is no OCS industrial infrastructure or activity (**Section 4.3.13**). OCS activities affecting air quality include: vessel operations during geophysical surveys and oil spill response exercises, drilling activities, platform construction and emplacement, pipeline laying and burial operations, platform operations, flaring, fugitive emissions, support vessel and helicopter operations, and evaporation of VOCs during transfers and spills.

Activities affecting air quality onshore include emissions from new infrastructure constructed onshore and offshore activities that occur within 40 km (25 mi) of a state's boundary. Onshore air emissions could negatively impact vulnerable communities in these areas, depending on its proximity to each community. Locally produced smog and haze has been observed near some villages in Alaska. Air quality and its potential effect on respiratory health is a major concern for area residents (NRC 2003b).

Activities associated with onshore air emissions could have a **moderate** impact on nearby communities, depending on the mitigation being applied and the output of emissions in proximity to any historically marginalized communities, because of decreased air quality. Onshore activity is not under the jurisdiction of BOEM. Despite the differences in industrial infrastructure onshore, impacts on the Arctic communities would be **moderate** due to the ability for air quality, and any damage caused by degraded air quality, to recover after emissions cease. Any subsequent regional or site-specific analyses will consider the most recent zoning and population data available at the time of the decision as well as additional mitigation measures designed in concert with affected communities.

Lighting

OCS lighting includes platform lighting, construction lighting, MODU lighting, and/or vessel lighting. OCS facilities are routinely equipped with mandatory navigation lighting and special use lighting for work areas, outside passageways, machinery spaces, control stations, alleyways, stairways, and exits. Navigation lights are operated to ensure that the facility is visible to other vessels and aircraft. Special use lighting is intended to ensure the safety of vessel personnel. As a result, navigation lighting must be visible to specified distances. Onshore lighting includes lighting from onshore support facilities, ports, construction facilities, transportation, and processing facilities.

Lighting from OCS production structures (as well as related onshore support activities) could impact coastal communities. Lighting from new onshore facilities could have a **minor** to **moderate** impact on nearby communities, depending on the mitigation being applied and light pollution proximity to any coastal communities, particularly those near industrial areas. For areas in the Arctic, this could be more noticeable because there is little industrial development in these areas. In the summer months, lighting would be less noticeable than colder months, due to extended daylight in the Arctic.

Visible Infrastructure

Existing onshore infrastructure occurs from Nuiqsut eastward to Point Thompson near the western edge of the Arctic NWR. Onshore infrastructure is currently prohibited to the east of Point Thompson. West of Nuiqsut, there is approximately 90 miles of coastline where additional oil and gas development could occur. Should the area be developed, potential impacts would most likely be in the coastal region. As such, community residents and visitors are not accustomed to seeing OCS infrastructure (NSB 2014a). Subsistence hunters typically travel offshore in search of their harvest, where there is currently no development or disturbance.

Visible onshore infrastructure could have a **moderate** impact on nearby communities, because there are no structures in the OCS in the Arctic program areas. The remoteness of these areas are part of the baseline cultural norm, and industrial development could impact that culture. Visible onshore infrastructure could impact vulnerable communities in these areas, depending on its proximity to these communities. While zoning laws are designed to protect public health, the effects of historical practices to exclude low-income communities and communities of color still can be observed, often in close proximity to industrial zones (Maantay 2002).

Space-Use Conflicts

New onshore facilities can include drill pads, drilling rigs, onshore pipelines and vertical support members, ports and pipelines coming ashore, and additional facilities could be needed. The Iñupiat rely significantly on subsistence over this broad landscape. Onshore subsistence hunting requires wide geographic ranges of 50 or more miles from the community (NSB 2016c, BOEM 2015b, Stephen R. Braund and Associates 2010). Onshore space-use conflicts could impact vulnerable communities in these areas because historical practices to exclude low-income communities and communities of color still can be observed, often in close proximity to industrial zones (Maantay 2002).

Conflicts between industry and subsistence harvesters could have **moderate** to **major** impacts due to industry-related noise or activities that could affect the behavior of resources being harvested, depending on the mitigation measures being applied.

4.4.2 Alternative B – Exclusion of or Mitigation in Environmentally Important Areas

Environmental effects from the activities associated with the Proposed Action could be avoided or minimized through the exclusion or mitigation of activities potentially occurring in the EIAs. Four EIAs have been identified for the Beaufort Sea Program Area, two for the Chukchi Sea Program Area, and one for the Cook Inlet Program Area. No EIAs have been analyzed under Alternative B for the GOM Program Area. Alternative B is described in detail in **Section 2.3**.

4.4.2.1 Alternative B(1): Beaufort Sea

There would not be any change in potential impact from Alternative A for the following resource areas: air quality; water quality; coastal and estuarine habitats; pelagic communities; fish and EFH; archaeological and historical resources; land use and infrastructure; Arctic terrestrial wildlife and habitat; population, employment, and income; and commercial and recreational fisheries. This is because the exclusion or implementation of mitigation measures within these areas would only benefit resources found with them or that rely on them. Resources for which there could be change in potential impacts are discussed in the following subsections.

4.4.2.1.1 Marine Benthic Communities

Reducing oil and gas activity in the Beaufort Sea EIAs would result in less impacts than those expected under the Proposed Action for marine benthic communities. However, it would not change the overall levels of effect determination for the program area. Exclusion of the EIAs under consideration combined with mitigation measures of other impact-producing activities would provide the highest level of protection for all benthic resources in the Beaufort Sea Program Area. Taken together, there would be little to no activity in these sensitive benthic marine habitats in the Beaufort Sea Program Area. Impacts of highest concern are bottom-disturbing activities and non-routine events. Elimination of drilling, pipeline trenching, and other activities that cause disturbance to the seafloor would eliminate the bottom-disturbing impacts resulting from these actions. Existing lease activity still could result in negative impacts similar to those discussed earlier. Reducing oil and gas E&D activity in these areas would decrease the potential for cumulative effects and decrease the chances of a non-routine impact occurring in the area.

Barrow Canyon

Barrow Canyon has some areas of high diversity and abundance of benthic organisms. However, the known areas lie outside the program area and are in the Chukchi Sea (Schonberg et al. 2014). Thus, most of the hard-bottom benthic habitats in Barrow Canyon would not be protected by this particular EIA. However, soft-bottom benthic habitats within this EIA would be protected from nearly all IPFs. While excluding this area seasonally or completely could afford some protection to benthic communities from disturbance and disruption, it would not change the levels of effect determination for benthic communities in the program area, which would be negligible to moderate.

Camden Bay

There are some scattered hard-bottom habitats in the coastal waters of Camden Bay, including Boulder Island Shoal (Dunton et al. 1984). If Camden Bay is excluded from the Program, nearly all IPFs to the benthic habitats in this area would be eliminated. While excluding this area seasonally or completely could afford some protection to benthic communities from disturbance and disruption, it would not change the levels of effect determination for benthic communities in the program area, which would be negligible to moderate.

Cross Island

Boulder Patch, an area of abundant invertebrates and kelp beds, lies close to Cross Island. The Cross Island EIA encompasses this sensitive area, thus offering the highest level of protection to these abundant and diverse benthic communities. Exclusion of this area would eliminate nearly all IPFs, aside from spills that might enter the area from adjacent lease blocks. The size of the EIA makes these remotely sourced impacts unlikely. While excluding this area seasonally or completely could afford some protection to benthic communities from disturbance and disruption, it would not change the levels of effect determination for benthic communities in the program area, which would be negligible to moderate.

Kaktovik

If the Kaktovik EIA were excluded, the benthic habitats within it would be protected from nearly all IPFs. There would still be a potential for negative impacts on benthic resources from spills and CDEs. However, reduced activity in the area would make these events less likely, and perhaps diminish their impacts due to distance from the event. While excluding this area seasonally or completely could afford some protection to benthic communities from disturbance and disruption, it would not change the levels of effect determination for benthic communities in the program area, which would be negligible to moderate.

4.4.2.1.1 Marine Mammals

Reducing oil and gas activity in the Beaufort Sea EIAs would result in reduced impacts than those expected under the Proposed Action for marine mammals (**Table 4.4.2-1**). However, it would not change the overall levels of effect determination for the program area. Exclusions of all EIAs combined with seasonal restrictions on other impact-producing activities permitted by BOEM (e.g., seismic exploration surveys) would provide the highest level of protection for all marine mammal species in the Beaufort Sea Program Area. This would result in little or no E&D activities taking place within the EIAs. E&D activities still could occur within these areas on active leases from previous lease sales. Ship and aircraft traffic associated with OCS oil and gas industry activities still could transit the excluded areas. If the exclusion applied only to leasing activities, G&G activities could be permitted to operate within the EIAs and ancillary, exploration, and development activities could take place on existing leases. The Cross Island and Kaktovik EIAs have active leases within their boundaries.

Alternately, a seasonal/temporal exclusion could be applied to all or some of the EIAs. This could exclude impact-producing activities (e.g., seismic surveys, exploration drilling) from taking place during the most sensitive time periods; for example, when bowhead whales are migrating past Camden Bay and subsistence hunting is taking place. Temporal/seasonal exclusions could be applied to any or all exploration activities within an EIA. If exploration leads to development and production on a particular lease block or blocks, production likely could not be halted seasonally and the impacts associated with production activities would not be reduced. Either full or seasonal exclusions of marine mammal foraging habitats or migration corridors during sensitive time periods could reduce impacts on marine mammals to negligible to minor, depending upon the species and the combination of mitigation measures selected.

Table 4.4.2-1. Change in Impacts on Marine Mammals in the Beaufort Sea Program Area from Alternative B

Impact-Producing Factor	Alternative A Impact Finding	Impact Change within or because of EIAs Relative to the Proposed Action
Noise	**Negligible – Moderate**	**Negligible** to **minor**. Within EIAs where leasing is excluded and BOEM-permitted activities with noise as an IPF are restricted during the open water season and during periods of migration.
Noise: Vessel/Aircraft Traffic	**Negligible – Moderate**	**No change**. Exclusion of EIA areas could decrease vessel and aircraft traffic within that area. However, most moderate impacts would occur within the coastal areas that are outside of the EIA.
Accidental Spills	**Negligible – Major**	**No change**. Exclusion of EIA areas would not prevent movement of an oil spill into that area if one should occur. However, limiting activities within the EIA could make it more unlikely that a spill would impact sensitive areas.

The IPFs of most relevance for Beaufort Sea marine mammal species are noise and the potential for spills. Bowhead and beluga whales are the most sensitive to noise associated with industry activities. These species could reduce communication calls when anthropogenic noise sources are nearby and could move away from the source of the noise (Blackwell et al. 2015, Awbrey and Stewart 2005). Reducing or eliminating noise impacts by limiting activities during migration and in foraging areas would be of benefit to these species. Polar bears and ice seals are less impacted by noise, but would be more at risk in the event of an accidental oil or fuel spill. Polar bears occur on the barrier islands and along the coastline in late summer and fall, and congregate in large numbers on Cross Island and Barter Island (Kaktovik). Reducing or eliminating activities that could result in a spill at these locations would benefit this species.

Barrow Canyon

Barrow Canyon is a highly productive area due in part to the bathymetry of the canyon and to upwelling and ocean currents. It encompasses areas of high benthic biomass and high productivity, which serve as seasonally important foraging areas for beluga and bowhead whales and seabirds. Bowhead and beluga whales migrate through the area in fall and spring; in some years, bowhead whales remain in the area for a prolonged foraging period. Ringed and bearded seals also forage here, which in turn draws polar bears. Exclusion or activity restrictions implemented for this area would provide protection of foraging habitat for marine mammals. It also would provide protection to individual marine mammals from auditory injuries and impairment from project-related noise and alteration or destruction of benthic feeding habitat from development activities.

Camden Bay

Camden Bay has been identified as an important ecological and subsistence area by whalers from Kaktovik and Nuiqsut. Whalers also have identified Camden Bay as an important area for bowhead whales (Huntington 2013). Aerial survey data analysis identifies areas farther east of Kaktovik and west toward Cross Island as being more frequently used by bowhead whales (NMFS 2013). This EIA primarily would benefit subsistence hunters and bowhead whales. Exclusion of this area, or implementation of seasonal activity restrictions for this area, would provide protection from disturbance to migrating and foraging bowhead whales.

Cross Island

Cross Island is an important bowhead subsistence area for whalers from Nuiqsut and has become a primary resting spot for polar bears awaiting freeze up in fall. Whalers report that bowhead whales are sensitive to anthropogenic noises and smells, which could impact hunting success. Exclusion of this area, or implementation of seasonal activity restrictions for this area, would provide protection from anthropogenic noise and smells to migrating bowhead whales and polar bears.

Kaktovik

Like Cross Island, Kaktovik (on Barter Island) is an important bowhead whale subsistence area for whalers and has become a primary resting spot for polar bears awaiting freeze up in fall. In recent years, 40 to 80 polar bears have congregated near the whale bones at the edge of town prior to freeze up. Exclusion of this area, or implementation of seasonal activity restrictions for this area, would provide protection to migrating bowhead whales and polar bears. **Table 4.4.2-1** provides a summary of the impact determinations for each IPF and how the impact determination would change with the implementation of the EIAs.

4.4.2.1.2 Birds

Reducing oil and gas activity in the Beaufort Sea EIAs would result in lesser impacts than those expected under the Proposed Action for birds. However, it would not change the overall levels of effect determination for the program area. A seasonal/temporal exclusion could be applied to all or some of the EIAs. This could exclude impact-producing activities from occurring during the most sensitive time periods of the open water season; for example, when waterfowl are congregating in nearshore waters prior to migrating southward. Temporal/seasonal exclusions could be applied for any or all exploration activities within an EIA. If exploration leads to development and production on a particular lease block or blocks, production could not be halted seasonally, and the impacts associated with production activities would not be reduced.

The IPF of most relevance for Beaufort Sea bird species is the potential for accidental spills. Many waterfowl species nest along the coastline at tundra ponds, while some seabirds (e.g., black guillemots [*Cepphus grille*], Arctic terns) nest on the barrier islands. Reducing or eliminating activities that could result in a spill at these locations would benefit these species, but would not change the levels of effect determination since impacts would still occur throughout the rest of the program area. The Teshekpuk Lake area has been identified as an IBA of global significance, while Harrison and Camden Bays have been identified as IBAs of continental significance (Audubon Society 2010).

Barrow Canyon

Barrow Canyon is a highly productive area due in part to the bathymetry of the canyon and to upwelling and ocean currents. It encompasses areas of high benthic biomass and high productivity, which serve as seasonally important foraging areas for seabirds (Kuletz et al. 2015). While excluding this area seasonally or completely would afford some protection to bird species from disturbance and disruption, it would not change the levels of effect determination for birds.

Camden Bay

Camden Bay has been identified as an important ecological and subsistence area by whalers from Kaktovik and Nuiqsut. Some colonial nesting species (common eiders and glaucous gulls [*Larus hyperboreus*]) nest in areas adjacent to or near Camden Bay. Shorebirds gather near the bay in large numbers in fall prior to migration. Camden Bay also is a seasonally important foraging area for other species (Arctic terns and black guillemots) (Kuletz et al. 2015). While excluding this area seasonally or completely would afford some protection to bird species from disturbance and disruption, it would not change the levels of effect determination for birds.

Cross Island

While excluding this area seasonally or completely would afford some protection to bird species from disturbance and disruption, it would not change the levels of effect determination for birds.

Kaktovik

While excluding this area seasonally or completely would afford some protection to bird species from disturbance and disruption, it would not change the levels of effect determination for birds.

4.4.2.1.3 Tourism and Recreation

Reducing oil and gas activity in the Beaufort Sea EIAs would result in less impacts than those expected under the Proposed Action for tourism and recreation. However, it would not change the overall levels of effect determination for the program area. Exclusion of the Beaufort Sea EIAs would reduce impacts from the activities associated with the Proposed Action on recreational and tourism resources within the Beaufort Sea. In particular, the Kaktovik and Camden Bay EIAs would provide additional distance between development and the shore of the Arctic NWR. This additional distance would slightly reduce the potential impacts of noise, visible infrastructure, and oil spills to tourists seeking a remote and natural experience at the Arctic NWR.

Camden Bay

Exclusion of or mitigation in this area from 2017–2022 OCS leasing would likely have **negligible** to **minor** impacts from visible infrastructure, noise, space-use conflict, and accidental spill impacts on visitors to the Arctic NWR. These impacts would be less than those anticipated for the activities associated with the Proposed Action, because this area would be protected from development in the vicinity of Camden Bay, just west of the Native Village of Kaktovik.

Kaktovik

Exclusion of or mitigation in this area from 2017–2022 OCS leasing would likely have **negligible** to **minor** impacts from visible infrastructure, noise, space-use conflict, and accidental spill impacts on visitors to the Arctic NWR. These impacts would be less than those anticipated for the activities associated with the Proposed Action because this area would be protected from development in the vicinity of the Native Village of Kaktovik.

4.4.2.1.4 Sociocultural Systems

Reducing oil and gas activity in the Beaufort Sea EIAs would result in less impacts than those expected under the Proposed Action for sociocultural systems (**Table 4.4.2-2**). However, it would not change the overall levels of effect determination for the program area. Exclusions of all EIAs combined with seasonal restrictions on other impact-producing activities that are permitted by BOEM (e.g., seismic exploration surveys) would provide the highest level of protection for subsistence species (and the communities that rely on them) in the Beaufort Sea Program Area. These areas include the vicinity of Barrow Canyon and the existing Barrow Whaling Area Presidential Withdrawal, the Camden Bay EIA, the vicinity of Cross Island, and the vicinity of Kaktovik (Barter Island) around the existing Presidential Withdrawal area.

Table 4.4.2-2. Change in Impact on Sociocultural Resources from Alternative B

Impact-Producing Factor	Alternative A Impact Finding	Impact Change within or because of EIAs Relative to the Proposed Action
Noise	**Moderate – Major**	Could reduce effects to **negligible** if excluded or during the time of the temporal mitigation.
Traffic: Vessel/Aircraft Traffic	**Moderate – Major**	Could reduce effects to **negligible** if excluded or during the time of the temporal mitigation.
Bottom/Land Disturbance	**Moderate**	Could reduce effects to **negligible**.
Routine Discharges	**Moderate**	Could reduce effects to **negligible**.
Space-use Conflict	**Moderate – Major**	Could reduce effects to **negligible** if excluded or during the time of the temporal mitigation.
Visible Infrastructure	**Moderate – Major**	Could not reduce effects and they would remain **moderate** to **major** because of potential onshore infrastructure changes.

This would result in little or no E&D activities taking place within the EIAs. E&D activities could still occur within these areas on active leases from previous lease sales. Ship and aircraft traffic associated with OCS oil and gas industry activities could still transit the excluded areas. If the exclusion applied only to leasing activities, G&G activities could be permitted to operate within the EIAs and ancillary, exploration, and development activities could take place on existing leases.

Alternative B could reduce the potential for moderate to major effects described under Alternative A to **negligible** for resources within an EIA or for the people that depend upon those resources (**Table 4.4.2-2**). The reason for this conclusion is that Alternative B either excludes OCS activity altogether or minimizes potential effects in the EIA. For example, temporal mitigation restrictions could be applied during the most sensitive time periods when whales are migrating and subsistence hunting is occurring. Mitigation (e.g., seasonal closures) from lease stipulations, Government-to-Government consultation, and Conflict Avoidance Agreements developed under the MMPA are designed to reduce impacts on local communities and could be applied to noise, traffic, space-use conflicts, and accidental spills and CDEs, thereby reducing effects. Although vessel and air traffic could still occur through or over the EIAs, traffic could occur at reduced levels and frequencies. Alternative B would still allow OCS activities outside of an EIA, and those activities would still result in **moderate** to **major** effects as previously analyzed.

It is possible that OCS activities would still occur in parts of the OCS outside of the EIAs and proximate to communities, and therefore result in lesser visual impacts. Although impacts would be less severe than under the Proposed Action, impacts could be **moderate** given the largely undisturbed seascape. Exclusion of EIAs under Alternative B could prevent OCS activity or facilities in some areas and subsequently obviate the need for onshore activity or facilities in the immediate vicinity of communities. However, exclusion of EIAs or temporal mitigation would not necessarily avoid all onshore construction and related visual effects; therefore, there is the potential for **moderate** to **major** impacts depending on the location and scale of development. As described in Alternative A, visual impacts can result in **moderate** to **major** impacts on the sense of well-being and cultural identity.

4.4.2.1.5 Environmental Justice

Reducing oil and gas activity in the Beaufort Sea EIAs would result in lesser impacts than those expected under the Proposed Action for environmental justice. However, it would not change the overall levels of effect determination for the program area. Exclusions of all EIAs combined with seasonal restrictions on other impact-producing activities that are permitted by BOEM (e.g., seismic exploration surveys) would provide the highest level of protection for subsistence species (and the communities that rely on them) in the Beaufort Sea Program Area. This would result in little or no E&D activities taking place within the EIAs. E&D activities could still occur within these areas on active leases from previous lease sales. Ship and aircraft traffic associated with OCS oil and gas industry activities could still transit the excluded areas. If the exclusion applied only to leasing activities, G&G activities could be permitted to operate within the EIAs and ancillary, exploration, and development activities could take place on existing leases.

Barrow Canyon

This EIA is in the vicinity of Barrow Canyon and the existing Barrow Whaling Area Presidential Withdrawal. Exclusion of, or mitigation in, this area in the 2017–2022 Program would likely result in **negligible** to **minor** impacts, having less impact than the Proposed Action on the surrounding community and its culture, because this area would be protected from development, causing little if any change in subsistence activities in the vicinity of Barrow Canyon just east of the community of Barrow.

Camden Bay

This area is important ecologically and for subsistence use. Exclusion of, or mitigation in, this area in the 2017–2022 Program would likely result in **negligible** to **minor** impacts, having less impact than the Proposed Action on the surrounding community and its culture because this area would be protected from development, causing little if any change in subsistence activities in the vicinity of Camden Bay just west of the community of Kaktovik.

Cross Island

The area to the north and east of Cross Island is an important and historically significant subsistence hunting area. Exclusion of, or mitigation in, this area in the 2017–2022 Program would likely result in **negligible** to **minor** impacts, having less impact than the Proposed Action on the surrounding community and its culture because this area would be protected from development, causing little if any change in subsistence activities in the vicinity of Cross Island between the communities of Nuiqsut and Kaktovik.

Kaktovik

This EIA is offshore Kaktovik (Barter Island) around the existing presidential withdrawal area. Exclusion of, or mitigation in, this area in the 2017–2022 Program would likely result in **negligible** to **minor** impacts, having less impact than the Proposed Action on the surrounding community and its culture because this area would be protected from development causing little if any change in subsistence activities in the vicinity of the community of Kaktovik.

4.4.2.2 Alternative B(2): Chukchi Sea

There would not be any change in potential level of impact from Alternative A for the following resource areas: air quality; water quality; marine benthic communities; coastal and estuarine habitats; pelagic communities; fish and EFH; Arctic terrestrial wildlife and wildlife habitat; archaeological and historical resources; land use and infrastructure; population, employment, and income; commercial and recreational fisheries; and tourism and recreation. This is because the exclusion or implementation of mitigation measures within these areas would benefit only resources found with them or that rely on them. Resources for which there could be change in potential impact levels are discussed in the following subsections.

4.4.2.2.1 Marine Benthic Communities

Reducing oil and gas activity in the Chukchi Sea EIAs would result in leser impacts than those expected under the Proposed Action for marine benthic communities. However, it would not change the overall levels of effect determination for the program area. The Walrus Foraging Area and the Walrus Movement Corridor, including Hanna Shoal (Dunton et al. 2005), encompass areas of high benthic biomass and especially large numbers of bivalves (Schonberg et al. 2014). Exclusion of this area in the Program would eliminate practically all IPFs to benthic environments. This would benefit not only the benthic communities in the EIA but also the animals that rely on these assemblages for food, namely walrus and other marine mammals, and potentially species of seabirds. While excluding this area seasonally or completely could afford some protection to benthic communities from disturbance and disruption, it would not change the levels of effect determination for benthic communities in the program area, which would be **negligible** to **moderate**.

4.4.2.2.2 Marine Mammals

Reducing oil and gas activity in the Chukchi Sea EIAs would result in lesser impacts than those expected under the Proposed Action for marine mammals (**Table 4.4.2-3**). However, it would not change the overall levels of effect determination for the program area. The Walrus Foraging Area EIA includes the HSWUA. The Movement Corridor includes the area between the HSWUA and terrestrial resting areas, or haul outs. The HSWUA has been identified as important walrus foraging habitat by the USFWS in the *Final Incidental Take Regulations for Polar Bears and Pacific Walrus for the Chukchi Sea* issued June 12, 2013 (78 FR 35364). This determination is based on walrus tagging studies conducted by the USGS that have tracked walrus movements and identified foraging and resting habitat (Jay et al. 2012).

Hanna Shoal is an area of high benthic biomass and is a primary foraging habitat for walrus, gray whales, and a variety of seabird species during the open water season (Brueggeman 2009, Gall et al. 2013). Sea ice remnants grounded on the shoal remain after much of the sea ice has retreated off of the shelf area, which provides resting habitat for walrus and seals between foraging attempts. In addition, bowhead whales move through the Hanna Shoal area during the fall migration from August to December (Quakenbush et al. 2012). Once the remnant ice melts, and in recent low-ice years, as many as 35,000 walrus have been hauling out near Point Lay and transiting from terrestrial haul outs to the HSWUA to forage (Fischbach et al. 2016). Exclusion of these areas or implementation of activity restrictions would provide protection of foraging habitat for walrus and other marine mammals from disturbance by industry activities as they forage and move between terrestrial haul outs and foraging areas. This protection would be limited in the nearshore area; however, as other operators (e.g., commercial aircraft and barges, research vessels, private vessels, aircraft) still would transit along the nearshore corridor and research vessels would continue to operate in the HSWUA. Exclusion activity restrictions in these areas would primarily benefit walrus but also gray whales, bearded seals, and to a lesser extent, other marine mammal and seabird species. Because walrus are benthic feeders, exploration activities that disturb the seafloor and impact the benthos, such as exploration drilling, could impact walrus by reducing available prey species, even if the activities were conducted when walrus were not present.

Table 4.4.2-3. Change in Impacts on Marine Mammals in the Chukchi Sea Program Area from Alternative B

Impact-Producing Factor	Alternative A Impact Finding	Impact Change within or because of EIAs Relative to the Proposed Action
Noise	**Negligible – Moderate**	**Negligible** to **minor** within EIAs where leasing is excluded and BOEM-permitted activities with noise as an IPF are restricted during the open water season and during periods of migration.
Traffic: Vessel/Aircraft Traffic	**Negligible – Moderate**	**No change**. Exclusion of EIAs could decrease vessel and aircraft traffic within those areas. However, most major impacts would occur within the coastal areas that are outside of the EIA.
Bottom/Land Disturbance: Drilling Muds/Cuttings/Debris	**Negligible – Moderate**	**Negligible to minor** if the Walrus Foraging Area is excluded, due to its ecological importance within the Chukchi Sea.
Accidental Spills	**Negligible – Major**	**No change**. Exclusion of EIA areas would not prevent movement of an oil spill into that area if one should occur. However, limiting activities within the EIA could make it more unlikely that a spill would impact sensitive areas.

4.4.2.2.3 Birds

Reducing oil and gas activity in the Chukchi Sea EIAs would result in less impacts than those expected under the Proposed Action for birds. However, it would not change the overall levels of effect determination for the program area. The Walrus Foraging Area EIA includes the HSWUA and the corridor between foraging areas and terrestrial resting areas or haul outs. Hanna Shoal is an area of high benthic biomass and is a primary foraging habitat for walrus, gray whales, and a variety of seabird species during the open water season (Brueggeman 2009, Gall et al. 2013). Exclusion of this area or activity restrictions implemented for this area primarily would benefit walrus but also gray whales, bearded seals, and to a lesser extent, other marine mammal and seabird species.

4.4.2.2.4 Sociocultural Systems

Reducing oil and gas activity in the Chukchi Sea EIAs would result in less impacts than those expected under the Proposed Action for sociocultural systems. However, it would not change the overall levels of effect determination for the program area. Exclusions of all EIAs combined with seasonal restrictions on other impact-producing activities that are permitted by BOEM (e.g., seismic exploration surveys) would provide the highest level of protection for subsistence species (and the communities that rely on them) in the Chukchi Sea Program Area. This would result in little or no E&D activities taking place within the EIAs. E&D activities could still occur within these areas on active leases from previous lease sales. Ship and aircraft traffic associated with offshore oil and gas industry activities could still transit the excluded areas. If the exclusion applied only to leasing activities, G&G activities could be permitted to operate within the EIAs and ancillary, exploration, and development activities could take place on existing leases.

Alternative B could reduce the potential for moderate to major effects described under Alternative A to **negligible** within an EIA (**Table 4.4.2-4**). The reason for this conclusion is that Alternative B either excludes OCS activity altogether or minimizes potential effects in the EIA. Temporal mitigation restrictions could be applied during the most sensitive time periods when whales are migrating and subsistence hunting is occurring. Mitigation (e.g., seasonal closures) from lease stipulations, government-to-government consultation, and Conflict Avoidance Agreements developed under the MMPA are designed to reduce impacts on local communities and could be applied to noise, traffic, OCS space-use conflicts, and accidental spills and CDEs, thereby reducing effects. Although vessel and air traffic could still occur through or over the EIAs, traffic is expected to occur at reduced levels and frequency. Alternative B would allow OCS activities outside of an EIA, and those activities would still result in **moderate** to **major** effects, as previously analyzed.

Table 4.4.2-4. Change in Impacts on Sociocultural Systems in the Chukchi Sea Program Area from Alternative B

Impact-Producing Factor	Alternative A Impact Finding	Impact Change within or because of EIAs Relative to the Proposed Action
Noise	**Moderate – Major**	Would reduce effects to **negligible** if excluded or during the time of the temporal mitigation.
Traffic: Vessel/Aircraft Traffic	**Moderate – Major**	Would reduce effects to **negligible** if excluded or during the time of the temporal mitigation.
Bottom/Land Disturbance	**Moderate**	Would reduce effects to **negligible**.
Routine Discharges	**Moderate**	Would reduce effects to **negligible**.
Space-use Conflict	**Moderate – Major**	Would reduce effects to **negligible** if excluded or during the time of the temporal mitigation.
Visible Infrastructure	**Moderate – Major**	Would not reduce effects and they would remain **moderate** to **major** because of potential onshore infrastructure changes.

Because of the existing coastal buffer, visual impacts from OCS activities on the OCS would be limited to vessel traffic and pipeline-related operations. Exclusion of EIAs under Alternative B could reduce OCS activity or facilities in some areas and subsequently obviate the need for onshore activity or facilities in the immediate vicinity of communities. However, exclusion of EIAs or temporal mitigation would not necessarily avoid all onshore construction and related visual effects; therefore, there is the potential for moderate to major impacts depending on the location and scale of development. As described in Alternative A, visual impacts can result in **moderate** to **major** impacts on the sense of well-being and cultural identity.

4.4.2.2.5 Environmental Justice

The analysis of Alternative B(2) considers new leasing in the program area and exclusion or programmatic mitigation (through temporal closure) of two related EIAs. The EIAs in this area include two interrelated subareas: the Walrus Foraging Area (Alternative B(2)(a)) and the Walrus Movement Corridor (Alternative B(2)(b)). Reducing oil and gas activity in the Chukchi Sea EIAs would result in less impacts than those expected under the Proposed Action for environmental justice. However, it would not change the overall levels of effect determination for the program area. Reducing or eliminating impacts during subsistence activities would benefit the communities that rely on them. There are no active leases in this area, and this area would be protected from new development. This would result in little or no E&D activities taking place within the EIAs. Ship and aircraft traffic could still transit the excluded areas. If the exclusion applied only to leasing activities, G&G activities could be permitted to operate within the EIAs. Exclusion of, or mitigation in, this area in the 2017–2022 Program would likely result in **negligible** to **minor** impacts, having less impact than the Proposed Action on the surrounding community and its culture because this area would be protected from development, causing little if any change in subsistence activities taking place near the communities of Barrow and Wainwright.

4.4.2.3 Alternative B(3): Cook Inlet

There would not be any change in potential level of impact from Alternative A for all resources except marine mammals because this EIA consists of a small area of Beluga Whale Critical Habitat at the northern edge of the program area. Reducing oil and gas activity in the Cook Inlet EIA could result in less impacts than those expected under the Proposed Action for beluga whales in Cook Inlet. There would not be any change in potential level of impact from Alternative A for marine mammal species other than beluga whales. While selection of this EIA for exclusion would offer some protection to Beluga Whale Critical Habitat, the level of impact would remain **minor** to **moderate**, depending upon which other mitigation measures were applied (e.g., PSOs to determine shut down and ramp-up procedures).

The Cook Inlet beluga whale is one of five genetically distinct populations in Alaska. It is geographically isolated, and remains year-round in Cook Inlet for mating, rearing, and feeding. Cook Inlet beluga whales were designated as endangered under the ESA in 2008. Surveys conducted by NMFS have estimated a current population of approximately 300 beluga whales in Cook Inlet, down from historical estimates of 1,300 (NMFS 2015c).

Beluga whales are highly vocal and use calls for social purposes and to locate prey. Beluga whales would reduce vocal activity in noisy environments (Širović and Kendall 2009, Small et al. 2011) and especially when frightened or in the presence of predators (Sjare and Smith 1986a, Sjare and Smith 1986b, Finley 1990, Karlsen et al. 2002, Belikov and Bel'kovich 2003). Anthropogenic noise and its impacts on prey species and habitat have been identified as threats to the beluga whales in their Recovery Plan (NMFS 2015d). Reducing anthropogenic noise and activity by excluding this area could be of some benefit to the remaining small numbers of Cook Inlet beluga whales (**Table 4.4.2-5**). Noise reduction would not have any appreciable effect for other marine mammal species in Cook Inlet.

Table 4.4.2-5. Change in Impacts on Beluga Whales in the Cook Inlet Program Area from Alternative B

Impact-Producing Factor	Alternative A Impact Finding	Impact Change within or because of EIAs Relative to the Proposed Action
Noise	**Negligible – Moderate**	**No change**. The critical habitat areas are so small that they would not provide adequate protection from noise, especially seismic activities.
Traffic: Vessel/Aircraft Traffic	**Negligible – Moderate**	**Negligible** to **minor** if vessels and aircraft avoid critical habitat areas.
Accidental Spills	**Negligible – Major**	**No change**. The small size of the beluga whale area likely would not provide any protection from accidental spills.

4.4.3 Alternative C – Reduced Proposed Action

Alternative C contemplates the exclusion of one or more program area(s) while maintaining the complement of lease sales in areas that are not excluded. The following analysis considers the impacts on the area that is excluded. In areas that are not excluded, the impacts would be largely the same as those under the Proposed Action (Alternative A) analyzed in **Section 4.4.1**. Under Alternative C, there would be no activities from the 2017–2022 Program within the excluded program area(s); therefore, no impacts related to OCS activities in that area would occur. In the excluded area(s), effects related to the Program could occur in two ways: (1) activities in one program area could result in impacts in the excluded area(s); and (2) species that migrate between program areas could be impacted within an included program area that then results in impacts in an excluded area. **Table 4.4.3-1** shows the change in impacts relative to the Proposed Action for each element of Alternative C – C(1) exclusion of the Beaufort Sea Program Area, C(2), exclusion of the Chukchi Sea Program Area, C(3), exclusion of the Cook Inlet Program Area, and C(4), exclusion of the GOM Program Area. The potential impacts for areas not excluded are also shown in **Table 4.4.3-1**.

Energy substitutes would be required to replace oil and gas production foregone in the event one or more program area(s) is excluded from the Program. **Section 2.4** discusses the relative contribution of each program area to the overall production expected from the 2017–2022 Program and **Section 3.5.2** discusses the substitutes that could be expected to replace foregone production. **Section 4.4.4** discusses, to the extent possible, the impacts of energy substitutes that are reasonably foreseeable in the program areas should leasing not occur in the 2017-2022 Program. Impacts from energy substitutions would only occur in each program area under Alternative C if (1) substitutions are required to meet demand; and (2) activities associated with energy substitutions actually occur in a program area considered in Alternative C (likely to occur only in the GOM). Otherwise, impacts from substitutions could occur in other program areas outside of any Alternative C program area depending on the energy substitute. Any energy substitution compensating for no leasing in program areas under Alternative C would be less than the substitutions required if all program areas were removed under Alternative D. The need for these substitutes is considered over the life of the Program. The exact timing of when these substitutes would come online or the influence changes in current policy could have on the need for substitutes is not considered because to do so would be largely speculative.

Table 4.4.3-1. Comparison of Potential Impacts under Alternative C, Considering Inclusion and Exclusion of each Individual Program Area

Resource	Alternative A Proposed Action				Alternative C Reduced Proposed Action with Energy Substitutes							
	Beaufort	Chukchi	Cook Inlet	Gulf of Mexico	Beaufort Sea		Chukchi		Cook Inlet		Gulf of Mexico	
					Include	Exclude	Include	Exclude	Include	Exclude	Include	Exclude
Air Quality	Minor	Minor	Minor	Moderate	=	↓	=	↓	=	↓	=	↓
Water Quality	Moderate	Moderate	Moderate	Moderate	=	↓	=	↓	=	↓	=	↓
Coastal & Estuarine Habitats	Minor	Moderate	Minor	Moderate	=	↓	=	↓	=	↓	=	↓
Marine Benthic Communities	Moderate	Moderate	Moderate	Moderate	=	↓	=	↓	=	↓	=	↓
Pelagic Communities	Minor	Minor	Minor	Minor	=	↓	=	↓	=	↓	=	↓
Marine Mammals	Moderate	Moderate	Moderate	Moderate	=	↓	=	↓	=	↓	=	↓
Sea Turtles	not applicable	not applicable	not applicable	Moderate	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	=	↓
Birds	Minor	Minor	Minor	Minor	=	↓	=	↓	=	↓	=	↓
Fish & EFH	Minor	Minor	Minor	Minor	=	↓	=	↓	=	↓	=	↓
Arctic Terrestrial Wildlife & Habitats	Moderate	Moderate	not applicable	not applicable	=	↓	=	↓	not applicable	not applicable	not applicable	not applicable
Archaeological & Historical Resources	Major	Major	Major	Major	=	↓	=	↓	=	↓	=	↓
Population, Employment, & Income	Moderate	Moderate	Minor	Minor	=	↓	=	↓	=	↓	=	↑
Land Use & Infrastructure	Moderate	Moderate	Moderate	Moderate	=	↓	=	↓	=	↓	=	↑
Commercial & Recreational Fisheries	not applicable	not applicable	Minor	Minor	not applicable	not applicable	not applicable	not applicable	=	↓	=	↓
Tourism & Recreation	Moderate	Moderate	Moderate	Moderate	=	↓	=	↓	=	↓	=	↓
Sociocultural Systems	Major	Major	Minor	Minor	=	↓	=	↓	=	↓	=	↑
Environmental Justice	Major	Major	Minor	Minor	=	↓	=	↓	=	↓	=	↑

● (yellow) = Minor | ● (orange) = Moderate | ● (red) = Major | "=" = No Change | ↑ = More impact OR ↓ = Less impact than the Proposed Action | ■ (gray) = not applicable

Table 4.4.3-2 shows a comparison of where potential cross-boundary and migratory species impacts could occur between program areas. For example, if the Beaufort Sea Program Area is removed from the Program, cross-boundary impacts could still occur on the adjacent Chukchi Sea Program Area, and vice versa. These impacts could occur from activities and IPFs in one program area that move into another program area, thereby resulting in impacts in a program area removed from leasing consideration. This could include dispersal of spilled oil, vessel traffic routes, and propagation of seismic noise. Additionally, it is possible that impacts on migratory animals, including whales, fish, and birds, could occur in an excluded program area because those animals could be impacted in an included program area. An example would be impacts on birds migrating from an area with no OCS activities to an area with OCS activities, if it is anticipated that those activities could result in avoidance/alteration of migratory routes or other patterns of migration.

Direct and indirect impacts associated with the removal of a program area under Alternative C would be largely equivalent to Alternative D for that program area for the 2017–2022 Program as would impacts from ongoing and future actions (effects baseline), with the exception of the impacts related to energy substitutes. If leasing did not continue after the 2017–2022 Program, oil and gas leasing would be effectively eliminated from the suite of reasonably foreseeable future activities that would cause environmental impacts. It is possible that energy substitutes would also be required under Alternative C, depending on the area(s) excluded and the timing of leasing under future programs. Although energy substitutions could be required under both Alternatives C and D, a greater volume of substitutes would be necessary to meet national energy demand under Alternative D since all program areas would be removed from leasing and no new OCS oil and gas production would occur. The types of impacts under Alternatives C and D would be similar, although substitute use is expected to be less under Alternative C since some OCS oil and gas production would still occur.

Table 4.4.3-2. Comparison of Alternative C Variations

Alternative C Variations	Analysis for Areas Removed	Analysis for Areas Not Removed	Cross-Boundary IPFs Remain?[1]	Potential for Migratory Species Impacts across Program Areas?[2]	Potential for Substitution Impacts in the Removed Program Area?
1. C1 – Exclude Beaufort Sea Program Area	Section 4.4.4	Section 4.4.1	Chukchi Sea → Beaufort Sea	Chukchi Sea to Beaufort Sea, Cook Inlet, and GOM	No
2. C2 – Exclude Chukchi Sea Program Area	Section 4.4.4	Section 4.4.1	Beaufort Sea → Chukchi Sea	Beaufort Sea to Chukchi Sea, Cook Inlet, and GOM	No
3. C3 – Exclude Cook Inlet Program Area	Section 4.4.4	Section 4.4.1	Chukchi Sea → Beaufort Sea Beaufort Sea → Chukchi Sea	Chukchi Sea and Beaufort Sea to Cook Inlet and GOM	No
4. C4 – Exclude GOM Program Area	Section 4.4.4	Section 4.4.1	Chukchi Sea → Beaufort Sea Beaufort Sea → Chukchi Sea	Chukchi Sea to and from Beaufort Sea and Cook Inlet	Yes
5. Exclude Beaufort Sea and Chukchi Sea Program Areas	Section 4.4.4	Section 4.4.1	No	Cook Inlet to Chukchi Sea and Beaufort Sea	No
6. Exclude Beaufort Sea and Cook Inlet Program Areas	Section 4.4.4	Section 4.4.1	Chukchi Sea → Beaufort Sea	Chukchi Sea to Beaufort Sea and Cook Inlet	No
7. Exclude Beaufort Sea and GOM Program Areas	Section 4.4.4	Section 4.4.1	Chukchi Sea → Beaufort Sea	Chukchi Sea to Beaufort Sea, Cook Inlet, and GOM	Yes
8. Exclude Chukchi Seas and Cook Inlet Program Areas	Section 4.4.4	Section 4.4.1	Beaufort Sea → Chukchi Sea	Beaufort Sea to Chukchi Sea, Cook Inlet, and GOM	No
9. Exclude Chukchi Sea and GOM Program Areas	Section 4.4.4	Section 4.4.1	Beaufort Sea → Chukchi Sea	Beaufort Sea to Chukchi Sea, Cook Inlet, and GOM	Yes
10. Exclude Cook Inlet and GOM Program Areas	Section 4.4.4	Section 4.4.1	Chukchi Sea → Beaufort Sea Beaufort Sea → Chukchi Sea	Chukchi Sea to Beaufort Sea and Beaufort Sea to Chukchi Sea and to GOM	Yes
11. Exclude Beaufort Sea, Chukchi Sea, and Cook Inlet Program Areas	Section 4.4.4	Section 4.4.1	Chukchi Sea → Beaufort Sea	GOM to Beaufort Sea and Chukchi Sea	No
12. Exclude Beaufort Sea, Chukchi Sea, and GOM Program Areas	Section 4.4.4	Section 4.4.1	No	Cook Inlet to Beaufort Sea and Chukchi Sea	Yes
13. Exclude Beaufort Sea, Cook Inlet, and GOM Program Areas	Section 4.4.4	Section 4.4.1	Chukchi Sea → Beaufort Sea	Chukchi Sea to Beaufort Sea, Cook Inlet, and GOM	Yes
14. Exclude Chukchi Sea, Cook Inlet, and GOM Program Areas	Section 4.4.4	Section 4.4.1	Beaufort Sea → Chukchi Sea	Beaufort Sea to Chukchi Sea, Cook Inlet, and GOM	Yes

Notes: Alternative A (Proposed Action) would have all four program areas (Beaufort Sea, Chukchi Sea, Cook Inlet, and GOM) and Alternative D would have no program areas.

1. Cross-boundary impacts could occur from vessel traffic, accidental spills, and seismic noise.
2. Migratory species impacts could occur on whales, fish, and birds.

4.4.3.1 C(1): Exclusion of the Beaufort Sea Program Area

If the Beaufort Sea Program Area is removed from the 2017–2022 Program, there would be no new leasing and the potential impacts identified in **Section 4.4.1** for the Beaufort Sea Program Area would not manifest. Impacts under C(1) for the Beaufort Sea Program Area are expected to be **substantially less** than those for the Proposed Action for air quality, water quality, coastal and estuarine habitats, marine benthic communities, pelagic communities, marine mammals, birds, fish and EFH, Arctic terrestrial wildlife and habitat, archaeological and historical resources, commercial and recreational fisheries, land use and infrastructure, tourism and recreation, sociocultural systems, and environmental justice. The resources within the excluded area would still experience impacts from the range of past, present, and reasonably foreseeable future actions described in **Section 3.6** and **Appendix B**. The impacts for this area would be similar to those described in **Section 4.4.4** for the No Action Alternative. The impacts for any of the three other program areas not excluded would be the same as those described for the Proposed Action in **Section 4.4.1**. **Table 4.4.3-1** shows the impacts for all program areas considering the removal of the Beaufort Sea Program Area. If the Beaufort Sea Program Area were excluded and a spill occurred in the adjacent Chukchi Sea Program Area, there is the possibility that a spill in the Chukchi Sea could affect resources in the Beaufort Sea by spreading into the Beaufort Sea or impacting migratory species movement (through avoidance of certain areas with a spill or spill response activities) between the Chukchi and Beaufort Seas (**Table 4.4.3-2**).

Exclusion of the Beaufort Sea Program Area could also result in eliminating the potential for beneficial effects, particularly with regard to population, employment, and income. Alternative C(1) would eliminate any potential for an increase in tax and other revenues that could result in improved public infrastructure (e.g., road, sewer and water, community buildings) and community services (e.g., healthcare, education, fire and rescue) for areas within the NSB (NEI 2006). The potential for commensurate changes in personal income, standard of living, sense of well-being, and lifestyle amenities at the individual, family, and community levels would also be eliminated.

Impacts from energy substitutes are not expected to occur in the Beaufort Sea Program Area in the event that this area is not selected for 2017–2022 OCS leasing. Oil and gas production from the Beaufort Sea Program Area is expected to be 26 percent of the total OCS production for the 2017–2022 Program under the mid-price scenario. As discussed in **Section 4.4.4.12**, the demand for foregone energy resources would likely be met by equivalent changes in onshore production, imports, and a reasonably small amount of fuel switching and/or reduced consumption. However, the energy substitutes are unlikely to be concentrated in any one geographic area. Oil and gas production onshore and in state waters in Alaska is not expected to increase appreciably as a result of removal of the Beaufort Sea Program Area. Oil and gas imports would not increase to Alaska in the absence of OCS production.

As discussed in **Section 4.4.1.12**, North Slope oil production onshore and from state waters has been declining, threatening the viability of TAPS, which requires a certain level of throughput to operate. TAPS is the only existing means of transporting oil from the North Slope to market. Oil from the Beaufort Sea would be piped to TAPS for transportation to market, and it is anticipated that oil from the Chukchi Sea would as well. If TAPS throughput declines much further, it might become insufficient to support the system, threatening the loss of North Slope oil production and budget shortfalls for the NSB and the state's general fund. The losses of revenue, employment, and income resulting from the closure of TAPS would force a fundamental restructuring of local and state economies and have a major impact on the welfare of Alaska residents. While Alaska OCS production is unlikely to eliminate the near-term, low-flow challenges that face TAPS, it could help extend the viability of the pipeline at some point in the future.

As discussed above, impacts from energy substitutes required for foregone production in Alaska would be expected to occur primarily outside Alaska. Therefore, no impacts from energy substitutes are expected on resource areas from excluding any or all of the Alaska program areas.

4.4.3.2 C(2): Exclusion of the Chukchi Sea Program Area

If the Chukchi Sea Program Area is removed from the 2017–2022 Program, there would be no new leasing and the potential impacts identified in **Section 4.4.1** for the Chukchi Sea Program Area would not manifest. Impacts under C(2) for the Chukchi Sea Program Area are expected to be **substantially less** than those for the Proposed Action for air quality, water quality, coastal and estuarine habitats, marine benthic communities, pelagic communities, marine mammals, birds, fish and EFH, Arctic terrestrial wildlife and habitat, archaeological and historical resources, commercial and recreational fisheries, land use and infrastructure, tourism and recreation, sociocultural systems, and environmental justice. The resources within the excluded area would still experience impacts from the range of past, present, and reasonably foreseeable future actions described in **Section 3.6** and **Appendix B**. The impacts for this area would be similar to those described in **Section 4.4.4** for the No Action Alternative. The impacts for any of the three other program areas not excluded would be the same as those described for the Proposed Action in **Section 4.4.1**. **Table 4.4.3-1** shows the impacts for all program areas considering the removal of the Chukchi Sea Program Area. If the Chukchi Sea Program Area were excluded and a spill occurred in the adjacent Beaufort Sea Program Area, there is the possibility that a spill in the Beaufort Sea could affect resources in the Chukchi Sea by spreading into the Chukchi Sea or impacting migratory species movement (through avoidance of certain areas with a spill or spill response activities) between the Chukchi and Beaufort Seas (**Table 4.4.3-2**).

Exclusion of the Chukchi Sea Program Area could also result in eliminating the potential for beneficial effects, particularly with regard to population, employment, and income. Alternative C(2) would eliminate any potential for an increase in tax and other revenues that could result in improved public infrastructure (e.g., road, sewer and water, community buildings) and community services (e.g., healthcare, education, fire and rescue) for areas within the NSB (NSE 2006). The potential for commensurate changes in personal income, standard of living, sense of well-being, and lifestyle amenities at the individual, family, and community levels would also be eliminated.

Impacts from energy substitutes are not expected to occur in the Chukchi Sea Program Area in the event that this area is not selected for 2017–2022 OCS leasing. Oil and gas production from the Chukchi Sea Program Area is expected to be 23 percent of the total OCS production for the 2017–2022 Program under the mid-price scenario. As discussed in **Section 4.4.4.12**, the demand for foregone energy resources would likely be met by equivalent changes in onshore production, imports, and a reasonably small amount of fuel switching and/or reduced consumption. However, the energy substitutes are unlikely to be concentrated in any one geographic area. Oil and gas production onshore and in state waters in Alaska is not expected to increase appreciably as a result of removal of the Chukchi Sea Program Area. Oil and gas imports would not increase to Alaska in the absence of OCS production.

As discussed in **Section 4.4.1.12**, North Slope oil production onshore and from state waters has been declining, threatening the viability of TAPS, which requires a certain level of throughput to operate. TAPS is the only existing means of transporting oil from the North Slope to market. Oil from the Beaufort Sea would be piped to TAPS for transportation to market, and it is anticipated that oil from the Chukchi Sea would as well. If TAPS throughput declines much further, it might become insufficient to support the system, threatening the loss of North Slope oil production and budget shortfalls for the NSB and the state's general fund. The losses of revenue, employment, and income resulting from the closure of TAPS would force a fundamental restructuring of local and state economies and have a major impact on the welfare of Alaska residents. While Alaska OCS production is unlikely to eliminate the near-term, low-flow challenges that face TAPS, it could help extend the viability of the pipeline at some point in the future.

As discussed above, impacts from energy substitutes required for foregone production in Alaska would be expected to occur primarily outside Alaska. Therefore, no impacts from energy substitutes are expected on resource areas from excluding any or all of the Alaska program areas.

4.4.3.3 C(3): Exclusion of the Cook Inlet Program Area

If the Cook Inlet Program Area is removed from the 2017–2022 Program, there would be no new leasing and the potential impacts identified in **Section 4.4.1** for the Cook Inlet Program Area would not manifest. Impacts under C(3) for the Cook Inlet Program Area are expected to be **substantially less** than those for the Proposed Action for air quality, water quality, coastal and estuarine habitats, marine benthic communities, pelagic communities, marine mammals, sea turtles, birds, fish and EFH, , archaeological and historical resources, commercial and recreational fisheries, land use and infrastructure, tourism and recreation, sociocultural systems, and environmental justice. The resources within the excluded area would still experience impacts from the range of past, present, and reasonably foreseeable future actions described in **Section 3.6** and **Appendix B**. The impacts for this area would be similar to those described in **Section 4.4.4** for the No Action Alternative. The impacts for any of the three other program areas not excluded would be the same as those described for the Proposed Action in **Section 4.4.1**. **Table 4.4.3-1** shows the impacts for all program areas considering the removal of the Cook Inlet Program Area. If the Cook Inlet Program Area were excluded under Alternative C, there is some limited potential for impacts in other program areas that are not excluded to be felt in the Cook Inlet Program Area. For example, bird species that occur in the Cook Inlet Program Area that migrate or travel to the Arctic or the GOM during part of the year could experience impacts in those areas (**Table 4.4.3-1**). Alternative C(3) could also result in removing the potential for beneficial effects, particularly with regard to population, employment, and income. Alternative C(3) would eliminate any potential for an increase in tax and other revenues.

Impacts from energy substitutes are not expected to occur in the Cook Inlet Program Area in the event that this area is not selected for 2017–2022 OCS leasing. Oil and gas production from the Cook Inlet Program Area is expected to be 2 percent of the total OCS production for the 2017–2022 Program under the mid-price scenario. As discussed in **Section 4.4.4.12**, the demand for foregone energy resources would likely be met by equivalent changes in onshore production, imports, and a reasonably small amount of fuel switching and/or reduced consumption. As discussed above, impacts from energy substitutes required for foregone production in Alaska would be expected to occur primarily outside Alaska. Therefore, no impacts from energy substitutes are expected on resource areas from excluding any or all of the Alaska program areas..

4.4.3.4 C(4): Exclusion of the Gulf of Mexico Program Area

If the GOM Program Area is removed from the 2017–2022 Program, there would be no new leasing and the potential impacts identified in **Section 4.4.1** for the GOM Program Area would not manifest. Impacts under Alternative C(4) for the GOM Program Area are expected to be **substantially less** than the Proposed Action for air quality, water quality, coastal and estuarine habitats, marine benthic communities, pelagic communities, marine mammals, sea turtles, birds, fish and EFH, archaeological and historical resources, commercial and recreational fisheries, and tourism and recreation. Impacts could be **more** than the Proposed Action for population, employment, and income; land use and infrastructure; sociocultural systems; and environmental justice depending on the area(s) excluded, how the exclusion would affect industry activity, and the state of energy markets. The resources within the excluded area would still experience impacts from the range of past, present, and reasonably foreseeable future actions described in **Section 3.6** and **Appendix B**. The impacts for this area would be similar to those described in **Section 4.4.4** for the No Action Alternative. The impacts for any of the three other program areas not excluded would be the same as those described for the Proposed Action in **Section 4.4.1**. **Table 4.4.3-1** shows the impacts for all program areas considering the removal of the GOM Program Area. If the GOM Program Area were excluded under Alternative C, there is some limited potential for impacts in other program areas that are not excluded to be felt in the GOM Program Area. For example, bird species that occur in the GOM Program Area that migrate or travel to Alaska during part of the year could experience impacts in those areas (**Table 4.4.3-2**).

The removal of GOM lease sales from the Program would disrupt the functioning of oil and gas industries and their supporting industries and would prevent beneficial impacts from occurring. The extent of these impacts would depend on the economic environment during the time of the Program. For example, if Alternative C(4) were chosen in a period of high energy prices, there would be more lost economic activity, although it could prevent some population strains on public infrastructure. The impacts of Alternative C(4) would also depend on the market adjustments that would occur. For example, the lost oil and gas production would be replaced by production from other sources, such as domestic onshore production and foreign imports. Assuming industry believed that the GOM sales were to be removed only from the 2017–2022 Program and would be restored in future programs, markets would be more able to adjust in ways that could lessen the impacts on socioeconomic resources.

If leasing was not selected for the GOM Program Area, there would be a significant shift that would have impacts on the livelihoods and cultural norms of the communities in this area who depend in large part on the oil and gas industry. There could also be an increase in onshore development or accelerated development activity or decommissioning that could result in increases in infrastructure or changes in land use. However, if leasing in the GOM Program Area was only discontinued for 2017-2022 and reinstituted under future programs, these effects might not be as severe as if leasing were to cease for the foreseeable future.

If the GOM Program Area was removed from the 2017–2022 Program, approximately 49 percent of expected oil and gas production would require energy substitutes. Energy substitutes from the foregone GOM production would occur with increases in production from existing Federal and state leases, oil imports, and renewable energy. The imported oil could be transported through the GOM via tanker. As discussed in **Section 4.4.12**, exploration and development activities would be most immediately impacted, while production activities would be temporarily supported by existing facilities. Oil and gas production would not be greatly affected during the first few years because of existing facilities, but could gradually decline over subsequent years in the last portion of the life of the 2017–2022 Program.

4.4.4 Alternative D – The No Action Alternative

As described in **Section 2.5**, Alternative D considers two aspects: (1) the direct and indirect impacts expected to occur as a result of no leasing during the 2017-2022 Program; and (2) the effects baseline for the resource.

The direct and indirect impacts expected to occur as a result of no leasing are those that would occur *because* no leases would be offered under Alternative D for the 2017–2022 Program. The impacts that would occur *because* of no leasing under the 2017–2022 Program are limited to impacts from energy substitutes that would be required to compensate for foregone production of OCS oil and gas. Energy substitutes are described in **Section 3.5.2.** Certain direct and indirect impacts from energy substitutes considered in this analysis are described below and analyzed in each resource section; more information on the impacts of energy substitutes can be found in Industrial Economics, Inc. and SC&A, Inc. (2015). Impacts from energy substitutes required for foregone production in Alaska would be expected to occur primarily outside Alaska. Therefore, no impacts from energy substitutes are expected on resource areas in the Alaska program areas under the No Action Alternative. The impacts from energy substitutes during 2017–2022 are considered direct and indirect impacts of not having a Program and are considered as separate from and additive to the effects baseline that is also characterized in Alternative D.

The effects baseline for a given environmental resource is defined as the present and future condition of that resource over time in the absence of the 2017-2022 Program. This effects baseline is a result of the ongoing and reasonably foreseeable non-OCS future actions that would occur regardless of the 2017‑2022 Program and that influence the condition of a resource over time. There would be ongoing OCS activities in some of the program areas under leases issued up to and through the 2012‑2017 Program that could affect a resource's future condition (**Section 3.7**). Moreover, other present and non-OCS oil and gas future actions independent of the Proposed Action and occurring in the same program area (**Section 3.7** and **Appendix B**) could also affect a resource's future condition when compared to the present condition described in the Affected Environment (**Section 4.3**). These changes would occur *whether or not* new leasing takes place during the 2017–2022 Program or future programs. The impacts expected to occur on a resource from these ongoing and future activities are considered a part of the effects baseline. Future OCS programs are considered a reasonably foreseeable future action, but they are not considered as part of the effects baseline (**Section 3.7**). The impacts of each action alternative (**Sections 4.4.1**, **4.4.2**, and **4.4.3**) are considered additive to the effects baseline described in this analysis for Alternative D.

Principal Effects of No Action Energy Substitutes

The energy substitutes would have their own potential environmental impacts that could occur within or outside program areas that are considered in the Proposed Action. However, energy substitutes could introduce the potential for a different suite of environmental impacts that could occur within, adjacent to, or outside of OCS program areas considered in this Programmatic EIS and over the same time frame considered for the Proposed Action. These impacts are described broadly below and are also described in Industrial Economics, Inc. et al. (2015). Impacts from energy substitutes required for foregone production in Alaska would be expected to occur primarily outside Alaska. Therefore, no impacts from energy substitutes are expected on resource areas in the Alaska program areas under the No Action Alternative.

The distribution of energy substitute impacts in space and time is challenging to evaluate at the Programmatic stage due to the uncertainty associated with how, when, and where those substitutes would manifest; in fact, they are expected to manifest largely outside of the OCS program areas (**Section 3.5.2**). Evaluating in this Programmatic EIS how substitutes would influence environmental resources in geographies other than the OCS or indirectly on the OCS would be overly speculative. However, to the extent possible, this Programmatic EIS addresses the impacts of energy substitutes that are reasonably foreseeable in the program areas should leasing not occur in the 2017‑2022 Program (described as direct and indirect impacts). Some issues of particular environmental concern from energy substitutions are identified here.

Oil Spills: Oil imported into the U.S. could result in tanker spills in these and other OCS planning areas. In comparison to the Proposed Action, the number and potential volume of oil spills that could result from import tanker accidents would be reduced. Part of this reduction is explained by the fact that the volume of oil imports under Alternative D would be smaller than the precluded volume of OCS oil that would be produced under the Proposed Action. The risk rates (per Bbbl produced) associated with tankers and barges are slightly higher than those associated with platforms and pipelines (Anderson et al. 2012, ABS 2016). This spill rate does not necessarily capture the full risk of oil produced on the OCS to be spilled at some point between production and processing for consumers. The oil produced on the platform must be transported to shore-based processing facilities by either pipeline or tanker, representing an additional risk pathway for spills. When considering the full risk of oil produced on the OCS, the risk of spills in OCS waters could be higher than oil transported by tanker alone that was not produced on the OCS. The exploration and production risk associated with oil import substitutes would occur in oil-exporting nations. Because there are no oil import ports or terminals in the Arctic program areas, Alternative D would eliminate the risk of imported oil spills in that region; however, oil transported by tankers through the Northern Sea route or the Northwest Passage could impact the U.S. Arctic if a tanker spill were to occur. The reduction in the risk of oil spills from OCS production redistributes, rather than totally eliminates, the spill risk. The Pacific coast could be exposed to an additional import tanker spill occurrence under Alternative D, whereas these areas would have no or more limited exposure to oil spill risk from OCS activities under the Proposed Action. Impacts from exploration, development, and production activities would not necessarily be diminished, but would occur in areas outside of the OCS. Terrestrial spills associated with onshore production or transport could affect waterways, aquatic ecosystems, and wetlands adversely; wildlife that depend on these important habitats could be injured or killed depending on the severity of exposure.

Waste Management: Waste management issues are a concern associated with nuclear and coal-fired power plants. The country has been struggling for decades to determine how to best manage the spent fuel from nuclear power plants and coal ash from coal on a long-term basis because of possible radiation and heavy metal contamination of ground and surface water.

Acid Mine Drainage from Coal Mining: Runoff from coal mining sites could increase the acidity of surface waters near and downstream from coal mining sites, adversely affecting habitat for aquatic organisms and limiting human recreational uses.

Contamination of Groundwater from Oil and Gas Extraction: The extraction of oil and gas from onshore sources can, in some cases, lead to the contamination of local groundwater supplies related to enhanced recovery operations, including hydraulic fracturing. In addition, oil and gas wells could lead to groundwater contamination from accidental spills, losses of well control, or pipeline leaks.

Other Discharges from State and Onshore Oil and Gas Operations: To facilitate resource extraction from subsurface formations, oil and gas producers use water to increase pressure, causing oil and gas to rise to the surface (e.g., enhanced oil recovery and hydraulic fracturing). Producers must manage these waters as well as waters extracted from geologic formations during oil and gas extraction. The environmental impacts associated with this produced water vary based on the geologic characteristics of the reservoir that produced the water, and the separation and treatment technologies employed by producers. Additional impacts could include possible degradation of surface water and groundwater quality from spills or leaks of processing chemicals during handling, mixing, or injection, or from the increased potential for chemical contamination of drinking water by injected fluids left in the reservoir.

Air Quality Deterioration from Emissions: The major environmental impacts associated with expanded oil imports via tanker, domestic onshore oil and gas, and coal combustion include potential degradation of local ambient air quality from atmospheric emissions of dust; engine exhaust; off-gassing; flaring and burning products, particulates, SO_2, CO, NO_x, hydrogen sulfide (H_2S), and hydrocarbons. For example, tanker emissions occur not only in transport but for long periods in port while imported oil is being unloaded.

Aquatic Ecosystem Effects from Hydropower. Hydroelectric facilities can have a major impact on aquatic ecosystems if mitigation actions are not taken (e.g., fish ladders and intake screens). Fish and other aquatic life can be injured and killed by turbine blades. In addition to direct contact with the turbine blades, there also can be fish and wildlife impacts at the reservoir site and downstream from the facility because of habitat alteration, changes in upstream and downstream migration of biota, and changes in river flow and sediment patterns. See Bunn and Arthington (2002) for a synopsis of impacts of altered riverine flow regimes.

Habitat and Wildlife Disturbance: Habitat and wildlife impacts associated with onshore facilities, coal mines, solar energy, and wind energy include fragmentation and loss of land. Depending on scale, these construction activities and presence of these installations would displace wildlife and cause deforestation and general distortion of the terrestrial landscape.

Low-Probability Catastrophic Effects: The potential exists for low-probability catastrophic consequences from the development and use of energy substitutes to OCS oil and gas. For example, a nuclear accident could occur as a result of nuclear power production, or a CDE could occur in offshore waters of other nations during oil and gas exploration and production activities.

Socioeconomic and Sociocultural Effects: OCS oil and gas-related activities have been an important source of employment and income in GOM coastal areas. Alternative D would result in reduced employment and income opportunities and could affect the stability and cohesion of communities and cultures. Alternative D also could be interpreted as a boom-bust event. The infrastructure and population of affected areas in the GOM have developed over decades in association with a regular occurrence of lease sales and resulting OCS activities. Alternative D could result in situations where local infrastructure and populations could not be maintained, resulting in out-migration and a reduction in public services. Furthermore, Alternative D's disruption of a continuous process of activity in the GOM could affect future investments, which would compound the social, economic, and cultural effects associated with Alternative D. In other program areas such as the Beaufort Sea that have little or no OCS oil and gas activity, the impact would be limited to foregone employment and tax revenue opportunities.

4.4.4.1 Air Quality

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under a No Action Alternative, the expected emissions from the activities associated with the Proposed Action would not be released, but criteria pollutants would be emitted from other sources and the expected substitution of other fuel sources for those not recovered from the OCS would be released elsewhere. The substituted oil and gas, and the replacement of energy needs with other sources of energy, would result in the emissions of criteria pollutants onshore in the United States. In addition, the import of oil on tankers also releases criteria pollutants, including on the OCS. The emission of criteria pollutants on the OCS would be less under Alternative D than the Proposed Action, but there would be a small increase in emissions onshore. No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska.. In the GOM, existing higher amounts of industrialization and shipping would result in continued impacts; long-term reductions could eventually result in the GOM regional emissions to have a small impact on air quality. In the GOM, oil and gas infrastructure, support vessels, and air traffic contribute a significant amount of emissions; however, the emissions from other sources also threaten air quality.

Effects Baseline (Ongoing and Future Actions). Emissions from past programs, other unrelated vessel traffic and various sources of onshore emissions would continue (see **Section 3.7** and **Appendix B** for information on past, present, and reasonably foreseeable future activities in the program areas). Since these onshore sources make up most emissions contributing to nonattainment areas, these designations would remain unchanged without changes in emissions from the affected state. Over time, as operations on leases from past programs concluded and facilities were decommissioned, emissions of criteria pollutants on the OCS would slowly reduce. As these emissions decrease, concentrations of criteria pollutants on the OCS would reduce, improving regional air quality. Other activities near the OCS would continue, including ongoing and future domestic oil and gas exploration, development, and production onshore and in state, Russian, Mexican, and Canadian waters, all of which could impact the same area associated with the Proposed Action. Other activities that could generate emissions within and adjacent to the OCS include bridge and coastal road construction; military operations; NASA activities; harbor, port, and terminal operations; marine vessel traffic; onshore coal and mineral mining; scientific research; commercial fishing; recreation and tourism; and dredging and marine disposal.

Emissions reductions are likely in the future. In 2012, the USEPA adopted international emissions standards for ships operating off North American coasts, requiring ships operating within 370 km (200 nmi) of U.S. coastlines to use low-sulfur fuels, thereby reducing emissions of SO_x and $PM_{2.5}$. Engine-based controls also could reduce NO_x emissions. The USEPA also is phasing in several new Tier 3 and Tier 4 NO_x emissions standards applicable to newly built marine diesel engines (40 CFR 1042 subpart B). The 2012 Cross-State Air Pollution Rule requires 27 states in the eastern U.S. to reduce power plant emissions contributing to O_3 or $PM_{2.5}$, and some states must significantly reduce SO_2 and NO_x. Overall, the effects baseline would result in **minor** impacts in the Beaufort Sea, Chukchi Sea, and Cook Inlet Program Areas due to the low amount of industrialization and shipping traffic in the region. In the GOM, existing higher amounts of industrialization and shipping would result in short-term, **moderate** impacts; long-term reductions could eventually result in the GOM regional emissions to have a **minor** impact on air quality.

4.4.4.2 Water Quality

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The expected discharges (routine and operational) from the activities associated with the Proposed Action would not be released. There could be releases of discharges such as potential fuel, waste, and other operational discharges from additional tankering or barging associated with energy substitutions. Overall, the release of operational and routine discharges on the OCS would be less with Alternative D than the Proposed Action. An oil spill from activities in state waters or from tankering could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, water quality would continue to be subject to a variety of IPFs from non-Program activities as well as ongoing oil and gas activities stemming from previous lease sales. **Section 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. Ongoing OCS oil and gas activities and discharges from these activities would continue under leases previously issued. In the Chukchi Sea Program Area, the one active OCS lease will expire in December 2020. Therefore, all impacts on water quality from OCS oil and gas activities as a part of the effects baseline would cease after 2020 in the Chukchi Sea Program Area. As detailed in **Section 4.3**, water quality is also affected by many other factors, including urbanization; forestry practices; mining; municipal waste discharges; agriculture; ongoing and future oil and gas exploration, development, and production onshore and in state, Mexican, Canadian, and Russian waters; marine vessel traffic-related discharges; wastewater; persistent contaminants and marine debris; natural oil seepage; dredging and marine disposal; bridge and coastal road construction; commercial fishing; recreation and tourism; harbor, port, and terminal operations; marine mineral mining; military and NASA operations; renewable energy development; natural events; oil seeps; and climate change. All of these factors would continue to contribute to the condition of water quality within all program areas under the No Action Alternative. Impacts on water quality as a part of the effects baseline are expected to range from **negligible** to **moderate** because discharges (from non-OCS oil and gas production activities) are still considered avoidable with proper measures, and yet other discharges would be unavoidable. In addition, impacts from climate change on water quality are expected to continue. There is also the potential for accidental events to occur from existing OCS and state water exploration, production, and development, which would increase the range of potential impacts to **major**.

4.4.4.3 Marine Benthic Communities

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Marine benthic communities would be subject to a variety of IPFs from activities stemming from energy substitutes that would occur as a direct result of the removal of the activities associated with the Proposed Action. Activities associated with energy substitutions could include more tankering, increased alternative energy activities, and increased oil and gas activities in state waters under the No Action Alternative. No impacts on benthic communities are expected on the OCS as a direct result of substitutes. No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska. The impacts on marine benthic resources on the OCS are expected to be less under Alternative D than the Proposed Action. However, an oil spill from activities in state waters could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, marine benthic communities would be subject to a variety of IPFs from non-Program activities. Some of the activities listed in **Section 3.7** and **Appendix B** would produce potential impacts on marine benthic communities from IPFs including routine discharges, bottom/land disturbance, commercial fishing and non-routine events (fuel and oil spills). There is the possibility of new activity in state waters of the Beaufort or Chukchi Seas in addition to the Northstar facility in the Beaufort Sea. If future development were to take place in state waters, limited impacts could occur from any possible scenario including the building of new gravel islands or the drilling and development of wells from a bottom-founded or anchored structure. Continuing discharges from the Northstar facility are considered “not detectable” and are limited to very small sources such as fire hose testing. Produced water (originating from both state and Federal downhole locations) is reinjected. The Cook Inlet Program Area could experience some additional new oil and gas development in state waters; however, these increases would likely have negligible impacts on benthic communities and should not cross into OCS waters. Continuation of existing development activities in Cook Inlet state waters would similarly have little impacts on benthic communities. Any continued development in state waters would likely not involve any new pipelines or related additional impacts on benthic communities beyond routine discharges onto soft-bottom habitat due to extensive existing infrastructure.

One additional significant source of impacts in the foreseeable future includes climate change and associated ocean acidification, even for the near-term. Changes in ocean water temperature can affect community structure as well as the fitness of individual organisms, including mortality, reproduction, and development (Beukema et al. 1998, Philippart et al. 2003, Kirby et al. 2007). Latitudinal shifts in marine benthic species have been documented for benthic organisms (Southward et al. 2004, Mieszkowska et al. 2006, Eggleton et al. 2007). Some benthic communities would benefit from the northward expansion or increases in abundance related to warming, while other species would not or be negatively impacted. Ocean acidification, the result of excess CO_2 in the atmosphere, can also impact benthic communities. Changes in ocean pH already have begun to impact the fitness of benthic organisms such as corals, shellfish, fish, and pteropods (Orr et al. 2005, Hoffman et al. 2010, Gattuso and Hansson 2011). Deepwater corals on the OCS are especially sensitive to pH shifts. Decreased calcification rates have been observed in numerous shallow-water zooxanthellate corals related to decreased pH (refer to Hoffman et al. 2010). Similar effects could be expected for deepwater corals such as *Lophelia pertusa* (Lunden et al. 2013; Lunden et al. 2014, Hennige et al. 2014, Hennige et al. 2015) and for various other calcifying organisms in deep water (Thresher et al. 2015) and could make it more difficult for deepwater calcifying organisms to form or maintain calcium carbonate-based skeletons or shells. Lunden et al. (2014) reported reduced calcification rates of *L. pertusa* at lower experimental pH levels, but also some indication of acclimation. Increasing temperatures could also lead to declines in oxygen concentrations in the ocean due to reduced solubility and reduced ventilation from stratification and circulation changes. Lower oxygen levels can negatively impact organism health and community structure (Levin et al. 1991). Changes in storm intensity, storm frequency, and circulation patterns could become additional stressors on benthic communities (Birchenough et al. 2015).

Some habitats would be impacted by climate change more than others. Arctic areas could experience significant shifts in species ranges. Diminished ice cover extending through longer periods of the year would also impact species distributions and ecosystem dynamics. Coral habitats, both in shallow and deep water could experience significant challenges from both warming-related factors as well as associated pH increases (acidification). Climate change impacts are presented in more detail in **Section 4.2.1**. Generally, the overall impacts on marine benthic communities when considering the effects baseline would range from negligible to minor, but with the inclusion of all non-Program impact trends including climate change, an impact determination of minor to moderate is necessary, primarily because of consideration of at least some climate change impacts in the reasonably foreseeable future. Substantial increases in ocean temperature and lower pH could result in moderate to major impacts on some benthic communities such as deep-sea coral habitats and shallow coral reefs but could be considered less likely.

4.4.4.4 Coastal and Estuarine Habitats

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The effects of Alternative D on coastal and estuarine habitats are expected to be less than those for Alternative A because most impacts from the production and transport of substitutes would likely occur outside of Alaska.

Under the No Action Alternative, coastal and estuarine habitats would be subject to a variety of IPFs from activities stemming from energy substitutions, which could occur in the GOM as a direct result of the removal of the activities associated with the Proposed Action (**Section 3.5.2**). No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska. The potential impacts are expected to be less under Alternative D than the possible impacts from the Proposed Action. However, an oil spill in nearshore waters or the grounding of a tanker in the GOM could have significant impacts.

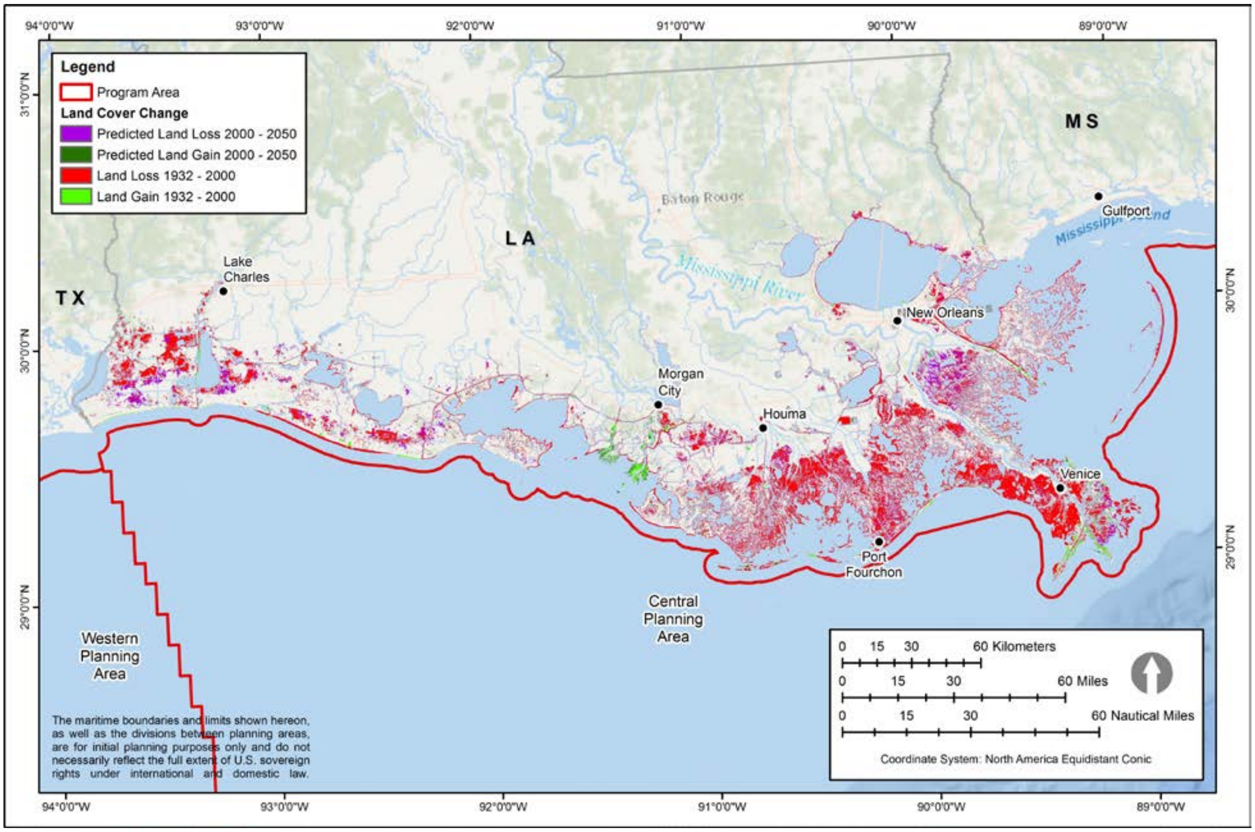
Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, coastal and estuarine habitats would be subject to a variety of IPFs from non-Program activities (**Section 3.7** and **Appendix B**). Numerous non-OCS activities could impact coastal habitats and would be expected to have **negligible** to **minor** impacts for the Beaufort Sea, Chukchi Sea, and Cook Inlet Program Areas, mainly due to sea level rise. In the GOM Program Area, **major** impacts would be expected as a result of continuing coastal wetlands and barrier shoreline losses, as discussed in the **Section 4.3.1.3**. Wetlands and seagrass beds could be impacted by anchoring, fishing/trawling, navigation, and recreational use. The most substantive threats to estuarine and coastal habitats include conversion of wetlands to other land uses, subsidence, and possible continuing climate change, in particular, sea level rise in all program areas and loss of permafrost in Arctic program areas. Other stressors on wetlands include stormwater runoff from upland development and watershed modification (e.g., channelization) as well as vessel traffic associated with state oil and gas development, oil and gas imports, commercial fishing, military and NASA operations, commercial shipping, scientific research, mineral mining, and recreational use. Any onshore activities that alter the hydrology or change the estuarine flow can lead to saltwater intrusion, which can destroy freshwater marshes. Upland non-OCS activities could introduce contaminants or pollutants from agricultural runoff, wastewater discharges, and municipal discharges resulting in degradation of water quality (**Section 4.5.2**), which could negatively affect wetlands and seagrass. Indirect impacts on seagrass habitats could occur from ongoing and reasonably foreseeable non-OCS future activities and naturally occurring events such as hurricanes. Any of the activities that impact coastal wetlands and seagrass beds could lead to increased shoreline erosion and loss of habitat.

Exploration, development, and production is expected to continue in the Prudhoe Bay area near the Beaufort Sea Program Area on state lands and waters; activity is expected to decrease in this area in the future. Activity on existing OCS leases is assumed to replace some of the declining activity on state lands and waters so there might not be the need for new onshore infrastructure or change in patterns of other coastal activity. Despite little need for additional onshore infrastructure, sea level rise could inundate some habitat and coastal erosion could increase with loss of permafrost (Mars and Houseknecht 2007). Although state land oil and gas activity is anticipated to decrease, farther inland on Federal lands there could be more onshore oil and gas activities in the NPR-A (managed by the BLM) that could impact hundreds of acres of moist and wet tundra over the next 50 to 70 years. About 30 exploration wells have been drilled in the NPR-A since 1999. Production first began in the NPR-A in October 2015 for the Greater Mooses Tooth Unit No. 1 oil and gas development project. As an idea of scale, the Greater Mooses Tooth Unit No. 1 project would remove about 20 acres of moist and wet Arctic tundra from the 22.8 million acre NPR-A. Other similar projects are likely to follow because an application has been submitted to BLM for a Greater Mooses Tooth Unit No. 2 permit. These projects are in the far northeastern area of the NPR-A near Nuiqsut, and would tie into existing facilities near Prudhoe Bay.

In the Chukchi Sea Program Area, there would be no need for new onshore infrastructure that might impact coastal and estuarine habitat. There is only one active lease, but the lease term expires in 2020. Overall coastal activity (OCS or non-OCS) is not expected to change dramatically from what now exists.

For the Cook Inlet, the following activities would be expected to occur: harbor, port, and terminal operations; the Port of Anchorage Intermodal Expansion Project (in the vicinity of Cook Inlet); industry; transportation facilities; the Knik Arm Crossing Project (in the vicinity of Cook Inlet); mining (coal and minerals); recreation and tourism along the shore and beaches; scientific research; and subsidence from natural processes, oil and gas extraction in state waters, and mining activities. These actions also could generate bottom/land disturbance and oil spills that could affect coastal and estuarine habitats for long periods. The Cook Inlet Program Area would likely experience some additional oil and gas development in state waters and some increase in recreation and tourism than what has occurred and presently exists. There could be new pipelines, new boat access points, and additional wave action from boats (commercial and recreational) from what presently occur, but there is expected to be only a minor increase in oil and gas development and recreation and tourism activity.

GOM coastal and estuarine habitats would continue to decline, particularly in Louisiana, as a result of levees on the Mississippi River that limit the flow of sediment to the GOM coastal environment. There would also be subsidence of coastal sediments; sea level rise; use and erosion of navigation channels; and agricultural, residential, and commercial development (Boesch et al. 1994, Day et al. 2000, Day et al. 2001). Hurricanes, though infrequent, can cause substantial long-term land loss. For example, Palaneasu-Lovejoy et al. (2013) found that persistent land loss due to Hurricane Katrina in 2005 measured approximately 4.9 percent of their deltaic study area four years later. Land loss rates in coastal Louisiana declined in the late 20th and early 21st century (**Figure 4.4.4-1**; Couvillion et al. 2011). However, net land loss in coastal Louisiana from 2000 to 2050 is still projected at a staggering 1,329 km^2 (513 mi^2) (Barras et al. 2003). The contribution of OCS oil and gas activities to current and future land loss would be **moderate** because some of the OCS navigation channels are armored (e.g., Port Fourchon) and no new OCS oil and gas shorebase facilities would be needed.



Source: Couvillion et al. 2011

Figure 4.4.4-1. Actual and Projected Areas of Land Loss and Gain in Coastal Louisiana

There are concerted efforts for research and restoration of barrier beaches and coastal wetlands under various programs in the GOM, including the Coastal Wetlands Planning, Protection and Restoration Act, with an average budget of about $50 million per year since 1990, and the Coastal Impact Assistance Program, with more than $800 million from 2005 to present. There is also the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012, with $5.5 billion, and the National Resource Damage Assessment funds of up to $8.8 billion from a settlement on April 4, 2016, starting in April 2017 for distribution over at least 15 years. Nonetheless, coastal and estuarine habitat would likely continue to decline, albeit at a slower rate than what has occurred in the past 70–80 years, and would still result in a **major** impact.

4.4.4.5 Pelagic Communities

No New 2017–2022 Leasing and Consideration of Energy Substitutes: Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. IPFs from energy substitutes, which would emerge in the absence of the Proposed Action, could affect pelagic communities. No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska. There could be some impact on pelagic communities from discharges from tankers in the GOM, but these are expected to be insignificant. Impacts are expected to be less under Alternative D than under the Proposed Action. However, an oil spill in nearshore waters or from the grounding of a tanker could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, IPFs from non-Program activities would affect pelagic communities. IPFs for ongoing and reasonably foreseeable future actions are presented in **Section 3.7** and **Appendix B**. IPFs affecting pelagic communities are noise, vessel traffic, routine discharges, bottom disturbance, lighting/physical presence, and non-routine events (fuel and oil spills). Pelagic communities would be exposed to discharges from permitted point sources, such as sewage treatment discharges, and nonpoint sources including agricultural runoff, bilge and/or gray water, or accidental releases (e.g., oil spills). Feeding by larval fishes and zooplankton could be affected by increased turbidity generated by dredging, commercial fishing (bottom trawling), marine mining, marine construction, and scientific research. Lights on OCS structures on existing leases as well as moving or moored vessels would attract some crustacean zooplankton and larval fishes, potentially subjecting individuals to predation.

Cooling water used to cool machinery in LNG operations, seafood processing vessels, and oil and gas production facilities can entrain (and presumably kill) large numbers of plankton (including larval fishes and shrimps) in the process (USEPA 2006, Gallaway et al. 2007). Operations requiring cooling water intake could occur in all planning areas under the No Action Alternative. The USEPA requires existing oil and gas operations, LNG vessels, and seafood processing vessels using ≥ 2 million gallons of cooling water to use best professional judgment to comply with Section 316(b) of the CWA (USEPA 2014). The potential for population-level effects depends on the numbers and geographical locations of facilities.

A major environmental factor affecting pelagic communities in all planning areas is climate change. Atmospheric temperature rise, which leads to rising sea surface temperature, altered wind and current patterns, increased freshwater inputs, and ocean acidification can broadly affect planktonic organisms. Effects of climate change have been most pronounced in the Arctic region and to a lesser extent Cook Inlet, where rising sea and air temperatures have caused a reduction in sea ice and a concomitant increase in open water areas (Wassmann 2015, Wood et al. 2015). The net result is that the Chukchi and Beaufort Seas are warmer, fresher, and more ice-free than in the past. Longer ice-free seasons can shift peak phytoplankton production times so that they do not coincide with seasonally programmed zooplankton reproductive periods or hatching times of larval fishes (Wassmann 2011). Such mismatches can result in population and recruitment declines for zooplankters and larval fishes. Changing temperatures allows the survival of expatriated species in novel areas of the Arctic Ocean, potentially displacing Arctic species and altering community composition (Ershova et al. 2015).

In the open waters of the GOM, sea surface temperature, sea surface height anomalies, and wind speed have gradually increased over a 20-year period, but primary productivity (chlorophyll-*a* concentrations) has shown no significant trends (Muller-Karger et al. 2015). During a similar time period, Muhling et al. (2012) reported an increase in numbers and kinds of fish larvae collected from GOM OCS waters. Understanding long-term effects of rising sea surface temperatures on plankton and larval fishes depends on species-specific factors. For example, model projections based on species-specific temperature tolerance of bluefin tuna indicate that as GOM water temperatures increase, spawn intensity decreases (Muhling et al. 2011).

Ocean acidification would negatively affect the ability of planktonic organisms with calcium carbonate exoskeletons to grow or maintain these structures (Fabry et al. 2008). Calcium is widely used by marine plankton such as crustaceans, forams, and coccolithophores. Any alteration of pH in the ocean environment could affect sensitive planktonic species from the organismal level up to a larger population level response. In addition, ocean acidification could lead to alterations in the sequestration of carbon driven by these organisms. Carbon sequestration by planktonic organisms plays a crucial role in the large-scale ocean carbon cycle. Alterations in the oceanic biogeochemical cycle could lead to impacts on food webs, potentially triggering larger scale ecosystem responses.

Under the effects baseline, impacts on pelagic communities would be **negligible** to **minor** because although the activities discussed above (including residual impacts from the *Deepwater Horizon* oil spill and riverine discharge [hypoxia] for the GOM) would continue to contribute noise, routine discharges, bottom disturbance, and lighting/physical presence, pelagic communities are reasonably healthy within the program areas. Nevertheless, a large oil spill (CDE) resulting from activities on existing leases, could have **major** effects on pelagic communities in any of the program areas. For a detailed account of CDEs, see **Section 4.4.5**.

4.4.4.6 Marine Mammals

Beaufort Sea and Chukchi Sea Program Areas

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Marine mammals would be subject to a variety of IPFs from activities stemming from energy substitutions, which could occur as a direct result of the removal of the activities associated with the Proposed Action (**Section 3.5.2**). No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska. Impacts are expected to be less under Alternative D than under the Proposed Action. However, an oil spill from activities in state waters could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, marine mammals would be subject to a variety of IPFs from non-Program activities. **Section 3.7** and **Appendix B** provide information on ongoing and future activities that could be reasonably anticipated for each program area. Activities listed in **Appendix B** include commercial shipping, scientific research activities, commercial fishing, tourism cruises, and ongoing oil and gas activities. Additional sources of impacts on marine mammals include entanglement, ingestion of trash or debris, impacts from toxins, climate change-related impacts, disease, changes in prey availability, and legal and illegal harvest.

Commercial shipping, tourism (including icebreaker tourism), and research activities have all been increasing in the Arctic as the open water season increases. These activities could result in impacts on marine mammals from noise, disturbance from vessel or aircraft traffic, ship strikes, disturbance or removal of prey by commercial fishing, routine discharges or bottom disturbance, or non-routine events (fuel or other spills). Potential impacts on marine mammals from these activities are similar to those described under the Proposed Action (**Section 4.4.1.6**) and include behavioral disturbance due to noise generated by equipment and human activity, masking of communications from anthropogenic noise, behavioral disturbance due to vessels and aircraft (including helicopters), injury or loss of prey species due to accidental releases (e.g., oil spills) or intentional releases (e.g., cuttings), loss or degradation of habitat due to existing OCS activities, and energetic costs associated with avoidance of vessels or other sound sources. Additional impacts are anticipated as a result of climate change. Impacts resulting from climate change include changes in prey base due to ocean warming or acidification and loss of sea ice as a resting, breeding, molting, and foraging platform in the Arctic. Impacts from climate change are anticipated to continue to be the largest source of impacts on most marine mammal species in the Arctic. Impacts on marine mammal species from the ongoing and future actions composing the effects baseline range from **negligible** to **major** depending upon the species, location, and IPF. For example, impacts on Eastern North Pacific gray whales from current conditions are negligible because the population is healthy and stable. Impacts on polar bears from activities associated with the effects baseline are anticipated to be major, primarily due to decreased sea ice and increasing time spent onshore with limited food sources (Atwood et al. 2016a, Atwood et al. 2016b). It is anticipated that seal and walrus species would be increasingly impacted by loss of sea ice. Fin and humpback whales are ranging farther north into the Chukchi Sea as the open water season becomes more extended (Clarke et al. 2015a).

Cook Inlet Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Marine mammals would be subject to a variety of IPFs from activities stemming from energy substitutions, which would occur as a direct result of the removal of the activities associated with the Proposed Action (**Section 3.5.2**). The impacts are expected to be less under Alternative D than under the Proposed Action. However, an oil spill from activities in state waters could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, marine mammals would be subject to a variety of IPFs from non-Program activities. **Section 3.7** and **Appendix B** provide descriptions of the types of ongoing and future activities that could be reasonably anticipated for each program area. Activities listed in **Appendix B** include commercial shipping, scientific research activities, commercial fishing, tourism cruises, and ongoing oil and gas activities from previous lease sales. Additional sources of impacts on marine mammals include entanglement, ingestion of trash or debris, impacts from toxins, climate change-related impacts, disease, changes in prey availability, and legal and illegal harvest.

Commercial shipping, tourism, and commercial and recreational fishing occur in Cook Inlet during the open water season. Anchorage is a major port city on Cook Inlet and several other ports also contribute vessel traffic, airplane traffic, and pollutants into the inlet. Oil and gas platforms are operational year-round in the inlet. These activities would produce impacts on marine mammals from noise, disturbance from vessel or aircraft traffic, ship strikes, entanglement in trash or fishing net debris, disturbance or removal of prey from fishing, routine discharges or bottom disturbance, or non-routine events (fuel or other spills). Potential impacts on marine mammals from these activities are similar to those described under the Proposed Action (**Section 4.4.1**) and include behavioral disturbance due to noise generated by equipment and human activity, masking of communications from anthropogenic noise, behavioral disturbance due to vessels and aircraft (including helicopters), injury or loss of prey species due to accidental releases (e.g., oil spills) or intentional releases (e.g., cuttings), loss or degradation of habitat due to OCS activities, and energetic costs associated with avoidance of vessels or other sound sources. Additional impacts are anticipated as a result of climate change. Impacts resulting from climate change include changes in prey base due to ocean warming or acidification, and decreased sea ice as a resting, breeding, molting platform for seals, sea lions, and sea otters. Impacts from climate change and ship traffic and pollution are anticipated to continue to be the largest source of impact on most marine mammal species in Cook Inlet. Impacts on marine mammal species from activities associated with the effects baseline range from **negligible** to **major** depending upon the species. Cook Inlet beluga whales are particularly vulnerable due to their small population size and sensitivity to disturbance (NOAA Fisheries 2016).

GOM Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Marine mammals would be subject to a variety of IPFs from activities stemming from energy substitutions, which would occur as a direct result of the removal of the activities associated with the Proposed Action (**Section 3.5.2**). In the GOM, impacts from substitutes could result from the presence of tankers (e.g., noise, ship strike). The impacts are expected to be less under Alternative D than under the Proposed Action. However, an oil spill from activities in state waters or from a tanker grounding could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, marine mammals would be subject to a variety of IPFs from non-Program activities. **Section 3.7** and **Appendix B** provide descriptions of the types of ongoing and future activities that could be reasonably anticipated for each program area. Activities listed in **Appendix B** include commercial shipping, scientific research activities, commercial fishing, tourism cruises, and ongoing oil and gas activities from previous lease sales. Additional sources of impacts on marine mammals include entanglement, ingestion of trash or debris, impacts from toxins, climate change-related impacts, disease, changes in prey availability, and legal and illegal harvest.

The major IPFs for marine mammals in the GOM include noise from ongoing oil and gas activities, including exploration, drilling, production, and decommissioning associated with prior programs. Of these, the greatest impact is expected to be from ongoing deep penetration seismic surveys using high-volume airguns. Oil spills, including CDEs, from ongoing oil and gas activities would also affect marine mammals due to activities associated with the effects baseline. There is vessel traffic in the GOM associated with existing oil and gas activities, recreational and commercial fishing, and commercial shipping. Vessel traffic introduces noise into the environment that could affect marine mammals; marine mammals also could be impacted by ship strike from any of these. Commercial and recreational fishing could impact marine mammals directly because the animals are either caught incidental to fishing operations or are indirectly impacted by depleting or creating competition for prey resources. Habitat quality in the GOM has been affected negatively in two primary ways; the first is the perennial hypoxic zone in shelf waters offshore the Mississippi River (Bianchi et al. 2010); and the second is the impacts associated with the *Deepwater Horizon* explosion, spill, and response. The oil spill caused health issues in some populations of bottlenose dolphin and recent studies suggest that OCS benthic habitats could have been affected such that animals forego foraging in the area (Venn-Watson et al. 2015, Winsor et al. 2015). Impacts on marine mammals due to activities associated with the effects baseline range from **negligible** to **major** depending on the species, the area, and the IPF. Species such as sperm whales, which are listed as endangered, Bryde's whale, which has a very small, genetically distinct population in the GOM and has been proposed for listing under the ESA, and certain stocks of bottlenose dolphins, such as those living in the bays, sounds, and estuaries that were disproportionately affected by *Deepwater Horizon*, could be affected more severely than species such as pelagic delphinid species with large population numbers and less overlap in their distribution with anthropogenic activities.

4.4.4.7 Sea Turtles

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Sea turtles do not occur in, or are extralimital to, the Alaska program areas. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Energy substitutions would be anticipated to result in some combination of increased tankering, foreign oil imports, onshore oil and gas production, and renewable energy development to offset the absence of oil and gas production from the activities associated with the Proposed Action. These activities would increase risk to sea turtles in the GOM as compared to the effects baseline conditions. Specific IPFs associated with energy substitute activities that would impact turtles include noise, vessel traffic, routine discharges, bottom/land disturbance, facility lighting, and accidental spills. These impacts could differ in magnitude to those anticipated from the Proposed Action. For example, tanker imports of crude and petroleum products into the GOM are also projected to increase under the No Action Alternative, which could present risk of vessel strike and accidents resulting in tanker oil spills (**Section 4.4.5**). To support the increase in tanker imports, there could be an increase in the frequency and quantity of dredging that is conducted to maintain navigation channels resulting in increased risk to sea turtles through dredge entrainment and habitat alternation to the benthic (direct dredging impact) and nesting (indirect placement impact) habitats. The impacts of energy substitutes are expected to be less under Alternative D than under the Proposed Action. However, an oil spill from activities in state waters or from a tanker grounding could have significant impacts.

Effects Baseline (Ongoing and Future Actions). **Section 3.7** and **Appendix B** describe the types of ongoing and future activities that could be reasonably anticipated, providing specific examples of known ongoing and expected projects for each program area. All of the activities listed in **Appendix B** for the GOM could introduce impacts on sea turtles from IPFs including noise, traffic/collisions, routine discharges, bottom disturbance, contaminant releases, lighting, and non-routine events (fuel and oil spills). Sea turtles are vulnerable to a significant risk from multiple non-program activities and associated IPFs. For example, it is expected that sea turtles would be at risk from IPFs associated with existing oil and gas related development as well as other non-oil and gas related activities such as foraging in the vicinity of OCS dredging, migrating through areas of commercial fishing activity or areas of high recreational and commercial vessel traffic, etc. Potential impacts on sea turtles from these activities are similar to those described under the Proposed Action (**Section 4.4.1.7**) and **Appendix E**.

In summary, potential impacts on sea turtles as a result of ongoing and reasonably foreseeable future actions are expected to be **minor** to **major** because of the wide range of other non-OCS oil and gas activities and scale of impacts for each, in addition to the status of the species involved. Though NOAA and the USFWS have developed recovery plans for each listed sea turtle species to help identify and guide the protection, conservation, and recovery of sea turtles, the myriad activities and associated IPFs described above continue to negatively impact long-term population trends for all sea turtle species in the GOM.

4.4.4.8 Birds

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Birds could be subject to a variety of IPFs from activities stemming from energy substitutions, which would occur as a direct result of the removal of the activities associated with the Proposed Action. No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska. In the GOM, birds would be subject to potential impacts from increased tankering as a result of the No Action Alternative. These impacts would be similar to those described for vessel traffic in **Appendix E**. The impacts from Alternative D would be less than those anticipated from the Proposed Action. An oil spill from activities in state waters or a tanker grounding in the GOM could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, birds would be subject to a variety of IPFs from non-Program activities. All of the activities listed in **Section 3.7** and **Appendix B** would produce impacts on birds from IPFs including noise, traffic, routine discharges, bottom/land disturbance, air emissions, lighting/physical presence, and non-routine events (fuel and oil spills). Potential impacts on birds from these activities are similar to those described under the Proposed Action (**Section 4.4.1.8**) and include behavioral disturbance due to the presence of noise generated by equipment and human activity; behavioral disturbance due to the passing of vessels and aircraft (including helicopters); exposure to discharges from permitted point sources such as sewage treatment discharges and nonpoint sources such as irrigation runoff, or accidental releases (e.g., oil spills) from activities on existing leases; loss or degradation of habitat due to construction and operations activities and injury or mortality and energetic costs associated with structure (onshore and on the OCS) presence and associated lighting. Loss or degradation of habitat could also occur as a result of onshore industrial, commercial, and residential development. Additional impacts are anticipated as a result of climate change.

At least 100 million and possibly up to one billion birds die each year from striking plate glass windows, including many long-distance migrants (Klem 1989, Klem 1990, Dunn 1993) while hundreds of millions more are killed each year by communication towers, power transmission lines, cars, pesticides, and domestic and feral cats (Erickson et al. 2005, Longcore et al. 2013, Loss et al. 2013, Loss et al. 2014a, Loss et al. 2014b). Ingestion of plastics appears to be increasing in seabirds and could reach 99 percent of all seabird species by 2050 if not mitigated by effective waste management (Wilcox et al. 2015). Although trends vary by species, marine and coastal bird populations are generally considered to be in decline (Morrison et al. 2001, Morrison et al. 2006, Paleczny et al. 2015, NACBI 2016). Populations of monitored seabirds have declined by nearly 70 percent globally since the 1950s, with the wide-ranging pelagic species declining more than coastal species (Paleczny et al. 2015). Similarly, recent trend analyses of North American shorebird populations indicate that many species were in decline through the 1980s and 1990s (Morrison et al. 2001, Morrison et al. 2006). However, some shorebird populations appear to have stabilized since that time (Andres et al. 2012). As a result, potential impacts on birds due to activities associated with the effects baseline are expected to be **moderate** to

major because bird populations are generally in decline, the broad range of other non-OCS oil and gas activities and resultant IPFs resulting in a diverse array of impacts on birds from disruption and dispersal to mortality, and the potential scale of impacts (spreading into a wider geographic areas than the Proposed Action) for each.

4.4.4.9 Fish and Essential Fish Habitat

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Under the No Action Alternative, IPFs from energy substitutes, which would emerge in the absence of the activities associated with the Proposed Action, could affect managed/listed species and EFH. No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska. In the GOM, fish and EFH could be subject to potential impacts from increased tankering, including discharges or vessel noise. These impacts would be similar to those described in **Appendix E**. The impacts are expected to be less under Alternative D than under the Proposed Action. However, an oil spill from activities in state waters or a tanker grounding in the GOM could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, IPFs from non-Program activities would affect managed/listed species and EFH. Activities that produce these IPFs are presented in Section 3.7 and **Appendix B**. IPFs affecting managed/listed species and EFH are noise, vessel traffic, routine discharges, bottom disturbance, lighting/physical presence, and non-routine events (fuel and oil spills) from activities in state waters or on existing OCS leases. Managed/listed species and EFH would be exposed to discharges from permitted point sources such as sewage treatment discharges and nonpoint sources including agricultural runoff, bilge and/or gray water, or accidental releases (e.g., oil spills). Managed/listed species could be displaced from sheltering or feeding areas by bottom disturbance from dredging, commercial fishing (bottom trawling), marine mining, marine construction, and scientific research. Lights on OCS structures as well as moving or moored vessels would attract some fishes and invertebrates species (particularly early life stages) potentially subjecting individuals to predation. Climate change is expected to impact managed/listed species and EFH.

In addition to permitted discharges (described in the introduction), the program area waters receive freshwater and other chemicals and materials inputs from rivers. These inputs can cause decreases in salinity and light penetration as well as increases in phytoplankton production, turbidity, and organic material load (Bianchi et al. 2010). The most pronounced effect of riverine discharges is seen in the GOM where high organic loads lead to hypoxic conditions (dissolved oxygen $\leq$ 2 mg/l). Such conditions, which occur mostly during summer, would kill or displace managed/listed species and their prey (Bianchi et al. 2010, Rabalais et al. 2002). Climate change and associated factors would affect managed/listed and EFH in all planning areas. Associated factors include sea surface temperature rise, altered wind and current patterns, increased freshwater inputs, changes in sea ice distribution, and ocean acidification. Fishes and invertebrates would likely seek out preferred temperatures over ocean basins as water temperatures rise and change (Simpson et al. 2011, Logerwell et al. 2015). Collective range shifts by individual species could result in changes in regional species composition and community structure with unpredictable consequences (Karnauskas et al. 2015, Wassmann 2011). Ocean acidification can affect growth and physiology of fishes and their life stages (Ishimatsu et al. 2008, Llopiz et al. 2014, Kroeker 2010).

An additional source of impact on managed/listed species and EFH for the GOM Program Area is long-term effects of the *Deepwater Horizon* oil spill. The *Deepwater Horizon* oil spill variably affected EFH (deep coral, mesophotic, and shallow marshes) used by a variety of managed species (DWHNRT 2016). In addition, large numbers of fish eggs and larvae were killed or potentially impaired, which could have lasting effects on population age structure of several species (DWHNRT 2016). Spilled oil and applied dispersants would have caused physiological and anatomical damage to the larvae and juveniles of pelagic dolphinfishes and tunas (Joye et al. 2016). Other potential issues (dietary and habitat shifts) to fish species, populations, and habitat caused by the *Deepwater Horizon* spill continue to be investigated and will take time to understand (Joye et al. 2016). As part of the effects baseline, impacts from *Deepwater Horizon* would likely decline over time.

Impacts on managed/listed species and EFH from ongoing and future actions would be **negligible** to **minor** because although the activities discussed above (including the *Deepwater Horizon* oil spill and hypoxia for the GOM) would continue to contribute noise, routine discharges, bottom disturbance, and lighting/physical presence, managed/listed species and EFH are reasonably healthy within the program areas. Nevertheless, a large oil spill (CDE) could have major effects on managed/listed species and EFH in any of the planning areas. For a detailed account of CDEs, see **Section 4.4.5.**

4.4.4.10 Arctic Terrestrial Wildlife and Habitat

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Energy substitution would be anticipated to result in some combination of increased tankering, foreign oil imports, onshore oil and gas production, and renewable energy development to offset the absence of oil and gas production from the activities associated with the Proposed Action (**Section 3.5.2**). No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska.

Effects Baseline (Ongoing and Future Actions). **Section 3.7** and **Appendix B** describe the types of activities that could be reasonably anticipated as part of the effects baseline, providing specific examples of known ongoing and expected projects for each program area. Current and reasonably foreseeable levels of these activities are described below to provide context for the impacts on each resource in the following sections.

Offshore activities in Russian waters are unlikely to cause any impact on Artic terrestrial habitat and wildlife in Alaska. An exception to this could be development in Canadian Arctic offshore waters with approximately 150 miles of the border between Alaska and Canada in the Makenzie River Delta area. Oil and gas exploration has occurred here in the past and there is potential for it to continue in the future. As in Alaska, offshore development in Canada would likely require onshore infrastructure and a pipeline. The PCH range extends from eastern Alaska into Canada towards the western edge of the Mackenzie River Delta, so there are potential impacts on the PCH from development in Canadian offshore waters. Oil and gas activities in state waters could impact Arctic habitat and wildlife since any offshore development would require a shore-based component and pipeline. Effects from development on existing OCS leases, in state waters, and Canadian waters could range from **minor** to **moderate**.

Scientific research on terrestrial habitat and mammals would continue as part of the effects baseline, but the effects would likely be **minor**. This is because some basic animal population surveys are necessary to manage sport and subsistence harvests and would continue, but development is typically the key factor to initiate more detailed and intensive surveys to determine potential effects of planned and executed development.

The development of infrastructure could have effects ranging from **negligible** for small coastal harbors and infrastructure to **moderate** for pipeline projects that would have to cross vast areas of Arctic habitat and would likely have support infrastructure associated with them such as pump stations and roads and an increase in air traffic.

Impacts on Arctic terrestrial wildlife from military operations would come primarily from disturbance from aircraft overflights and is likely to be **minor** due to the low frequency of occurrence and because there is a vast area with only a seasonally distributed scattered population of animals.

Mining could have **minor** to **major** impacts on Arctic terrestrial habitat and wildlife. Key factors in the level of impact include the location of the mine, the distance from a shore terminal or existing road for export, the type of mine, and the method of mining and processing.

Recreational activities in the Arctic including boating, rafting, fishing and hunting, wildlife viewing, and aircraft traffic and these would be anticipated to increase due to activities associated with the effects baseline in the foreseeable future. It is likely that recreation and tourism would increase in this region. However, the potential increase in these activities is tempered by the short season, high cost, and limited accessibility associated with these areas, so impacts are likely to be **minor**.

The effects of climate change are expected to impact resources in the Arctic and would increase in the foreseeable future. Declines in permafrost extent and persistence, altered plant growth, sea level rise, changing atmospheric temperatures, and alteration of biological resource and prey distribution and density are all anticipated to impact (positively and negatively) resources for the foreseeable future. Additional information on climate change is provided in **Section 4.2.1**. Impacts on Arctic terrestrial wildlife and habitats could range from **minor** to **major** depending on the rate of change, degree of change, and adaptability of the resident and, potentially, newly arriving species.

4.4.4.11 Archaeological and Historical Resources

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Archaeological and historic resources would be subject to a variety of IPFs from activities stemming from energy substitution, which would occur as a direct result of the removal of the activities associated with the Proposed Action. No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska. Activities associated with energy substitutes (e.g., tanker vessel traffic, wind energy facilities) could result in oil spills and seafloor disturbance, and visual effects on onshore archaeological and historic properties from offshore wind turbines, in a wider geographic area than the Proposed Action (**Section 4.4.4**). Impacts related to energy substitutions for 2017–2022 could result in increased onshore oil and gas production, which could lead to increased ground disturbance impacts on onshore archaeological and historical resources. The impacts of energy substitutes on archaeological and historic resources are expected to be less under Alternative D than under the Proposed Action. However, an oil spill from activities in state waters or the grounding of a tanker could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, archaeological and historic resources would be subject to a variety of IPFs from non-Program activities. **Section 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. Archaeological and historic resources could be affected by various oil and gas activities as a result of previous lease sales in Federal and state waters, as well as future lease sales in state waters. These IPFs include bottom (seafloor) disturbance, accidental oil spills, and CDEs. Other activities likely to contribute to seafloor disturbance impacts on archaeological and historical resources include scientific research and looting. Additionally, climate change-induced sea level rise, the potential for more frequent and stronger hurricanes, and the thawing of permafrost could also contribute to the impacts on submerged and onshore cultural resources through wave action, erosion, and currents, which could uncover and potentially destroy archaeological sites.

Due to the lack of current oil and gas activity in the Chukchi Sea and Cook Inlet Program Areas, it is highly unlikely that archaeological and historical resources would be impacted by sea floor disturbance from OCS oil and gas activities; however, there is a continued possibility that sea floor disturbance and oil spills would impact archaeological and historical sites in state waters, and from previous leases in Federal waters in the Beaufort Sea. Due to climate change-induced reduction in sea ice in the Arctic, cruise ship and shipping traffic is projected to increase in the Arctic. There is a possibility that archaeological and historical properties could be impacted by other anchoring activities related to shipping or cruise ships, as well as seafloor disturbance from scientific research activities. Accidental oil spills and CDEs from oil and gas activities in state waters and previously leased Federal waters (in the Beaufort Sea) could still impact OCS, nearshore, and onshore archaeological and historical resources.

The GOM Program Area has extensive oil and gas activities in state waters and in Federal waters from leases issued under previous Five-Year Programs. In addition to the activities discussed in the previous paragraph, archaeological and historic resources could be affected by seafloor disturbance from commercial fishing (such as trawling), scientific research, dredging, marine disposal, and looting.

Potential impacts on archaeological and historical resources due to activities associated with the effects baseline, if they were to occur, are expected to be **minor** to **major** because of the sensitivity of these resources to seafloor disturbance impacts and oil spills (see **Section 4.4.1.11**) and resultant loss of irreplaceable cultural information from the broad range of other non-OCS oil and gas activities, and the potential scale of impacts (spreading into a wider geographic area than the Proposed Action) for each.

4.4.4.12 Population, Employment, and Income

Alaska Program Areas

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The NSB, KPB, State of Alaska, and their residents would lose the potential for important sources of employment, income, value added, funds from revenue sharing and taxes, business opportunities for local companies, and related benefits that could result from exploration, development, production, and transportation related to Alaska OCS lease sales contemplated under the Proposed Action. The potential for disruption and strains on local public infrastructure and services that would occur under a high-price scenario would also not occur.

As discussed in **Section 4.4.1.12**, North Slope oil production onshore and from state waters has been declining, threatening the viability of TAPS, which requires a certain level of throughput to operate. TAPS is the only existing means of transporting oil from the North Slope to market. Oil from the Beaufort Sea would be piped to TAPS for transportation to market, and it is anticipated that oil from the Chukchi Sea would as well. If TAPS throughput declines much further, it might become insufficient to support the system, threatening the loss of North Slope oil production and budget shortfalls for the NSB and the state's general fund. The losses of revenue, employment, and income resulting from the closure of TAPS would force a fundamental restructuring of local and state economies and have a major impact on the welfare of Alaska residents. While Alaska OCS production is unlikely to eliminate the near-term, low-flow challenges that face TAPS, it could help extend the viability of the pipeline at some point in the future. These potential impacts on the State of Alaska, local government, and Alaska residents are not caused by previous or new OCS leasing, but the potential fiscal relief provided by the economic opportunities from new OCS activities would be precluded under Alternative D, and some residents and officials from the NSB and Alaska overall have expressed the importance of OCS oil and gas activities to the future of their communities and/or state.

In the absence of production under the Proposed Action for the Alaska OCS, the demand for energy that would have been met by that production would likely be met by equivalent changes in onshore production, imports, and a reasonably small amount fuel switching. The energy substitutes for forgone Alaska OCS production are unlikely to be concentrated in any one geographic area, and that should render impacts insignificant wherever they occur. There also would be a reasonably small change in energy consumption (due to minor changes in oil prices due to differences in the supply of oil), the effects of which on population, employment, and income would be small and/or difficult to characterize.

The effects from Alternative D on population, employment, and income are expected to be less than those from Alternative A. Most impacts from the production and transport of substitutes would likely occur outside of Alaska. Under Alternative D, Alaska and local communities would experience neither the positive or the negative socioeconomic implications of the activities associated with the Proposed Action, as discussed in **Section 4.4.1.12**.

Effects Baseline (Ongoing and Future Actions). **Section 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. There are numerous categories of reasonably foreseeable future actions that have an impact on public revenue and expenditures, employment and personal income, and social organizations and institutions. These include the following: onshore oil and gas exploration, development, and production; mining exploration, development, and production; military, transportation, community development projects, and subsistence activities (as they affect the non-cash economy), and recreation and tourism.

All of Alaska's oil is produced in the North Slope and KPB; the Cook Inlet oil and gas industry accounts for approximately 37 percent of the KPB's total economic output (NEI 2014). However, activities related to state oil and gas are not estimated to induce substantive growth in employment, earnings, or revenues in the KPB in the foreseeable future. Marine transportation, ports, and terminals would impact the economy and population. While the level of marine transportation and other activities at ports and terminals have been flat following the recession in 2009, moderate increases in vessel traffic (1.5 to 2.5 percent annually) are projected because of population growth, lower fuels costs, and other post-recession improvements in the economy (Cape International, Inc. 2012). In addition, completion of expansions at several ports is likely to increase activities and vessel calls at ports, harbors, and terminals for the next 40 to 50 years.

As diminished sea-ice coverage accelerates over time due to climate change, several additional disruptions to economy and population are likely to occur from altered habitat and changes in wildlife distribution. Climate change could induce regional economic and sociocultural effects through increased economic activities such as commercial fishing, sport fishing, coastal mining, renewable energy development, tourism, recreation, and marine shipping. These activities would involve increases in vessel traffic and infrastructure construction (e.g., new businesses in Anchorage), which would cause additional impacts on employment and population. Additionally, such economic activities would require substantial levels of skilled labor and high-value infrastructure, which would add new impacts on existing employment patterns, and by extension, on the population in the region.

Gulf of Mexico Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. There is an expansive existing GOM OCS oil and gas industry that developed in response to decades of annual GOM lease sales. Alternative D would disrupt the functioning of the industry and could cause gradual losses of the jobs, income, revenues, and profits that the industry supports.

The selection of Alternative D, cancellation of OCS leasing for 2017–2022, could trigger various adjustment processes. The loss of oil and gas production would increase prices and would necessitate obtaining oil and gas supplies from other sources. The negative impacts on the economy would depend on the market share of OCS oil and gas supplies relative to other sources, as well as on the tightness of the overall oil and gas markets at the time. In aggregate, Alternative D could cause serious negative impacts, particularly in areas that are highly dependent on OCS oil and gas activities, such as parts of southern Louisiana.

Effects Baseline (Ongoing and Future Actions). **Section 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. Non-OCS program activities affecting the region include employment and earnings related to various other industrial sectors (e.g., construction, manufacturing, services, and state and local government) and the high unemployment rates in the five GOM coastal states.

4.4.4.13 Land Use and Infrastructure

Beaufort Sea and Chukchi Sea Program Areas

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska.

Effects Baseline (Ongoing and Future Actions). **Section 3.7** and **Appendix B** describe the types of ongoing and future activities that could be reasonably anticipated providing specific examples of known ongoing and expected projects for each program area. As part of the effects baseline, it is anticipated that non-OCS oil and gas activities would still continue in portions of the Arctic. This can be attributed to state leases and the subsequent buildout of supporting infrastructure when projects move from exploration to development phases. These activities would be particularly apparent near the Beaufort Sea Program Area from operations at Prudhoe Bay, and from current activities associated with onshore leasing under BLM authority in the NPR-A. Activities include, but are not limited to, offshore construction, onshore construction, buildout of temporary and permanent roads, and subsequent increases in vessel traffic. Outside of energy development, construction of temporary and permanent roads, dredging and excavation activities for harbors and channels, as well as climate change, are already modifying regional land uses. It is anticipated that these trends will continue into the future regardless of energy production in the Arctic, and that any modifications to land use could have **minor** to **moderate** impacts because a majority of the Arctic remains undeveloped due to the high costs associated with building new infrastructure and the lack of transportation infrastructure.

Cook Inlet Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska. Energy needs in the Cook Inlet region can be partially met from the buildout of renewable energy projects and from production from state leases. However, the effects of Alternative D on land use and infrastructure are expected to be less than those from Alternative A because most impacts from the production and transport of substitutes would likely occur outside of Alaska.

Effects Baseline (Ongoing and Future Actions). **Section 3.7** and **Appendix B** describe the types of ongoing and future activities that could be reasonably anticipated, providing specific examples of known ongoing and expected projects for each program area. As part of the effects baseline, it is anticipated that non-OCS oil and gas activities would continue in the Cook Inlet region from existing state leases. Outside of energy development, the Cook Inlet region is already experiencing modifications to local land uses from activities such as the Port of Anchorage Intermodal Expansion Project, sea level rise and associated climate change impacts, and new recreational and tourism opportunities. These activities would occur regardless of energy development on the OCS, and are expected to result in land use impacts of their own. As such, **minor** to **moderate** changes in land use are expected due to activities associated with the effects baseline.

Gulf of Mexico Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Oil and gas development is the main industrial activity occurring in the GOM region. As oil and gas development has taken place in the coastal waters of the GOM states and in Mexico's waters, supporting infrastructure is found throughout the region. These include an extensive network of platforms and pipelines, natural gas processing and pipeline distribution networks, and port facilities. In some areas, there would be new infrastructure development to support onshore energy development and in others there would be decommissioning of existing infrastructure developed primarily to serve OCS oil and gas operations. Under the No Action Alternative, energy needs from lost OCS production would be met with increases in production from existing Federal and state leases, oil imports, and renewable energy. These substitute sources could impact land use and infrastructure and could result in negative impacts on the environment (**Section 4.4.4**). In particular, importing oil via tanker could increase the potential risk for oil spills in the GOM and could subsequently impact coastal land uses. The impacts of energy substitutes are expected to be less under Alternative D than under the Proposed Action. An oil spill from activities in state waters or tanker grounding could have significant impacts.

Effects Baseline (Ongoing and Future Actions). **Section 3.7** and **Appendix B** describe the types of ongoing and future activities that could be reasonably anticipated, providing specific examples of known ongoing and expected projects for each program area. Outside of energy development, the GOM region is already experiencing modifications to local land uses from activities such as port and harbor expansions, construction of sewage treatment plants associated with agricultural and other industrial operations, coastal erosion, and other associated climate change impacts. These activities are expected to occur regardless of new leasing on the OCS, and would result in their own set of impacts on land use and infrastructure. Impacts from these activities on land use and infrastructure are expected to be **minor**.

4.4.4.14 Commercial and Recreational Fisheries

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Commercial and recreational fisheries would be subject to a variety of IPFs from activities stemming from energy substitution, which would occur as a direct result of the removal of the activities associated with the Proposed Action (**Section 3.5.2)**. No tankering associated with substitutes is expected over the Alaska OCS and no impacts are expected from substitutes in Alaska. The impacts of energy substitutes are expected to be less under Alternative D than under the Proposed Action. However, an oil spill from activities in state waters or a tanker grounding in the GOM could have significant impacts.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, commercial and recreational fisheries would be subject to a variety of IPFs from non-Program activities. **Section 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. IPFs that would affect this resource due to activities associated with the effects baseline include noise, traffic, routine discharges, bottom/land disturbance, lighting, visible infrastructure, space-use conflicts, and non-routine events (i.e., fuel and oil spills). Potential impacts on commercial and recreational fisheries from these other activities are similar to those described under Alternative A (**Section 4.4.1**). IPFs associated with many other OCS projects have the potential to result in the loss or degradation of fishable habitat due to construction and operations activities, or a decrease in fish stocks, resulting in lower catch limits. Coastal access could also decrease as a result of onshore industrial and commercial development.

In areas of dense fishing effort, or where gear is spread over a large area, commercial fishing has the potential to cause semi-permanent standoff-distance conflicts on the OCS. Marine standoff-distance conflicts are already an issue between many competing fisheries in some portions of each program area (e.g., pelagic longline fisheries, deepwater crab fisheries). On a space-use basis, commercial and recreational fishing can occur anywhere in favored areas where it is not temporarily or permanently excluded (i.e., in areas where there are no surface or bottom obstructions). Virtually all commercial trawl fishing is performed in water depths < 200 m (656 ft). Space-use conflicts would be expected to continue without the activities associated with the Proposed Action. A very small fraction of total OCS area in the program area is now unavailable for commercial fishing.

In prior years, the GOM seafood industry and its associated infrastructure has been negatively affected by disasters such a Hurricanes Katrina and Rita, as well as the 2010 *Deepwater Horizon* explosion, spill, and response. Health of the GOM ecosystem has been adversely impacted by increasing anthropogenic influences over past decades, primarily due to energy extraction, population growth, and coastal development; these pressures are expected to continue under the effects baseline.

Non-routine events such as oil spills from existing OCS leases or activities in state waters could cause fishery closures for species such as pollock and halibut in Alaska and shrimp, menhaden, and oysters in the GOM. This could lead to major economic impacts (Upton 2011). There are no existing OCS leases in the Cook Inlet, but activities in state waters could result in an oil spill. Population-level impacts and associated changes in fishery yields as a result of oil spills, particularly Deepwater Horizon in the GOM, are difficult to tease apart and continue to require research (Fodrie et al. 2014). Sea temperatures have increased and will continue to increase. The increase in sea temperatures could work synergistically to exacerbate other ecosystem pressures, such as increases in the frequency and size of hypoxic events, and would therefore contribute to declining fishery yields.

In each of the program areas, climate change is having, and will continue to have, a dramatic impact on fisheries resources. Climate-induced changes to ocean ecosystems, such as increasingly warming oceans, species shifts, rising sea levels, and ocean acidification, are already happening. Shifts in species distribution would modify both commercial and recreational fisheries by changing transit time needed to reach fishing grounds if distribution changes as a result of changing water temperatures. Recreational fishing for salmonids could be substantially impacted through the reduction or loss of cold water stream habitat vital for reproductive success. In addition to these observed changes, there are anticipated changes such as increasing hypoxic zones, decreasing salinity, changing nutrient supplies, and increasing extreme weather events, which are all likely to have a profound impact on fisheries resources upon which people, businesses, and communities depend. Climate change is anticipated to lead to large-scale redistribution of global catch potential with maximum potential declines in semi-enclosed bodies of water such as the GOM (Cheung et al. 2010).

The effects baseline for commercial and recreational fisheries is expected to change over the next 50 years both with and without the activities associated with the Proposed Action. As a result, impacts from ongoing and future actions could range from **minor** to **major**.

4.4.4.15 Tourism and Recreation

Beaufort Sea Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The effects of the ongoing and future actions on tourism are expected to be less than Alternative A because impacts from the production and transport of substitutes would likely occur outside of Alaska. In the Beaufort Sea Program Area, there are no currently planned exploration activities, and with no new leasing there might be less incentive to consider any new exploration activities because of the high cost of development due to the harsh environment in Arctic OCS waters. Because of the limited industrialization in this remote area, wilderness has characterized this environment and become an expectation for visitors. Conditions for visitor trips to and along the Arctic NWR, the Dalton Highway, and communities of Kaktovik and Nuiqsut from OCS oil and gas would remain unchanged from the little industrial activity ongoing in this area.

Effects Baseline (Ongoing and Future Actions). **Section 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. Recreation and tourism activities are generally pursued by non-residents. Marine and coastal vessel and air traffic occur in the area. With the exception of adventure cruise ships that transit the Beaufort Sea and Chukchi Sea coasts in small numbers, much of the air sightseeing traffic is concentrated in the Arctic NWR. Recreation and tourism activities are expected to continue into the future. Current and past sport hunting and fishing, or other recreation- or tourism-related activities, would be similar in the types of activities and areas used in the future. Existing OCS oil and gas activity is not expected to be a significant source of impacts because there is little activity ongoing.

Effects of climate change, including increasing air and ocean temperatures, rising sea level, reduced sea ice, ocean acidification, and shifts in the distribution of flora and fauna, could affect tourism and recreation in the Beaufort Sea area. The effects of climate change already have been observed and are expected to continue for the foreseeable future.

Chukchi Sea Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The effects of Alternative D on tourism are expected to be less than Alternative A because impacts from the production and transport of substitutes would likely occur outside of Alaska. In the Chukchi Sea Program Area, there are no planned exploration activities, and with no new leasing, there might be less incentive to consider any new exploration activities because of the high cost of development due to the harsh environment in Arctic OCS waters. Conditions for visitor trips to the communities of Barrow, Wainwright, Point Lay, and Point Hope from OCS oil and gas would remain unchanged from the little industrial activity ongoing in this area.

Effects Baseline (Ongoing and Future Actions). S**ection 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. There is one existing lease in the Chukchi Sea and it is expected to expire in 2020 without any development taking place. Tourism and recreation activities are generally pursued by non-residents. Marine and coastal vessel and air traffic occur in the area. With the exception of adventure cruise ships that transit the Beaufort Sea and Chukchi Sea coasts in small numbers, much of the air sightseeing traffic is concentrated in the Arctic NWR. Recreation and tourism activities are expected to continue into the future. Current and past sport hunting and fishing, or other recreation- or tourism-related activities would be similar in the types of activities and areas used in the future.

Effects of climate change, including increasing air and ocean temperatures, rising sea level, reduced sea ice, ocean acidification, and shifts in the distribution of flora and fauna, could affect tourism and recreation in the Chukchi Sea area. The effects of climate change already have been observed and are expected to continue for the foreseeable future.

Cook Inlet Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The effects of

Alternative D on tourism are expected to be less than Alternative A because impacts from the production and transport of substitutes would likely occur outside of Alaska. In the Cook Inlet Program Area, there are no existing oil and gas leases in Federal waters. Conditions for tourism and recreation from OCS oil and gas would remain unchanged as there are no existing OCS leases in Cook Inlet.

Effects Baseline (Ongoing and Future Actions). S**ection 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. The oil and gas industry is active in the Cook Inlet area as companies continue to produce oil and gas from existing wells in state waters. In addition, several companies are actively exploring for oil and gas state waters and several companies propose to conduct additional seismic surveys. Oil and gas activities on land and in state waters can produce visual impacts when proximal to shore or onshore resources. These development activities, if widespread, could result in impacts on scenic values for residents, recreationists, and tourists in the Cook Inlet region. Although the levels of activities at ports and terminals have been flat following the recession in 2009, moderate increases (1.5 to 2.5 percent annually) are projected because of population growth and post-recession improvements in the economy. In addition, completion of expansions at several ports is likely to increase activities and vessel calls at ports, harbors, and terminals over the life of the Program. Ports and terminals can have visual impacts on water and coastal visual resources, particularly with regard to large offloading facilities that could be visible at greater distances. Nighttime visual impacts in the form of direct glare and sky glow can occur at these facilities.

Effects of climate change, including increasing air and ocean temperatures, rising sea level, reduced sea ice, increased wildfires, ocean acidification, and shifts in the distribution of flora and fauna, could affect tourism and recreation in the Cook Inlet area. The effects of climate change already have been observed and are expected to continue for the foreseeable future. Overall, impacts from ongoing and future actions could range from **minor** to **major.**

GOM Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The GOM has an extensive existing OCS oil and gas industry. While this industry receives economic contributions from many areas, the largest concentrations of OCS oil and gas companies and supporting activities are near Houston, Texas, and in coastal Louisiana.

This area would be protected from development, but would experience little if any change in visible infrastructure, noise, and space-use conflict due to existing oil and gas activities in the region. An oil spill from activities in state waters or a tanker grounding in the GOM could have significant impacts.

Effects Baseline (Ongoing and Future Actions). **Section 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. Impacts on tourism and recreation in the GOM as a result of ongoing and future OCS and non-OCS activities and natural phenomena are expected to be minor over the next 40 to 70 years. Non-OCS activities or phenomena affecting these resources include OCS construction (e.g., dredging and dredge-disposal operations, marine mineral mining, state oil and gas development, domestic transportation of oil and gas, and foreign crude oil imports), onshore construction (e.g., coastal and community development), the discharge of municipal and other waste effluents, and marine vessel traffic.

Platforms installed within 16 km (10 mi) of coastal recreation areas, such as beaches, parks, and wilderness areas, can affect recreational experiences by affecting ocean views. Transportation of oil and gas, combined with other commercial, industrial, and recreational vessel traffic that continues to occur within the GOM, can affect recreational experiences through increased noise, boat wake disturbances, visual intrusions, and increased trash and debris washing ashore. In addition to transportation and oil and gas, other activities contribute to the trash and debris found on the beaches including (but not limited to) beach visitors, commercial and recreational fishing, merchant shipping, naval operations, and cruise lines. As a result, impacts from ongoing and future actions could range from **minor** to **major**.

4.4.4.16 Sociocultural Systems

Beaufort Sea and Chukchi Sea Program Areas

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The effects of Alternative D are expected to be less than those for Alternative A. This is largely in part because impacts from production and transport of energy substitutes are expected to occur outside of Alaska and would not result in a significant change from what would be expected if no leasing occurred.

Under Alternative D, there would be no potential for an increase in tax and other revenues that could result in improved public infrastructure (e.g., road, sewer and water, community buildings) and community services (e.g., healthcare, education, fire and rescue) for areas within the NSB (NSE 2006). The potential for commensurate changes in personal income, standard of living, sense of well-being, and lifestyle amenities at the individual, family, and community levels would also be eliminated.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, several actions and trends listed in **Section 3.7** and **Appendix B** have the potential to impact sociocultural systems in the Arctic. These include, but are not limited to, impacts from E&D activities associated with leasing onshore in the NPR-A, as well as those expected from the Liberty Development and Northstar facility in the Beaufort Sea. While oil and gas activities would still continue in portions of the Arctic, it is plausible that the region could also experience net population growth and greater diversity as more development projects occur. The in-migration of oil and gas workers could increase the need for public services and infrastructure, housing, water and sewage treatment, communication networks, road construction and maintenance, health facilities, and public safety and rescue operations, all of which can impact established sociocultural systems.

Climate change has the potential to affect sociocultural systems. As warming has created more ice-free lanes along the coast, the Beaufort and Chukchi Seas have seen increases in marine traffic from cargo and tourist ships, a pattern that is likely to continue. Noise from increased shipping can disturb whale migration patterns, and increased shipping could increase the number of ship strikes on marine mammals. Because these activities could influence whale migration patterns, subsistence hunters could also need to adapt and in many cases, travel greater distances. The same argument can be made for subsistence caribou hunters, whereby new development supporting onshore oil and gas activities could impact caribou migration patterns. Combined with other climate-related impacts such as loss of sea ice and associated coastal erosion, climate change is expected to continue altering the landscape and physical and cultural health of many Native communities. As such, these future trends and activities would have their own set of impacts on sociocultural systems, separate from OCS leasing in the Arctic. Thus, any development could result in **moderate** to **major** impacts on sociocultural systems due to the relatively undeveloped nature of the Arctic.

Cook Inlet Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The Cook Inlet region currently supports oil and gas infrastructure from existing state leases, and energy needs in the region from lost OCS production would likely be met from the buildout of renewable energy projects and from continuing production from non-OCS leases. As these energy substitutes have their own set of environmental and economic impacts, it is anticipated that some of these impacts could displace those anticipated under the Proposed Action to other geographic areas and resources. However, it is still anticipated that the effects of Alternative D on sociocultural resources from energy substitutes would be less than those from Alternative A, as a majority of impacts from production and transport of substitutes would occur outside of Alaska.

Effects Baseline (Ongoing and Future Actions). As part of the effects baseline, several actions and trends described in **Section 3.7** and **Appendix B** could impact sociocultural systems in the Cook Inlet region. While the No Action Alternative delays or eliminates potential impacts on seafloor disturbance and habitat alteration, waste discharges, air emissions, noise, and other impact sources from OCS oil and gas activities, the Cook Inlet Program Area currently supports oil and gas economy in state waters. The Cook Inlet region is also set to see an increase in industrial activity, given projects such as the Port of Anchorage expansion and the proposed Alaska LNG project. While these activities are expected to impact the local community, climate change is already impacting portions of the Cook Inlet as the region supports several commercial salmon fisheries. Given changing habitat conditions and less predictability with salmon runs from warmer waters, climate change has the potential to impact the entire community structure. While some of these changes are gradual, these ongoing and future actions would contribute to **negligible** to **minor** impacts on sociocultural systems under the No Action Alternative.

GOM Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. Energy substitutions would be anticipated to result in some combination of increased tankering, foreign oil imports, onshore oil and gas production, and renewable energy development to offset the absence of oil and gas production from the activities associated with the Proposed Action. An oil spill from activities in state waters or from a tanker grounding could have significant impacts.

Effects Baseline (Ongoing and Future Actions). S**ection 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. Non-OCS program activities and processes affecting sociocultural systems are expected to continue. These include oil and gas development in state waters, coastal habitat changes, coastal land loss, and regional economic changes. These activities and processes can lead to major impacts related to population change, job creation and loss, and changes in social institutions including family, government, politics, and education. OCS oil and gas-related activities have been an important source of employment and income in GOM coastal areas. Taking into consideration indirect effects, climate change is already impacting GOM fisheries as increasingly warming oceans and ocean acidification are contributing to shifts in species distribution. As commercial and recreational fishing is also critical to the cultural and economic identify of many GOM populations, these impacts, combined with decreasing dependence on the oil and gas economy, could result in **moderate** to **major** impacts on sociocultural systems.

4.4.4.17 Environmental Justice

Beaufort Sea Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. In the Beaufort Sea Program Area, there are no planned exploration activities, and with no new leasing, there could be less incentive to consider any new exploration activities because of the high cost of development due to the harsh environment in Arctic OCS waters. The effects of Alternative D on environmental justice from energy substitutes are expected to be less than Alternative A. This is because impacts from the production and transport of substitutes would not occur inside Alaska and would not result in a change from what would be expected if no leasing occurred.

The impacts from the No Action Alternative would be similar to the cultural baseline now in the offshore environment. The demand for energy that would have been met by that production would likely be met by increased onshore production, imports, and a reasonably small amount fuel switching, which could cause an increase of noise, routine discharges, air emissions, lighting, visible infrastructure, space use conflict, and risk of accidental spills to occur closer to shore. The increased supply from these sources would reflect growth on population, employment, and income as well, but these would be geographically disbursed and are likely to occur outside of Alaska (**Section 4.4.1.12)**.

Effects Baseline (Ongoing and Future Actions). S**ection 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. Development activities on past leasing would still proceed. Community development projects in Arctic communities (e.g., major infrastructure projects, such as construction of airports and response centers or smaller projects) could occur in the future. These projects could result in construction noise in coastal areas, and could generate additional amounts of marine and aircraft traffic to support construction activities. Marine and air transportation could contribute to the effects baseline through the disturbance of marine mammals and impacts to the subsistence harvest.

Cultural values are reflected in governmental and tribal (governmental) bodies to ensure that economic development and social services address the needs of local communities appropriately. Social organizations and institutions would remain important in meeting community needs and preserving community culture, with regard to issues associated with resource development and trends in Federal, state, and local revenue.

Climate change could affect the habitat, behavior, distribution, and populations of marine mammals, fish, and other wildlife. Climate change could also affect the availability of, or access to, subsistence resources, particularly spring hunts for bowhead whales and other marine mammals. Climate change also affects the length of seasons that ice roads are operable, potentially leading to more reliance on marine access. The effects baseline of cultural conditions for vulnerable communities could range from **minor** to **major**.

Chukchi Sea Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. In the Chukchi Sea Program Area, there are no planned exploration activities, and with no new leasing, there could be less incentive to consider any new exploration activities because of the high cost of development due to the harsh environment in Arctic OCS waters. The effects of Alternative D on environmental justice from energy substitutes are expected to be less than Alternative A. This is because impacts from the production and transport of substitutes would not occur inside Alaska and would not result in a change from what would be expected if no leasing occurred. The impact from the No Action Alternative for this section would be similar to the cultural baseline now in the offshore environment. The demand for energy that would have been met by that production would likely be met by increased onshore production, imports, and a reasonably small amount fuel switching, which could cause an increase of noise, routine discharges, air emissions, lighting, visible infrastructure, space-use conflict, and risk of accidental spills to occur closer to shore. The increased supply from these sources would reflect growth on population, employment, and income as well but almost exclusively outside of Alaska (**Section 4.4.1.12)**.

Effects Baseline (Ongoing and Future Actions). S**ection 3.7** and **Appendix B** provide information on the activities that could be reasonably anticipated for each program area. Development activities on past leasing would still proceed. Community development projects in Arctic communities (e.g., major infrastructure projects, such as construction of airports and response centers or smaller projects, such as construction of a new washeteria) could occur in the future. These projects could result in construction noise in coastal areas, and could generate additional amounts of marine and aircraft traffic to support construction activities. Marine and air transportation could contribute to the effects baseline through the disturbance of marine mammals and impacts to the subsistence harvest.

Cultural values are reflected in governmental and tribal (governmental) bodies to ensure that economic development and social services address the needs of local communities appropriately. Social organizations and institutions would remain important in meeting community needs and preserving community culture, with regard to issues associated with resource development and trends in Federal, state, and local revenue.

Climate change could affect the habitat, behavior, distribution, and populations of marine mammals, fish, and other wildlife. Climate change could also affect the availability of, or access to, subsistence resources, particularly spring hunts for bowhead whales and other marine mammals. Climate change also affects the length of seasons that ice roads are operable, potentially leading to more reliance on marine access. The effects baseline of cultural conditions for vulnerable communities could range from **minor** to **major**.

Cook Inlet Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The impacts from the No Action Alternative would be similar to the cultural baseline now in the offshore environment. The effects of Alternative D on environmental justice from energy substitutes could be greater than Alternative A. This is because impacts from the production and transport of substitutes could increase in state waters closer to coastal communities. The demand for energy that would have been met by that production would be met by increased onshore production, imports, and a reasonably small amount fuel switching, but it is anticipated that these impacts would generally occur outside of Alaska and be distributed over a huge geographic area (**Section 4.4.1.12)**.

Effects Baseline (Ongoing and Future Actions). Other sources of impacts on environmental justice communities include the following: oil and gas activities in state waters, marine transportation, ports and terminals, and climate change. Oil and gas exploration and development has occurred onshore and in state waters of upper Cook Inlet over the past 50 years. Current infrastructure in upper Cook Inlet includes platforms in state waters, associated oil and gas pipelines, and onshore processing and support facilities. The categories of marine transportation and ports and terminals include activities of a similar nature to the Proposed Action. Most vessel traffic in Cook Inlet moves along north-south transit lines, with deep-draft vessels generally using the eastern side of the inlet. Eighty percent of large ship operations were made by only 15 vessels that regularly call at Homer, Nikiski, or Anchorage (Cape International Inc., 2012). The Port of Anchorage is planning a modernization project that would increase the harbor depth, enabling the port to accommodate larger ships. The level of vessel traffic expected during the life of the Proposed Action would be minimal compared to overall vessel traffic in Cook Inlet and would not be expected to have a serious impact on environmental justice communities.

Climate change could result in impacts on environmental justice communities through increasing air and water temperatures, sea level rise, and ocean acidification. While the effects of climate change will be long-term, the effects that would occur during the life of the Proposed Action are not expected to impact environmental justice communities in the vicinity of Cook Inlet.

GOM Program Area

No New 2017–2022 Leasing and Consideration of Energy Substitutes. Under the No Action Alternative, direct and indirect impacts of the Proposed Action would not occur. The GOM has an extensive existing OCS oil and gas industry. While this industry receives economic contributions from many areas, the largest concentrations of OCS oil and gas companies and supporting activities are near Houston, Texas, and in coastal Louisiana.

The likelihood of increased onshore production as a result of energy substitution from this alternative could put vulnerable communities at a greater risk of experiencing impacts from noise, air emissions, lighting, visible infrastructure, and space-use conflicts, due to closer proximity of the activity to the communities. The level of impact expected under Alternative D from energy substitutes for the GOM is less than the impacts under the Proposed Action. An oil spill from activities in state waters or from a tanker grounding could have significant impacts due to closer proximity to the coast.

Effects Baseline (Ongoing and Future Actions). Ongoing OCS oil and gas activities are not expected to expose residents to notably higher risks than currently occur. However, the distribution of OCS-related activities and infrastructure indicates that some places and populations in the GOM region would continue to be vulnerable to environmental justice concerns due to their proximity to these activities.

Non-OCS activities and processes that are ongoing and expected to continue into the foreseeable future include non-OCS oil and gas development, coastal habitat changes, coastal land loss, economic development, regional economic changes, and recovery from storms. These activities and processes could disproportionately impact low-income populations and communities of color. In the GOM, ongoing OCS and non-OCS future activities in combination with the effects of storm damage/recovery, climate change, and regional economic issues could result in disproportionate **minor** to **major** adverse impacts on low-income and minority populations.

4.4.5 Accidental Spills and Catastrophic Discharge Events

Oil spills are accidental and unauthorized events. Industry practices and Government regulations minimize the risk of oil spills, and industry and Government entities prepare to respond should a spill occur. Despite these efforts, there is no way to guarantee that oil spills would not occur. Therefore, it is imperative for BOEM to analyze the potential for spills of various sizes, and their potential impacts on the environment as well as assess opportunities for prevention and mitigation to reduce oil spill occurrence and improve spill response. This analysis applies to effects from an actual spill as well as spill containment and cleanup activities. Such an analysis is presented here, and applies across the broad spectrum of environmental resource areas discussed in this chapter.

For the purpose of this Programmatic EIS analysis, accidental oil spills are classified into two broad categories: (1) expected accidental small (≥ 1 to < 1,000 bbl) and large (≥ 1,000 bbl) spills from platforms and pipelines; and (2) a low-probability CDE. See **Section 3.2** for information on historical oil spill data and probabilities for the Proposed Action. A CDE references a very large spill well outside of the normal range of probability that could result from OCS exploration, development, and production activities involving rigs, facilities, pipelines, tankers, and/or support vessels. A CDE is not considered within any Proposed Action or development scenario and is considered an unlikely event. Although a CDE is unauthorized and not an expected outcome of the Proposed Action, the potential impacts of such a low-probability incident still are considered within this Programmatic EIS because of the possible magnitude and severity of potential impacts.

The magnitude and severity of impacts from a spill on any resource would depend on the spill's location, size, depth, and duration as well as the type of spill, meteorological conditions such as wind speed and direction, seasonal and environmental conditions, and the effectiveness of response activities. The aforementioned factors can have a substantial effect on weathering processes such as evaporation, emulsification, dispersion, dissolution, microbial degradation and oxidation, and transport of the spilled products.

4.4.5.1 Fate and Transport of Oil

In considering oil spill impacts, it is important to understand physical transport and fate of the spilled products. As mentioned, several factors (e.g., environmental, spill type) contribute to the fate of spilled oil. However, understanding circulation patterns and physical oceanographic conditions is vital for examining oil and gas production and exploration activities with respect to preserving the environment (Ji 2004, Lugo-Fernandez and Green 2011). A brief overview of regional circulation patterns is provided in the following text and figures.

4.4.5.1.1 Alaska – Beaufort Sea, Chukchi Sea, and Cook Inlet

In Alaska, sea ice, ocean currents, tides, waves, and storm surges affect OCS oil and gas operations near the coastline (**Figures 4.4.5-1** and **4.4.5-2**). Tides are considered minor along the coastal regions of the Arctic Ocean (NRC 2003b, MBC Applied Environmental Sciences 2003), but tidal ranges in Cook Inlet are among the largest in the world (Archer and Hubbard 2003). U.S. Arctic coastal waters largely are covered by sea ice, with some open water areas between October and June. The minimum sea ice extent occurs in September as sea ice begins to form, reaching a maximum extent in March (Weeks and Weller 1984). In Cook Inlet, sea ice is present for a considerably shorter period of time. Arctic climate conditions (i.e., cold water and cold air temperatures) typically result in lower rates of oil weathering processes such as evaporation, emulsification, and oxidation (Thomas 1983) as well as lower rates of dispersion because of the increased viscosity of oil at lower temperatures (Payne et al. 1991). However, studies have shown that preexisting microbes within Arctic waters are capable of substantially degrading oil when present in the water column (McFarlin et al. 2014).

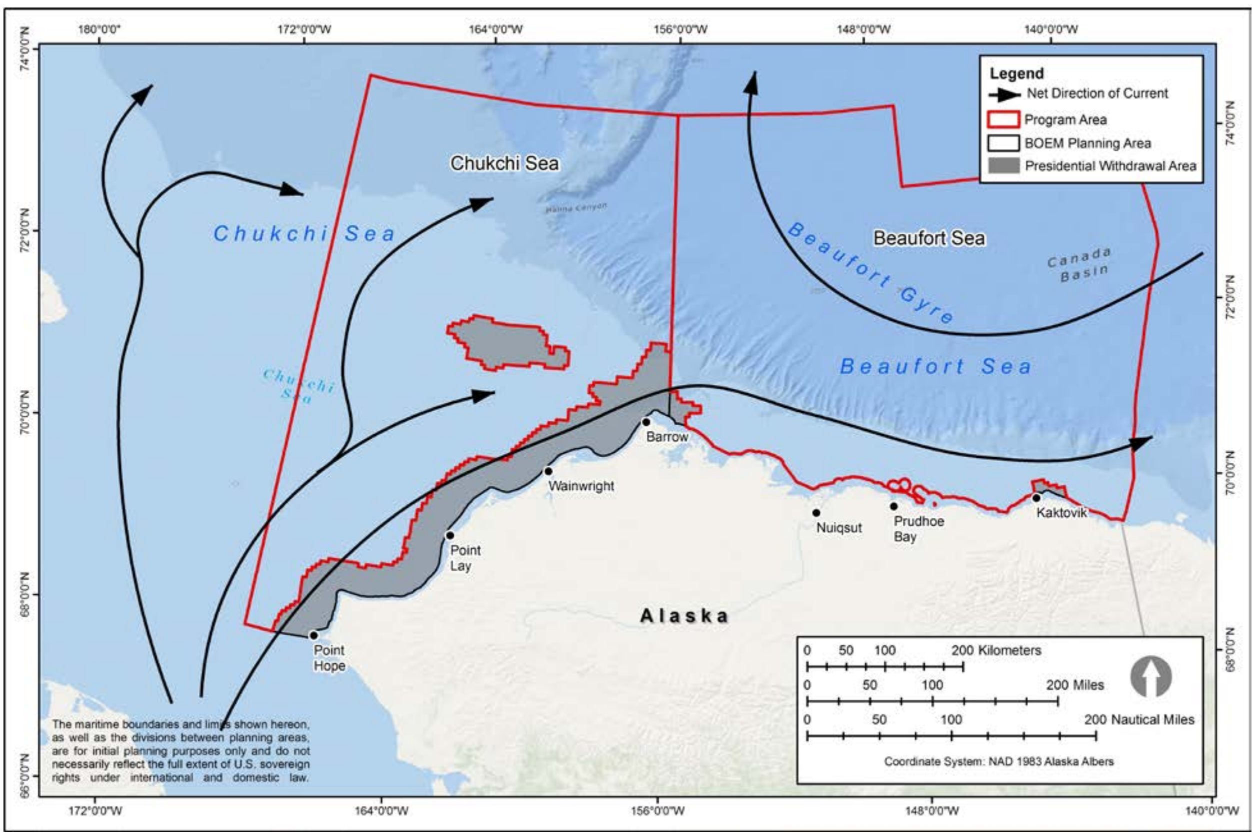


Figure 4.4.5-1. Major Circulation Features in the Beaufort and Chukchi Seas

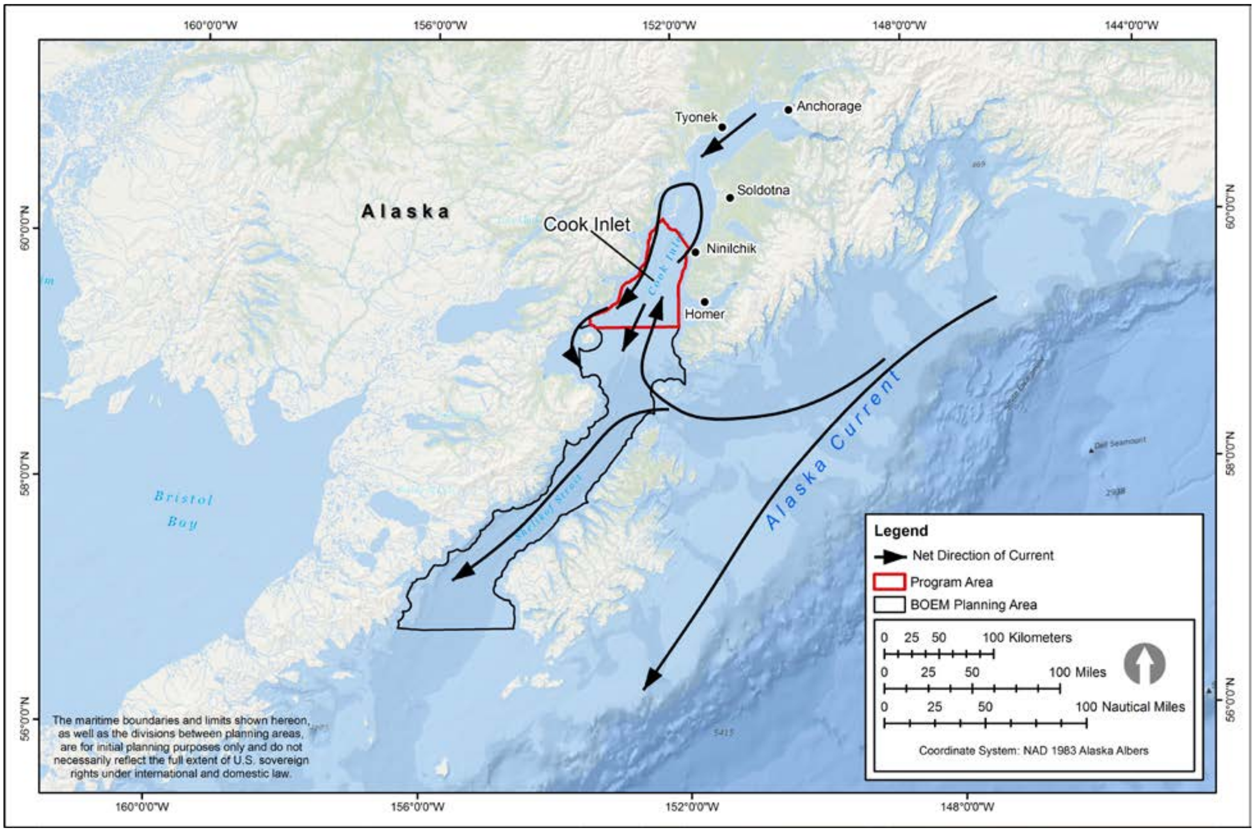
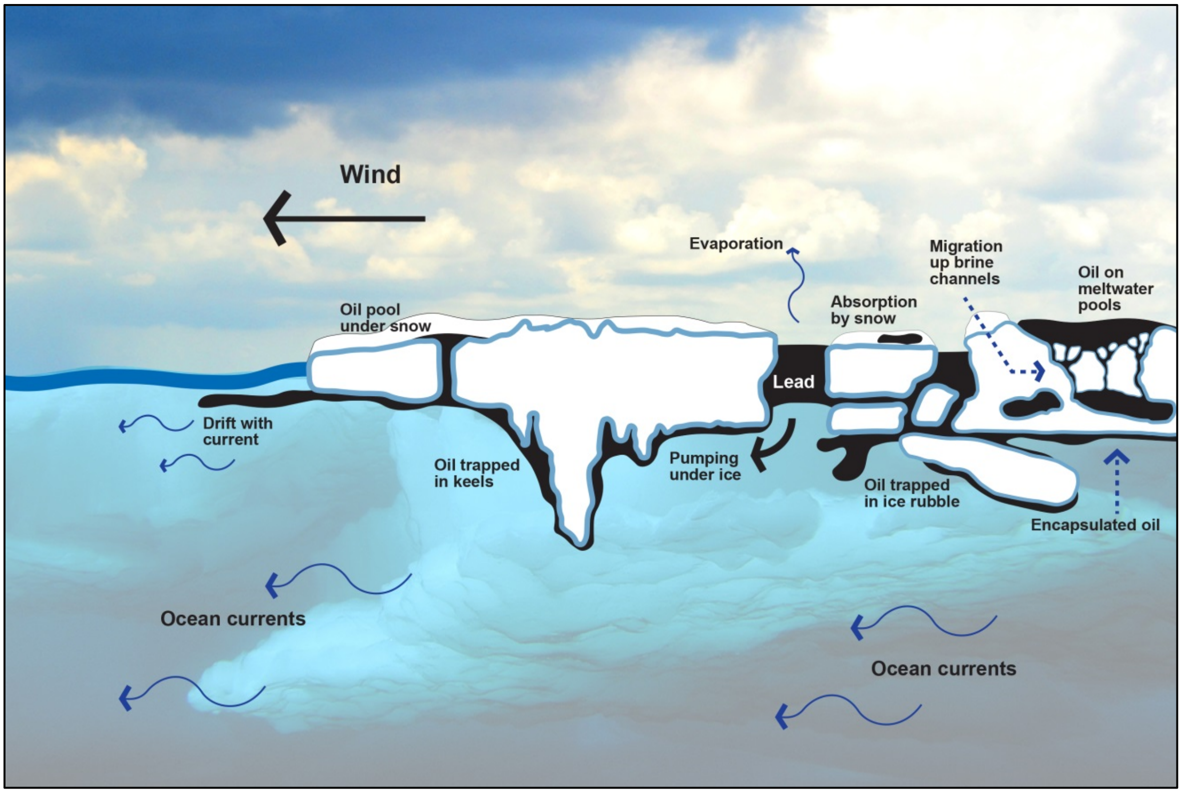


Figure 4.4.5-2. Major Circulation Features in Cook Inlet

Spill response in the Arctic varies widely depending on the season and leads to a need for different approaches, planning, and techniques (Nuka Research and Planning Group, LLC and Pearson Consulting 2014). The presence of sea ice has the potential to confine oil spills (Weeks and Weller 1984). A large spill occurring on or under ice would be trapped and persist until the ice melted, allowing the trapped oil to disperse. Volatile components of the oil would be more likely to freeze into the ice rather than dissolve or disperse into the water column. In addition, seasonally limited daylight can be a major issue for oil spill response during freeze up, and over the winter (NRC 2014). If a spill were to occur in the Beaufort or Chukchi Seas or in Cook Inlet during fall or winter, the presence of ice could partially contain the oil and reduce spreading and other physical degradation processes. However, oil spill response and cleanup also would be more difficult due to the presence of ice. Additionally, oil from spills occurring in the winter would be trapped under ice, resulting in localized degradation of water and sediment quality and persistence in the environment (Payne et al. 1991, Buist et al. 2008). The interaction of oil and ice is shown in **Figure 4.4.5-3**. Spill response techniques utilizing dispersants would have mixed effectiveness in colder waters due to several factors including decreased ability of response vessels to reach spilled locations to apply dispersants (and respond to spill) along with decreased wave action. The colder temperatures could also extend the exposure time of oil to dispersants applications potentially increasing effectiveness of their use (NRC 2014).

4.4.5.1.2 Gulf of Mexico

In the GOM, the dynamic factors that have the greatest potential to affect potential impacts from accidental and unauthorized events can be characterized as those associated with episodic weather events (e.g., hurricanes, tropical storms), large-scale circulation patterns such as the Loop Current and its associated mesoscale eddies (**Figure 4.4.5-4**), vertically coherent deepwater currents, and high-speed jets (DiMarco et al. 2004).



Source: Drozdowski et al. 2011

Figure 4.4.5-3. Interactions between Oil and Ice

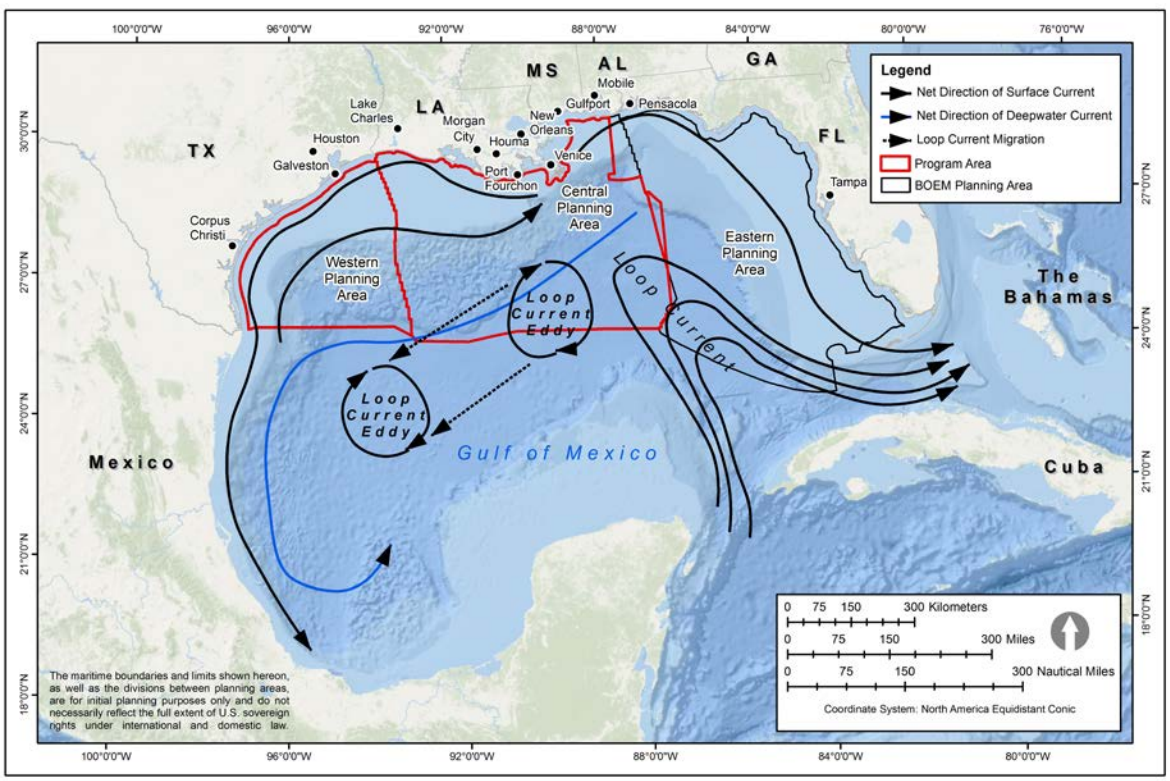


Figure 4.4.5-4. Major Circulation Features in the GOM

4.4.5.2 Potential Impacts per Resource Area

As noted previously, the magnitude and severity of potential impacts from a spill on any resource would depend on the spill's location, size, depth, and duration as well as the type of spill, meteorological conditions such as wind speed and direction, seasonal and environmental conditions, and the effectiveness of response activities. Associated spill response and cleanup activities also could affect resource areas. In addition, effects on resource areas analyzed below would increase if that resource area is already impacted by climate change. **Figure 4.4.4-5** provides a conceptual model of potential impacts on environmental resources from a spill.

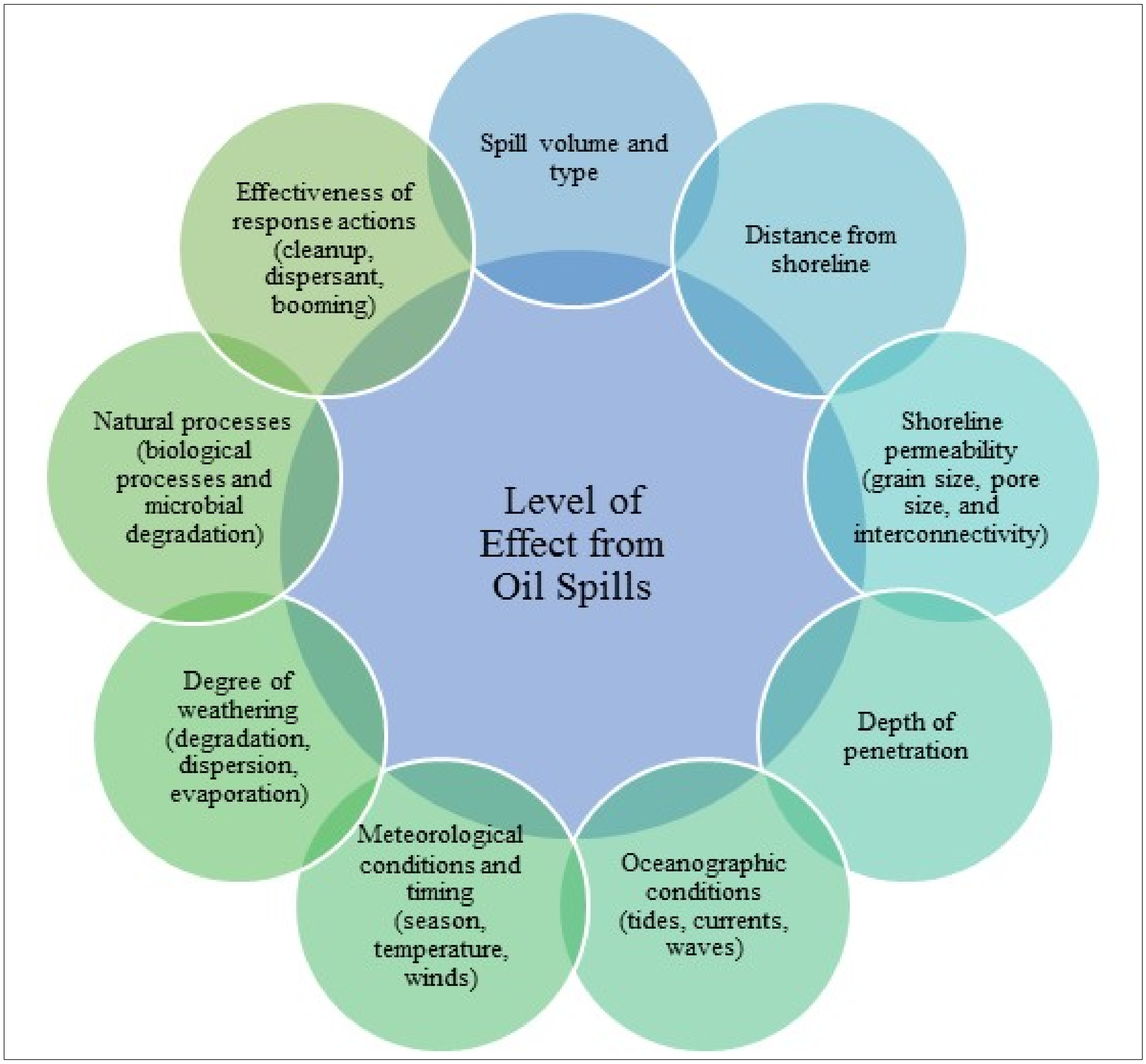


Figure 4.4.5-5. Factors Determining the Level of Effect on Resources from Oil Spills

There are terrestrial species in the Cook Inlet and GOM Program Areas that are not expected to be affected by routine activities (**Section 4.4.1**) but could be affected by an oil spill. The Draft EIS for Cook Inlet Lease Sale 244 (BOEM 2016j) provides information on the terrestrial species that could occur in the vicinity of the Cook Inlet Program Area and potential impacts on these species from oil spills. The Draft EIS for GOM OCS Lease Sales: 2017–2022 describes four subspecies of beach mice listed as endangered under the ESA that could be affected by a spill in the GOM Program Area as well as the potential impacts of a spill (BOEM 2016e). The analyses in these documents for oil spill impacts on terrestrial species are hereby incorporated by reference and summarized in the paragraphs below.

Direct exposure pathways include ingestion of oil from consumption of contaminated food, grooming contaminated fur, and inhalation of fumes, which could have short- and long-term health impacts on individual organisms (BOEM 2016e, BOEM 2016j). Direct exposure is generally limited to oil spills that contaminate shorelines, and to organisms that frequent shorelines. Direct exposure could also result from organisms that access water that has been contaminated by an oil spill while swimming or foraging. Direct contact with spilled oil could also cause skin irritation and loss of insulating properties of fur, which could impact terrestrial mammals (BOEM 2016j).

Indirect impacts could include contamination and depletion of food supply and destruction of habitat. Indirect impacts could arise even when oil does not reach terrestrial environments, such as when aquatic food sources are contaminated or impacted by an oil spill. The severity of indirect impacts depends on the specific spill characteristics, region, species, time of year, and reliance on specific habitats. Displacement from critical habitats and other direct and indirect impacts of oil spills could have cascading effects on populations and ecosystems (BOEM 2016j).

Overall, spills could have a **negligible** to **major** impact on terrestrial mammals. The severity of the impact depends on the spill characteristics, and the sensitivity and resilience of species found in the affected area. Species listed as threatened or endangered could be disproportionally affected due to their limited geographic range and low population numbers. A high-level summary of the potential range of effects of oil spills per resource area analyzed under this Programmatic EIS is provided here.

Air quality impacts on ambient VOC concentrations resulting from a spill would be high in the immediate vicinity of the spill area, but would decrease quickly due to dispersion of the spill itself, and of the VOCs by winds, waves, and currents. Concentrations of criteria pollutants could temporarily exceed NAAQS, but over time, air quality would return to pre-spill conditions. *In situ* burning of spilled crude or diesel, a potential component of the spill response strategy, would generate a plume of black smoke and emissions of NO_2, SO_2, CO, PM_{10}, and $PM_{2.5}$ that temporarily would affect air quality. PM_{10} and $PM_{2.5}$ in the form of soot would land on surfaces near the fire but would dissolve or wash off in subsequent rains for soot landing onshore. Such exposure would be limited by the distance from the proposed activities to shore. After the burn, air quality would quickly return to pre-burn conditions. Some oil and gas reservoirs contain H_2S, a toxic gas. An accidental release of H_2S in the atmosphere near a platform could present a serious hazard to platform workers and people in close proximity. In the case of an aquatic H_2S release, the gas is soluble in water, so a small gas leak would result in almost complete dissolution into the water column; however, a larger leak would reach the atmosphere. The impact of accidental events, including the occurrence of accidental oil and fuel spills and unexpected CDEs, on air quality is likely to be **minor** for smaller spills to **moderate** for CDEs, given the potential increase in airborne pollutants and limited options for mitigation.

Water quality could be impacted by the dissolution and dispersion of the petroleum constituents throughout the water column (including the surface) as well as from response activities (e.g., vessel discharges or use of dispersants). A spill could also release natural gas into the water column, which would reduce the dissolved oxygen levels due to microbial degradation of the CH_4, potentially creating hypoxic or “dead” zones, although studies have shown this is not likely (Camilli et al. 2010, Kessler et al. 2011a, Kessler et al. 2011b). A spill in Alaskan waters could lead to long-term water quality impacts from entrainment in ice. To an extent, natural processes will physically, chemically, and biologically aid the degradation of oil (NRC 2003a).

A CDE in coastal or marine waters could present sustained degradation of water quality from hydrocarbon contamination in exceedance of state and Federal water and sediment quality criteria. These effects could be significant depending on the duration of the release and the area impacted by the spill. A CDE at depth would introduce large quantities of oil into the water column, with chemically or mechanically dispersed and suspended oil droplets potentially creating a plume at depth (Reddy et al. 2012, Valentine et al. 2014). It would also cause large patches of sheen or oil on the sea surface. Overall, depending on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities, impacts from expected accidental spills into the coastal and marine environment are expected to range from minor to major. A CDE could present sustained degradation of water quality depending on the time, location, type, and size of the spill, and impacts are expected to range from **moderate** to **major**.

Benthic communities could be impacted by spills in several ways. Spills that persist long enough to reach shore could contaminate shoreline benthic communities. Sublethal impacts that would occur on exposed deepwater benthic organisms would include reduced feeding, reduced reproduction and growth, physical tissue damage, and altered behavior. Laboratory tests by DeLeo et al. (2015) on the relative effects of oil, chemical dispersants, and chemically dispersed oil mixtures on three species of northern GOM deepwater corals found much greater health declines in response to chemical dispersants and oil-dispersant mixtures than to oil-only treatments, which did not result in mortality. It is important to note that, generally, laboratory experimental concentrations are designed to discover toxicity thresholds (as in DeLeo et al. 2015) that exceed probable exposure concentrations in the field.

Some oil eventually could settle on the seafloor through a binding process with suspended sediment particles (adsorption), or after aggregation as marine snow (Passow et al. 2012). It is expected that the greatest amount of adsorbed oil particles would be deposited close to the spill, with the concentrations reducing with distance from the source. If the spill occurred close to a deepwater benthic habitat, some of the organisms might be smothered by the particles, and experience long-term exposure to hydrocarbons (Hsing et al. 2013, Fisher et al. 2014, Valentine et al. 2014). Beyond the localized area of impact in that case, particles would increasingly biodegrade and disperse. Impacts on deepwater benthic organisms would be expected to be largely sublethal and could include reduced recruitment success, reduced growth, and reduced biological cover as a result of impaired recruitment (Rogers 1990, Kushmaro et al. 1997). Overall, impacts on marine benthic communities from expected accidental spills are expected to range from minor to major. Impacts from an unexpected CDE are expected to range from **moderate** to **major**. The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Potential impacts on **coastal and estuarine habitat** are very complex and depend on several interrelated factors, including oil type, time of year in which a spill occurs, and specific habitat characteristics. Highly sensitive shoreline habitats include marshes, sheltered tidal flats, and sheltered rocky shores (NOAA 1994). The vulnerability of intertidal habitats generally is rated as highest for vegetated wetlands (Hayes et al. 1992, NOAA 1994, NOAA 2010), and semipermeable substrates that are sheltered from wave energy and strong tidal currents. Oil contacting these habitats is less likely to be removed by waves. Oil that impacts beaches will thicken as its volatile components are lost and would form tarballs or aggregations that incorporate sand, shell, and other materials. Oil that impacts wetlands or vegetated submerged habitats would result in substantive injury to vegetation, plant mortality would be realized, and some permanent wetland loss would occur. Coastal wetlands are highly sensitive to oiling, and can be significantly affected because of the inherent toxicity of hydrocarbon and non-hydrocarbon components (Lin and Mendelssohn 2012). Indirectly, oil can affect animals that use submerged habitats and wetlands during their lifecycles, especially benthic organisms that reside in the sediments and are an important component of the food web. Habitat degradation could persist and have long-term residual impacts on the community structure and habitat function. In addition, the elimination of vegetation along coastal salt marshes would accelerate erosion and retreat of shorelines (Silliman et al. 2012). Furthermore, oil from winter spills would be trapped under ice, resulting in localized, delayed, or persistent degradation of habitat quality and ecosystem function. Overall, impacts on coastal and estuarine habitats from expected accidental spills are expected to range from **minor** to **major**. Impacts from an unexpected CDE are expected to range from **moderate** to **major**. The degree of these potential impacts depends on the size, exact location and timing of the event as oiling can have adverse impacts on coastal wetland vegetation (Mishra et al. 2012); it is also dependent upon the effectiveness of containment and cleanup activities.

Pelagic communities could experience cascading effects from a spill due to localized impacts on planktonic habitats (such as *Sargassum*), reduction in water quality, or direct contact with oil, which could lead to impacts on plankton and other organisms that use pelagic habitats. Following the *Deepwater Horizon* oil spill, there was substantial loss and subsequent recovery of *Sargassum* mats in the GOM (Powers et al. 2013). A crude oil release from a wellhead (subsurface release, blowout) or from a drilling rig (surface release) could impact phytoplankton and zooplankton within an affected area. Zooplankton are especially vulnerable to acute crude oil pollution, showing increased mortality and sublethal changes in physiological activities (e.g., egg production) (Moore and Dwyer 1974, Linden 1976, Lee et al. 1978, Suchanek 1993). In addition, zooplankton could accumulate PAHs through ingestion of micro-droplets (Berrojalbiz et al. 2009, Lee et al. 2012) or through absorption by crude oil droplets attaching to zooplankton, as observed in laboratory and field studies (see Almeda et al. 2013).

Oil floating on the surface could directly contact ichthyoplankton found at or near the surface, coating eggs and larvae. Most ichthyoplankton would be unable to avoid spills, and affected individuals could be at risk of death, delayed development, abnormalities, endocrine disruption, or other effects resulting in decreased fitness and reduced survival rates (Incardona et al. 2014, Mager et al. 2014, Snyder et al. 2015, Brown-Peterson et al. 2015). In general, early life stages are more sensitive to acute oil exposure than adults, but some research indicates embryos, depending on the developmental stage, could be less sensitive to acute exposure than larval stages (Fucik et al. 1995). Localized loss of eggs and one or more size classes could occur in areas affected by high oil concentrations or if oil contacts spawning habitats in coastal and nearshore waters. Another notable group, reef-building corals, also release reproductive bundles that rise through the water column to the surface during very limited times of the summer. Surface spills would have significant impacts on these coral spawning products if a spill occurs during or near spawning. Overall, impacts on marine pelagic communities from expected accidental spills are anticipated to range from **minor** to **major**. Impacts from an unexpected CDE are expected to range from **moderate** to **major**. The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

In general, a small spill is not expected to affect **marine mammals** due to the fact that the spill would quickly disperse in the water column. However, if a small spill were to occur in close proximity in space and time to an individual marine mammal, it could have some effect on that animal. Marine mammals are expected to be affected primarily by large accidental spills or CDEs. In the event of a CDE, the location and extent of the spill would determine which species would be affected. **Marine mammals** could be affected by oil spills through various pathways: direct surface contact, inhalation of fuel or its volatile components, or ingestion (via direct ingestion or by the ingestion of contaminated prey). These pathways would lead to decreased health, reproductive fitness, and longevity as well as increased vulnerability to disease. An oil spill also can lead to the localized reduction, disappearance, or contamination of prey species. Generally, the potential for ingesting oil-contaminated prey is highest for benthic-feeding marine mammals (e.g., those that feed on clams and polychaetes, which tend to concentrate petroleum hydrocarbons), reduced for plankton-feeding whales, and lowest for fish-eating marine mammals as food web biomagnification of petroleum hydrocarbons does not occur (Würsig 1988).

In Alaska, an oil spill during periods of restricted open water could have severe effects, as cetaceans such as bowhead and beluga whales use ice leads during their migrations and would concentrate within these leads in the spring (BOEM 2012b). Furthermore, pinnipeds and polar bears also would be directly exposed to oil while coming ashore onto impacted beaches. Sea otters and polar bears would be particularly vulnerable due to their reliance on fur to maintain body heat. Once oiled, sea otters quickly become hypothermic, and both species ingest oil while grooming, resulting in lethal impacts on organs. Polar bears could also ingest oil while feeding upon oiled seals or scavenging oiled carcasses. Impacts on calving grounds could result in population-level effects. Overall, oil spills associated with accidental events are expected to result in **negligible** to **major** impacts on marine mammals within a program area, depending on the numbers of individuals coming into contact with the spilled fuel and their exposure time as well as the exposure of federally listed species to the spill. Impacts from an unexpected CDE are expected to range from **minor** to **major**. The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Sea turtles could be affected by oil spills depending on the time of year. Effects of spilled oil on sea turtles are discussed by Geraci and St. Aubin (1987), Lutcavage et al. (1995, 1997), Milton et al. (2003), and Shigenaka et al. (2010). Oil, including refined diesel fuel, would affect sea turtles through various pathways, including direct contact, inhalation of the fuel and its volatile components, and ingestion directly or indirectly through the consumption of fouled prey species (Geraci and St. Aubin 1987). The effects of contact with spilled oil would include decreased health, reproductive fitness, and longevity as well as increased vulnerability to disease and contamination of prey species. Studies have shown that direct exposure of sensitive tissues (e.g., eyes, nares, other mucous membranes) and soft tissues to volatile hydrocarbons associated with oil spills would produce irritation and inflammation. Oil or diesel fuel can adhere to sea turtle skin and shells. Sea turtles surfacing within or near an oil spill would be expected to inhale petroleum vapors, causing respiratory stress. Ingested oil, particularly the lighter fractions, can be acutely toxic to sea turtles. In addition, several aspects of sea turtle biology and behavior place them at risk, including lack of avoidance behavior, indiscriminate feeding in convergence zones, inhalation of large volumes of air before dives (Milton et al. 2003), and affinity to the *Sargassum* community for food and cover (Witherington et al. 2012).

Female sea turtles seasonally emerge during the warmer summer months to nest on GOM beaches. Though sea turtles could physically nest on oiled beaches, it is likely that nesting females would abandon nesting attempts. If nesting occurs, the nesting female and eggs could get oiled. Hatchlings would have to traverse the beach and shore-face through oiled sand and water to reach preferred habitats of offshore *Sargassum* floats. It is not likely that the spill would result in long-term displacement of adult sea turtles from preferred feeding, breeding, or nesting habitats or migratory routes. Impacts from accidental events would 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 and probability of accidental spills. Overall, impacts on sea turtles from expected accidental spills are expected to range from **negligible** to **major**. Impacts from an unexpected CDE are expected to range from **negligible** to **major**. The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Birds could be adversely affected through direct contact with spilled oil, by the fouling of their habitats and contamination of their food by oil, and as a result of oil spill response activities. Direct contact with oil can lead to tissue and organ damage from oil ingested and inhaled during feeding and grooming as well as interference with food detection, predator avoidance, homing of migratory species, disease resistance, growth rates, reproduction, and respiration. Oiled birds quickly become hypothermic, lose buoyancy, are unable to fly, and die from direct exposure to the toxicity of the oil itself. Raptors and scavenging birds also could ingest oil while scavenging other oiled wildlife, which could lead to vomiting, diarrhea, and hemorrhaging. Exposure of eggs, young, and adult birds to oil could result in a variety of lethal and sublethal effects. Fouling of habitats can reduce habitat quality and lead to displacement of affected birds to secondary locations, while contamination of foods could lead to a variety of lethal and sublethal toxic and physiological effects. Even a small spill could have a major impact on ESA-listed spectacled eiders in the Chukchi Sea if it were to occur in Ledyard Bay in late summer when spectacled eiders congregate while molting and flightless. Conversely, a larger spill could occur in an OCS area in winter when few birds are present and have only a minor impact on bird species. Overall, impacts on birds from expected accidental spills are anticipated to range from **negligible** to **major**. Impacts from an unexpected CDE are anticipated to range from **minor** to **major**. The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Fish and EFH could be impacted by persistence of spilled oil in the environment. A large spill in open waters of the OCS proximal to mobile adult fishes would likely be sublethal; potential effects would be reduced because adult fish have the ability to avoid adverse conditions, metabolize hydrocarbons, and excrete metabolites and parent compounds. Impacts on adult fishes in an affected area would be indistinguishable from natural variation in a population. However, long-term exposure to contaminants could result in a higher incidence of chronic sublethal effects (Murawski et al. 2014, Baguley et al. 2015, Millemann et al. 2015, Snyder et al. 2015). Oil floating on the surface could directly contact ichthyoplankton found at or near the surface, coating eggs and larvae. Most ichthyoplankton would be unable to avoid spills, and affected individuals would be at risk of death, delayed development, abnormalities, endocrine disruption, or other effects resulting in decreased fitness and reduced survival rates (Incardona et al. 2014, Mager et al. 2014, Brown-Peterson et al. 2015, Snyder et al. 2015). In general, early life stages are more sensitive to acute oil exposure than adults, but some research indicates embryos, depending on their developmental stage, would be less sensitive to acute exposure than larval stages (Fucik et al. 1995). Spills reaching nursery habitat or overlapping spatiotemporally with a spawning event have the greatest potential for affecting the early life stages of fishes and invertebrates. Overall, impacts on fish and EFH from expected accidental spills are expected to range from **negligible** to **moderate**. Impacts from an unexpected CDE are expected to range from **negligible** to **major**. The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Arctic Terrestrial Wildlife and Habitat would be affected by an oil spill. The magnitude and severity of impacts would depend on the spill location and size, type of product spilled, environmental conditions at the time of the spill, and the effectiveness of response activities. Small spills OCS would not be expected to impact terrestrial mammals. However, a small spill from on onshore pipeline would be expected to have minor, short-term and localized effects on terrestrial mammals including direct contact, inhalation, and ingestion of oiled forage or prey species, leading to bioaccumulation of toxic petroleum hydrocarbons. The impacts on terrestrial mammals from a large accidental spill associated with accidents on platforms, pipelines or tankers that occur on the OCS or onshore would be expected to range from **minor** to **moderate** and depend on the magnitude of the spill, season it occurs, coastal habitat affected, and effectiveness of cleanup measures. A large spill occurring within or in the vicinity of sensitive habitats or occurring during the breeding season would be expected to have more significant impacts than a spill in non-sensitive areas or outside the breeding season. The primary impact from a land-based spill would likely be contamination of freshwater sources and food resources. Consumption of water or food contaminated with crude oil would result in bio-accumulation of toxic petroleum hydrocarbons, which can result in several acute and chronic effects, including death. Small, less mobile species would also be impacted by direct contact with oil, which would impact their ability to thermoregulate and groom their fur.

In the unlikely event that a CDE were to occur in the Beaufort Sea, the nature and magnitude of impacts on terrestrial mammals would depend on a number of variables, including the magnitude of the spill, meteorological and oceanographic conditions as time of event, type of coastal habitat effected, distribution of species within the area, and effectiveness of cleanup measures. In general, a CDE (well blow-out, a tanker grounding, or a pipeline rupture) could result in degradation of freshwater resources and fouling of coastal habitats from crude oil being washed ashore that could impact terrestrial mammals. Terrestrial mammals living along the immediate shoreline would be impacted by direct contact, inhalation, and ingestion of oiled forage or prey species, leading to bioaccumulation of toxic petroleum hydrocarbons. Terrestrial mammals foraging in intertidal habitats would be the most at risk due to the high likelihood that the food resources of these species would be contaminated. Bioaccumulation of petroleum hydrocarbons can lead to various acute and chronic effects, including death. Impacts from a CDE could range from **minor** to **major**.

Archaeological and historical resources could be impacted by a spill if material contaminated with oil reaches the seafloor and directly impacts a shipwreck site by disrupting the local environment, resulting in degradation of the resource and loss of information (**Section 4.4.1.11**). In the event that a spill impacts coastal areas, it could affect shallow water shipwrecks and coastal historic and pre-contact archaeological sites. Overall, impacts on archaeological and historical resources from expected accidental spills and an unexpected CDE would range from **negligible** to **moderate**, depending on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Population, employment, and income impacts of a spill highly depend on spill size, location, and other factors discussed previously, and could include the loss of employment, income, and property value; increased traffic congestion; increased cost of public service provision; and possible shortages of commodities or services (Austin et al. 2014a, Austin et al. 2014b, Eastern Research Group, Inc. 2014). For example, oil spills could impact industries that depend on resources that are damaged or rendered unusable for a period of time. Beach recreation, recreational fishing, and commercial fishing would be vulnerable if beach or fish resources were damaged. An oil spill also could impact transportation routes or affect the operations of port facilities. In the short-term, the impacts of a spill would be measured in terms of projected cleanup expenditures, and the number of people employed in cleanup and remediation activities. Longer-term impacts could affect commercial and recreational fishing and/or tourism if these activities were to suffer due to real or perceived impacts of the spill, and could include substantial losses.

In Alaska, subsistence users supplement current income and wages through subsistence hunting for food sources and artifacts for selling. For a large release event, negative and significant economic and sociocultural impacts would be felt by subsistence users. OCS spills could lead to impacts on other resource areas (e.g., fishing and biological resources). In the GOM, larger spills could lead to decreased levels of oil and gas industry operations, through direct damages or indirect policy changes imposing additional restrictions on new or existing activities. The impacts on an affected industry also would ripple through that industry's supply chain; consumer spending by employees of these firms also would have impacts on the broader economy.

In all areas, under analysis within this Programmatic EIS, the response and cleanup operations following an oil spill could impact local economies. A large amount of money would be spent on cleanup and compensation, but the amounts—and the percentage that would be received by local communities—could vary considerably, depending on specific circumstances, and negative effects and economic opportunities are likely to be unevenly distributed among local residents and their businesses. The influx of response workers to local areas can have positive economic impacts, especially for local residents and businesses that assist with cleanup or provide housing, goods, or services for cleanup efforts. However, that influx of workers and cleanup activity also can disrupt the normal functioning of local economies, possibly compounding the negative effects of the event itself. In addition, people and equipment that are dedicated to oil spill response efforts could be diverted from some existing services such as hospitals, firefighting, and emergency services available to local residents. Overall, impacts on population, employment, and income from expected accidental spills are expected to range from **negligible** to **minor**. Impacts from an unexpected CDE are expected to range from **moderate** to **major** (at least to some affected industries and communities). The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Land use and infrastructure impacts would depend on the nature and magnitude of any spill and also the level and location of new construction, the degree to which the area already is developed, and the location of the spill. Potential impacts on land use and infrastructure likely would include stresses of the spill response on existing infrastructure, direct land-use impact (such as impacts of oil contamination to ships and port facilities), and restricted access to coastal infrastructure while cleanup is being conducted. These impacts generally would be temporary and localized, particularly for small spills. For large spills, the degree of impact would be influenced by many factors such as distance from the shoreline, oceanographic conditions (i.e., tides, winds, currents, waves), degree of weathering (i.e., degradation, evaporation), and effectiveness of response actions. Recovered oil and waste generated from the cleanup could impact capacity at waste disposal sites, and operations at ports and related infrastructure could be impacted if oil were to come ashore at these areas.

Given the history of oil and gas leasing in the GOM and Cook Inlet, major impacts on land use and infrastructure would not be expected because existing spill response infrastructure is already in place, or would be readily available in the event of a CDE. In the Arctic, responses to a spill would be complicated by the region's remote location and limited existing infrastructure (Nuka and Pearson 2010, Robertson et al. 2013). For example, the closest major port on the U.S. Arctic coastline (i.e., Unalaska in the Aleutian Islands) is approximately 2,407 km (1,496 mi) from Point Barrow. Furthermore, limited docking facilities are present along the Arctic coast and are in shallow water, making vessel access difficult. In addition, a large portion of Arctic communities are not connected to each other or to the rest of the state by onshore roadways, and the few major airstrips that could handle cargo aircraft also are not connected to highways or docks. As such, the impacts from operating in the Arctic likely would be greater in the event of an accidental spill or CDE. Overall, impacts on land use and infrastructure would range from **minor** to **major** depending on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Commercial and recreational fisheries could be affected by spills, with the magnitude and severity of impacts dependent on the spill location and size, the type of product spilled, environmental conditions at the time of the spill, and effectiveness of response activities. Small spills rapidly dissipate, and fish kills rarely occur. Species and life stages residing in the upper water column are most at risk for contact with spilled oil. Pelagic species and filter feeders such as menhaden that forage at the water's surface would be most likely to encounter a surface spill. Tunas, mackerels, billfishes, and dolphinfishes known to feed at the surface likely would avoid small spills. Planktonic early life stages (i.e., eggs and larvae) of many fish species would be less able to avoid a spill and, therefore, are most vulnerable to toxic properties of oil. Depending on the location and duration of a spill, commercial and recreational fishing opportunities would be lost. Revenues for commercial fisheries could temporarily decline. State or Federal agencies would close affected areas to fishing and maintain closures until the threat of contamination of gear or target species is deemed over. Fishers would experience additional expenditures required to move to unaffected fishing grounds. Larger spills could contaminate target species and result in large-scale fishery closures. Closures would result in loss of revenue to commercial fishers. Public perception of seafood quality and safety following an unexpected CDE could affect revenues far into the future. A minimum loss of $247 million was estimated from the fishery closures associated with the *Deepwater Horizon* oil spill (McCrea-Strub et al. 2011). Recreational fishing opportunities would be lost, and recreational fishers would turn to other forms of recreation. Overall, impacts on commercial and recreational fisheries from expected accidental spills are expected to range from **negligible** to **major**. Impacts from an unexpected CDE are expected to range from **moderate** to **major**. The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Tourism and recreation impacts would be similar to those discussed under the population, employment, and income section. Impacts of a spill highly depend on spill size and could include the loss of employment, income, and property value; increased traffic congestion; increased cost of public service provision; and possible shortages of commodities or services (Austin et al. 2014a, Austin et al. 2014b, Eastern Research Group, Inc. 2014). Oil spills could impact industries (e.g., tourism, fishing) that depend on resources that have been damaged (e.g., fisheries) or rendered unusable for a period of time. Beach recreation and recreational fishing would be vulnerable to damage caused by a spill and subsequent cleanup efforts. An oil spill could also impact transportation routes or affect the operations of port facilities. Longer-term impacts could affect tourism if spills or resulting activities were to suffer due to real or perceived impacts of the spill and could include substantial losses.

The south-central tourist region of Alaska encompasses the Cook Inlet Planning Area, and accounts for 50 percent of visitor industry-related employment and 44 percent of visitor-related spending in the state (ADCCED 2015, ADCCED 2016b). Ecotourism accounts for the majority of tourism-related activities near the Cook Inlet, particularly during the open water seasons, and in the Beaufort Sea and Chukchi Sea Program Areas.

Deposition of floating debris on beaches and platform placement could affect commercial fishing temporarily. Beaches and recreational fishing could be impacted from an oil spill and any associated cleanup activities, which would disrupt local tourism industries.

The *Deepwater Horizon* event affected many coastal communities that were still rebounding from the impacts of Hurricane Katrina, complicating the response by community members to the *Deepwater Horizon* event (Goldstein et al. 2011).

Overall, impacts on tourism and recreation from expected accidental spills are expected to range from **minor** to **major**. Impacts from an unexpected CDE are expected to range from **moderate** to **major**. The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Sociocultural systems can be affected by oil spills. See the analysis for archaeological/historic resources; commercial and recreational fishing; and population, employment, and income for examples. Oil spills also could have major impacts on subsistence activities. Considering the cultural significance and ties to the traditional way of life that subsistence activities represent for the Iñupiat and Alaska Natives, the Native communities of the North Slope have historically expressed serious concerns about what would happen if there were an accidental oil spill in the Arctic. Major areas of concern are with impacts on subsistence resources, especially the bowhead whale, and oil spill cleanup actions. An oil spill could have physical, psychological, social, economic, spiritual, and cultural impacts on Alaska Natives, who use the ocean and associated riverine tributaries as a source of food and consider it part of their cultural heritage.

In addition, there are concerns about exposure of indigenous populations to contaminants, primarily through traditional subsistence food consumption (AMAP 2009), such as whale, walrus, and fish. Plants and animals exposed to persistent contaminants (e.g., organic chemicals, metals) often associated with oil spills, could ingest or absorb these contaminants, which can move through the various food chains, accumulating in food items consumed by humans, and thereby contributing to negative health impacts. This is true whether there is concern about consumption relating to subsistence use of harvested animals or plants; concerns about contaminated seafood or plants in Cook Inlet and in the GOM Program Areas. Humans can be affected through contact with the contaminants, such as through inhalation, skin contact, or intake of contaminated foods; reduced availability of subsistence resources; interference with subsistence harvest patterns; and stress due to fears of long-term implications of the spill (BOEM 2012b). Overall, impacts on sociocultural systems from expected accidental spills are expected to range from **minor** to **major**. Impacts from an unexpected CDE are expected to range from **moderate** to **major**. The degree of these potential impacts depends on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

Environmental justice issues arise because low-income and minority populations are more vulnerable to oil spills in coastal waters than members of the general population. Low-income and minority populations would be more sensitive to spills in coastal waters than the general population because of 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 (BOEM 2015e). In addition, there are potential human health risks associated with involvement in spill cleanup activities such as decreased liver function (D'Andrea and Kesava 2014). Overall, impacts on these populations from expected accidental spills and the unexpected CDE is the same as under the sociocultural discussion and would range from **minor** to **major**, depending on the location, timing, and magnitude of the event as well as the effectiveness of containment and cleanup activities.

As discussed in **Section 4.4.1.12**, much of the Alaska Native population in the Arctic resides in coastal areas. Any new onshore and OCS infrastructure occurring within this Program could be near these populations or near areas where subsistence hunting occurs. Any adverse environmental impacts on fish and mammal subsistence resources from installation of infrastructure and routine operations of these facilities could have disproportionately higher health or environmental impacts on Alaska Native populations. Mitigation measures, cooperative agreements between Native and industry groups, and government-to-government and government-to-ANCSA consultations with federally recognized tribes and ANCSA corporations are designed to limit the effects from routine operations.

Public concerns regarding pollution of locally harvested fish and game, loss of traditional food sources and hunting grounds, and rapid social changes are examples of negative impacts on humans in Alaska. The harvesting of wildlife resources in the North Slope of Alaska contributes widely to the cultural, nutritional, and economic way of life of the residents living there (NRC 2003b). These impacts could affect physical and mental health of community members. Changes in the traditional way of life can lead to deteriorating physical well-being and mental health, which could contribute to other negative social consequences. North Slope communities are concerned about the impacts of noise associated with routine operations on bowhead whale migration routes, as they depend on these whales for subsistence (NRC 2003b). If the whales migrate farther offshore, there are increased safety risks for the whalers who must travel in more dangerous seas to hunt. Increased stress and anxiety from oil and gas development would contribute to mental health issues of Alaskans (NRC 2003b). The increased development has increased smog and haze near some villages, and air quality is a major concern for residents (NRC 2003b). Increased rates of diabetes are likely the result of residents consuming higher concentrations of non-subsistence foods, and consuming less fish and marine mammal products (NRC 2003b). The geographical isolation of the NSB communities could cause stress to municipal resources, and compromise the availability of potable water resources for responders in the event of an emergency or oil spill (NSB 2016c).

The *Deepwater Horizon* event affected many communities that had health disparities compared to others in the U.S. and that were still suffering from the impacts of Hurricane Katrina (Goldstein et al. 2011). Louisiana currently is ranked among the most severely affected states in the nation in terms of rates of infant death, death from cancer, premature death, death from cardiovascular disease, children in poverty, and violent crime (United Health Foundation 2015). Children are particularly at risk for effects of environmental exposure; they breathe more air per unit of body mass, detoxify chemicals less effectively, and could suffer from accidental exposure more readily than adults (Goldstein et al. 2011). In addition, in the case of the *Deepwater Horizon* event, many communities were still recovering from Hurricane Katrina, complicating the response by community members to the *Deepwater Horizon* event (Goldstein et al. 2011). The Centers for Disease Control reported that

50 percent of adults in New Orleans had psychological stress, while post-traumatic stress disorder was prevalent among first responders, leading to alcohol and domestic abuse (Goldstein et al. 2011).

Minority communities have specific concerns related to their psychosocial welfare. Working-age Vietnamese residents in New Orleans had numerous unresolved problems in the aftermath of Hurricane Katrina (Vu et al. 2009). Suspension of free health services led to the reemergence of disparities between racial and ethnic groups (Do et al. 2009). Symptoms of post-traumatic stress disorder were found in this population group, especially among members with a low degree of acculturation and high exposure to floods, together with long stays in emigration transit camps (Norris et al. 2009). As was the case for small, isolated Alaska Native communities with the *Exxon Valdez* oil spill (Goldstein et al. 2011), it is likely that the *Deepwater Horizon* event lead to higher levels of depression, generalized anxiety disorder, post-traumatic stress disorder, violence, and other psychological problems among minority communities.

Summary

Oil spills are unwanted, accidental, and unauthorized events but can occur despite best efforts to prevent them. Oil spills can affect the environment, but the magnitude and severity of impacts on a particular resource depend on many factors, including spill location, size, depth of spill, duration of spill, type of spill, meteorological conditions such as wind speed and direction, seasonal and environmental conditions, susceptibility of specific resource, and the effectiveness of response activities. The resource susceptibility can be hard to predict due to potentially overlapping impacts from climate change. In addition, temperature and oceanographic conditions can have a significant effect on weathering processes such as evaporation, emulsification, and oxidation as well as the transport of the spilled products.

It is difficult at the broader Five-Year Program level of the Proposed Action to fully predict an accidental event. It becomes a more manageable assessment at the individual lease sale stage where more information is known regarding the location, amount of activity, spill risk of activities being proposed, and specific environmental resources in the area. It is at this level of detail that BOEM's Oil Spill Risk Analysis Modeling can be conducted in order to better estimate spill risk, spill trajectories, and probability of contact with an environmental resource (see http://www.boem.gov/Oil-Spill-Modeling-Program/). Modeling results then are used by BOEM experts to ascertain potential risk to specific environmental resources and to determine how that risk can be further mitigated.

As noted in **Section 3.3**, a CDE is not expected as a result of the Proposed Action. This is partly given the extremely low probability of such a spill in general, but more importantly, as a result of the comprehensive reforms to OCS oil and gas regulation and oversight put in place after the *Deepwater Horizon* event. By learning from these past experiences and strengthening regulatory oversight, these reforms help ensure that the U.S. can safely and responsibly expand development of its domestic energy resources. For more information on these reforms, see http://www.boem.gov/Reforms-since-the-Deepwater-Horizon-Tragedy/.

4.4.6 Programmatic Mitigation

4.4.6.1 Environmentally Important Areas

As discussed in **Section 1.4.5**, several EIAs were identified during scoping by BOEM's internal experts that represent regions of important environmental value where there is potential for conflict between ecologically important or sensitive habitats; maintenance of social, cultural, and economic resources; and possible oil and gas development. A description of these areas can be found in **Section 2.6.1**.

As discussed under Alternative B, this section also provides the Secretary of the Interior with information to determine, at her discretion, whether to adopt programmatic mitigation measures as part of the Program or defer application of programmatic mitigations to the lease sale decision stage. Implementation of mitigation measures in these areas could reduce potential impacts on certain resources from activities under the Proposed Action.

4.4.6.1.1 Harrison Bay

The Harrison Bay EIA is in the Beaufort Sea Program Area (**Figure 2.6-1**). This is an important nearshore area that encompasses relatively high productivity and is important to birds and seals during the open water season. The Harrison Bay area is also a feeding and denning area for polar bears. Programmatic mitigation for Harrison Bay would limit or modify activities that could impact birds, specifically. Other resource areas would also benefit from this mitigation.

Marine Benthic Communities

If activity within Harrison Bay was limited between June and August, the benthic habitats within it would be protected from most of the adverse impacts caused by IPFs. There still would be a potential for adverse impacts on benthic resources from spills and CDEs. However, reduced activity in the area would make these events less likely and perhaps diminish their impacts due to distance from the event.

Marine Mammals

Ringed and spotted seals concentrate in Harrison Bay and the adjacent shoreline has been identified by the USFWS as a polar bear denning area. This EIA has been identified primarily for the protection of bird species, but would be of some small benefit to seals and polar bears. This EIA would not be of obvious benefit to other marine mammal species, which pass through the area but do not remain for appreciable amounts of time.

Birds

Harrison Bay has been identified by the National Audubon Society as an IBA of continental significance for long-tailed ducks (*Clangula hyemalis*), king eiders (*Somateria spectabilis*), red-throated loons (*Gavia stellata*), Arctic terns, surf scoters (*Melanitta perspicillata*), brants (*Branta bernicla*), and glaucous gulls. It also has been identified by the ADF&G as a most environmentally significant area. This EIA has been identified primarily for the protection of bird species. It is a major migration staging area for red-throated and yellow-billed loons (*Gavia adamsii*) in summer and fall, and for spectacled and king eiders in spring and fall. Spectacled eiders are an ESA-listed species. Limiting activities in this area by implementing a time-area closure from June through August would provide additional protection from disturbance and disruption, which can have high energetic costs for birds staging prior to long migrations. Programmatic mitigation for this area could provide for an additional buffer from the potential for it to be impacted by oil and gas industry-related spills, but would not protect against spills from other sources (e.g., barge traffic, shipping, tourism cruises), and would not change the overall levels of effect determination for birds.

4.4.6.1.2 Chukchi Corridor EIA

The Chukchi Corridor EIA is in the Chukchi Sea Program Area (**Figure 2.6-2**). This area includes a corridor along the existing Presidential Withdrawal areas that contains important seasonal habitat for many species, including marine mammals and birds, as well as important subsistence use areas and spring ice lead systems. Programmatic mitigation measures for this area could limit or modify activities during migration periods and until after the spring lead system has broken up and the sea ice has retreated.

Marine Benthic Communities

The Chukchi Sea is an area of high benthic productivity (Dunton et al. 2005). The Chukchi Corridor EIA would provide additional protection for the nearshore benthic habitats in the program area. This corridor, in addition to the existing Presidential Withdrawal areas, encompasses the majority of the known hard-bottom habitats in the Chukchi Sea. It is possible that employment of mitigation measures in this area could reduce adverse impacts caused by IPFs, aside from those caused by non-routine spills.

Marine Mammals

The Chukchi Corridor EIA would provide additional protection for the nearshore lead system area that most marine mammals and seabirds transit during migration in spring. The spring migration includes beluga and bowhead whales, walrus, and a variety of seabird and sea duck species. Gray whales (*Eschrichtius robustus*) migrate up the coastline later in the open water season, and fin and humpback whales have been seen near shore in the Chukchi Sea as well. Seals and polar bears use the lead system extensively while foraging in late winter and spring. The corridor extension also would provide an additional buffer between industrial activities and subsistence activities, which tend to occur primarily within 56 to 80.5 km (35 to 50 mi) from shore. Programmatic mitigations implemented for this area would provide additional protection for a variety of marine mammal and seabird species as well as an additional buffer for subsistence activities. A seasonal closure during migration periods and until after the spring lead system has broken up and the sea ice has retreated would benefit many species, including beluga, bowhead, and other whales, and migrating sea ducks and seabirds. It would partially benefit species that continue to use the nearshore corridor throughout the open water season, such as walrus and colonial seabird species. If exploration of leases within the corridor leads to production activities, these activities could not be limited to seasonal occurrences.

Birds

The Chukchi Corridor EIA would provide additional protection for the nearshore lead system area that most marine mammals and seabirds transit during migration in spring. The spring migration includes eiders, loons, and a variety of seabird and sea duck species. The corridor extension would provide an additional buffer between industrial activities and birds who nest and forage primarily within 56 to 80.5 km (35 to 50 mi) of shore, including large colonies of seabirds at Cape Lisbourne, concentrations of brant and other waterfowl in Kaseguluk Lagoon, and eiders in Ledyard Bay (**Figure 2.6-2**). A seasonal closure during migration periods and until after the spring lead system has broken up and the sea ice has retreated would benefit migrating sea ducks and seabirds. Programmatic mitigation for this area could provide for an additional buffer from the potential for it to be impacted by oil and gas industry-related spills, but would not protect against spills from other sources (e.g., barge traffic, shipping, tourism cruises), and would not change the overall levels of effect determination for birds. Expanding the coastal buffer could provide some benefit to nesting and foraging birds by decreasing disturbance and disruption impacts and the risk of a spill in nearshore waters, particularly for nesting and molting birds.

4.4.6.2 Biologically Sensitive Underwater Features EIA

The Biologically Sensitive Underwater Features EIA includes blocks subject to Topographic Features and Live Bottom (Pinnacle Trend) lease stipulations. These stipulations require the lessee to implement mitigation measures designed to avoid or minimize harm from seafloor-disturbing activities on sensitive and unique topographic and pinnacle trend features found across the GOM Program Area (**Figure 2.6-3**). If selected, this programmatic mitigation would require all lessees to comply with mitigation measures for topographic or pinnacle trend features and would eliminate the need for specific lease stipulations for blocks containing these features. All of the existing restrictions and requirements for applicable lease blocks would apply for all leases issued under the 2017–2022 Program.

The existing mitigation measures for topographic features are based on an exclusion of all activity from the most sensitive biological areas defined via bathymetric contours (generally 85 m [279 ft]). There are currently 38 topographic banks covered by this stipulation. The No Activity Zones directly overlying sensitive bank features are exclusionary of all activities. Although not a part of the EIA, a progression of expanding buffer distances around all banks (e.g., 1.6 km [1 mi], 4.8 km [3 mi], and 7.4 km [4 mi] for the Flower Garden Banks only) does not entirely exclude activities but provides appropriate levels of protection by preventing drilling discharges at the surface within each zone (requiring shunting of muds and cuttings to within 10 m of the seabed). These targeted mitigations have proven effective and are supported by extensive and ongoing scientific research.

There are currently 74 blocks affected by the Live Bottom (Pinnacle Trend) stipulation; these are in the northeastern portion of the Central Planning Area (**Figure 2.6-3**). Implementation of this programmatic mitigation would require a lessee for a block currently subject to this stipulation to assess live-bottom habitat in the block and to undertake measures to protect the live bottom features. These measures could include relocation of operations, shunting of fluids and cuttings, and monitoring to assess the impact of the activity on the live bottoms.

Implementation of mitigation measures for this EIA are consistent with current practice and would continue the effective protection of these biologically sensitive areas. Impacts from activities in adjacent areas (e.g., spills, CDEs) could still affect these features. The nature and magnitude of any such impacts on benthic communities of these topographic features depend on the location, size, and duration of any spills in the other portions of the program area. It is possible but not likely that increased turbidity would affect hard-bottom habitat if bottom disturbance occurred near the boundary of a No Activity Zone. The shunting requirements should minimize the adverse effects of discharged drilling muds and cuttings, although low-relief banks in shallower water would be adversely affected to some degree. Ongoing research and activities, such as the proposed expansion of the Flower Garden Banks NMS, could result in the identification of new features or revised mitigation measures. New areas or revised mitigation measures would be subject to analysis at the lease sale stage and would not be covered under this programmatic mitigation.

It is assumed that the mitigations described under NTL 2009-G39 (providing avoidance and mitigation requirements for biologically sensitive hard/live-bottom areas in waters 300 m [984 ft] or less) would continue under this EIA and Alternative A. Adequate mitigation measures would still be required for additional features, such as low-relief live bottoms and potentially sensitive biological features to protect these important areas from negative impacts of OCS activities. Overall, the protections in NTL 2009-G39 should minimize the potential for direct disturbance to coral reefs and live-bottom habitat. However, sediment disturbance and the discharge of drilling muds and cuttings in nearby areas could result in increased turbidity and sedimentation around these features that could kill or inhibit respiration, filter feeding, and photosynthesis by hard-bottom biota. Because of their generally shallow depth, low-relief habitats are particularly vulnerable to turbidity and sedimentation. This is the reason that shunting requirements around high-relief topographic features are not required near the lower relief pinnacle features. Low-relief, live-bottom areas and potentially sensitive biological features not detected would be subject to direct mechanical damage from site E&D activities, although available remote sensing technology is very effective at detecting these features. Thus, appropriately siting discharge locations in pre-disturbance mitigation plans would be critical to minimize the effects of bottom disturbance and discharges.

4.4.6.3 Conflict Management Plan

The concept of a CMP for leases issued in the Beaufort Sea, Chukchi Sea, or Cook Inlet Program Area is intended to minimize the potential for conflict between subsistence activities and oil and gas industry operations taking place under BOEM jurisdiction in Alaska.

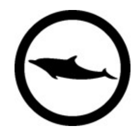
BOEM would require an oil and gas industry operator to submit a CMP to BOEM prior to beginning exploration or development activities. The CMP would document the operator's work with subsistence communities to determine best practices to prevent unreasonable conflicts with subsistence activities, and would outline specific mitigation measures that the operator would implement. The CMP would apply to BOEM authorized and permitted activities in the OCS, as well as support activities (such aircraft or vessel resupplies or crew transfers), which could occur in the OCS and/or onshore.

The CMP is not a replacement for the Conflict Avoidance Agreements that industry and Arctic subsistence communities prepare through the MMPA process with NMFS. Conflict Avoidance Agreements are more narrowly focused on impacts on marine mammal subsistence in the OCS environment and could include compensation for subsistence users through the transfer of benefits. A CMP would not require the transfer of benefits or third party agreements. It is BOEM's intention to facilitate coordination between industry and Arctic communities through a CMP to further minimize the potential for impacts on local communities.

Coastal and Estuarine Habitats

A CMP would be of great use to resolve issues related to construction of shore base facilities, roads, and pipelines regarding the timing of construction, location, and methods of construction. Most of the onshore construction would involve jurisdiction of the USACE and the BLM, so a CMP submitted with application for permit that shows how conflicts can be avoided and impacts mitigated should foster a more rapid analysis and permit decision by those agencies.

Marine Mammals



The CMP ensures that exploration, development, and production operations shall be conducted in a manner that prevents unreasonable conflicts between the oil and gas industry and subsistence activities for any lease issued under this program during periods of subsistence use. Restrictions to activities proposed during subsistence-use critical times would benefit subsistence hunters and communities but also would have tangible benefits to marine mammal species by reducing disturbance to these species from industry activities. While restrictions on oil and gas activities during subsistence activities would afford some protection to marine mammal species from disturbance and disruption, it would not change the levels of effect determination for marine mammals.

Birds

Restrictions on activities proposed during subsistence-use critical times within lease blocks would benefit subsistence hunters and communities but also would have tangential benefits to bird species with overlapping critical habitat or foraging areas.

Arctic Terrestrial Wildlife and Habitat

Restrictions on activities proposed during subsistence-use critical times within lease blocks would benefit subsistent hunters and communities but also would have tangential benefits to terrestrial wildlife species with overlapping foraging areas. While restrictions on oil and gas activities during subsistence activities would afford some protection to terrestrial wildlife species from disturbance and disruption, it would not change the levels of effect determination relative to the Proposed Action.

Land Use and Infrastructure

A CMP could help establish best management practices and outline specific mitigation measures that would minimize environmental impacts and allow for the oil and gas industry to co-exist with subsistence uses. As such, it is anticipated that the CMP could reduce impacts associated with land use and infrastructure in Alaska if implemented effectively.

Sociocultural Systems and Environmental Justice

BOEM would require oil and gas industry operators to submit the CMP prior to initiating any exploration or development activities associated with leases issued in the Alaska program areas. The CMP would represent a good faith effort by the applicant to prevent or mitigate conflicts with subsistence activities (e.g., outlining specific mitigation measures for operators, additional consultation with affected communities). The CMP would be focused on reducing impacts on subsistence use from the activities associated with the Proposed Action. If implemented effectively, a CMP has the potential to reduce impacts on subsistence activities.

4.5 CUMULATIVE IMPACTS

A cumulative impact, as defined by the CEQ, "results from the incremental impact of [an] action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). The analyses presented in this section include the direct and indirect impacts of the Proposed Action (Alternative A, see **Section 4.4.1**), the effects baseline of ongoing (i.e., past and present) and future actions described in Alternative D (see **Appendix B** for a list of actions; impacts are discussed in **Section 4.4.4**), future OCS programs (**Section 3.7**), and any synergistic or countervailing effects. Energy substitutes are not analyzed in the framework of cumulative impacts because the Proposed Action is assumed to occur and no substitutes would be required. Repeated actions, even minor ones, could produce significant impacts over time through additive or interactive (synergistic) processes. The goal of the cumulative impacts assessment, therefore, is to identify such impacts early in the planning process to improve decisions and move toward more sustainable development (CEQ 1997a).

The analyses in this section consider the incremental contribution of the Proposed Action (Alternative A, see **Section 4.4.1**) to ongoing and reasonably foreseeable future actions. Cumulative impacts under any of the other alternatives, including the Preferred Alternative, are expected to be less than those contemplated for the Proposed Action (Alternative A) because all other alternatives consider some reduced level of activity. In addition, cumulative impacts would not occur in any area excluded from the 2017–2022 Program because if there is no activity from the Proposed Action within a given program area, there cannot be an incremental contribution to past, present, or reasonably foreseeable future actions.

Appendix B identifies the ongoing and reasonably foreseeable actions and trends composing the effects baseline, including past and present OCS oil and gas leasing activities; past, present, and future actions associated with oil and gas activities onshore and in state waters; subsistence activities; military and NASA operations; vessel trips; commercial and recreational fishing; infrastructure projects; sand and other resource mining; renewable energy development; and climate change. **Appendix B** lists projects, actions, and trends that have been considered as part of the effects baseline for each program area. **Appendix B** also identifies future OCS programs as a reasonably foreseeable future action. Future OCS leasing is not considered under the effects baseline in Alternative D but is considered in the cumulative effects analysis (**Section 3.7**).

Accidental spills are considered separately from the actions included in the effects baseline analysis. Accidental oil spills can occur from OCS and non-OCS activities, and the magnitude and severity of potential impacts from a spill on any resource would depend on the spill location and size, depth of spill, duration of spill, type of spill, meteorological conditions such as wind speed and direction, seasonal and environmental conditions, and the effectiveness of response activities. Accidental spills from OCS activities are covered in detail in **Section 4.4.5**. Non-OCS activities that have the potential for accidental spills include state oil and gas exploration, development, and production; the domestic transportation of oil; foreign crude oil imports; commercial shipping; commercial fishing; and private vessel use. In addition, hurricanes and extreme weather events can damage pipelines and infrastructure, resulting in a release of oil. Impacts from non-OCS activities oil spills would be largely similar to those described in **Section 4.4.5**.

Because of the variability associated with accidental oil spills, inclusion of the oil spill impacts results would result in a broadening of the potential impact range in the cumulative scenario in every resource section, which masks the incremental contribution of other OCS and non-OCS routine activities; therefore, these impacts will not be discussed in detail in the cumulative impacts section for each resource. For all the resource sections, accidental oil spill impacts range from **negligible** or **minor** to **major**, with the exception of air quality and archaeological and historical resources, where the upper threshold is **moderate**.

4.5.1 Air Quality

The activities associated with the Proposed Action could impact air quality when added to other impacts from similar and unrelated past, present, and reasonably foreseeable future actions over the life of the Program. See **Section 4.4.4.1** for the air quality impacts from the Proposed Action.

Table 4.5.1-1 provides the estimated cumulative high-price scenario annual air emissions from OCS activities for the Program's duration, for the activities associated with the Proposed Action as well as ongoing and future OCS oil and gas activities. These emissions were estimated using emissions factors from BOEM's 2012 Revised OECM. The majority of emissions would come from well drilling, support vessels, and construction of new production platforms and pipelines.

Table 4.5.1-1. Estimated Cumulative Air Emissions from the Proposed Action's OCS Activities, in Thousands of Short Tons per Year, High-Price Scenario

Pollutant	Beaufort Sea	Chukchi Sea	Cook Inlet	Western GOM	Central and Eastern GOM
NO_x	4,566.07	2,221.91	118.70	1,787.71	7,902.71
SO_x	59.36	50.98	5.50	42.23	175.53
PM_{10}	225.52	102.79	3.03	54.67	243.39
$PM_{2.5}$	202.25	92.53	2.93	53.10	236.42
CO	1,844.87	830.61	33.64	523.00	2504.96
VOC	546.94	465.39	39.21	115.22	583.06

Notes: The high-price scenario would likely result in the highest level of emissions for the Proposed Action
Key: CO = carbon monoxide; NO_x = nitrogen oxides; $PM_{2.5}$= particulate matter with a diameter equal to or less than 2.5 microns; PM_{10}= particulate matter with a diameter equal to or less than 10 microns; SO_x = sulfur oxides; VOC = volatile organic compound

The activities associated with the Proposed Action would contribute to onshore levels of NO_x, SO_x, and PM_{10}, but concentrations onshore could exceed the NAAQS (USEPA 2015b) and PSD increments (40 CFR part 55) for short periods of time under a high-price scenario in the GOM. The GOM coast has locations where O_3 is classified as nonattainment (**Figure 4.3.1-1**); however, the contribution from OCS Program activities to O_3 concentrations remains low. Concentrations of O_3 are expected to continue their long-term decline due to air pollution control measures implemented by state and Federal regulatory agencies. Although the GOM coastal region has substantial visibility impairment from anthropogenic emissions sources, visibility is expected to improve somewhat as a result of regional and national emissions reduction programs. The contribution from cumulative case OCS oil and gas activities to visibility impairment is expected to remain small relative to other sources. However, these trends could reverse as a result of climate change. Climate change is expected to increase the amount of vegetation in certain locations, which releases VOCs and interacts with NO_x released from oil and gas operations to produce increased haze and O_3 at ground levels. Activities unrelated to the program, such as those discussed in the effects baseline under the No Action Alternative (**Section 4.4.4.1**) would also be expected to continue.

Cumulative impacts on air quality on and near the GOM OCS associated with the Proposed Action, ongoing and future OCS oil and gas programs, as well as unrelated activities are expected to be **moderate**, because of the level of industrialization, both in the GOM, and along the surrounding coasts. Expected long-term declines in emissions could eventually bring the region into attainment status, resulting in **minor** impacts. Meanwhile, the less industrialized Alaska program areas have few emissions currently. Although the addition of OCS oil and gas operations would make it among the largest sources of air emissions in the region, the operations would be spread over a large area, with few other sources. The Proposed Action would allow for exploration, development, and production in the less industrialized Alaska program areas, leading to a **minor** contribution to air quality impacts in the Arctic and Cook Inlet areas.

4.5.2 Water Quality

Cumulative impacts on water quality result from the incremental impacts of the activities associated with the Proposed Action when added to impacts from ongoing and reasonably foreseeable future actions as described in the effects baseline in **Section 4.4.4.2** plus future OCS programs. Water quality is also affected by many other factors as outlined under the Proposed Action (**Section 4.3.1** and **4.4.1**) and the effects baseline under the No Action Alternative (**Section 4.4.4.2**). In the GOM Program Area, impacts from the activities associated with the Proposed Action and ongoing OCS programs could lessen with time because oil and gas production in those areas is currently on the decline. Impacts from climate change are also considered potential cumulative impacts on ocean water quality. As detailed in **Section 4.3.1**, these impacts include decreased oxygen (Long et al. 2016), changing nutrient loads, and altered ocean circulation (Brierley and Kingsford 2009).

The cumulative impacts on water quality on and near the OCS associated with the Proposed Action, ongoing and future OCS oil and gas programs, as well as unrelated activities including climate change, are expected to be **negligible** to **moderate** because impacts from activities associated with the Proposed Action and non-OCS program activities would be mitigated (i.e., minimized) by the various regulatory controls already in place to protect the coastal and marine waters. The incremental contribution of the activities associated with the Proposed Action to water quality would represent a small percentage of the total cumulative impacts.

4.5.3 Marine Benthic Communities

The cumulative impact assessment considers effects on marine benthic communities from the Proposed Action's activities in the program areas when added to impacts from past, present, and reasonably foreseeable future actions as described in the effects baseline in **Section 4.4.4.3** plus future OCS oil and gas activities. Impacts associated with Proposed Action activities include noise, drilling muds and cuttings discharges, debris, and seafloor disturbance (e.g., pipelines). All of these activities and associated impacts contribute to cumulative impacts. The incremental contribution of the activities associated with the Proposed Action to overall cumulative impacts ranges from **negligible** to **moderate** (see **Section 4.4.1.8** and **Appendix E**). For the Proposed Action, only localized impacts from drilling muds and cuttings near drilling discharges on soft bottom communities would exceed a minor impacts level determination, reaching a potential **moderate** level. This is primarily because of the effectiveness of mitigation measures protecting sensitive benthic communities and other effective management measures.

Numerous ongoing non-Program activities that contribute to bottom disturbances are discussed in the effects baseline in the No Action Alternative in **Section 4.4.4.3**; however, the full consideration of cumulative impacts expands those factors. Non-OCS Program activities that could contribute to cumulative impacts include a number of sources in state waters that can cross state/Federal boundaries including: oil and gas activities in state-owned marine waters, onshore industry and agriculture, dredging, and marine disposal. Impacts from increasing water temperature and ocean acidification would likely be the most significant source of cumulative impacts from non-OCS sources.

The longer-term influences of climate change on marine benthic communities are difficult to predict due to unknown factors of resilience and variability in areas that would be affected by impacts of climate change and ocean acidification. Some benthic communities would benefit from the northward expansion or increases in abundance while other species would not be impacted, or would be negatively impacted. Climate change impacts on benthic communities for the reasonably foreseeable future are considered to remain within the minor to moderate range because of the potential for adaptation, some limitation of population-level impacts due to expansion of habitats, and the time scale used in this evaluation. The cumulative impacts on marine benthic communities from all non-OCS activities are expected to be minor to moderate, depending on the location.

In summary, the total cumulative impacts on marine benthic communities from all OCS and non-OCS activities are expected to be **minor** to **moderate.** The incremental contribution of the activities associated with the Proposed Action would represent a small percentage of the total cumulative impacts because of the ongoing and anticipated impacts of broad environmental influences including climate change and acidification.

4.5.4 Coastal and Estuarine Habitats

The cumulative impacts on coastal and estuarine habitats from the activities associated with the Proposed Action, reasonably foreseeable future actions as described in the effects baseline in **Section 4.4.4.4** plus future OCS oil and gas activities (**Appendix B**) are expected to be **minor** to **major**, depending on the location and factors such as possible sea level rise and coastal sediment dynamics. Typical oil and gas activities associated with the Proposed Action that could impact coastal and estuarine habitats in the Chukchi Sea Program Area include construction of new or modification of existing infrastructure, including ports, roads, construction facilities, oil and gas pipelines/landfalls, and onshore processing facilities. Increased vehicle traffic would also be likely. These incremental activities could result in **moderate** impacts because of the possible thousands of wet and moist tundra acres impacted by shorebase and pipeline construction. However, almost all the additional possible coastal and estuarine impacts from the activities associated with the Proposed Action would be subject to USACE and BLM permitting and could be mitigated to some extent. In the remaining Alaska program areas, the Proposed Action would not be expected to raise cumulative impact levels to more than **minor** as would be expected to occur with all other activities and IPFs including sea level rise. In the GOM, non-OCS IPFs would be expected to have **major** effects due to sea level rise and subsidence, and therefore the Proposed Action would add a small increment to the continued land loss in coastal wetlands and barrier islands and thus result in little change to cumulative impacts.

4.5.5 Pelagic Communities

Impacts from the activities associated with the Proposed Action were determined to range from **negligible** to **minor** (**Section 4.4.1.5** and **Appendix E**). A comprehensive assessment of past, present (ongoing), and reasonably foreseeable future actions that would impact pelagic communities in the program areas are described in the effects baseline in **Section 4.4.4** and **Appendix B**. All of these activities and associated impacts plus impacts from future OCS oil and gas leasing, contribute to cumulative impacts.

Cumulative impacts on pelagic communities caused by the incremental impacts of the Proposed Action when added to impacts from past, present, and reasonably foreseeable future actions are expected to be **minor** and activities related to the Proposed Action represent a small percentage of the total cumulative impacts. This impact level is expected because most of the plankton populations in the planning areas have been fluctuating or increasing over recent years and IPFs added incrementally by the Proposed Action are not expected to greatly increase levels of noise, routine discharges, bottom disturbance, or lighting/physical presence.

4.5.6 Marine Mammals

Alaska Program Areas

Cumulative impacts on marine mammals from the activities associated with the Proposed Action, ongoing and reasonably foreseeable non-OCS future actions, and future OCS oil and gas leasing programs include noise, vessel strikes, and accidental oil spills. Additional sources of impacts on marine mammals that are part of the effects baseline described in **Section 4.4.4.6** include entanglements or ingestion of trash or debris, climate change-related impacts, changes in prey availability, and legal and illegal harvest.

Noise impacts under the cumulative case are significant because of auditory masking and disturbance from preferred habitats. These noise sources are not expected to result in potential acute auditory injuries to marine mammals, but could lead to chronic impacts on population fitness.

As described in **Section 3.6**, marine mammals could be affected by various noise-producing activities associated with the 2017–2022 Program. Most of the sources of noise (with the exception of seismic surveys and explosive removals of OCS structures) are not expected to result in potential auditory injuries to marine mammals with mitigation measures in place. Impacts are expected to be limited to the disturbance or displacement of individuals. These impacts would also result from activities associated with existing leases and future leases.

The possibility exists for collisions between vessels and marine mammals; collisions with humpback and other large whales occur with some regularity in Alaska (Neilson et al. 2012). Any collisions with marine mammals are expected to result in injury or mortality. The overall level of vessel traffic related to non-OCS actions is much higher than vessel traffic from OCS activities.

Ongoing anthropogenic activities and associated impacts are much higher in Cook Inlet than in the Beaufort and Chukchi Seas. Impact levels also vary between areas due to the differences in risk based on population level, and status of other ongoing IPFs. For example, North Pacific right whales are highly endangered and at great risk from collisions regardless of the source of the vessel traffic. Polar bears, found only in the Beaufort Sea and Chukchi Sea Planning Areas, are at great risk from climate change regardless of other ongoing anthropogenic activities. OCS activities related to the Proposed Action would add a small incremental level of effect, particularly with regard to noise, temporary or long-term habitat loss, accidental discharges, and potential for collisions, to ongoing and future OCS oil and gas programs as well as unrelated activities. The cumulative impacts on marine mammals from all OCS and non-OCS activities are expected to be **minor** to **major**, depending upon the species and the program area. The incremental contribution of the Proposed Action would represent a small percentage of the total cumulative impacts and is expected to be **negligible** to **moderate.**

GOM Program Area

Cumulative impacts for marine mammals in the GOM result from the incremental contribution of the Proposed Action to the effects baseline described under the No Action Alternative plus future OCS oil and gas leasing programs. The cumulative impacts on marine mammals from all ongoing and reasonably foreseeable future activities in the GOM are expected to be **negligible** to **major** as described in the effects baseline in **Section 4.4.4.6**. The incremental contribution of the Proposed Action would represent a small percentage of the total cumulative impacts and is expected to be **negligible** to **moderate** because the cumulative extent of oil and gas activities are a major stressor to marine mammals in the GOM. Although the Proposed Action represents a small portion of these activities, it contributes to and extends the timeline under which marine mammals could be subject to impacts from oil and gas exploration, development, production, and decommissioning.

4.5.7 Sea Turtles

A comprehensive assessment of past, ongoing, and reasonably foreseeable non-OCS future actions that would impact sea turtles in the GOM are described in **Section 4.4.4**. All of these activities, plus future OCS oil and gas leasing programs, contribute to cumulative impacts. The incremental contribution of impacts on sea turtles associated with the Proposed Action when added to these other past, present, and reasonably foreseeable future actions is most relevant for noise and vessel strikes because of the potential population-level impacts or in the case of endangered species, impacts on individuals.

Impacts of the activities associated with the Proposed Action were determined to range from **negligible** to **moderate** (**Section 4.4.1.7** and **Appendix E**). Cumulative noise impacts could be significant because of the risk of behavioral disruption and auditory masking but would not be expected to result in potential acute auditory injuries to sea turtles. As described in **Section 3.6** and **4.4.1.7,** sea turtles could be affected by various noise-producing activities associated with the 2017–2022 Program. Most of the sources of noise (with the exception of seismic activities and explosive removals of OCS structures) are not expected to result in significant risk to sea turtles from auditory masking or injury when effective mitigations are in place. Impacts are expected to be limited to the disturbance or displacement of individuals.

The possibility exists for collisions between vessels and sea turtles. It is possible that behavioral disturbance from noise-producing activities could elevate this risk by causing animals to exhibit more surface-oriented behavior. Additional vessel traffic associated with the Proposed Action could further increase the risk of collision. Any collisions with sea turtles are expected to result in injury or mortality.

A significant amount of ongoing anthropogenic activities and associated impacts exist in the GOM Program Area. Many of these activities continue to present challenges to the long-term survival of all five sea turtle species in the GOM irrespective of OCS oil- and gas-related activities. For example, sea turtle bycatch associated with commercial fishing activities (e.g., long line and shrimp trawling) continues to be one of the most significant threats to the long-term survivability of sea turtle species. OCS activities in the GOM Program Area related to the Proposed Action would add a small incremental level of effect, particularly with regard to noise and potential for vessel strike, to ongoing and future OCS oil and gas programs as well as unrelated activities. The cumulative impacts on sea turtles from the Proposed Action and other past, ongoing, and reasonably foreseeable actions under the cumulative scenario are expected to be **minor** to **major** because of the wide range of other non-OCS oil and gas activities and scale of impacts for each that continue to negatively impact long-term population trends for all sea turtle species in the GOM. Activities related to the Proposed Action would represent a small percentage of the total cumulative impacts, particularly with regard to noise and vessel strikes. Impacts on sea turtle life history requirements associated with climate change would result in the concentration of nesting, foraging habitats in specific areas throughout the GOM. Some IPFs could result in more significant impacts on sea turtles if the location of effect overlaps a future area of high sea turtle abundance as a result of climate change impacts.

4.5.8 Birds

Cumulative impacts on birds result from the incremental impacts of the Proposed Action when added to impacts from past, present, and reasonably foreseeable non-OCS future actions plus future OCS oil and gas leasing programs. The incremental contribution of impacts on birds associated with the Proposed Action when added to these other past, present, and reasonably foreseeable future actions is most relevant for noise, vessel and aircraft traffic, emplacement of structures and associated lighting because of the potential for disturbance and disruption, collision mortality, and population-level impacts, or, in the case of endangered species, impacts on individuals from spills.

Impacts from the activities associated with the Proposed Action were determined to range from negligible to minor (**Section 4.4.1.8** and **Appendix E**). A comprehensive assessment of past, present (ongoing), and reasonably foreseeable non-OCS future actions that would impact birds in the program areas are described in **Section 4.4.4** and **Appendix B**. All of these activities and associated impacts, with the exception of those stemming from energy substitutes, which are only a component of the No Action Alternative, contribute to cumulative impacts.

As previously stated, bird populations are generally in decline (Morrison et al. 2001, Morrison et al. 2006, Paleczny et al. 2015, NACBI 2016) as a result of several population-level stresses, the most prominent of these are related to climate change, loss of nesting/ breeding habitat, cat predation, collisions with structures, and changes in abundance and location of prey species (NABCI 2014, NABCI 2016). Additional factors impacting bird populations include human disturbance at nesting and migration staging areas, chronic marine pollution, and entanglement with or ingestion of trash and debris (Yasue 2006, NABCI 2014). The influences of climate change on birds are difficult to predict due to the complexity of predicting climate-induced ecological impacts (Mustin et al. 2007). For example, climate change is likely to impact a wide range of aspects of a bird’s ecology, and the question remains as to whether species are capable of shifting to occupy new ranges (Mustin et al. 2007). Impacts on birds from climate change could include shifts in timing of important seasonal events, such as egg laying and migration, which could force birds’ lifecycles out of synchrony with plants and insects upon which they depend. Climate change could also result in shifting of species’ ranges (range contractions are expected more frequently than range expansions), which could disrupt ecological communities of birds and other interdependent plants and animals. Further, this could lead to birds being brought into contact with different prey species, parasites, or predators and competitors as their habitats change or they are forced into areas less suited to them. Alterations of the timing and magnitude of biological productivity could also occur, forcing bird populations to seek new levels and distributions of prey items in response to these changes. Additionally, alterations of habitats such as loss of sea ice or drying of freshwater habitats could impact various stages of development (Butler and Taylor 2005, Wormworth and Mallon 2006, Liebezeit et al. 2012, Tillmann and Seimann 2011, Wauchope et al. 2016).

The cumulative impacts on birds from the Proposed Action and other past, ongoing, and reasonably foreseeable future actions are expected to be **moderate** to **major** since some bird populations are in decline, the amount of coastal development threatening nesting/breeding and foraging habitats, and the numbers of birds that collide with structures on a yearly basis. Activities related to the Proposed Action represent a small percentage of the total cumulative impacts, particularly with regard to noise and the potential for mortality from collisions with vessels, aircraft, flares, and structures.

4.5.9 Fish and EFH

Impacts of the activities associated with the Proposed Action were determined to range from negligible to minor (**Section 4.4.1.9** and **Appendix E**). A comprehensive assessment of past, present (ongoing), and reasonably foreseeable non-OCS future actions that would impact fish and EFH in the program areas are described in **Section 4.4.4** and **Appendix B**. All of these activities and associated impacts, plus impacts from future OCS oil and gas leasing programs, contribute to cumulative impacts.

The cumulative impact of long-term, large-scale fisheries activity on fishes and habitat resources is not known. However, commercial fishing practices that are indiscriminate, such as some types of trawling and pots, are responsible for significant amounts of bycatch that can injure or kill juveniles of many fish species. These types of fishing practices could damage future year classes, reduce available prey species, and damage benthic habitat for many GOM fish resources Temporary disturbance of sediments and related increases in turbidity from routine OCS activities could cause soft-bottom fish such as Atlantic croaker, sand sea trout, Atlantic bumper, sea robins, and sand perch to temporarily move from or be attracted to the disturbed area. Fish species that are normally associated with reefs, such as snappers, groupers, grunts, and squirrelfishes, could also move from areas of increased turbidity. Sedimentation could smother eggs, larvae, and juvenile fishes as well as the benthic prey of some of these fish species.

In addition, non-OCS program activities occurring in state waters are likely to contribute to cumulative impacts on fish and EFH. Other non-OCS activities that could impact fish communities include non-OCS activities with a potential to impact marine benthic and pelagic habitats, such as sand mining, sediment dredging and disposal, anchoring, offshore marine transportation, and pollutant inputs from point and non-point sources. Many of these activities would affect bottom-dwelling fishes at various life stages as well as their food sources in a manner similar to OCS bottom-disturbing activities.

Cumulative impacts on managed/listed species and EFH considering the incremental impacts of the Proposed Action when added to impacts from past, present, and reasonably foreseeable future actions are expected to be **negligible** to **minor**. Many of the managed species in the planning areas exhibit stable or increasing abundances (Karnauskas et al. 2013, Zador 2015). Activities related to the Proposed Action represent a small percentage of the total cumulative impacts, particularly with regard to noise, routine discharges, bottom disturbance, and lighting/physical presence.

4.5.10 Arctic Terrestrial Wildlife and Habitat

Cumulative impacts on Arctic terrestrial habitat and wildlife result from the incremental impacts of the Proposed Action when added to impacts from past, present, and reasonably foreseeable non-OCS future actions as described in the effects baseline in **Section 4.4.4.10** plus future OCS oil and gas leasing programs. For Arctic terrestrial wildlife and habitat, the incremental impacts are most relevant from IPFs including noise, vessel and aircraft traffic, bottom/land disturbance, emplacement of structures and associated lighting/physical presence and air emissions, because of the potential for disturbance and disruption and loss of habitat.

Impacts of the activities associated with the Proposed Action were determined to range from negligible to minor (**Section 4.4.1.10** and **Appendix E**). A comprehensive assessment of past, ongoing, and reasonably foreseeable non-OCS future actions that would impact terrestrial habitat and wildlife in the Arctic program areas are described in **Sections 4.4.4** and **Appendix B**. All of these activities and associated impacts, plus future OCS oil and gas leasing programs, contribute to cumulative impacts.

As stated previously, caribou populations adjacent to the Arctic program areas (PCH, CAH, and TCH) are generally stable or increasing (Cameron and Whitten 1979, Bente 2000, Carroll 2005, Lenart 2005a, Harper 2013, and Harper and McCarthy 2015). Human disturbance related to infrastructure development and aircraft noise has been identified as factors impacting caribou during calving and foraging (Smith and Cameron 1985, Cameron et al. 2005, Wolfe et al. 2000). In the Arctic, climate change can lead to loss of permafrost and changes in plant species assemblages. These could affect caribou by altering the tundra ecosystem during several critical phases of caribou life history, especially foraging before and after parturition. Other stressors on terrestrial habitat include stormwater runoff from upland development and an increase in the area of non-permeable surfaces. Any onshore activities that alter the hydrology or change the overland flow can lead to erosion or aggradation. Upland non-OCS related activities can introduce contaminants or pollutants from wastewater discharges and municipal discharges resulting in degradation of water quality, which can negatively affect wetlands and waterbodies. Stressors to wildlife can be due to habitat loss and fragmentation, habitat abandonment, habitat degradation, disturbance, roadkill, increased hunting access, introduction of anthropogenic food sources, and alteration of predator/prey balance.

The cumulative impacts on Arctic terrestrial wildlife and habitat from the activities associated with the Proposed Action and other past, ongoing, and reasonably foreseeable actions are expected to be **moderate** to **major.** The incremental contribution of activities related to the Proposed Action to overall cumulative impacts is expected to be **negligible** to **minor** in the Beaufort Sea Program Area since impacts from bottom/land disturbance and visible infrastructure would be minimized as infrastructure is already in place to support oil and gas operations in the area. However, the incremental contribution of activities related to the Proposed Action to overall cumulative impacts is expected to be **moderate** in the Chukchi Sea Program Area since the construction of new or modification of existing infrastructure, including ports, roads, construction facilities, oil and gas pipelines/landfalls, and onshore processing facilities would occur.

4.5.11 Archaeological and Historical Resources

Cumulative impacts on archaeological and historical resources would result from the incremental impacts of the activities associated with the Proposed Action when added to impacts from past, present, and reasonably foreseeable non-OCS future actions as described in the effects baseline in **Section 4.4.4** plus future OCS oil and gas leasing programs. The incremental contribution of impacts on archaeological and historical resources associated with the Proposed Action when added to these other past, present, and reasonably foreseeable future actions is most relevant for visual effects from emplacement of structures and associated lighting and seafloor (ground) disturbance because of the potential for altering the archaeological or historical resource setting and integrity, which would result in the loss of irreplaceable cultural information.

Impacts from the activities associated with the Proposed Action were determined to range from negligible to minor (**Appendix E**) for visual effects from emplacement of structures and associated lighting. Potential impacts on archaeological and cultural resources from seafloor (ground) disturbance range from moderate to major (**Section 4.4.1.11**). A comprehensive assessment of past, present (ongoing), and reasonably foreseeable future actions that would impact archaeological and historical resources in the program areas are described in **Section 4.4.4** and **Appendix B**. All of these activities and associated impacts, plus future OCS oil and gas leasing programs, contribute to cumulative impacts.

The cumulative impacts on archaeological and historical resources, if they were to occur, from the activities associated with the Proposed Action and other past, ongoing, and reasonably foreseeable future actions are expected to be **moderate** to **major**, because of the sensitivity of these resources to seafloor disturbance impacts and oil spills (see **Section 4.4.1.11**) and resultant loss of irreplaceable cultural information. The incremental contribution of activities related to the Proposed Action to overall cumulative impacts is expected to be negligible to minor. Where archaeological surveys are required and are conducted in compliance with BOEM survey standards prior to oil and gas activities on the OCS, the majority of potential archaeological sites can be located and mitigation strategies developed to avoid any adverse impacts.

4.5.12 Population, Employment, and Income

This analysis considers cumulative impacts on population, employment, and income in Alaska and the GOM coastal states, which are the areas that would be most impacted by the activities associated with the Proposed Action. The time frame for the analysis is the lifecycle of oil and gas exploration, development, and production likely to arise from the Proposed Action (see **Chapter 3** for more information).

This analysis employs the economic and demographic projections from Woods and Poole Economics, Inc. (2015) to define the contributions of other likely projects, actions, and trends to the cumulative case. 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 population, employment, and income associated with the continuation of current patterns in OCS leasing activity as well as the continuation of trends in other industries important to the region. The Woods and Poole projections represent a more comprehensive and accurate appraisal of cumulative conditions than could be generated using the traditional list of possible projects.

This analysis presents estimates of the levels of population, employment, and income that are expected to arise from past, present, and future OCS oil and gas lease sales. These estimates are derived from MAG-PLAN Alaska and MAG-PLAN GOM, BOEM's in-house economic models. These cumulative estimates can be compared to the Proposed Action estimates presented in prior sections. This analysis presents data from the USEIA regarding overall trends in energy markets. Finally, this section discusses the impacts of the Proposed Action relative to these cumulative trends.

Table 4.5.12-1 presents estimates from Woods and Poole Economics, Inc. (2015) for the average annual percentage changes of population, employment, and labor income from 2015 to 2035 in the states that would be most impacted by the activities associated with the Proposed Action. The year 2035 was chosen as an approximate peak year of economic activity arising from the Proposed Action activities. Average population increases are expected to range from 0.3 to 1.5 percent per year, average employment increases are expected to range from 0.9 to 1.8 percent per year, and average labor income increases are expected to range from 1.8 to 2.7 percent per year. Population, employment, and labor income growth are highly correlated among states. In terms of employment, the fastest growth is forecast in Texas and Florida; the slowest employment growth is forecast in Alabama and Mississippi. These growth rates can be combined with the level data in **Section 4.3.12** to estimate population, employment, and labor income in future years. The next sections present data on the economic impacts of the overall Program; the final section discusses the incremental impacts of the activities associated with the Proposed Action relative to the cumulative impacts on population, employment, and income.

Table 4.5.12-1. Average Estimated Annual Growth in Population, Employment, and Labor Income

State	Population (%)	Employment (%)	Labor Income (%)
Alaska	1.1	1.3	2.1
Texas	1.5	1.8	2.7
Florida	1.3	1.6	2.4
Louisiana	0.7	1.2	1.8
Alabama	0.6	1.1	1.9
Mississippi	0.7	1.1	1.8

Oil and gas activities onshore and in state waters are very important to population, employment, and income in Alaska. In contrast with what has happened in the GOM area, OCS activities have not had a major role in establishing the network of labor sources and supporting companies that exist in Alaska. However, production from onshore and state waters has been declining. Therefore, the impacts anticipated from the activities associated with the Proposed Action would, to a certain extent, provide an opportunity to help maintain the existing levels of population, employment, and income due to the oil and gas sector and supporting industries within overall increases across the economy as a whole. At the same time—with higher development levels—OCS activities would add to both the industry-specific and overall baseline population, employment, and income for the state. Overall socioeconomic impacts would depend on future industry activity levels and other factors. If oil and gas industry activity is consistent with the high-price scenario, employment and labor income impacts would be toward the high end of the range and could represent significant increases over existing levels, even if net increases would not be as great, given the declining baseline for oil and gas.

Increases in population can have both positive and negative impacts. The greater the employment increases, the more likely that population would increase as well; however, as explained in the analysis of likely impacts from the activities associated with the Proposed Action, the characteristics of oil- and gas-related employment weaken the traditional positive relationship between employment growth and local population growth.

Oil production and overall industry spending would provide important benefits for the NSB and the State of Alaska. Revenues from taxes on onshore support infrastructure, Federal 8(g) revenue sharing (from leases within 4.8 km [3 mi] of state waters), [11] and dividends from investments in petroleum service companies are important to the state and local governments, native corporations, and individual citizens. Depending on a number of factors, including timing and future oil prices, new OCS production to partially offset continued decline in Prudhoe Bay and other North Slope production areas could help extend the viability of TAPS and thus allow jurisdictions adjacent to the Arctic subregion to retain vital revenue sources from onshore facilities associated with continued offshore and onshore production, and providing more time to adjust to the eventual loss of oil-related revenues.

For more information on national costs and benefits, as well as on fiscal and other economic impacts, see the Net Benefits Analysis in Chapter 5 and Equitable Sharing Considerations in Chapter 8 of the PFP, published concurrently with this Programmatic EIS.

Beaufort Sea Program Area

Increases in employment and labor income in Alaska anticipated to result from the activities associated with the Proposed Action and future Beaufort Sea lease sales are likely to be viewed favorably by most affected communities. Increases in population can have both positive and negative impacts. MAG-PLAN Alaska estimates that the Beaufort Sea lease sale is anticipated to generate an annual

[11] Given the distance of the program area from shore, 8(g) revenue sharing would not apply to Chukchi Sea acreage.

average of approximately 550 jobs over almost two decades under the low-price, exploration-only scenario, and up to 37,000 total jobs for more than five decades in Alaska under the high-price, high development scenario.[12] The associated labor income would range between $10 million and $2.2 billion per year. The incremental contribution of routine operations under the Proposed Action to cumulative impacts on population and employment are expected to be **negligible** under the low-price scenario to possibly **moderate** under a high-price scenario with sustained activity due to the nature of OCS oil and gas related employment. Impacts on income and associated government revenues for the NSB and the state as a whole could range from **negligible** in the low-price scenario to **moderate** in the case of a sustained level of high OCS development similar to that in the high-price scenario.

Chukchi Sea Program Area

Although appreciable increases in population are not expected (see below), commercial discoveries in the Chukchi Sea could lead to an important onshore infrastructure construction phase prior to production.[13] This phase could require construction of temporary or permanent worker enclaves and related infrastructure and might result in disruptions in nearby communities, such as strains on public infrastructure and services, occurring along with the positive impacts of both employment opportunities and new sources of tax revenues (see below). MAG-PLAN Alaska estimates that the Chukchi Sea lease sale is anticipated to generate an annual average of approximately 300 jobs for almost two decades under the low price, exploration-only scenario, and up to 19,000 total jobs for more than five decades in Alaska under the high-price scenario.[14] The associated labor income would range between $5 million and $1.1 billion per year.

The incremental contribution of routine operations under the Proposed Action to cumulative impacts on population and employment are expected to be **negligible** under the low-price scenario to possibly **moderate** under a high-price scenario with sustained activity.

Impacts on income and associated government revenues for the NSB and the state as a whole could range from negligible in the low-price scenario to moderate in the case of a sustained level of high OCS development similar to that in the high-price scenario.

Cook Inlet Program Area

Impacts on employment and labor income in Alaska resulting from the activities associated with the Proposed Action and future Cook Inlet lease sales are expected to be positive and should not have much adverse impact on the immediately adjacent communities. MAG-PLAN Alaska estimates that the Cook Inlet OCS Program is anticipated to generate an average annual of approximately 3,000 jobs under the low-price scenario, and up to 10,000 total jobs in Alaska under the high-price scenario for more than three decades.[15] The associated labor income would likely range from $165 million to $620 million per year. The incremental contribution of routine operations under the Program to cumulative impacts on

[12] These include additional direct, indirect, and induced jobs—those created by lessees, contractors, support industries, and worker households. A large proportion of the employment and income impacts would occur in a variety of support industries; therefore, MAG-PLAN does not confine its estimates solely to results that would be reported under the oil and gas sector in standard employment statistics.

[13] There is already existing infrastructure to support production onshore and in state waters adjacent to the Beaufort Sea and Cook Inlet Program Areas. Additional infrastructure requirements to support production in the Chukchi Sea are covered in **Section 4.3.13.1**.

[14] These include additional direct, indirect, and induced jobs—those created by lessees, contractors, support industries, and worker households. A large proportion of the employment and income impacts would occur in a variety of support industries; therefore, MAG-PLAN does not confine its estimates solely to results that would be reported under the oil and gas sector in standard employment statistics.

[15] These include additional direct, indirect, and induced jobs, as described above.

population and employment are expected to be **negligible** under that low-price scenario to possibly **minor** under a high-price scenario with sustained activity, resulting in **negligible** to possibly **minor** adverse impacts related to strains on public infrastructure and services in some communities.

Impacts on income and associated government revenues for the KPB could range from **minor** in the low-price scenario to **moderate** in the case of a sustained level of very strong OCS development similar to the high-price scenario. For the state as a whole, the impacts are likely to be **negligible** to **minor**.

Gulf of Mexico Program Area

The activities associated with the Proposed Action would contribute to the economic impacts arising from all past, present, and future OCS lease sales in the GOM. The Proposed Action would primarily support existing jobs and income sources, but would be more likely to create new jobs and income under the high-price scenario. The Proposed Action would result in **negligible** to **minor** impacts due to a relative maintenance in the status quo in terms of jobs and revenue, although there could be some strains on public services and infrastructure. The GOM Program would have economic impacts on a variety of firms along the GOM OCS industry's supply chain. BOEM uses the MAG-PLAN model (described above) to estimate the impacts of OCS oil and gas industry expenditures. In the low-price scenario, expenditures associated with the GOM Program would support a peak of 110,000 jobs and $8 billion in labor income the United States. In the high-price scenario, expenditures associated with the GOM Program would support a peak of 250,000 jobs and $15 billion in labor income. In both the low- and high-price scenarios, most of the impacts would occur in the GOM region, particularly in coastal Texas and Louisiana.

The overall GOM Program also generates Federal Government revenues through bonus bids, rental payments, and royalty payments. BOEM estimates the revenues associated with the GOM Program under the low- and high-price scenarios for the following time horizons: bonus bids (26 years), rental payments (35 years), and royalty payments (70 years). In the low-price scenario, the GOM Program would generate approximately $9.4 billion in bonus bids, $2.6 billion in total rental payments (with an annual peak of $151 million), and $132 billion in royalty payments (with an annual peak of $3.5 billion). In the high-price scenario, the GOM Program would generate approximately $17.8 billion in bonus bids, $4.8 billion in total rental payments (with an annual peak of $175 million), and $922.9 billion in total royalty payments (with an annual peak of $18.8 billion). These revenues accrue to Federal and GOM state governments as described by the GOMESA. These revenues can support population, employment, and income, depending on how and where they are spent.

The activities associated with the Proposed Action also contribute to the risk of an oil spill arising from the GOM Program. **Section 4.4.5** provides more information regarding the impacts of oil spills on population, employment, and income.

Conclusions

The activities associated with the Proposed Action would lead to generally positive impacts on population, employment, and income. The extent of these impacts would depend on the economic environment during the next several decades. However, these impacts would be small compared to the impacts from the overall OCS Program, the overall energy market, and the various other factors that influence population, employment and income. In particular, the incremental contribution of the Program is expected to be **negligible** because the activities associated with the Proposed Action would contribute less than 1 percent to the population, employment, and income of each Gulf state in any given year. Additionally, these percentage impacts can become larger in some smaller geographic areas (for example, in coastal Louisiana). The activities associated with the Proposed Action would likely have minor to moderate adverse impacts if the high-price scenario were to occur. The socioeconomic impacts are generally positive and important to both local and state economies and budgets, but could also have corresponding adverse implications due to strains on public infrastructure and services created by rapid population growth.

4.5.13 Land Use and Infrastructure

Localized impacts on land use and existing infrastructure are anticipated as a result of ongoing and future OCS and non-OCS program activities in the Arctic, Cook Inlet, and GOM Program Areas. These impacts could range from long-term, **minor** to **major**, depending on the location and nature (extent and duration) of the land use change.

Beaufort Sea and Chukchi Sea Program Areas

Section 4.4.4 and **Appendix B** catalogue the types of activities that could be reasonably anticipated in the Arctic. Since 1979, 10 lease sales have been held in the Beaufort Sea Program Area and three in the Chukchi Sea Program Area, but no production activity has resulted to date. Taking into consideration current state activities, not limited to mining operations, and excavation for harbors and nearshore channels, it is anticipated that the industrialization of portions of the Arctic landscape could result in considerable changes to land use and infrastructure. In addition to those impacts described in the No Action Alternative, cumulative impacts on land use and onshore resources could range in significance depending on the nature and location of demands, with a majority of these impacts being considered temporary.

Climate change impacts can also have serious impacts on oil and gas infrastructure from the loss of Arctic sea ice and increased ocean wave action that can lead to higher rates of erosion. As a result, the eventual siting of new facilities would need to account for potential changes resulting from sea level rise, increased storm frequency and intensity, and temperature changes. Because permafrost is often used as a solid foundation for buildings, pipelines, and roads, degradation of permafrost from warming can affect the foundation for existing facilities and potentially reduce the longevity of these facilities. These past, present, and reasonably foreseeable future activities are expected to modify local land uses and could permanently alter the landscape of certain portions of the Arctic. Thus, cumulative impacts in the Arctic region could potentially result in moderate to major impacts based on where new infrastructure is proposed. The incremental contribution of routine operations under the Proposed Action to these impacts is anticipated to be **minor** to **moderate**.

Cook Inlet Program Area

Section 4.4.4 and **Appendix B** catalogue the types of activities that could be reasonably anticipated in the Cook Inlet region. The Cook Inlet Program Area has had oil and gas operations in state waters since the late 1950s and has a well-established oil and gas infrastructure. The most recent sale in which blocks were leased occurred in 1997, whereby two blocks were leased. A lease sale was held in 2004, but no blocks were leased. Much of the onshore infrastructure around Cook Inlet supports offshore oil and gas development, with cumulative impacts on land use and infrastructure resulting from demands on roads, expansion of ports and harbors, and the need to develop additional onshore facilities to accommodate ongoing and future activities in the area. In addition to those impacts described in the No Action Alternative, cumulative impacts on land use and onshore resources could be considerable, depending on the nature and location of demands. Additional indirect impacts concern those associated with climate change, since the southern half of Alaska is vulnerable to erosion and high tides.

The Cook Inlet has an eroding shoreline of glacially deposited bluffs, and future land uses in the area will need to account for anticipated rises in sea level, increased storm frequency and intensity, and temperature changes (IPCC 2016). These climate-related events could force the construction of new facilities further inland and preclude the reuse or expansion of existing properties as this infrastructure would no longer be suitable for operation. Thus, climate change and other past, present, and reasonably foreseeable activities could modify land uses and development patterns within the region. As such, cumulative impacts in the Cook Inlet region could potentially result in minor to moderate impacts based on where new infrastructure is proposed. The incremental contribution of routine operations under the Proposed Action to these impacts is anticipated to be **minor** to **moderate** because land uses in the area currently support industrial activities and it is expected that the region would be able to accommodate future development associated with oil and gas production.

Gulf of Mexico Program Area

Section 4.4.4 and **Appendix B** catalogue the types of activities that could be reasonably anticipated in the GOM region. Oil and gas development is the main industrial activity occurring in the GOM region. In addition to activity related to past OCS programs, oil and gas development has taken place in the coastal waters of the GOM states and in Mexico's waters. Most of the equipment and facilities supporting offshore oil and gas operations are in the western and central GOM offshore Texas, Louisiana, Mississippi, and Alabama. Because there are currently hundreds of onshore facilities that support the offshore oil and gas industry, cumulative impacts on land use and infrastructure would result from increased demands on roads, utilities, and public services, and the need to develop additional facilities to accommodate ongoing and future activities in the GOM. In addition to those impacts described in the No Action Alternative, these activities could impact land use and infrastructure depending on the nature and location of demands. Additional indirect impacts including those associated with climate change as rises in sea level, increased storm frequency and intensity, and temperature changes could influence where new infrastructure is developed. For example, changes in the sea level could result in facility relocation, the construction of seawalls and storm surge barriers, dune reinforcement, and land acquisitions to create buffer areas (IPCC 2016). Advance planning for the potential rise in the sea level due to climate change would help to avoid costly impacts on onshore infrastructure. Consequently, climate change could lead to the construction of new facilities rather than the reuse or expansion of existing properties in areas that are not currently zoned for oil and gas activities. As such, in addition to climate change, past, present, and reasonably foreseeable activities in the region are expected to modify certain land uses in the region. However, cumulative impacts in the GOM region would be minor to moderate based on where new infrastructure is proposed. The incremental contribution of routine operations under the Proposed Action to these impacts is expected to be **minor** to **moderate** because it is anticipated that land uses in the region would be able to support increases in demands for roads, utilities, and public services.

4.5.14 Commercial and Recreational Fisheries

Section 4.4.4 and **Appendix B** catalogue the types of activities that could be reasonably anticipated. Ongoing and future OCS activities that could affect commercial and recreational fisheries negatively include noise, traffic, routine discharges, bottom/land disturbance, lighting, visible infrastructure, space use conflicts, and non-routine events (i.e., fuel and oil spills). Levels of impacts related to non-OCS future actions are expected to increase in the Alaska and GOM program areas under the effects baseline (**Section 4.4.4**). **Section 3.6** indicates minor contributions from the Proposed Action to the cumulative case for number of E&D wells drilled, total structures installed, and miles of pipeline installed. The cumulative number of explosive removals could have spatially localized consequences for economically important fishes in the Alaska and GOM regions. Seismic airguns are an intensive but transient source of noise that can affect the behavior and distribution of target species.

Commercial and recreational fishing in the program areas would be affected by a variety of activities associated with the Proposed Action coupled with the ongoing OCS program and other actions. Other actions include commercial shipping, recreational vessel traffic, marine mining, military and NASA operations, cruise ship discharges, and climate change. Fishing and/or overfishing would alter habitat and affect the demographics of exploited species, which contribute to the cumulative scenario. Within the entire program area, four fish stocks are considered overfished and would likely require stricter fishing regulations to rebuild.

The cumulative impacts on commercial and recreational fisheries from the activities associated with the Proposed Action and other past, ongoing, and reasonably foreseeable future actions are expected to be minor to moderate, since fisheries in the program area are currently impacted by a variety of activities on the OCS and coast and the impacts associated with climate change such as warming water temperatures and ocean acidification would alter fish population demographics over time. Although it is difficult to predict how cumulative impacts might come into effect or work synergistically, routine activities related to the activities associated with the Proposed Action are expected to have a **negligible** to **minor** incremental contribution to the total cumulative impacts, particularly with regard to routine discharges and lighting, as discussed in **Section 4.4.1**.

4.5.15 Tourism and Recreation

Beaufort Sea Program Area

The Beaufort Sea Program Area is adjacent to the communities of Kaktovik and Nuiqsut and include the scenic Dalton Highway and the Arctic NWR. These remote areas have little industrial development outside of the communities (with the exception of Nuiqsut) and only state oil and gas activity in the nearshore environment.

In addition, research vessel cruises, ice breakers, and recent cruise ship expeditions through these areas could result in more noise and space-use conflict from ships, infrastructure, and air traffic, which can negatively affect visitors coming to the arctic for a remote experience. Residents of these communities are burdened to prepare for emergency management (search and rescue) plans in preparation for increasing numbers of tourists to the Arctic. Given these factors, cumulative impacts on tourism and recreation for the activities associated with the Proposed Action could be minor to moderate because of the potential for the increased popularity of these areas, lack of robust search and rescue capabilities, and potential for increasing development in areas closer to shore. Overall, the incremental contribution of routine Program activities on recreation and tourism would be **negligible**.

Chukchi Sea Program Area

The Chukchi Sea Program Area is adjacent to the communities of Barrow, Wainwright, Point Lay, and Point Hope. These remote areas have little industrial development outside of the communities, making tourism more appealing for visitors seeking remote locations.

In addition, research vessel cruises, ice breakers, and recent cruise ship expeditions through these areas could result in more noise and space-use conflict from ships, infrastructure, and air traffic, which can negatively affect visitors coming to the arctic for a remote experience. Residents of these communities are burdened to prepare for emergency management (search and rescue) plans in preparation for increasing numbers of tourists to the arctic, most recently by cruise ship. Given these factors, impacts on tourism and recreation from the activities associated with the Proposed Action and past, present, and reasonably foreseeable future actions could be minor to moderate because of the potential for the increased popularity of these areas, lack of robust search and rescue capabilities, and potential for increasing development in areas closer to shore. Overall, the incremental contribution of routine Program activities on recreation and tourism would be **negligible**.

Cook Inlet Program Area

The majority of Alaska's population resides adjacent to the Cook Inlet Program Area in the KPB. There are currently no oil and gas leases in the Cook Inlet Planning Area, but there is oil and gas activity closer to shore in state waters. Oil and gas activity occurring in state waters could cause impacts from noise, visible infrastructure, space-use conflict, and risk of accidental spills closer to shore.

Cumulative impacts on tourism and recreation in Cook Inlet as a result of ongoing and future OCS and non-OCS activities and natural phenomena would be **minor** to **moderate** over the next 40 to 70 years. Non-OCS activities or phenomena affecting these resources include offshore construction (e.g., state oil and gas development, domestic transportation of oil and gas), onshore construction (e.g., coastal and community development), and marine vessel traffic. The incremental contribution of routine operations under the Program to these impacts would be small, with potential adverse aesthetic impacts on sightseeing, boating, fishing, and hiking activities in the inlet.

GOM Program Area

The incremental contribution from the Proposed Action to cumulative impacts would be small, with potentially adverse aesthetic impacts on beach recreation and sightseeing, and potentially positive impacts on diving and recreational fishing.

The GOM region is still recovering from the adverse effects of several hurricanes over the past 15 years as well as the effects of the 2010 *Deepwater Horizon* oil spill. Severe storm events such as hurricanes and storm surges could impact the recreation and tourism economy if they result in severe beach damage or destruction of existing public infrastructure.

Noise from platform installation and platform removal can affect recreational fishing by temporarily disturbing fish and by causing fish kills if explosives are used to remove platforms. Platforms installed within 16 km (10 mi) of coastal recreation areas, such as beaches, parks, and wilderness areas, can affect recreational experiences by affecting ocean views. Transportation of oil and gas, combined with other commercial, industrial, and recreational vessel traffic that continues to occur within the GOM, can affect recreational experiences through increased noise, boat wake disturbances, visual intrusions, and increased trash and debris washing ashore. Given these factors, the incremental contribution of activities associated with the Proposed Action to these impacts could be minor due to the robust industry activity ongoing in the OCS and onshore environment, both of which have flourished with the tourism industry of the GOM.

4.5.16 Sociocultural Systems

Beaufort Sea and Chukchi Sea Program Areas

Section 4.4.4 and **Appendix B** catalogue ongoing and reasonably foreseeable future actions and trends that could potentially impact sociocultural systems in the Arctic. With regard to subsistence activities, increased construction and development of infrastructure can alter habitat and wildlife foraging behaviors, and could result in decreased subsistence success and harvest efficiency. Furthermore, the construction of shorebase facilities and pipeline corridors could impede local land uses, and potentially result in conflicts between subsistence uses because new development would increase in-migration of workers, demand for public services, and need for temporary and permanent roads. Further development of the oil and gas industry onshore coupled with development of oil and gas resources on the OCS could contribute to cumulative effects on the subsistence harvesting and sociocultural systems of the region.

As discussed in the effects baseline in **Section 4.4.4.16**, some of these impacts would occur regardless of OCS oil and gas development and subsequently result in adjustments to subsistence hunting and harvesting patterns. To the extent that OCS oil development requires onshore support infrastructure, it would contribute to a cumulative negative impact on onshore access to subsistence resources. However, with regard to economic growth, increased employment and resulting increases in population from the Proposed Action and other relevant foreseeable future actions would likely lead to increased demand for public services on the North Slope, not limited to new housing, waste disposal and storage services, health care, and access roads. Population increases could also lead to future demographic changes if the region experiences an influx of outside cultures. Given this development, it is likely that the distance between Native communities and oil and gas worker enclaves would decrease, thus increasing the likelihood of interaction amongst the two groups and raising the potential for cross-cultural conflicts and changes in traditional culture. As such, the overall impact of the cumulative case would result in **moderate** to **major** impacts on sociocultural systems. The incremental contribution of the Proposed Action is anticipated to result in **moderate** to **major** impacts on sociocultural systems given the relatively undeveloped nature of the North Slope.

Cook Inlet Program Area

Section 4.4.4 and **Appendix B** catalogue ongoing actions and trends that could impact sociocultural systems in the Cook Inlet Program Area. The region surrounding Cook Inlet includes economically complex cities such as Anchorage, the largest urban community in the state; towns such as Kenai, Soldotna, and Nikiski that are centers of the oil and gas industry; smaller towns such as Port Lions that depend on commercial fishing; and small predominantly Alaska Native communities. The region currently supports OCS oil and gas activities and offshore state leasing activities, and it is not anticipated that the Proposed Action would introduce new kinds of activities that would alter existing socioeconomic systems. In addition, the relatively small number of new residents that would come into the area because of the Program would not alter existing sociocultural systems. However, as described in the effects baseline in **Section 4.4.4.16**, climate change is already impacting community behavior and could result in greater impacts on the region’s identity. As such, it is anticipated that cumulative impacts would result in **negligible** to **minor** impacts on sociocultural systems and the incremental contribution of the activities associated with the Proposed Action would be **negligible** to **minor**.

GOM Program Area

Section 4.4.4 and **Appendix B** catalogue ongoing and potential future actions that could occur in the GOM. It is anticipated that the most significant activities in **Appendix B** would result in minor effects on sociocultural systems because the GOM region currently supports an oil and gas economy. The GOM is also home to a large and heterogeneous mix of cultures, subcultural groups, and populations, all of which are directly or indirectly affected by oil and gas development. Within the coastal region, the effects of the OCS oil and gas industry are felt most directly by populations living within the coastal community commuting zone where industry support facilities and the people who work in them are located. Although many of the subsistence activities in the GOM region are practiced recreationally, some Native American groups, such as the United Houma Nation and the federally recognized Chittimacha Tribe in southern Louisiana depend on fishing, hunting, and gathering for at least part of their subsistence. Additionally, commercial Vietnamese fishers are also dependent on the GOM as their livelihoods are tied to the health of the Gulf ecosystem. As discussed in the effects baseline in **Section 4.4.4.16** climate change has the ability to potentially impact the cultural identify of these subsistence communities. This can lead to modification of fishing practices and reduce long-term viability of specific fisheries as warmer waters could modify habitat and shift species distribution. However, it is anticipated that the incremental contribution of routine operations under the Program to cumulative impacts in the GOM would be small because oil and gas operations are not new to the region. The existing sociocultural system has developed over decades in concert with leasing activities; therefore, cumulative impacts are expected to be **negligible** to **minor** and the incremental contribution of the activities associated with the Proposed Action would be **negligible** to **minor**.

4.5.17 Environmental Justice

Cumulative impacts from all program areas considered in this analysis could result from changes in the proximity of oil and gas infrastructure and to marine vessel and aircraft traffic, especially when these changes occur in counties where historically marginalized communities reside. These communities are more likely to rely on coastal resources as a staple or alternative food source. One commenter noted:

> "…the addition of industrial waste creates the very real fear that [traditional] foods will be tainted by the discharge of drilling cuttings and muds, chemicals, sewage, and other man made substances. Whether or not these fears are confirmed through water quality studies focused on human health risk assessment, the mere belief that subsistence foods are unsafe to eat can lead to their avoidance in favor of less nutritious foods, resulting in adverse nutritional and health effects[;]equally important, community concerns about food tainting result in negative social and cultural effects."

While potential impacts on coastal communities linked to Program activities would be indirect, these activities could put additional stress on the impacts of ongoing and reasonably foreseeable future actions, including global climate change. **Section 4.3.17** discusses the current effects of climate change. For more information on this Program and climate change, refer to **Section 4.2.1**.

Beaufort Sea Program Area

The Beaufort Sea Program Area is adjacent to the subsistence-based communities of Kaktovik and Nuiqsut. Subsistence harvests are a central part of the cultural heritage of these communities and are used for food and clothing as well as fuel and art (ADF&G 2015). Part of the culture of people in these communities is the remote environment in which they live. These villages have little industrial development outside of the communities (with the exception of Nuiqsut) and the central concern voiced has been in regard to any activity that threatens the tradition of kinship and sharing for survival.

However, the coast adjacent to these planning areas has oil and gas activity onshore, and ongoing activity in state waters in the Beaufort Sea. In addition, research vessel cruises, ice breakers, and recent cruise ship expeditions through these areas can affect more than the remote way of life in the Arctic. Noise and space-use conflict from ships, infrastructure, and air traffic can affect the ability of a community to harvest whales, fish, and marine and terrestrial mammals. Increased activity in the Beaufort Sea has put the burden of emergency management (e.g., search and rescue, border security) on these communities. Given these factors, cumulative impacts on communities of color and low-income populations could be minor to major because of these changes to cultural norms. Minor impacts from routine activities associated with the Proposed Action assume proper representation and public participation for onshore activities. Overall, the incremental contribution of activities associated with the Proposed Action on environmental justice could be **moderate** to **major** because there is little to no industry infrastructure onshore in the Arctic and it would represent a significant influence on the surrounding community.

Chukchi Sea Program Area

The Chukchi Sea Program Area is adjacent to the subsistence-based communities of Barrow, Wainwright, Point Lay, and Point Hope. Subsistence harvests are a central part of the cultural heritage of these communities and are used for food and clothing as well as fuel and art (ADF&G 2015). Part of the culture of people in these communities is the remote environment in which they live. These villages have little industrial development outside of the communities and the central concern voiced has been in regard to any activity that threatens the tradition of kinship and sharing for survival.

However, the coast adjacent to these planning areas has oil and gas activity onshore. In addition, research vessel cruises, ice breakers, and recent cruise ship expeditions through these areas can affect more than the remote way of life in the Arctic. Noise and space-use conflict from ships, infrastructure, and air traffic can affect the ability of a community to harvest whales, fish, and marine and terrestrial mammals. Increased activity in the Chukchi Sea has created a burden on these communities to prepare for emergency management (search and rescue), as well as border security. Given these factors, cumulative impacts on communities of color and low-income populations could be minor to major because of these changes to cultural norms. Minor impacts from routine activities associated with the Proposed Action assume proper representation and public participation for onshore activities. The incremental contribution of the Proposed Action to cumulative impacts in the Chukchi Sea Program Area could be **moderate** to **major** because there is little to no industry infrastructure onshore in the Arctic and it would represent a significant influence on the surrounding community.

Cook Inlet Program Area

The majority of Alaska's population resides adjacent to the Cook Inlet Program Area in the KPB. There are no oil and gas leases in the Cook Inlet Planning Area, but there is oil and gas activity closer to shore in state waters.

In the Cook Inlet Planning Area, ongoing and future OCS and non-OCS activities in combination with the effects of onshore and offshore construction, increased marine vessel and helicopter traffic, and land use changes would result in disproportional **minor** to **major** adverse cumulative impacts on low-income and minority populations (especially those dependent on subsistence harvesting and fishing). The incremental contribution of routine operations under the Program to these impacts would be small.

GOM Program Area

The GOM region is still recovering from the adverse effects of several hurricanes over the past 15 years as well as the 2010 *Deepwater Horizon* oil spill. These events have had disproportionate effects on communities of color and low-income populations, especially in terms of property damage and loss of income. This makes these groups more vulnerable to any new hazard or natural disaster (NIEHS 2013).

The Proposed Action would result in levels of infrastructure use and construction similar to those that have already occurred in the GOM coast region during previous OCS programs. These activities are not expected to expose residents to notably higher risks than currently occur. While the distribution of OCS-related activities and infrastructure indicates that some places and populations in the GOM region would continue to be of environmental justice concern, the incremental contribution of the Proposed Action is not expected to affect those places and populations.

Non-OCS activities and processes that are ongoing and expected to continue into the foreseeable future, and include non-OCS oil and gas development, coastal habitat changes, coastal land loss, economic development, regional economic changes, and recovery from storms. These activities and processes could disproportionately impact low-income and minority populations. In the GOM, ongoing and future OCS and non-OCS activities in combination with the effects of storm and hurricane damage and regional economic issues would result in disproportionate minor to major adverse cumulative impacts on low-income and minority populations. The incremental contribution of routine operations under the Proposed Action to these impacts would be **negligible**.

5. OTHER NEPA CONSIDERATIONS

NEPA regulations require an EIS to include discussions of "any adverse environmental effects which cannot be avoided should the Proposed Action be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources, which would be involved in the proposal should it be implemented" (40 CFR § 1502.16). The U.S. Court of Appeals for the District of Columbia ruled that at the Program stage, no irreversible and irretrievable commitment of resources is made that would adversely affect the environment (*Center for Biological Diversity v. Department of the Interior*, 385 563 F.3d 466 [D.C. Cir. 2009]; *Center for Sustainable Economy v. Jewell*, 779 F.3d 588 [D.C. Cir. 2015]).

5.1 Unavoidable Adverse Environmental Effects

Each of the geographic regions has unique characteristics that influence the resources present and the potential for unavoidable adverse effects. While numerous adverse effects on resources can be avoided or minimized by adherence to regulations, guidance, conventions, use of best management practices and industry standards, and implementation of mitigation measures, some unavoidable adverse effects can be expected to remain regardless of avoiding, minimizing, rectifying, reducing, or eliminating the impact over time. The unavoidable adverse effects can vary in context, intensity, duration, and spatial extent across program areas. Additional analysis will be conducted at subsequent lease sale stages. These unavoidable effects are described in the graphic below.

Physical Resources

Air Quality

- Air emissions could cause temporary changes in regional air quality, but air quality would not be permanently changed.
- Activities would increase the ambient air concentrations of criteria pollutants to some extent.
- Potential for visibility effects due to ozone formation from NO_x and VOC emissions.

Water Quality

- Routine and operational discharges from support facilities, vessels, and production structures would affect water quality.
- Sediment resuspension and turbidity from activities could temporarily degrade water quality in localized areas.
- Discharges would undergo mixing, dilution, and dispersion within large bodies of water, resulting in highly localized and temporary effects.

Ecological Resources

Coastal and Estuarine Habitats

- Localized sedimentation, accelerated erosion, and physical habitat alteration could cause effects due to an increase in vessel traffic and possible onshore construction.
- Onshore activities could result in loss of wetlands or modification of the habitat, hydrology, and ecological function if not mitigated.

Marine Benthic Communities

- Potential for unavoidable adverse effects on benthic communities would be on low-relief or small, isolated, unmapped live-bottom habitat. Effects on soft-bottom communities would result from structure placement and removal.
- Discharges would result in temporary alteration of the biological, physical, and chemical composition of sediments surrounding activity areas.

Pelagic Communities

- Pelagic communities (e.g., *Sargassum*) could experience unavoidable adverse effects such as impingement on vessel water intakes.
- Planktonic communities in the water column could experience unavoidable adverse, localized, short-term effects from routine discharges.

Marine Mammals

- Adverse impacts could result from noise and disturbances associated with routine OCS and onshore activities in localized areas for short durations.
- Air traffic could have moderate impacts in the Arctic program areas where it could cause disruption to pinniped, polar bears, and sea otters.
- Ship traffic could result in ship strikes of marine mammals.
- Drilling debris could temporarily displace benthic feeders.

Sea Turtles

- Unavoidable adverse effects on sea turtles could occur from individuals being struck by vessels or as a result of decommissioning activities, resulting in injury or death.
- Noise would affect sea turtles in localized areas for short durations and would likely result in behavioral changes.

Birds

- Birds could be adversely affected by noise and disturbances associated with routine OCS and onshore activities.
- Habitat alteration from the construction of onshore facilities could affect a small portion of available habitat.
- Birds could collide with both onshore and OCS infrastructure; these collisions could result in injury or mortality.

Fishes and Essential Fish Habitat

- Noise in localized areas for short durations and would likely result in behavioral changes.
- Decommissioning via explosives could cause fatal impacts on fish in direct proximity to the activity.

Arctic Terrestrial Wildlife and Habitat

- Potential for mortality could result due to collisions with vehicle traffic.
- Emplacement of roads, especially adjacent to the Chukchi Sea Program Area where there is little existing infrastructure, could alter movement patterns of caribou and result in long term impacts on vegetation.

Social, Cultural, and Economic Resources

Archaeological and Historic Resources

Unavoidable adverse effects from routine operations on archaeological resources would probably be avoided and minimized with existing regulations; however, there is always a risk of impact on archaeological resources where surveys are not required, inadequate, or unavailable. If an archaeological resource was damaged, the impacts would be major as this would be an irretrievable effect.

Population, Employment, and Income

Unavoidable adverse effects from routine operations on population, employment, and income are unlikely to occur except in sparsely populated communities near frontier areas and only as a result of sustained high levels of industry activity.

Land Use and Infrastructure

Unavoidable adverse effects from routine activities onshore from creation or expansion of infrastructure could occur, increasing demands on coastal communities in areas where oil and gas activities are not currently occurring. Long-term changes include a shift in land use during the life of the Program.

Commercial and Recreational Fisheries

Commercial and, to a lesser extent, recreational fisheries could be adversely affected by loss of fishing areas occupied by OCS vessels, platforms, and exposed pipelines.

Tourism and Recreation

Unavoidable adverse effects on scenic quality could occur from visible infrastructure in some areas with infrastructure close to shore.

Sociocultural Systems

Some unavoidable adverse effects on subsistence harvests in the Alaska program areas could result from routine activities, potentially causing localized displacement or loss of small numbers of subsistence resources, which could adversely affect subsistence.

Environmental Justice

Unavoidable adverse effects from routine activities onshore from creation or expansion of infrastructure could occur, increasing demands on low-income or minority populations in areas where oil and gas activities are new or expansion is required. Unavoidable adverse effects could occur from routine activities onshore, nearshore, and on the OCS that impact terrestrial mammals, fish, and marine mammals important to subsistence communities.

5.2 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

By adopting mitigation measures for OCS operations, BOEM attempts to minimize long-term impacts and maintain or enhance the long-term productivity of areas in which oil and gas exploration and development occurs. After the completion of oil and gas production, the marine environment that would be affected by routine operations is expected to remain at or return to its anticipated long-term productivity levels. With proper removal of OCS oil and gas facilities or their retention in areas designed to enhance recreational fishing, OCS areas would continue to maintain fish resources and provide habitat for marine resources long after oil and gas operations have ceased. The long-term productivity of the marine environment in Alaskan and the GOM waters is affected by a wide variety of factors (many unrelated to OCS oil and gas activities), and it is speculative to suggest what productivity levels would be in 40 to 70 years when the Program activities would be complete. The onshore effects would contribute to the continuing alteration of nearby coastal areas from natural environments to urbanized and industrialized environments.

One confounding factor that could affect long-term productivity of the areas included in the Program is climate change. Even in the absence of the oil and gas activities that would occur under the Program, baseline environmental conditions are changing as a consequence of climate change. For example, relative sea level rise, ocean acidification, ocean heat content, changes in albedo (reflectivity), and distribution and abundance of precipitation are expected to occur regardless of OCS oil and gas activity (see IPCC 2014 for a synopsis). These occurrences and trends form part of the effects baseline and are thus considered in all alternatives impact analyses.

Short-term use of the environment in the vicinity of OCS activities includes the exploration and development of OCS oil and gas resources during the period of activity needed for the completion of the Program, which is estimated to be 40 to 70 years, with 10 to 15 years for oil and gas exploration and delineation activity and 30 to 45 years of resource development and production activity. Many of the effects of routine operations discussed in **Chapter 4** are the result of short-term uses and are greatest during the exploration, development, and early production phases as wells are drilled and platforms are installed. These effects would be reduced by implementing mitigation measures required by BOEM and are not expected to adversely affect long-term biological productivity of affected areas or resources.

Extraction and consumption of OCS oil and natural gas would be a long-term depletion of nonrenewable resources. Economic, political, and social benefits would accrue from the use of these natural resources. Most benefits would be short-term and provide short-term energy sources, reducing the U.S. dependency on oil imports and/or onshore oil and gas production. The production of OCS oil and natural gas from the Program could help to provide additional time for the development of long-term renewable energy sources or substitutes.

Several natural resources would experience long-term effects on biological productivity, whether due to Program-related events or not (e.g., CDEs such as the GOM *Deepwater Horizon* spill in 2010 or the Alaska *Exxon Valdez* spill in 1989). Studies on the effects of the *Exxon Valdez* spill on biota and habitats in Prince William Sound show some resources have recovered while others still display possible spill effects, and yet others have no clear indication of the presence or absence of long-term effects (see discussions for each resource in Chapter 4). Studies from the Gulf of Mexico Research Initiative and other funding sources on the effects of the *Deepwater Horizon* spill that could generate three petabytes of data are ongoing and the findings from the *Deepwater Horizon Natural Resource Damage Assessment* (DWHNRT 2016) are now available. Findings indicate that many effects were spatially and temporally limited and do not demonstrate long-term impacts on populations. However, the spill "caused a wide array of toxic effects, including death, disease, reduced growth, impaired reproduction, and physiological impairments that made it more difficult for organisms to survive and reproduce," but "The extent and degree of toxic levels of oil has declined substantially from 2010 to the present" (DWHNRT 2016). Changes in productivity are not expected. However, it would still be too early to ascertain the long-term effects. Long-term impacts of large oil spills on local economies and sociocultural systems could also occur. The *Deepwater Horizon Natural Resource Damage Assessment* (DWHNRT 2016) states that "The spill directly reduced the use of popular recreational activities including boating, fishing, and going to the beach between May 2010 and November 2011," indicating that longer-term impacts were not readily ascertained.

Onshore facility construction (e.g., pipelines, processing facilities, and service bases) is most likely to occur in the Alaska program areas and could cause short- and long-term changes, with possible localized long-term effects on coastal habitats. Some biological resources would have difficulty repopulating altered habitats and could be permanently displaced from the construction area. Short-term biological productivity would be reduced or lost in the immediate onshore areas where construction takes place; however, areas where long-term effects would be incurred would be limited in spatial extent, and the long-term productivity in some areas could be mitigated with habitat reclamation after the life of the Program. Short-term changes could include a shift in land use from subsistence-based activities to industrial activities during the life of the Program. Areas adjacent to onshore facilities and pipeline corridors would probably be subject to hunting regulations and restrictions. Land use in some localized areas would change from conservation to resource development. Long-term effects on land use could result if the infrastructure or facilities continued to be used after the lifetime of the Proposed Action.

In the Alaska program areas, gains in revenues from onshore oil and gas infrastructure development and related activities could be substantial. Oil-related revenues are a significant source of income for the state and for local governments in Alaska (especially the NSB) to fund their operations and employ local residents; however, in the GOM, little difference from existing conditions would occur. In Alaska, there could be an incentive to shift from a subsistence-based economy to a cash-based economy, or a possible reduction in subsistence resources and a decrease in subsistence activities. All of these changes could be factors in long-term consequences for native social and cultural systems. In the event of an oil spill, sociocultural systems and subsistence of local communities and populations could incur short-term consequences, while a large spill would have longer-term consequences on affected communities and populations in all Alaska program areas.

Archaeological and historic discoveries during oil and gas resource development would enhance long-term knowledge. Overall, discoveries would help to locate other sites, while possible but unlikely destruction of artifacts or damage to sites would represent long-term losses.

5.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Commitment of a resource is considered *irreversible* when the primary or secondary impacts from its use limit the future options for its use. An *irretrievable* commitment refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations. At the Program stage, no irreversible and irretrievable commitment of resources is made that would adversely affect the environment. The irreversible and irretrievable commitment of resources would only occur if leasing, exploration, development, production, and decommissioning activities follow approval of the Program. The following discussions consider these effects within the context of irreversible and irretrievable commitment of mineral, biological, land, and archaeological resources.

5.3.1 Mineral Resources

Future exploration, development, and production activities from Program-associated lease sales would result in the consumption of hydrocarbons (i.e., fuel), minerals (e.g., coal, iron), and other materials. Decommissioning activities would result in the recycling and repurposing of infrastructure (e.g., platforms, subsea completions, pipelines). Consumption rates would be commensurate with respective levels of activity. Fuel consumption resulting from Program-associated activities represents an irreversible and irretrievable commitment of hydrocarbon resources (i.e., any OCS oil and gas resources consumed would be irretrievable).

5.3.2 Biological Resources

Future exploration, development, production, and decommissioning activities from Program-associated lease sales could result in negligible to major effects on biological resources. For most biological resources, population-level effects resulting in irreversible and irretrievable commitment of those resources are not expected. Direct habitat loss or displacement would occur as a result of OCS exploration and development activities, producing possible reductions in local populations. Displacement and habitat loss would become irretrievable if alterations to the environment are permanent. Application of mitigation measures (e.g., sensitive habitat identification and avoidance and habitat restoration) should limit the amount of habitat permanently lost.

If one or more individuals of a listed species (i.e., ESA, MMPA) are injured or killed, or if important habitats used by these species are disturbed, an irretrievable and irreversible commitment of biological resources would be incurred. Consultation and coordination (e.g., with the USFWS or NOAA) prior to oil and gas exploration and development activities would be expected to result in the identification of appropriate mitigation measures. Implementation of applicable mitigation measures would reduce the potential for an irreversible and irretrievable commitment of these biological resources.

5.3.3 Land Resources

Future exploration, development, production, and decommissioning activities resulting from Program-associated lease sales could result in moderate effects on land resources. In mature oil and gas areas such as the GOM, only limited expansion of onshore activity and associated land use would be expected, with reliance on existing infrastructure most likely. In frontier or developing areas such as the Arctic and Cook Inlet, additional land disturbance would occur.

5.3.4 Archaeological Resources

Future exploration, development, production, and decommissioning activities resulting from Program-associated lease sales could result in major effects on archaeological resources if no mitigation measures are implemented. Any loss of undiscovered archaeological resources on or below the seafloor of the OCS in developed areas would be an irreversible and irretrievable commitment of resources. Archaeological surveys, avoidance through development design, documentation, and/or other mitigation measures would be conducted prior to development to minimize impacts.

6. CONSULTATION AND COORDINATION

6.1 PROCESS FOR THE PREPARATION OF THE 2017–2022 OCS OIL AND GAS LEASING PROGRAMMATIC EIS

6.1.1 Proposed Final Program and Final Programmatic EIS

This Programmatic EIS has been prepared to help inform the Secretary of the Interior's decision on the Proposed Final Program. **Figure 6.1-1** shows relationship between the NEPA and OCSLA processes.

6.1.2 Scoping for the Draft Programmatic EIS

Scoping activities occurred over a 60-day scoping period during January through March 2015 to solicit input from the stakeholders. BOEM posted a Scoping Report summarizing scoping comments online at www.boemoceaninfo.com in June 2015.

BOEM is required, per 43 CFR § 46.225, to invite eligible Government entities to participate as cooperating agencies during the development of an EIS. As defined by CEQ regulations (40 CFR § 1508.5), a cooperating agency can be any Federal agency that has jurisdiction by law or special expertise with respect to environmental impacts resulting from a proposed activity. The NOI, published on January 29, 2015, issued an invitation to other Federal agencies as well as state, tribal, and local governments to consider becoming cooperating agencies in the preparation of the Programmatic EIS. From that invitation, BOEM established cooperating agency status via formal Memoranda of Understanding (MOU). MOUs, which allow cooperating agencies to coordinate and collaborate during preparation of this Programmatic EIS, were established with the NASA Office of Strategic Infrastructure, the NPS Southeast Region, and the State of Alaska. These MOUs are included as supplemental information available on the project website (www.boemoceaninfo.com). In addition, NOAA provided informal cooperation with the preparation of this Programmatic EIS by providing geographic information systems (GIS) data that were used to help create figures and perform analyses included in this Programmatic EIS. **Appendix C** contains information provided by NPS and the State of Alaska.

6.1.3 Commenting on the Proposed Program and Draft Programmatic EIS

BOEM issued an NOA in the *Federal Register* for the Draft Programmatic EIS on March 18, 2016, to open a 45-day public comment period until May 2, 2016. A 90-day public comment period on the Proposed Program also began on March 18, 2016. The www.boemoceaninfo.com website contained a link to the Draft Programmatic EIS and other pertinent information on meetings and how and when to comment. Comments could be submitted through the www.regulations.gov docket, via mail, or at public meetings. BOEM held 13 public meetings in applicable Program locations during the comment period to solicit comments on the Draft Programmatic EIS; the meetings were an additional avenue for the public to ask questions and clarify the best way to submit comments during the comment period. The meetings helped provide the Secretary of the Interior with information from interested parties regarding the evaluation of potential effects of the Proposed Action and refinement of alternatives. Public meeting participation varied across the program areas, with about 575 total registered participants or approximately 44 registered participants per meeting. Some participants could have chosen not to register. Based on the consideration and analysis of comments on the Draft Programmatic EIS, a Final Programmatic EIS was prepared. BOEM posted a Comment Report summarizing comments on the Draft Programmatic EIS at www.boemoceaninfo.com in November 2016.

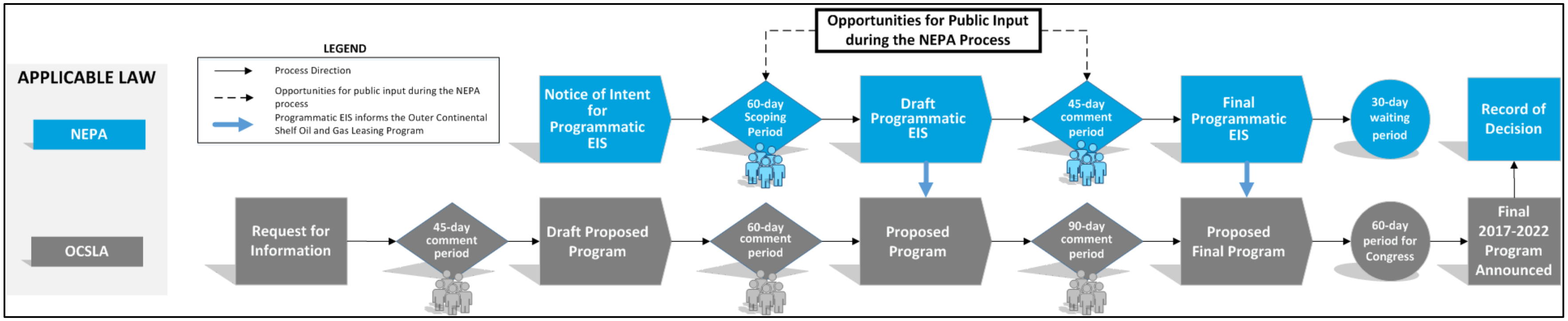


Figure 6.1-1. Relationship between the Proposed Program and the Programmatic EIS

6.2 NOTIFICATION AND DISTRIBUTION OF THE DRAFT AND FINAL PROGRAMMATIC EIS

As part of the notification of the comment period on the Draft Programmatic EIS, BOEM performed the following tasks:

- Published an NOA for the Draft Programmatic EIS in the Federal Register, announcing a 45-day comment period on March 18, 2016. All comments received during the comment period are included as part of the Programmatic EIS Administrative Record and were considered during preparation of the Final Programmatic EIS
- Provided notification of availability of the Draft Programmatic EIS and how to comment to groups and agencies that participated in scoping
- Emailed a group notification concerning the availability of the Draft Programmatic EIS and how to comment to all individuals who had provided their email address to BOEM during scoping or had requested to be on such a mailing list
- Placed multiple notices in print and online newspapers that serve local media markets in potentially affected program areas announcing availability of the Draft Programmatic EIS, all public meeting locations and times, and how to comment on the Draft Programmatic EIS
- Posted the Draft Programmatic EIS on the project website and updated website information (www.boemoceaninfo.com) to notify the public about meetings and methods to comment.
- Mailed official letters to the Governor's offices and Tribes (and coordinated meetings) of all states adjacent to the program areas that could have an interest in providing input on the proposed leasing activities, in accordance with BOEM's policy on consultation and coordination with state, local, and Tribal governments.
- Coordinated meetings with Alaska Native Villages and Alaska Native Village corporations adjacent to the Alaska program areas that could have an interest in providing input on proposed leasing activities, in accordance with USDOI policy on Consultation with Indian Tribes and Alaska Native Corporations.

As part of the notification on the Final Programmatic EIS, BOEM performed the following tasks:

- Published an NOA for the Final Programmatic EIS in the *Federal Register*, announcing its availability in November 2016. Under CEQ regulations, there is a required minimum 30-day period from the release of the Final Programmatic EIS before a decision can be made.
- Provided notification of availability of the Final Programmatic EIS to groups and agencies that participated in scoping and/or that commented on the Draft Programmatic EIS, as identified in **Table 6.2-2**.
- Emailed a group notification concerning the availability of the Final Programmatic EIS to all individuals who had provided their email address to BOEM during scoping, during the Draft Programmatic EIS comment period, or had requested to be on such a mailing list.
- Posted the Final Programmatic EIS on the project website and updated website information (www.boemoceaninfo.com)
- Mailed official letters to the Governor's offices, Tribes, and ANCSA corporations of all states adjacent to the program areas that could have an interest in proposed leasing activities, in accordance with BOEM's policy on consultation and coordination with state, local, and Tribal governments and ANCSA corporations.

The BOEM Office of Public Affairs maintains a robust database of more than 8,400 media and stakeholder contacts segmented into 247 individual lists targeted to specific interests. These contacts are routinely made aware of announcements, events, and services provided by BOEM. Contacts are added to the database according to requests and involvement in the issue being addressed. The lists are organized based on location (state or region), bureau program, interest, and specific events. The development of the Five-Year Program and the Programmatic EIS is of great interest to virtually all individuals in BOEM's Office of Public Affairs databases. BOEM's Office of Public Affairs sent out notification about availability of the Draft and Final Programmatic EIS to appropriate contacts on those lists.

Table 6.2-1. List of Agencies and Groups Notified of the Draft Programmatic EIS Availability

Government Agencies	
Alaska Chamber	North Slope Borough
Alaska Governor	Office of Rep. Frank Pallone, Jr.
Alaska Senator John Coghill, Senate Majority Leader	Office of the Governor, North Carolina
National Park Service	
Industry	
Alaska Frontier Constructors	Louisiana Oil Marketers & Convenience Store Association
Alaska Trucking Association	North American Submarine Cable Association
American Chemistry Council	North Carolina Farm Bureau Federation
American Iron and Steel Institute	Northern Gas Pipelines
American Trucking Associations	OffshoreAlabama.com
Associated Industries of Florida	Partnership for Affordable Clean Energy
Axistrade, Inc.	Perennial Environmental Services
Center for Regulatory Effectiveness	Ports Association of Louisiana
ConocoPhillips	Resource Development Council
Consumer Energy Alliance	Rock Acres Consulting
Consumer Energy Alliance-Texas	Shell
Dominion Resources	Solid Rock Engineering
Hawk Consultants	Tennessee Oil and Gas Association
Kentucky Oil and Gas Association	Texas Association of Business
LA 1 Coalition	Texas Association of Manufacturers
Louisiana Oil & Gas Association	W.D. Scott Group, Inc.
Nongovernmental Organizations	
Alaska Libertarian Party	Our Children's Trust
Alaska Wilderness League	Outer Banks Center for Dolphin Research
Altamaha Riverkeeper	Outer Banks Surfrider Chapter
American Littoral Society	Sandy Hook Sealife Foundation
Assateague Coastal Trust	Save Our Rivers, Inc.
Audubon, Oceana, Ocean Conservancy, PEW, WWF	Sierra Club
Audubon North Carolina	Sierra Club Ocean County
Center for a Sustainable Coast	South Carolina Wildlife Federation
Center for Biological Diversity	Southern Environmental Law Center
LegaSea OBX	St. Marys EarthKeepers
Marine Conservation Institute	Surfrider Foundation
Matanzas Riverkeeper/Friends of Matanzas	Surfrider Foundation - Florida Chapters
Natural Resources Defense Council	Surfrider Outerbanks
New Progressive Alliance	The Dolphin Project
NO to Off Shore Oil Drilling in North Carolina's waters!	The Nature Conservancy
NY4Whales	The Ocean Foundation
Ocean Conservation Research	The Wilderness Society
Oceana, Inc.	World Wildlife Fund
One Hundred Miles	

Federally Recognized Indian Tribes	
Gulf of Mexico Program Area	
Alabama Coushatta Tribe of Texas	Mississippi Band of Choctaw Indians
Caddo Nation of Oklahoma	Poarch Band of Creeks
Chitimacha Tribe of Louisiana	The Seminole Nation of Oklahoma
Choctaw of Oklahoma	Kickapoo Traditional Tribe of Texas
Coushatta Tribe of Louisiana	Tunica-Biloxi Indian Tribe
Jena Band of Choctaw Indians	Ysleta de Sur Pueblo
Miccosukee Tribe of Indians	
Beaufort Sea Program Area	*Cook Inlet Program Area*
Native Village of Kaktovik	Native Village of Nanwalek
Native Village of Nuiqsut	Ninilchik Village
Chukchi Sea Program Area	Eklutna Native Village
Inupiat Community of the Arctic Slope	Kenaitze Indian Tribe
Native Village of Barrow Inupiat Traditional Government	Native Village of Port Graham
Native Village of Point Hope	Native Village of Tyonek
Native Village of Point Lay	Seldovia Village Tribe
Native Village of Wainwright	The Village of Salamatoff
Native Village of Kotzebue	

Table 6.2-2. List of Agencies and Groups Notified of the Final Programmatic EIS Availability

Government Agencies	
Alaska Chamber	Native Village of Kotzebue
Alaska Governor	NOAA Fisheries
Alaska Senator John Coghill, Senate Majority Leader	North Slope Borough
Louisiana Department of Natural Resources	State of Alaska, Department of Natural Resources
Industry	
Alaska Frontier Constructors	Louisiana Oil Marketers & Convenience Store Association
Alaska Trucking Association	Mulberry Well Systems LLC
American Chemistry Council	North American Submarine Cable Association
American Iron and Steel Institute	North Carolina Farm Bureau Federation
American Trucking Associations	Northern Gas Pipelines
Arctic Slope Regional Corporation	OffshoreAlabama.com
Arctic Iñupiat Offshore, LLC	Olgoonik Corporation
ASRC Exploration, LLC	Partnership for Affordable Clean Energy
Associated Industries of Florida	Perennial Environmental Services
Axistrade, Inc.	Ports Association of Louisiana
Center for Regulatory Effectiveness	Resource Development Council
ConocoPhillips	Rock Acres Consulting
Consumer Energy Alliance	Shell
Consumer Energy Alliance-Texas	Solid Rock Engineering
Dominion Resources	Tennessee Oil and Gas Association
Hawk Consultants	Texas Association of Business
Kentucky Oil and Gas Association	Texas Association of Manufacturers
Nongovernmental Organizations	
ACTS-Achieving Community Tasks Successfully	Northern Alaska Environmental Center
Alaska Libertarian Party	NY4Whales
Alaska Process Industry Careers Consortium	Ocean Conservation Research
Alaska Wilderness League	Oceana, Inc.
Altamaha Riverkeeper	Oil Change International

Nongovernmental Organizations (continued)	
American Littoral Society	One Hundred Miles
American Petroleum Institute	Operation Homecare, Inc.
Assateague Coastal Trust	Our Children's Trust
Audubon, Oceana, Ocean Conservancy, PEW, WWF	Outer Banks Surfrider Chapter
Audubon North Carolina	Sabine Center for Climate Change Law, Columbia Law School
Business Council of Alabama	Sandy Hook Sealife Foundation
Center for a Sustainable Coast	Save Our Rivers, Inc.
Center for Biological Diversity	Sierra Club
Cultural Alaska	Sierra Club Ocean County
Earthjustice	Sierra Club Virginia Chapter
Greater Port Author Chamber of Commerce	South Carolina Wildlife Federation
Greenbelt Climate Action Network	Southern Environmental Law Center
Houma-Terrebonne Chamber of Commerce	Surfrider Foundation
Institute of the North	Surfrider Foundation- Florida Chapters
LegaSea OBX	Surfrider Outerbanks
Marine Conservation Institute	Texas Trucking Association
Matanzas Riverkeeper/Friends of Matanzas	The Dolphin Project
Mississippi Energy Institute	The Nature Conservancy
National Association of Charter Boat Operators	The Ocean Foundation
Natural Audubon Society	The Wilderness Society
Natural Resources Defense Council	Wildlife Conservation Society
New Progressive Alliance	World Wildlife Fund
Federally Recognized Indian Tribes	
Gulf of Mexico Program Area	*Chukchi Sea Program Area*
Alabama Coushatta Tribe of Texas	Iñupiat Native Village of Barrow
Chitimacha Tribe	Iñupiat Native Village of Point Hope
Chitimacha Tribe of Louisiana	Iñupiat Native Village of Point Lay
Coushatta Tribe	Iñupiat Native Village of Wainwright
Jena Band of Choctaw	*Cook Inlet Program Area*
Mississippi Band of Choctaw Indians	Native Village of Nanwalek
Poarch Band of Creek Indians	Ninilchik Village Tribe
Texas Band Kickapoo Tribal Council	The Eklutna Native Village
Tunica-Biloxi Indian Tribe	The Kenaitze Indian Tribe
Ysleta de Sur Pueblo	The Native Village of Port Graham
Beaufort Sea Program Area	The Native Village of Tyonek
Iñupiat Native Village of Kaktovik	The Seldovia Village
Iñupiat Native Village of Nuiqsut	The Village of Salamatoff

6.3 COMMENTS RECEIVED ON THE DRAFT PROGRAMMATIC EIS

A summary of numbers and types of comments on the Draft Programmatic EIS is shown here. For more information see **Appendix G**. All comments received during the public comment period were considered by BOEM. Comments were received from state and local officials; Federal, state, and local agencies; environmental organizations and NGOs; the oil and gas energy sector; and individuals.

BOEM received approximately 75,000 comments on the Draft Programmatic EIS; the vast majority of these were statements of either support or opposition to the Proposed Action with no substantive information related to the Programmatic EIS. Comments or letters were received from Federal, state, and local governments and agencies, NGOs, and industry associations; however, the vast majority of comments were from private citizens. From the comment submittals, BOEM identified 437 substantive comments. Although the comments covered a wide range of topics, most of the comments centered on climate change, the NEPA process and analysis, oil spills and CDEs, alternatives, marine mammals, and sociocultural systems. Please see the comments report at www.boemoceaninfo.com for more details on comment metrics and **Appendix G** for responses to substantive comments.

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